Volume 1

MATHEWS COMPANY

10’ / 12’ / 18’ Vacuum Cool Tower Dryer Series

10’ Vacuum Cool Tower

12’ Vacuum Cool Tower

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Operations Manual

DOC-T01-0811

OPERATIONS MANUAL – 10’ / 12’ / 18’ VACUUM COOL TOWER DRYER SERIES

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Section 1: Introduction

Grain Drying Theory for Tower Dryers

The equalizing of moisture in the grain to the air moisture is called grain drying. The process of drying grain in a Mathews Company Tower Series grain dryer requires **3 main components**:

1. **Air**: Volume is supplied by a blower that is vertically mounted inside the dryer. The function of the air is two-fold. The air acts as a heat transfer mechanism. The air assists the heat in penetrating the grain shell in order to dry the grain. The air absorbs the moisture from the grain and carries the moisture outside the dryer.

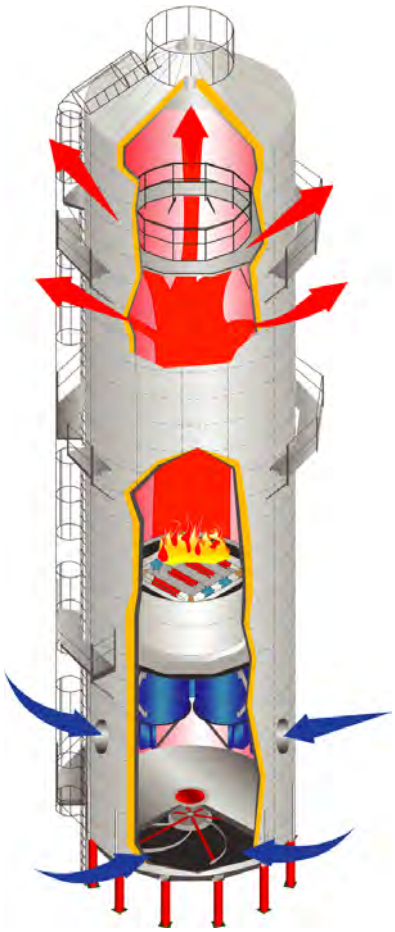


Figure 1: - ***"Tower Dryer Airflow"***

2. **Heat/Energy**: The burner that sits directly above the blower heats the air filling the plenum chamber, and transfers the heat to the grain. The heat releases the moisture from the grain. The accurate control of this heat is what makes the equipment energy efficient. The most effective way to regulate the control of this energy is through a gas control valve that opens and closes to allow fuel supply to change to keep the plenum temperature stable.

3. **Time**: Refers to the time the grain is spent inside the dryer. The time that the grain is exposed to both air and heat determines how much moisture is driven out of the grain. The longer the exposure, the more moisture removal occurs. Thus, the best method for controlling the amount of moisture removal in the grain is to increase and decrease the grain metering system of the dryer. The slower the metering system operates, the longer the grain is exposed to air and heat and the moisture removal is increased. The faster the metering system operates, the shorter the grain retention time and the moisture removal of grain is reduced. The easiest way to keep good grain quality and accurate control is to keep heat and air consistent while varying only grain retention time. This has proven to be the most common and efficient way to dry grain.

Functions of Air, Heat, and Time

The bottom third of the dryer is suction-cooled, pulling heat off the grain and returning it to the burner to lower energy consumption; this is the method of heat reclamation that creates the most efficient use of the energy in the dryer. The top two-thirds of the dryer are pressure-heated to dry grain. The air is pulled into the dryer through free air doors or grain columns. The amount of air volume the blower can move depends on the dryer pressure drop. The higher the pressure drop, the less air volume the blower moves. The free air doors have adjustable opening louvers. Increasing the amount of opening of the free air doors increases the air volume to the blower. The increased air volume will correlate to increased drying capacity. The free air door adjustment is also a means of controlling the discharge grain temperature. When the doors are closed, the discharge grain temperature will be closer to the ambient air temperature. The further the doors are opened, the higher the discharge temperature.

The dryer plenum temperature control system provides a means to maintain a consistent plenum temperature. The temperature can be changed to an appropriate drying temperature for the type of grain being dried, and is the method used for greatest fuel efficiency.

The blower pushes the air volume through the burner and the air transfers the heat to fill the plenum chamber and heats the grain. The grain will absorb the heat driving moisture out. The moisture emitted will saturate the air and the air will carry the moisture out of the dryer, leaving the grain hot. This heat will be reclaimed when it moves down the dryer column and is exposed to the suction cooling process resulting in fuel efficiency.

Section 2

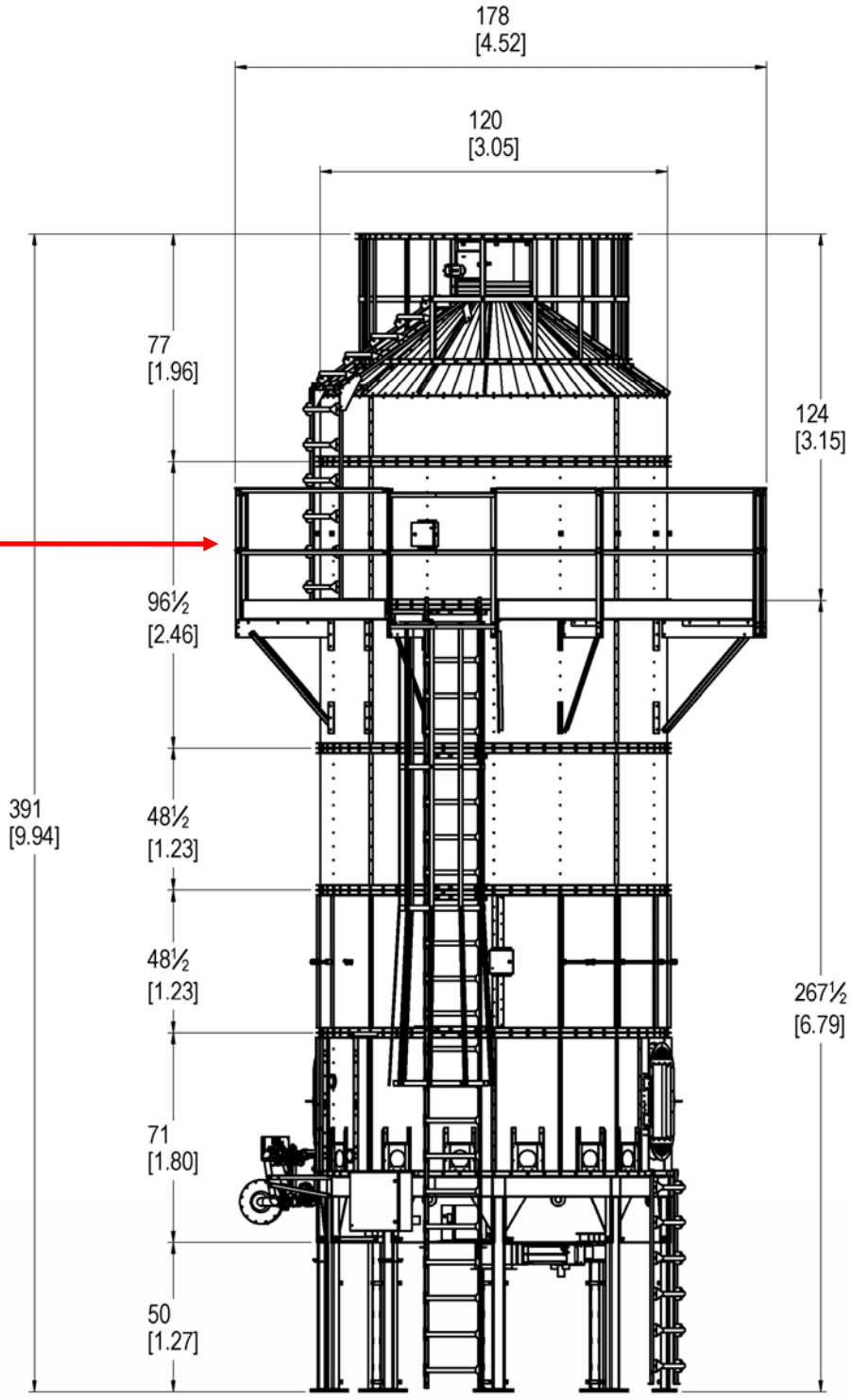
Section 2: Tower Series Dryer Specifications

10' Tower Series Specifications

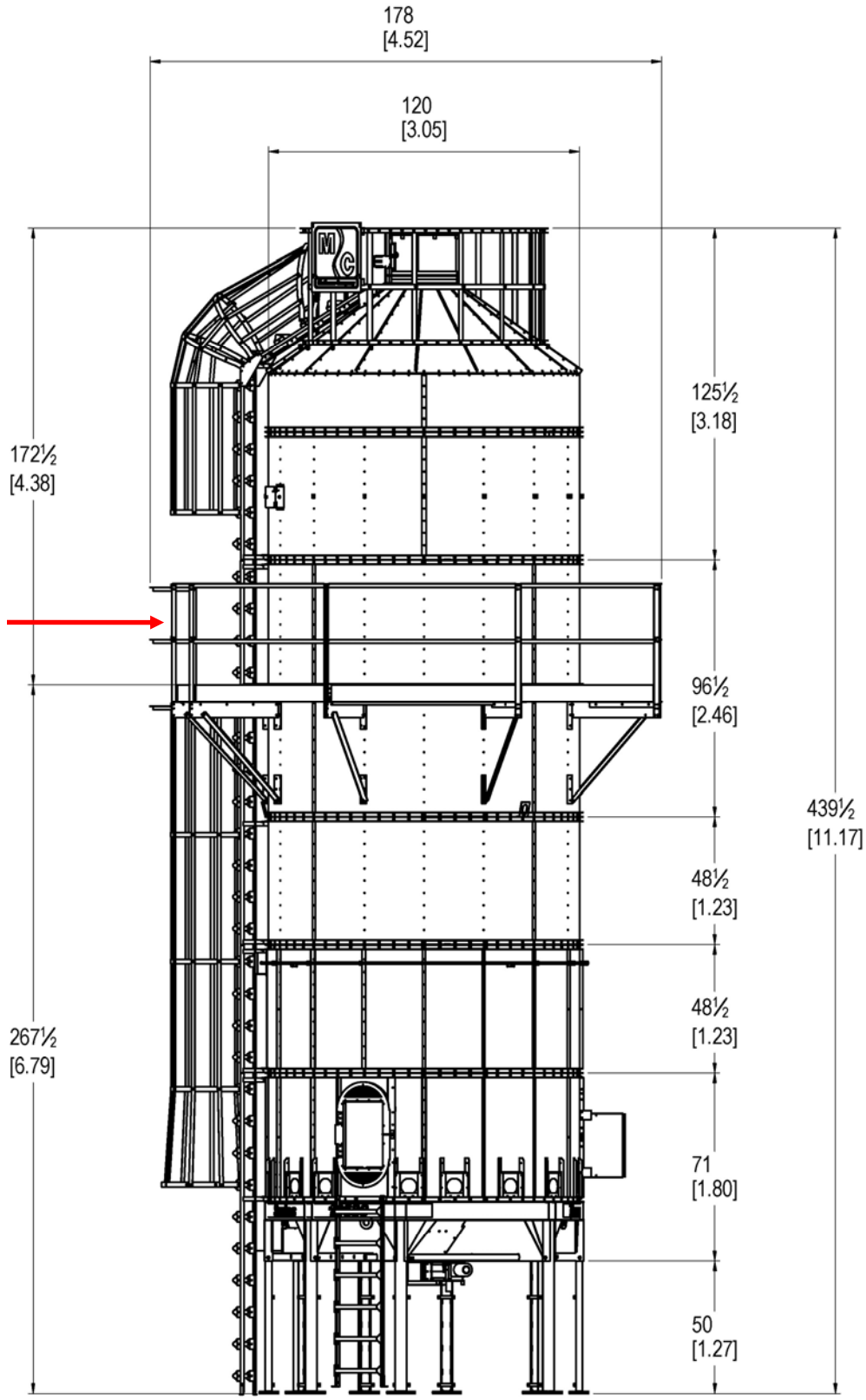
Model	10520	10630	10730	10840	101050	101275
Total Height	32'-7"	36'-8"	40'-8"	44'-8"	52'-10"	60'-11"
Outside Diameter	9'-9"	9'-9"	9'-9"	9'-9"	9'-9"	9'-9"
Weight (lbs)	8,150	9,100	10,000	11,000	13,300	15,100
Grain Column Thickness	12"	12"	12"	12"	12"	12"
Holding Capacity (bu)	606	695	790	873	1,049	1,225
Diameter with Walkways	15'-9"	15'-9"	15'-9"	15'-9"	15'-9"	15'-9"
Standard Number of Outside Walkways	NA	NA	1	2	3	3
Max Burner Capacity (MMBTU/hr)	5.3	6.6	7.5	9.2	11.2	13.6
Average Burner Capacity (MMBTU/hr)	2.9	3.6	4.1	5.1	6.2	7.5
Number of Fans	1	1	1	1	1	1
Fan Motor Size (HP)	20	30	30	40	50	75
Electrical Load (208V/3ph/60Hz) Amps	104	131	131	167	196	266
Electrical Load (230V/3ph/60Hz) Amps	95	118	118	152	176	241
Electrical Load (460V/3ph/60Hz) Amps	48	59	59	76	89	121

10' Tower Dimensions

10520 Dimensions

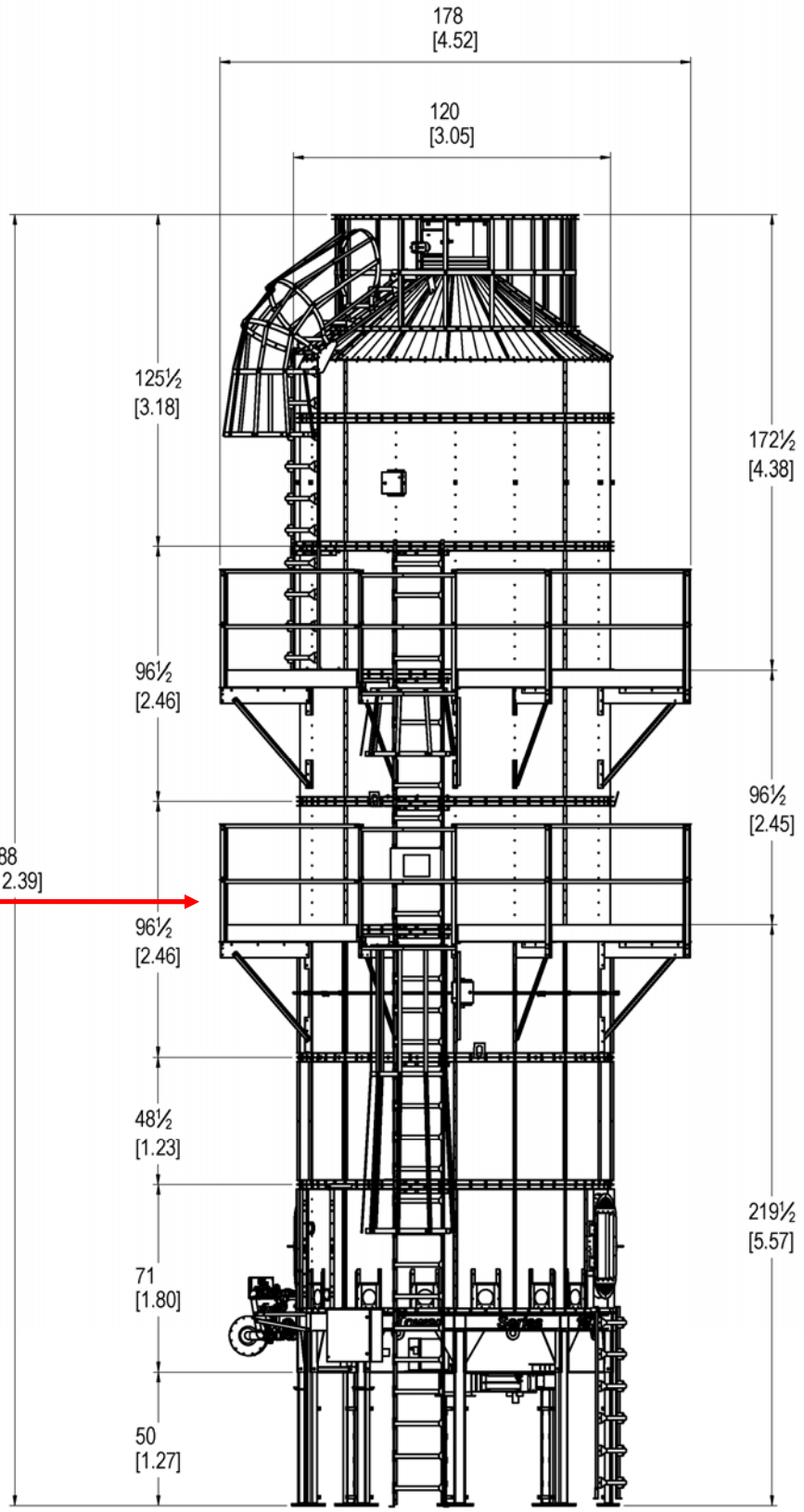


10630 Dimensions



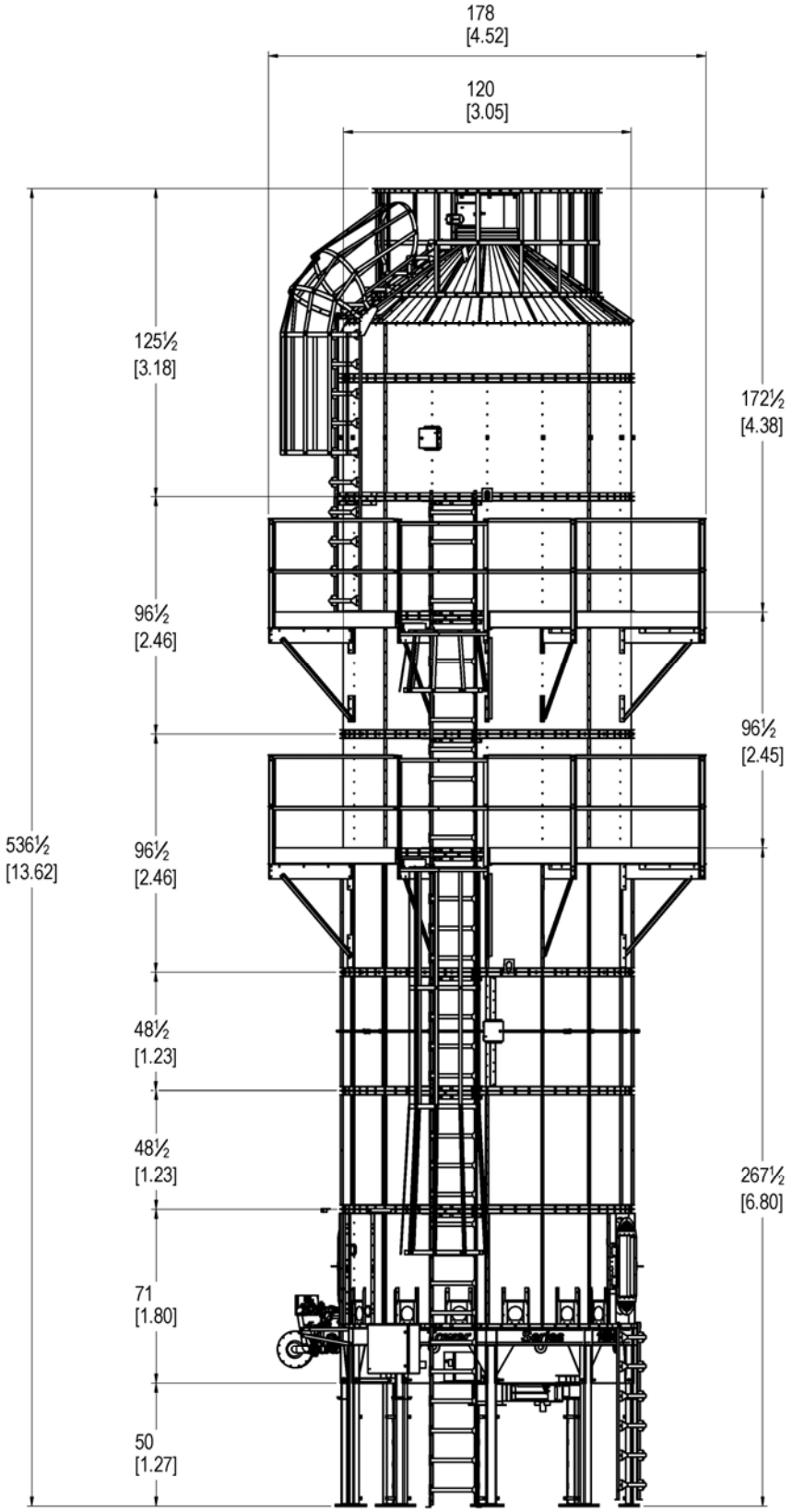
Shown With Optional Walkway

10730 Dimensions

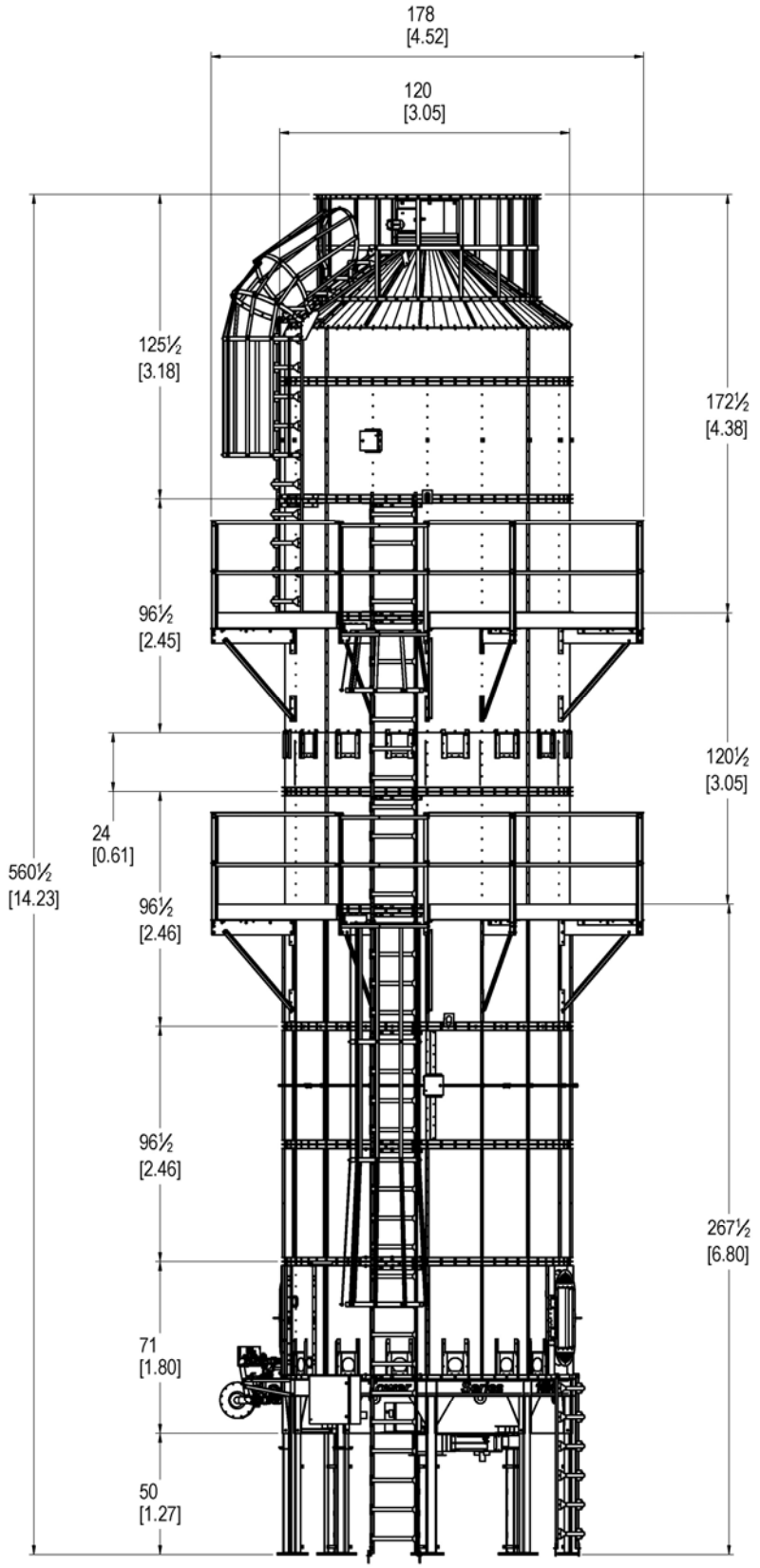


Shown With Optional Walkway

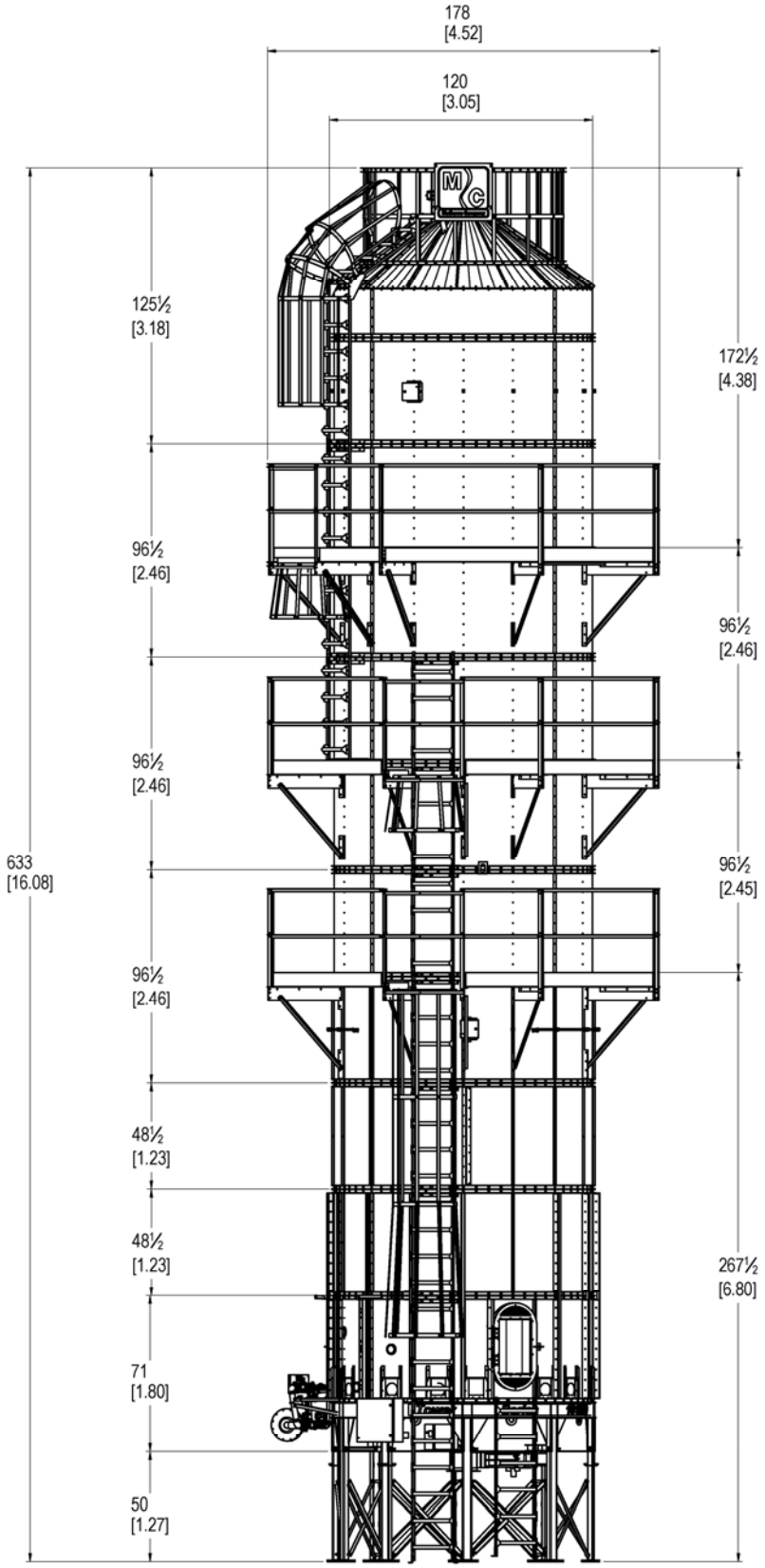
10840 Dimensions - With No Grain Exchanger



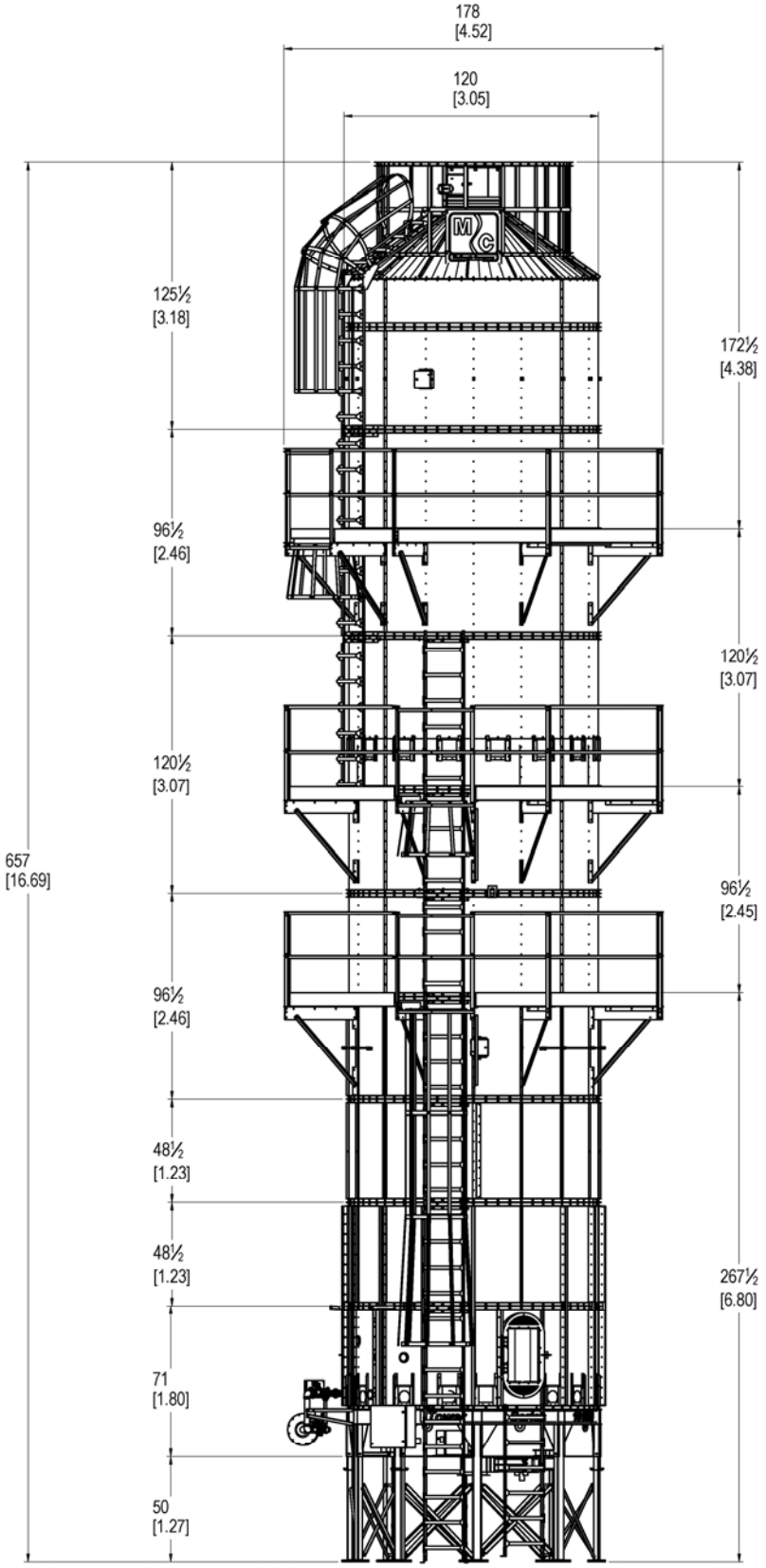
10840 Dimensions - With Grain Exchanger



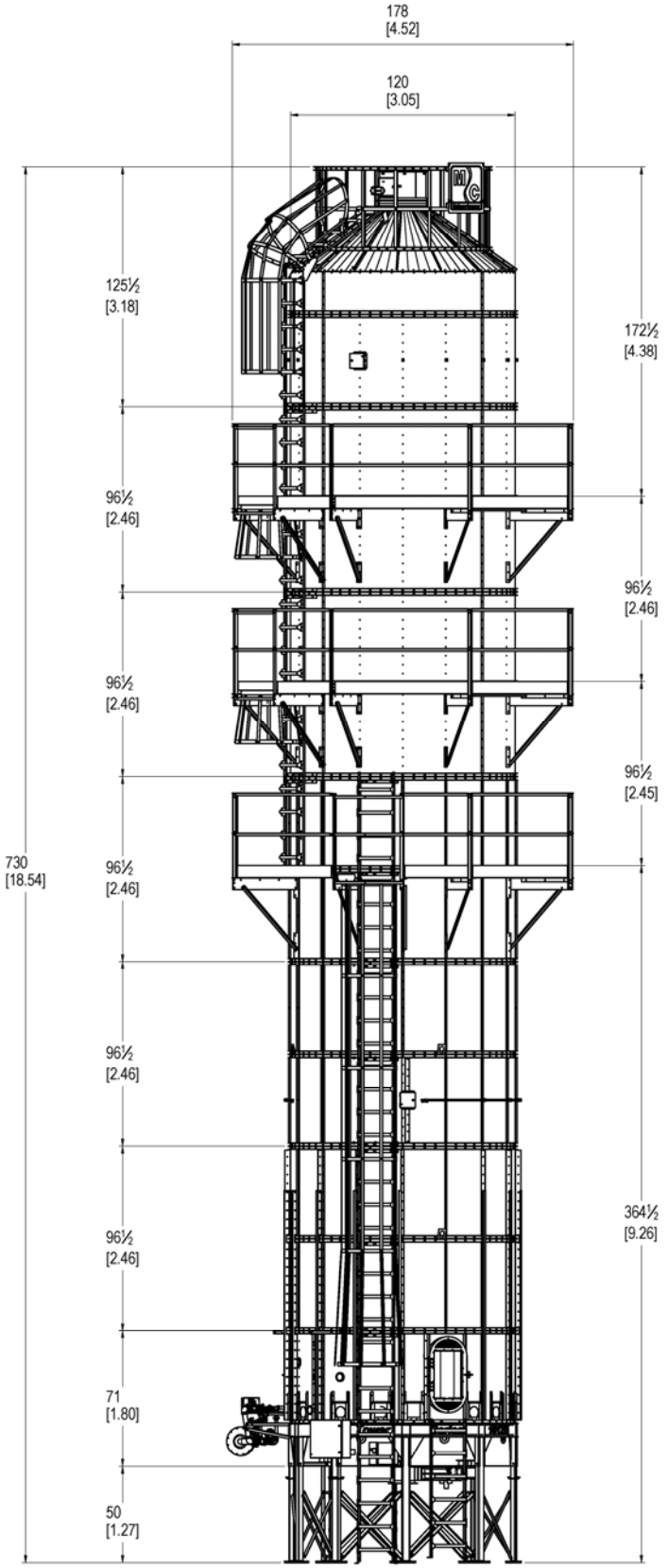
101050 Dimensions - With No Grain Exchanger



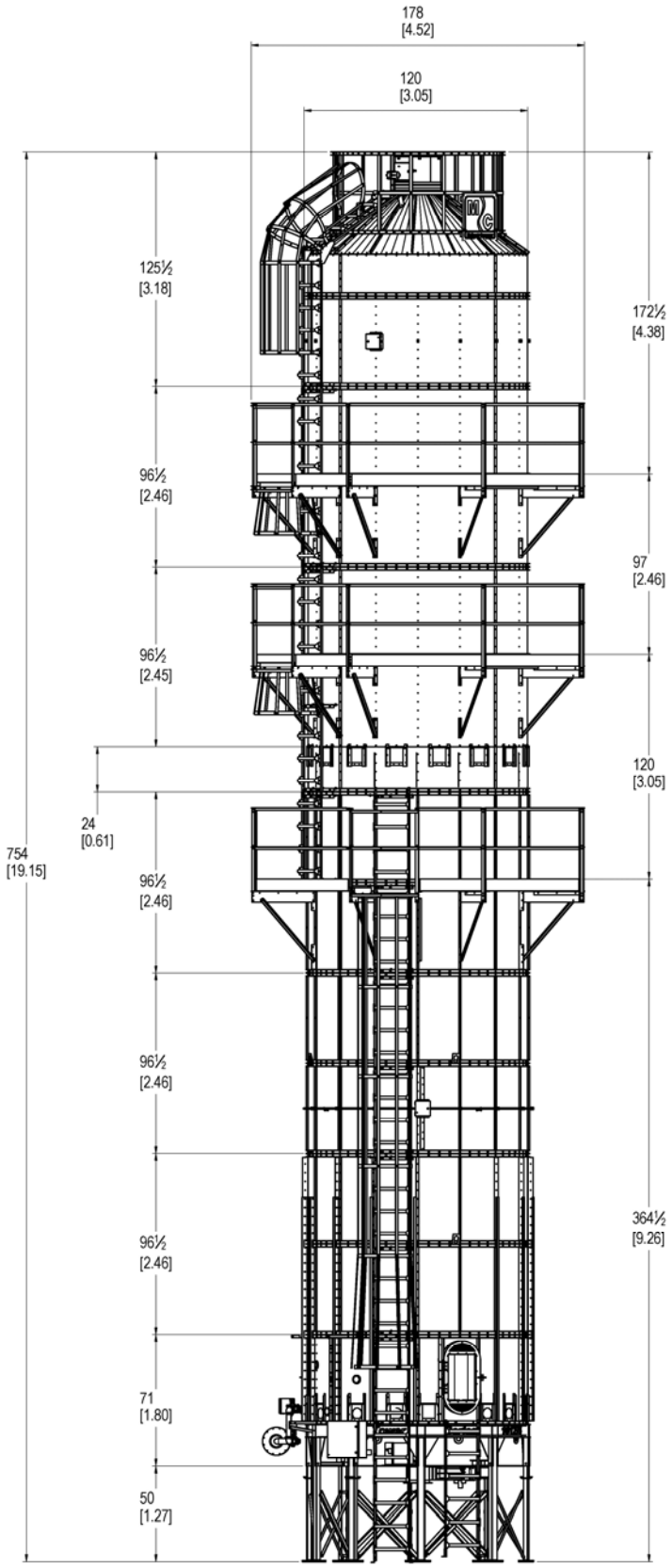
101050 Dimensions - With Grain Exchanger



101275 Dimensions - With No Grain Exchanger



101275 Dimensions - With Grain Exchanger

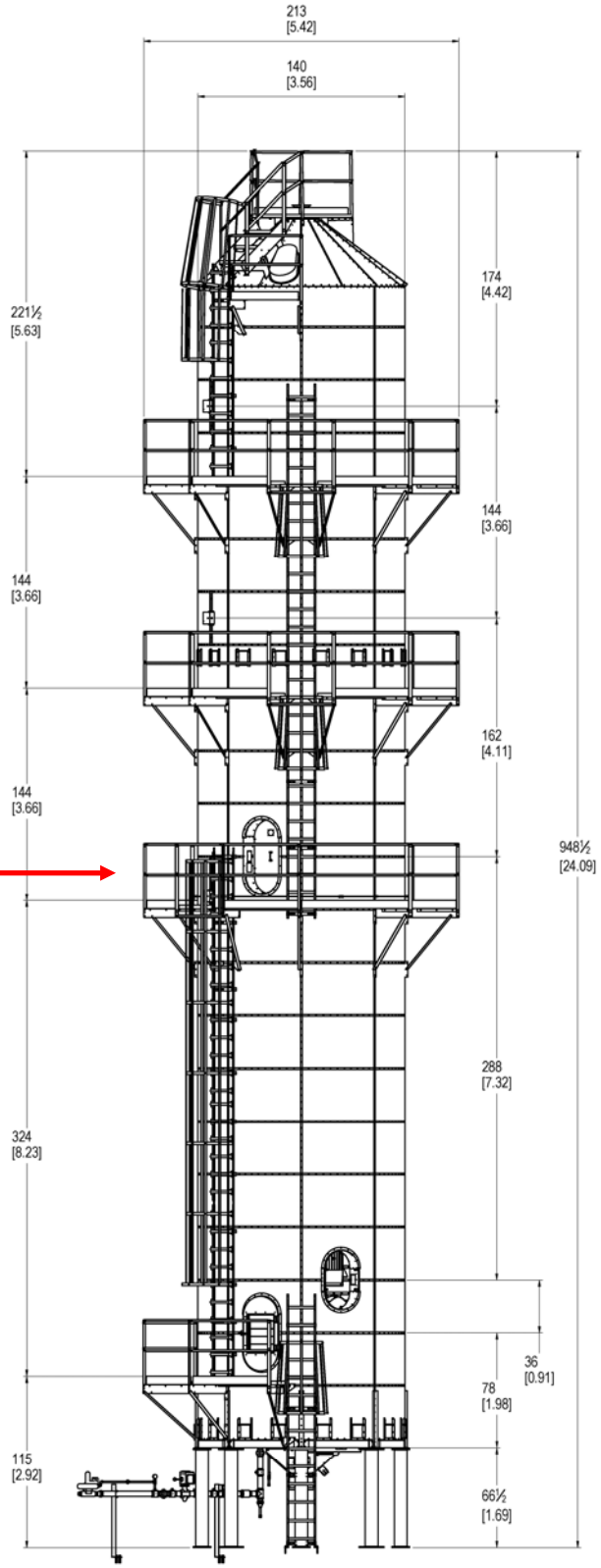


12' Tower Dryer Specifications

Model	2000	2400
Total Height	77'-3"	89'-3"
Diameter	11'-8"	11'-8"
Weight (lbs)	31,200	33,000
Grain Column Thickness	12"	12"
Holding Capacity (bu)	1,945	2,268
Diameter with Walkways	17'-9"	17'-9"
Number of Outside Walkways	2	3
Max Burner Capacity (MMBTU/hr)	21.8	26.4
Average Burner Capacity (MMBTU/hr)	11.9	14.4
Number of Fans	1	1
Fan Motor Size (HP)	100	100
Electrical Load (208V/3ph/60Hz) Amps	356	356
Electrical Load (230V/3ph/60Hz) Amps	323	323
Electrical Load (460V/3ph/60Hz) Amps	161.5	161.5

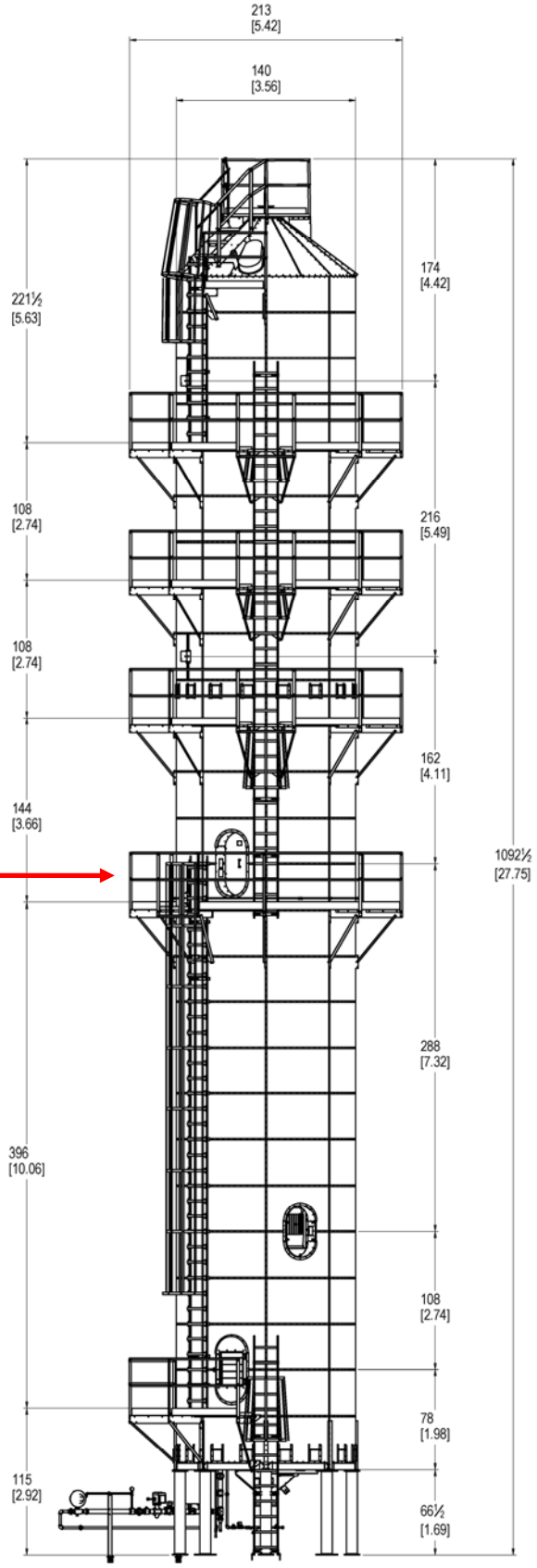
12' Tower Dimensions

2000 Dimension



Shown With Optional Walkway →

2400 Dimensions



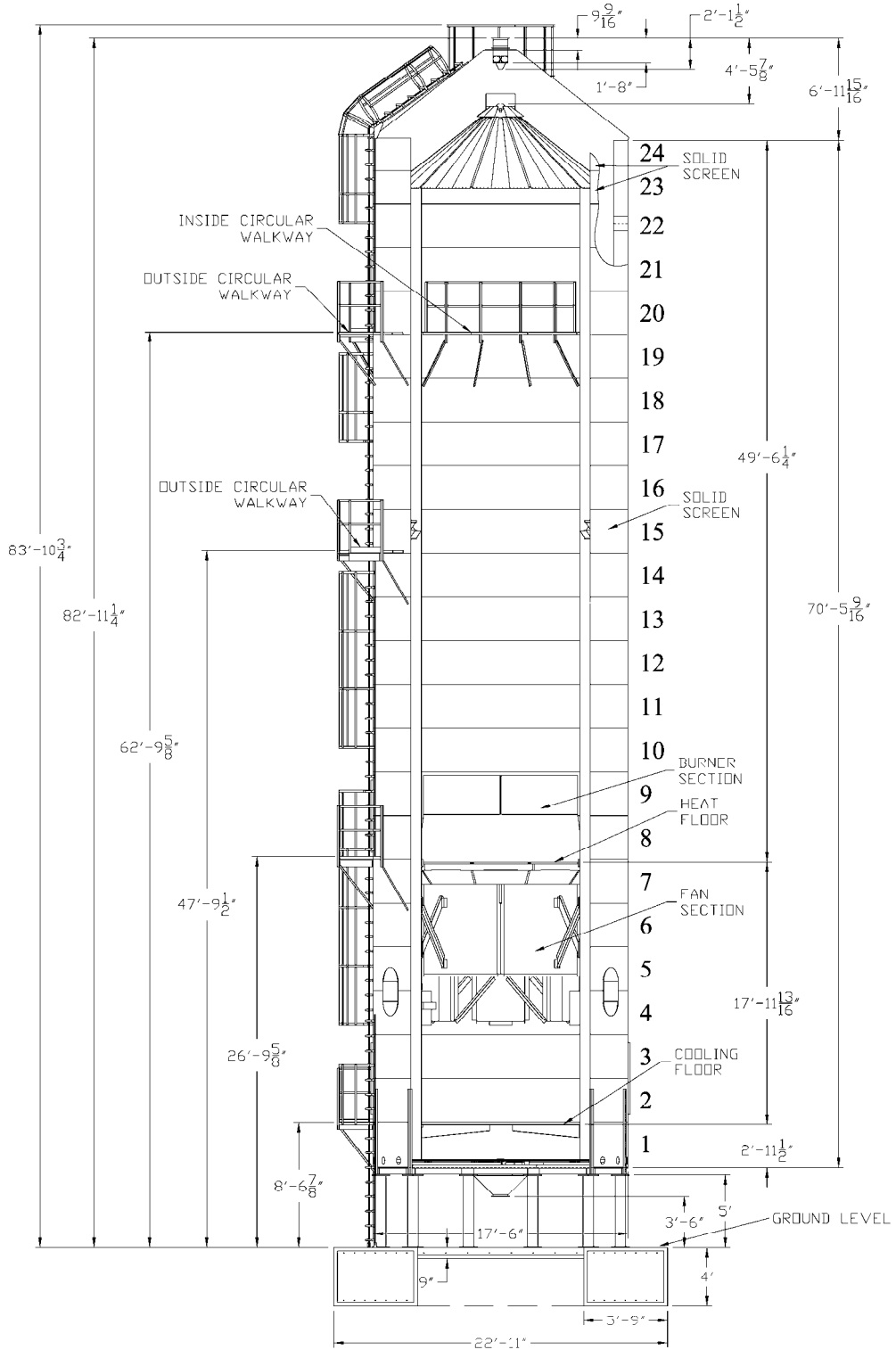
Shown With Optional Walkway

18' Tower Specifications

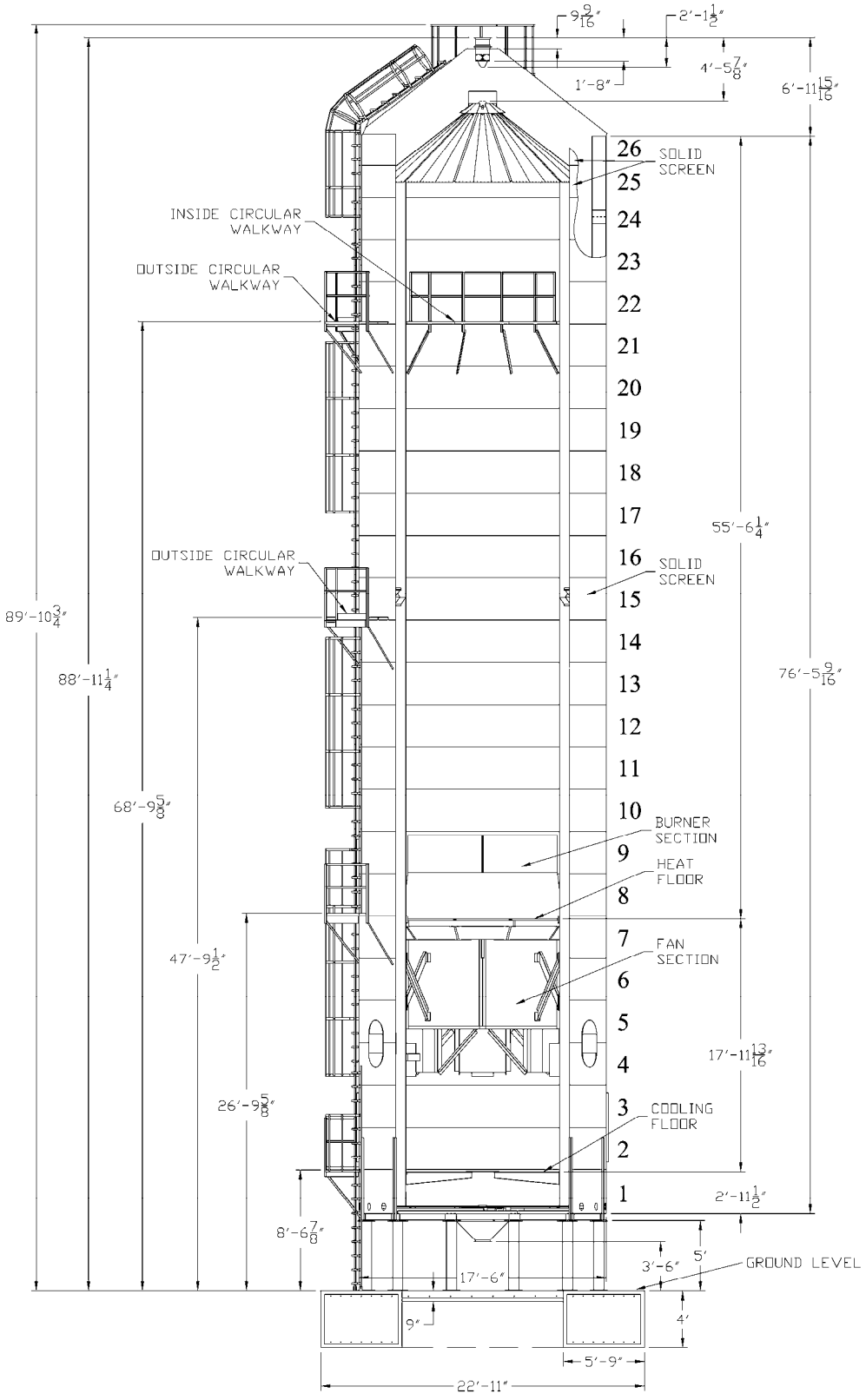
Model	3000	3500	4000
Total Height	83'-8"	89'-8"	98'-8"
Diameter	17'-6"	17'-6"	17'-6"
Grain Column Thickness	12"	12"	12"
Holding Capacity (bu)	3,711	3,962	4,339
Diameter with Walkways	22'-3"	22'-3"	22'-3"
Number of Outside Walkways	2	3	3
Max Burner Capacity (MMBTU/hr)	33.7	36.3	42.5
Average Burner Capacity (MMBTU/hr)	20.2	21.8	25.5
Number of Fans	3	3	3
Fan Motor Size (HP)	50	60	75
Electrical Load (208V/3ph/60Hz) Amps	442	546	647
Electrical Load (230V/3ph/60Hz) Amps	410	494	605
Electrical Load (460V/3ph/60Hz) Amps	205	247	302.5

18' Tower Dimensions

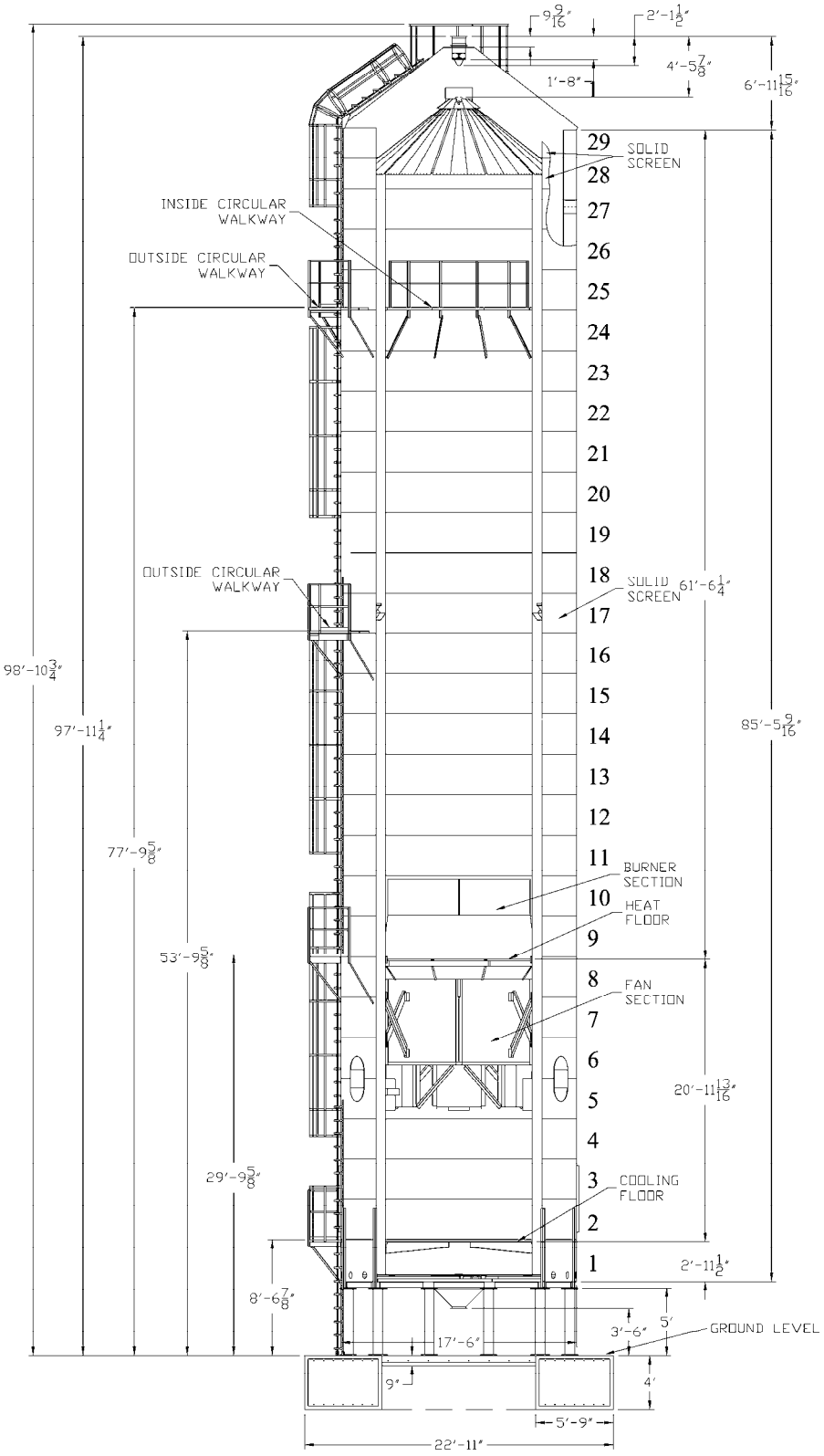
3000 Dimensions



3500 Dimensions



4000 Dimensions



Section 3

Section 3: Equipment Overview

Owner /Operator Notes

This manual was prepared to provide owners and operators of Mathews Company 10' / 12' / 18' Vacuum Cool Tower Grain Dryers with operating instructions and maintenance information that will enable them to keep their M-C Grain Dryers operating at peak efficiency.

Before operating your grain dryer, read the Start-Up and Operating Instructions. Become familiar with the controls, adjustments and settings required to obtain efficient operation.
To keep the dryer operating at peak efficiency, it should be: **CLEANED, LUBRICATED, BELT TENSION CHECKED, THE IGNITION SYSTEM CHECKED, FILL AND TEST DISCHARGE SYSTEM ADJUSTED.** This should be done annually prior to the drying season. Refer to "Pre-Season Check" in the Maintenance section. The Pre-Season check can be made when the dryer is empty. Any necessary repairs or adjustments should be completed so that the dryer will be ready to operate before the drying season.

Warranty Registration

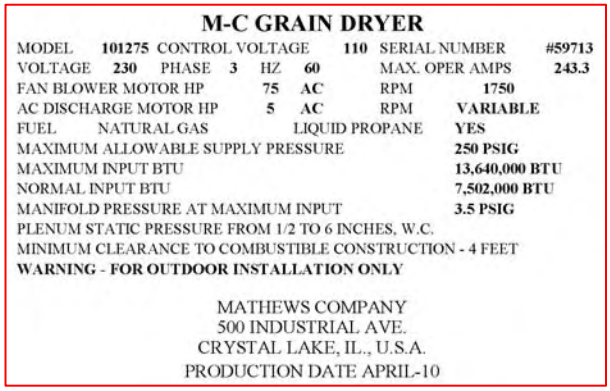
It is important to send in your warranty registration card as soon as your new grain dryer is delivered. Not only does the card validate your grain dryer's warranty, but it assists M-C in disseminating information particular to your dryer model.

PANEL LISTING SPECIFICATIONS

MODEL **101275** CONTROL VOLTAGE **110** SERIAL NUMBER **#59713**
MAXIMUM CONTROL CABINET OPERATING AMPS **7**
LARGEST BLOWER MOTOR HP **75** RPM **1750**
SHORT CIRCUIT CURRENT RATING IN AMPS **10KA**
SOFT START SETTING FOR LARGEST MOTOR **165 Amps**

MATHEWS COMPANY
500 INDUSTRIAL AVE.
CRYSTAL LAKE, IL., U.S.A.
PRODUCTION DATE APRIL-10

Figure 3: ***"Tower Series Panel Listing Specifications"***



M-C GRAIN DRYER

MODEL **101275** CONTROL VOLTAGE **110** SERIAL NUMBER **#59713**
VOLTAGE **230** PHASE **3** HZ **60** MAX. OPER AMPS **243.3**
FAN BLOWER MOTOR HP **75** **AC** RPM **1750**
AC DISCHARGE MOTOR HP **5** **AC** RPM **VARIABLE**
FUEL NATURAL GAS LIQUID PROPANE **YES**
MAXIMUM ALLOWABLE SUPPLY PRESSURE **250 PSIG**
MAXIMUM INPUT BTU **13,640,000 BTU**
NORMAL INPUT BTU **7,502,000 BTU**
MANIFOLD PRESSURE AT MAXIMUM INPUT **3.5 PSIG**
PLENUM STATIC PRESSURE FROM 1/2 TO 6 INCHES, W.C.
MINIMUM CLEARANCE TO COMBUSTIBLE CONSTRUCTION - 4 FEET
WARNING - FOR OUTDOOR INSTALLATION ONLY

MATHEWS COMPANY
500 INDUSTRIAL AVE.
CRYSTAL LAKE, IL., U.S.A.
PRODUCTION DATE APRIL-10

Figure 2: ***- "High Voltage Cabinet Information Decal"***

Model and Serial Number Location

The model, serial number and specifications of your Mathews Company continuous flow grain dryer are stamped on plates located on the base of the dryer.

Safety Precautions

1. Read and understand the operations manual before attempting to operate the dryer.
2. Keep **ALL** guards, access doors, covers, safety decals, and safety devices in place and securely fastened**. NEVER** operate the dryer while guards are removed.
3. Keep all untrained personnel away from system components and control panels at all times.
4. **NEVER** attempt to operate the unit by jumping or otherwise bypassing any safety devices.
5. Always open the main power supply disconnect switch and lock it in the open position with an approved lockout device prior to performing any service or maintenance work on the fan or burner unit.
6. Lock out power before removing guards, access doors, and covers.
7. Keep hands, feet and clothing away from all rotating parts.
8. Electrical repairs should be performed by trained, qualified personnel only. Failure to follow safe electrical procedures can result in serious injury.
9. If it should become necessary to perform checks on system components or high voltage test with "**engaged**" circuits, proceed with extreme caution and follow all established safety practices.
10. Routinely check for any gas leaks.
11. Do not allow children or bystanders to be near the grain dryer or grain handling machinery while it is operating.
12. Do not operate the grain dryer without all safety shields in place and secure.

Lock out / Tag out Procedure Requirements

The purpose of a lock out/ tag out procedure is to prevent injury and/or death to personnel by requiring that certain precautions be taken before servicing or repairing equipment. This includes shutting off and locking out the electrical power source of the equipment.

1. All maintenance personnel are issued a suitable lock (or locks). The lock has the individual worker's name and other identification on it. That worker will have the only key to the lock.
2. Each person who will be working on the machinery should put a lock on the machine's lockout device(s). Each lock must remain on the machine until the work is completed. (Only the personnel who placed the lock should remove his/her lock.)
3. Check to be sure that no one is operating the machinery **BEFORE** turning off the power. The machine operator must be informed before the power is turned off. Sudden loss of power could cause an accident.
4. Any mechanism under load or pressure, such as springs, should be released and blocked.
5. All energy sources that could activate the machine must be locked out.
6. The main valve or main electrical disconnect must be tested to be sure that the power to the machine is **OFF**.

7. Electrical circuits must be checked by qualified persons with proper and calibrated electrical testing equipment. An electrical failure could energize the equipment, even if the switch is in the **OFF** position. Stored energy in electrical capacitors should be safely discharged.
8. **CAUTION**: Return disconnects and operating controls to the **OFF** position after each test.
9. Attach accident-prevention tags, which give the reason for placing the tag, the name of the person placing the tag, how he/she many be contacted, and the date and time the tag was placed. No one removes the lock without proper authority.

Locks

Each worker must have his/her own lock and the only key to that lock.

The lock should be substantial, durable, and should have the name of the employee or personnel on it. In addition, locks can be color coded to indicate different shifts or types of services.

Figure 5: - *"Lock Out Tag"*

Figure 4: - *"Lock Out Lock Assembly"*

DO NOT USE TAGS ALONE. Use tags or signs in addition to locks.

Tags must state the:

- Reason for the lockout.
- Name of the employee or personnel who is working on the equipment and how that person may be reached.
- Date and time the tag was put in place.

Blocks

Suitable blocks are another important safety device for making a piece of equipment safe to be repaired or serviced. Blocks must be placed under raised dies, lifts, or any equipment that might inadvertently move by sliding, falling, or rolling.

Blocks, special brackets, or special stands, such as those commonly used under raised vehicles, must be available at all times. Another form of blocking is the placement of a blind. A blind is a disk of metal placed in a pipe to ensure that no air or other substance will pass through that point if the system is accidentally activated.

Before installing blinds or blocks, bleed down steam, air or hydraulic lines to get rid of any pressure. Coiled springs, spring loaded devices or suspended loads must also be released so that their stored energy will not result in inadvertent movement.

Figure 6: - ***"Lock Out Safety Sign"***

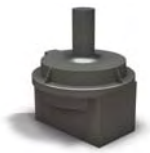
Grain Dryer Component Function

Field Device Components

Ignition Board
This board's function is to supply high voltage from the coil to either the spark or the igniter to ignite the burner. For continuous operation successful flame proving is necessary.

Rotary (Bin) Fill Switch
The rotary fill switch is located in the receiving tube at the top of the dryer. This is powered by 120 volts and contains normally open and closed contacts. The switch is motorized and will rotate a paddle until wet grain contacts the switch. The grain stops the rotation and proves the presence of grain. This switch is normally closed and allows the dryer to continue to fill as long as the switch rotates. When grain stops the device from rotating, the contact status changes to normally open and shuts off the fill system.

High Limit Switch
The high limit switch is located in the ignition box with a capillary bulb in the plenum chamber. This device is adjustable and should be set 40 degrees higher than the plenum temperature set point. If the plenum temperature reaches the high-limit set point, the device will actuate and shut down the dryer. The highlimit switch is normally closed until the temperature reaches the set point, upon reaching the set point the contacts will open, shutting down the dryer.



Air Pressure Switch
The air pressure switch is an air flow proving device. The switch is fully adjustable, allowing the operator to set the air pressure switch to detect air or vacuum(18' Tower) when the machine is full of grain. The air pressure switch is normally open and will not close until sufficient air pressure/vacuum is detected. Once sufficient air flow is detected, the switch closes and provides 120 volts to the ignition, allowing the operator to ignite the burner.

Temperature Controller
Temperature Controller displays temperature outputs measured by the plenum RTD and commands the gas control valve. The valve will open, automatically adjust gas to maintain or stabilize the plenum temperature automatically. This device can also function to shut down the machine if the actual plenum temperature rises or falls more than 40° F.

Belimo Valve Actuator
Is an electrical proportional valve that responds to signals from a cal controller output, the cal controller receives the signal from the plenum RTD and then sends the signal to the Belimo Valve Actuator. From there it will modulate controlling the gas flow to maintain the plenum temperature.

Mid-Grain RTDs

Mid-Grain RTDs (Resistance Temperature Device) located on the side of the dryer are used to detect the temperature of the grain. Four mid-grain RTDs are used to drive the TruDry Control System.

Plenum RTD

The Plenum RTD is a temperature sensing device used to transmit a signal to the temperature controller. It is located in the plenum chamber to monitor plenum air temperature.

Discharge Moisture Sensor

The discharge moisture sensor monitors the moisture and temperature of the discharge grain using a DC power and micro-processing technology to change the DC signal to the moisture and temperature of discharging grain. Moisture is measured using capacitance to the ground. The temperature of the grain is measured by a thermocouple device on a moisture sensor.

Linear Limit Devices (LLC)

Located outside the grain column within an LLC Box wrapped around the top screen section of dryer *(18' tower has the LLC located in the cooling section inside the dryer)*. The linear limit is an over-temperature-detection device.

Spark Plug

The spark plug receives high voltage current from the ignition board and arcs at the spark plug gap to provide direct spark ignition for the burner.

Variable Frequency Drive (VFD)

The VFD unit is a single phase input and three phase output device to run and protect the discharge motor. This device is controlled by the PLC.

Tower Series Components Breakdown

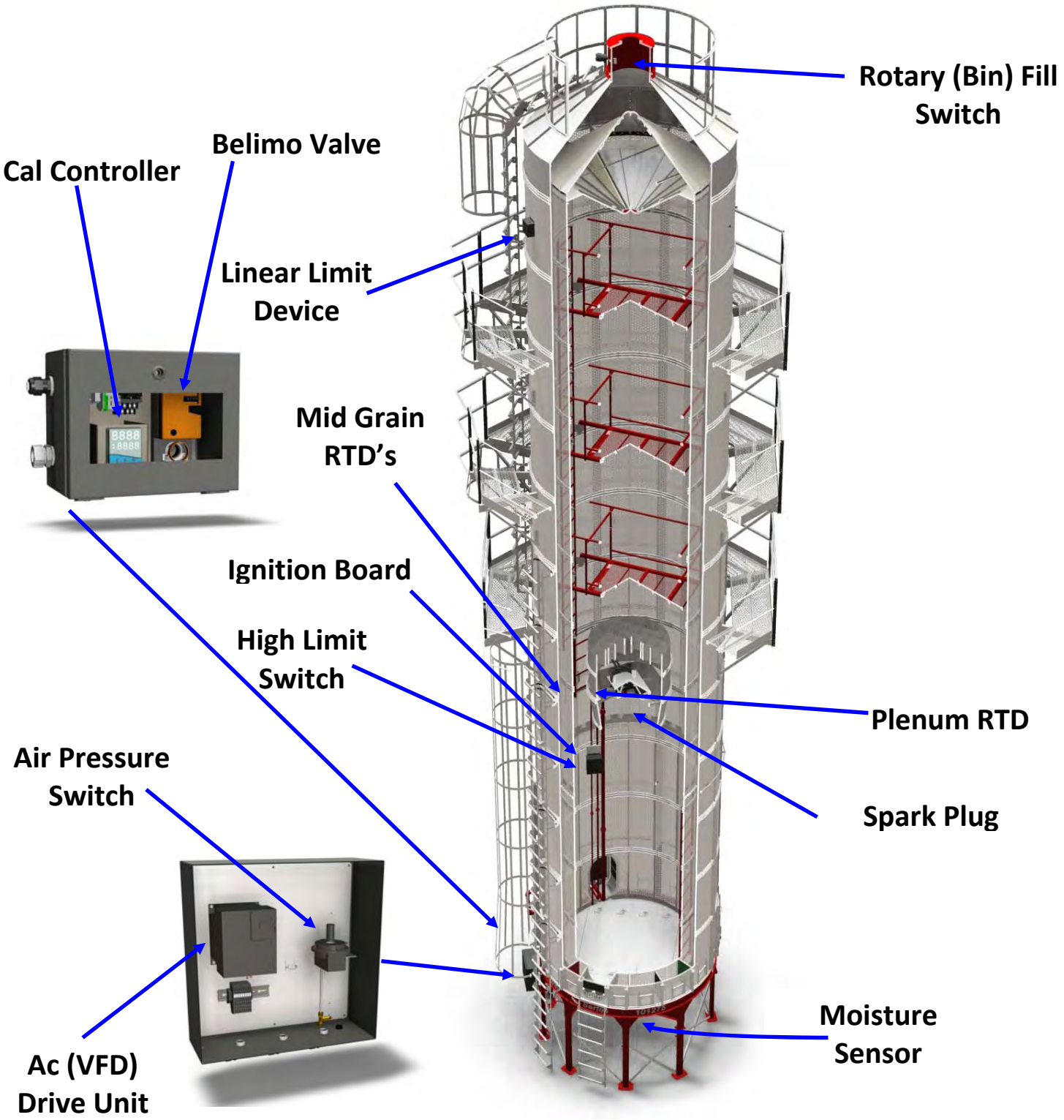


Figure 7: *"10' Tower Cut Away"*

Remote Cabinet Components

Overview

Push Buttons
These push buttons are used for starting and stopping the blower.

LED Lights
All lights are 120-volt power LED's for daylight viewable use.

Rotary Switches
These come in a variety of combinations and are typically used to actuate items on and off or switch modes OFF-ON-START.

HMI
Acronym stands for Human Machine Interface. This is the touch screen graphical display communication with the PLC.

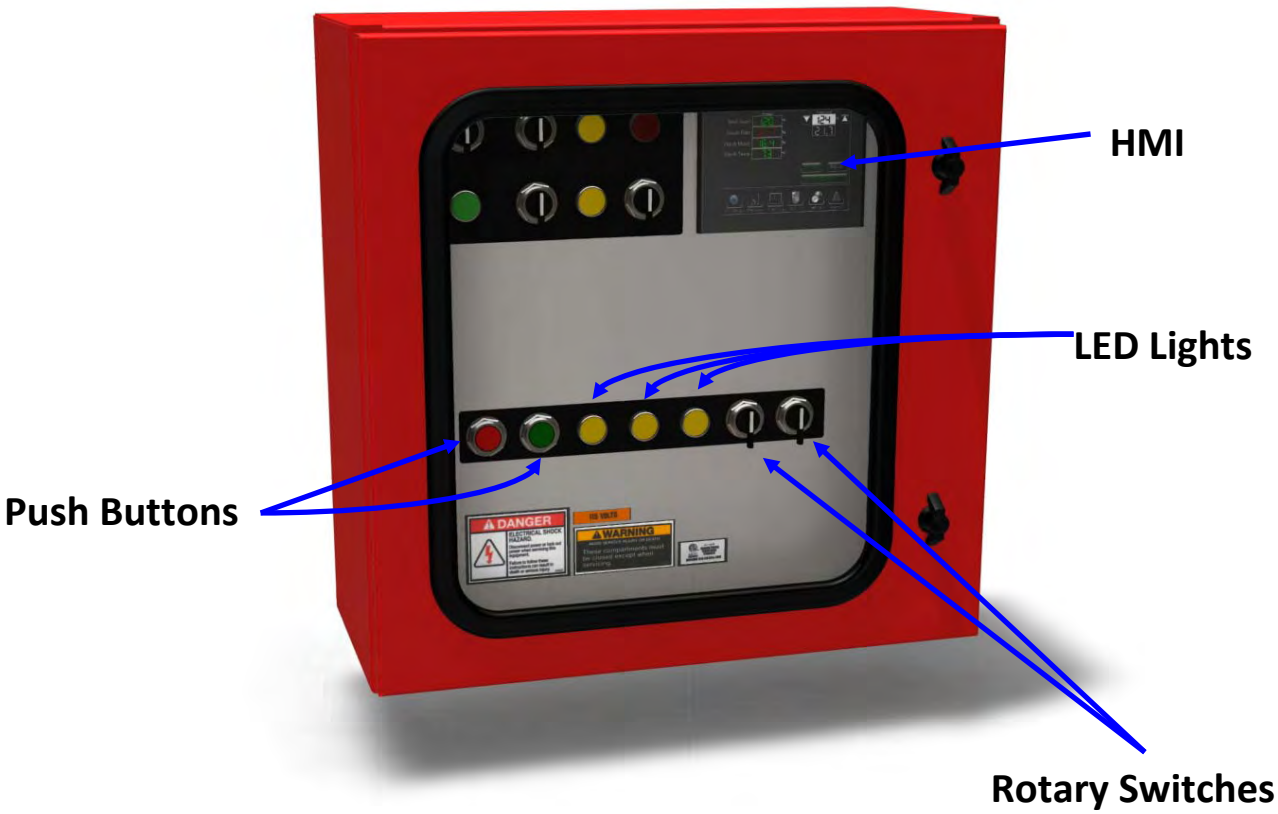


Figure 8: ***"Pinnacle Lite Remote Cabinet"***

Pinnacle

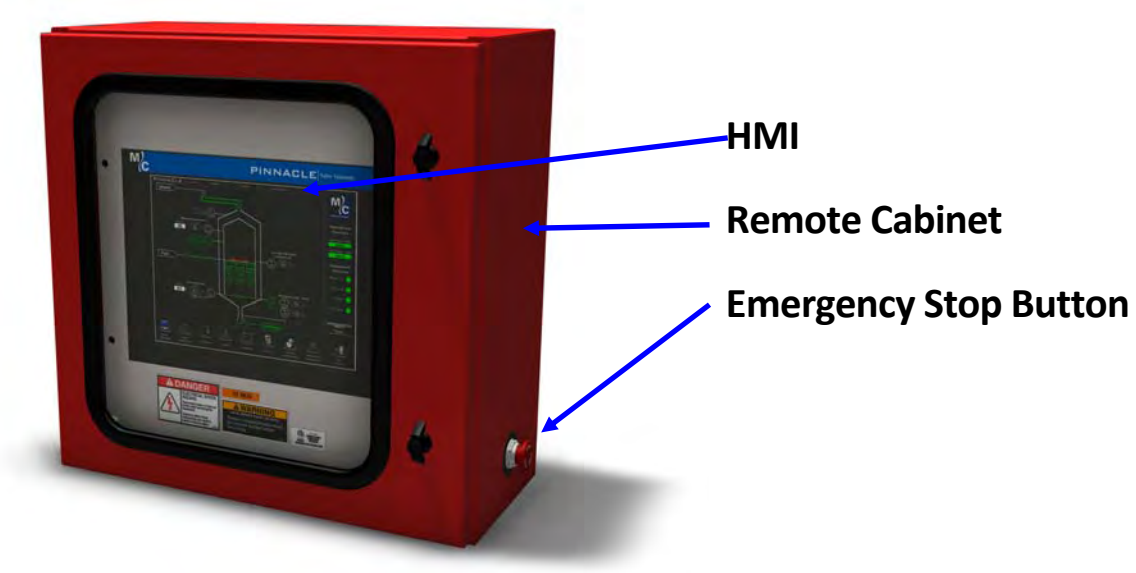


Figure 9: - *"Pinnacle Remote Cabinet"*

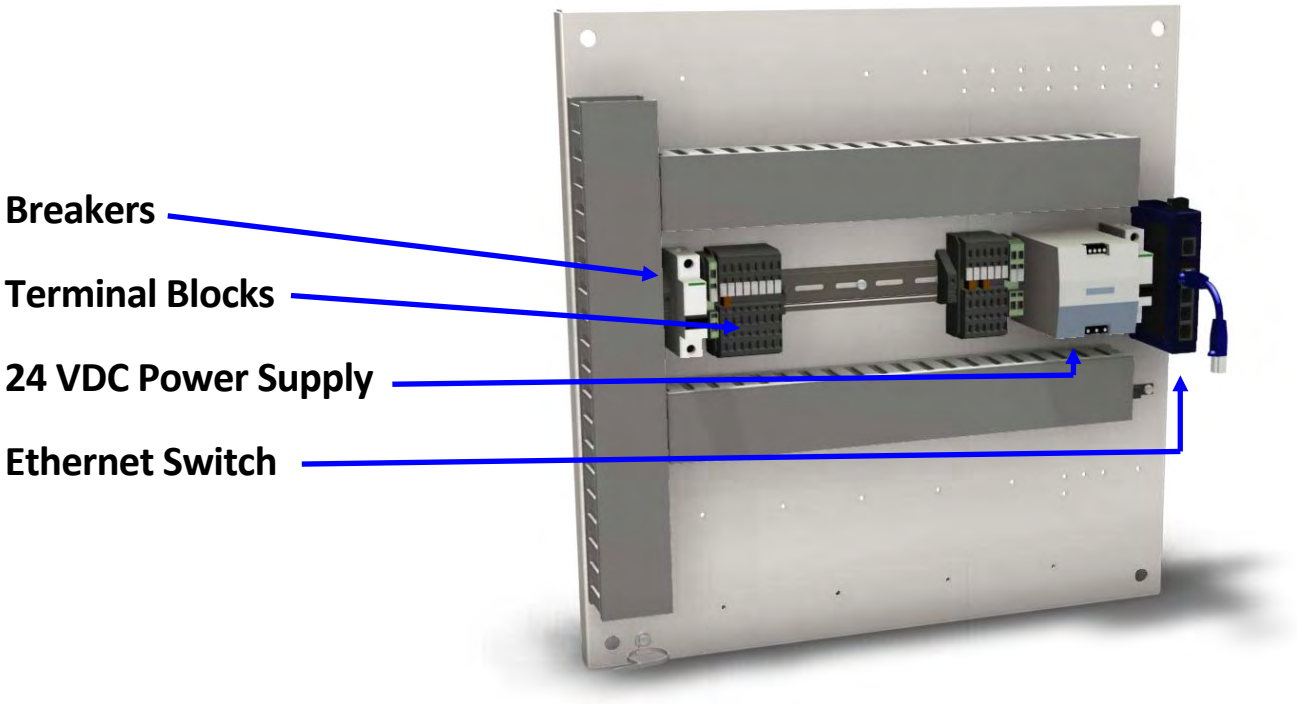


Figure 10: - *"Pinnacle Sub Panel Assembly"*

Pinnacle Lite

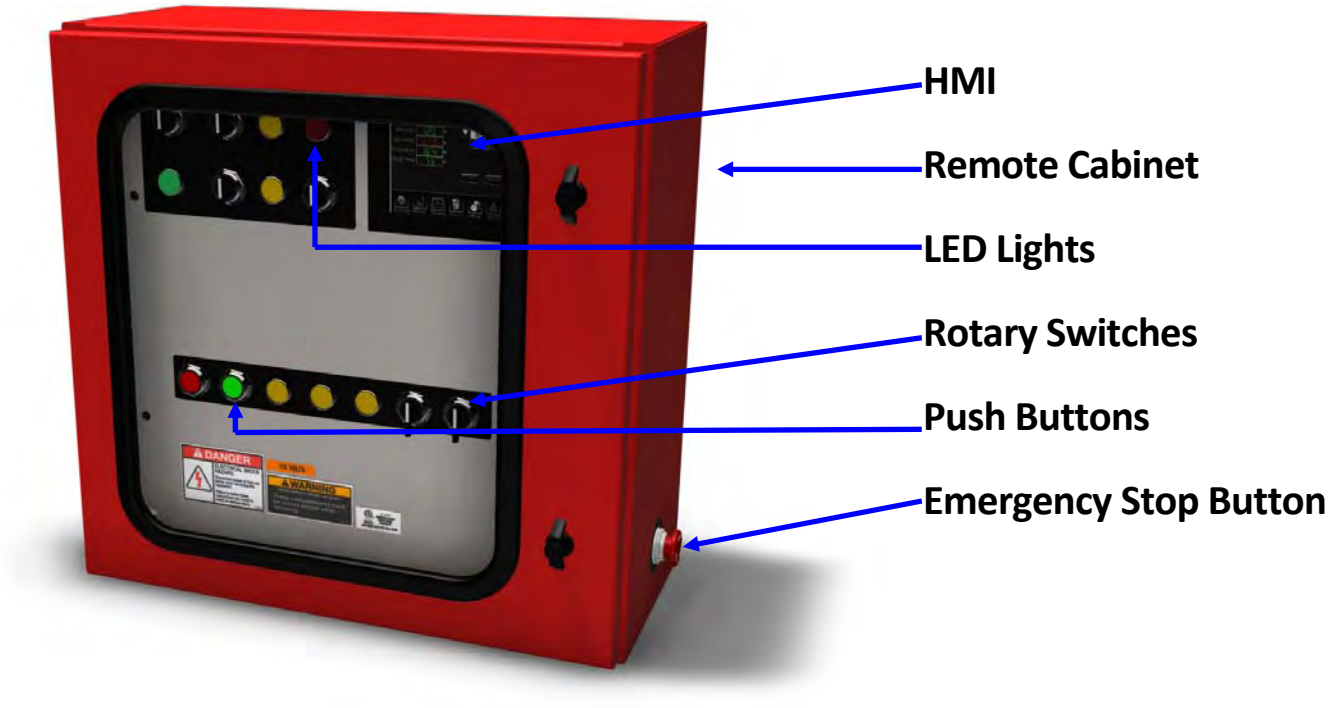


Figure 11: - *"Pinnacle Lite Remote Cabinet"*

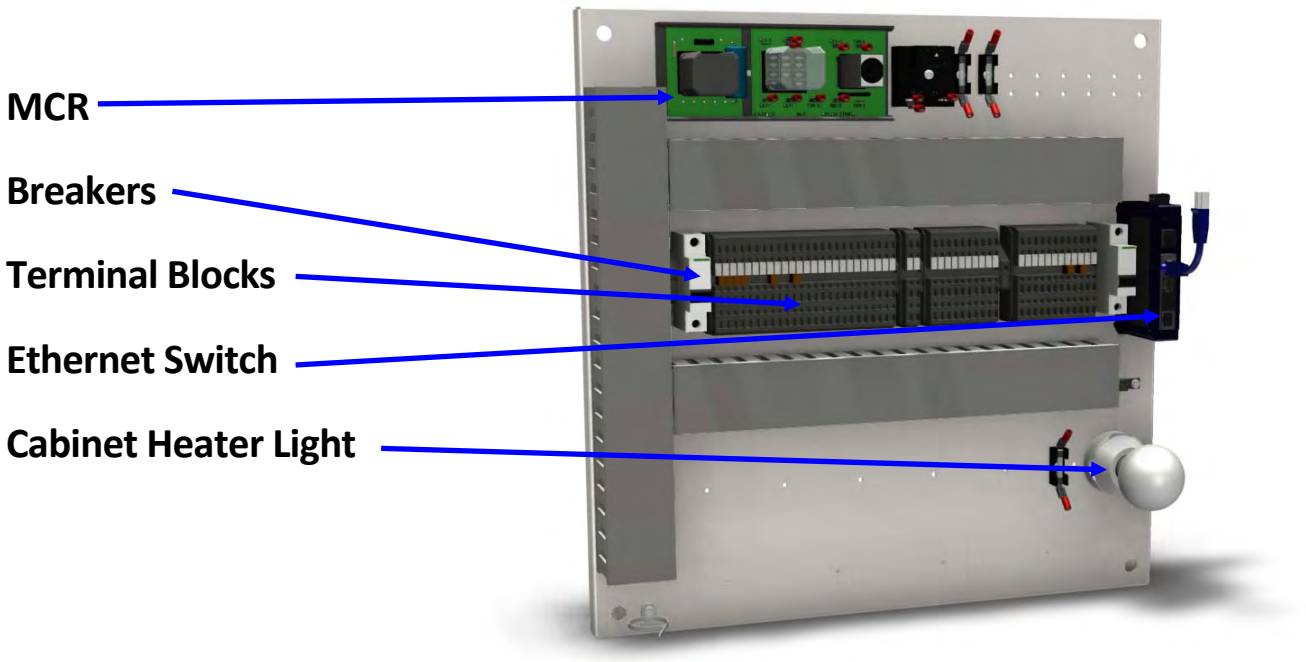


Figure 12: *"Pinnacle Lite Sub Panel Assembly"*

10' Tower High Voltage Cabinets

10' Tower Direct Start High Voltage

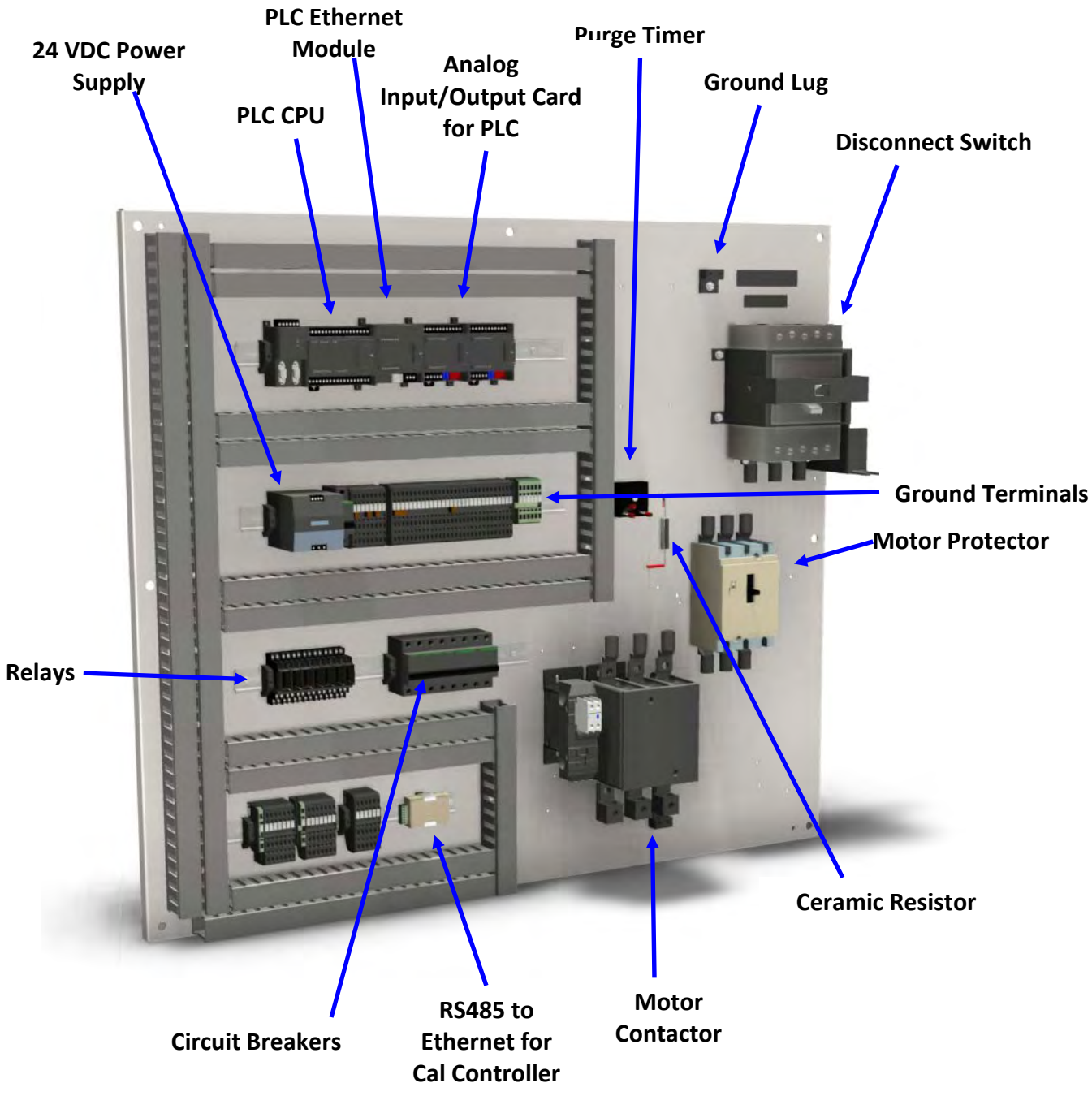


Figure 13: - *"10' High Voltage Direct Start Sub Panel"*

10’ Tower Dryer Soft Start High Voltage Cabinet

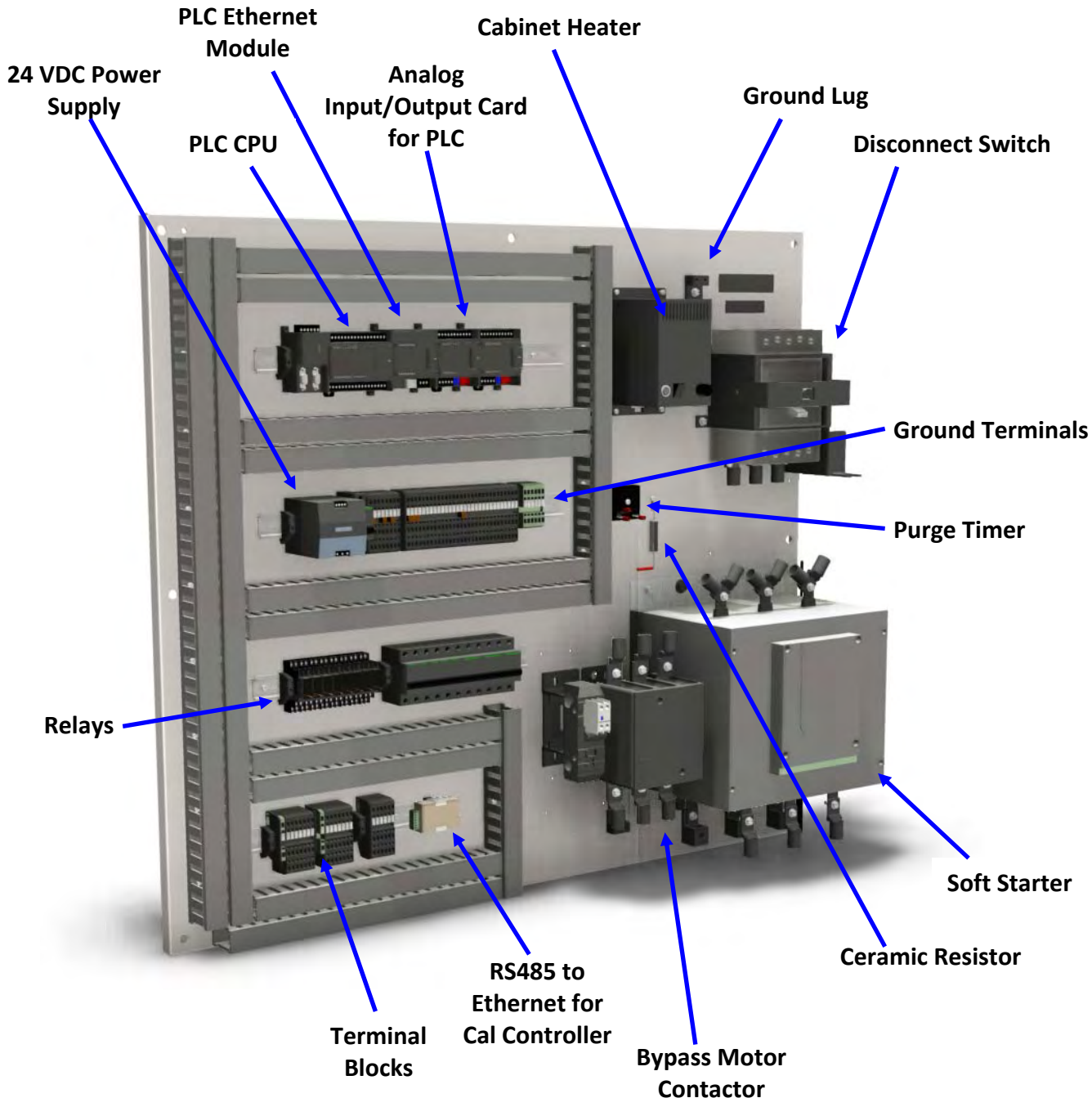


Figure 14: - *“10’ High Voltage Soft Start Sub Panel”*

12’ Tower High Voltage Cabinets

12’ Tower Direct Start High Voltage

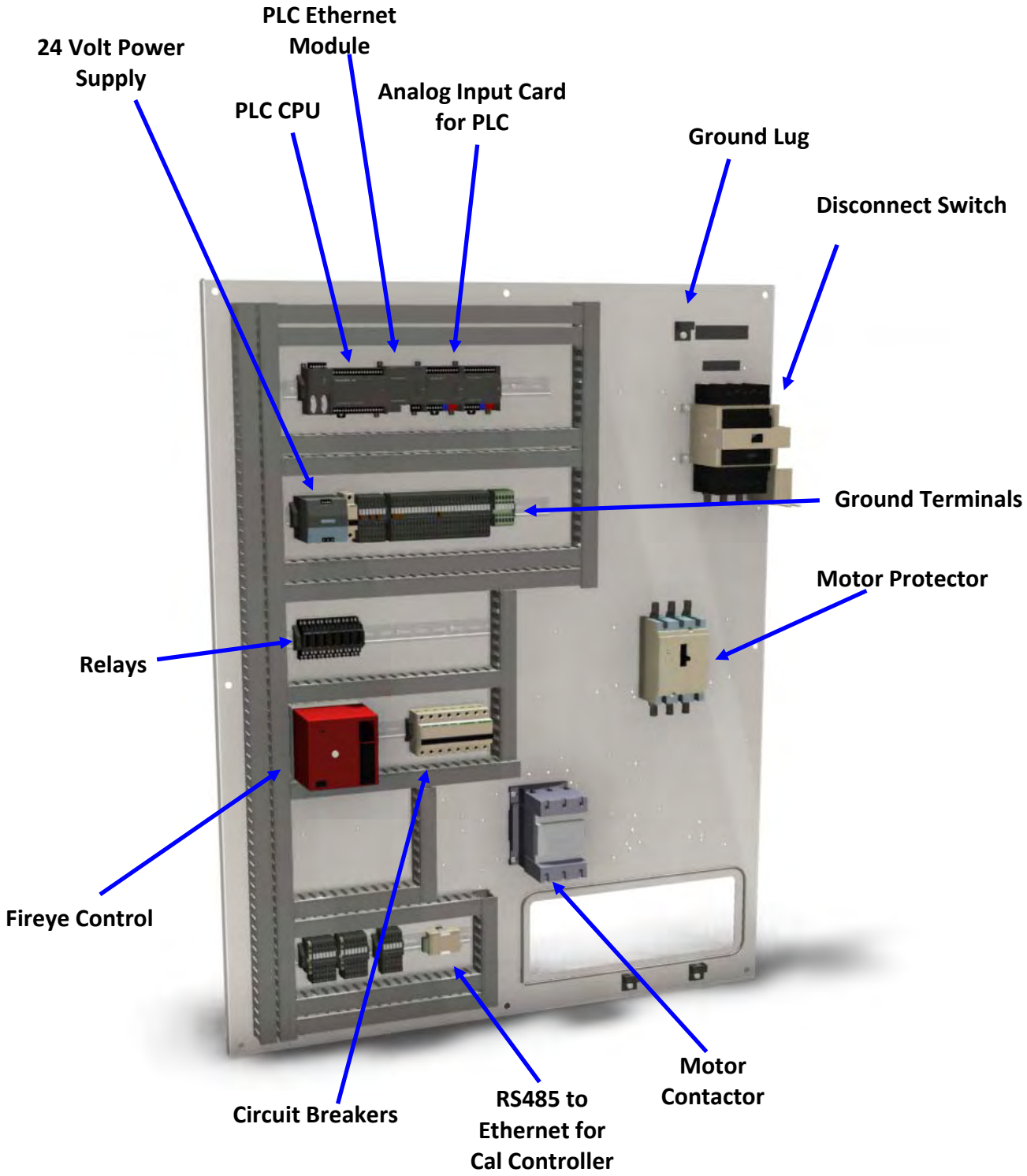


Figure 15: *"12' High Voltage Direct Start Sub Panel"*

12’ Tower Soft Start High Voltage

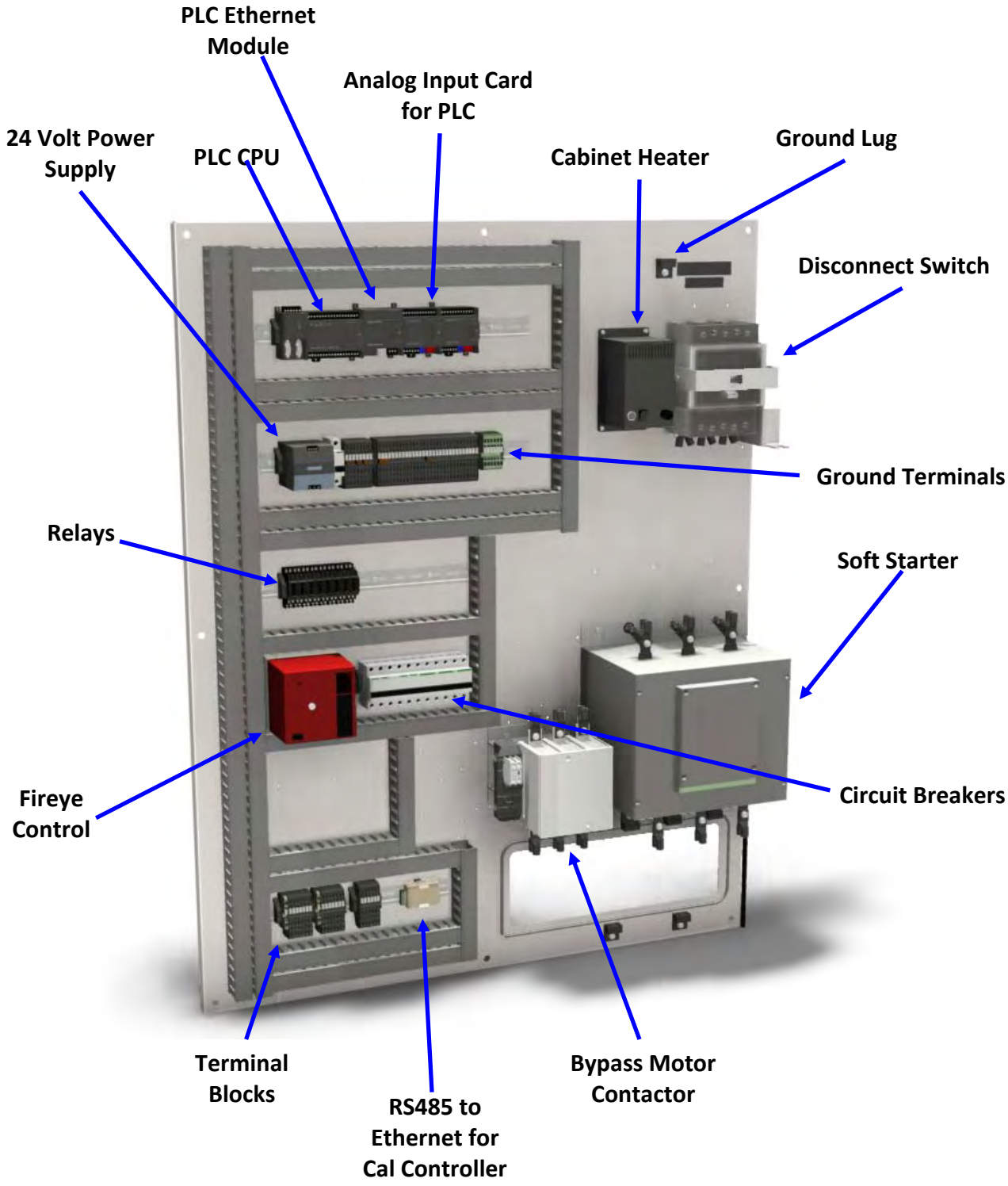


Figure 16: *"12' High Voltage Soft Start Sub Panel"*

18' Tower High Voltage Cabinet

18' Tri-Start High Voltage

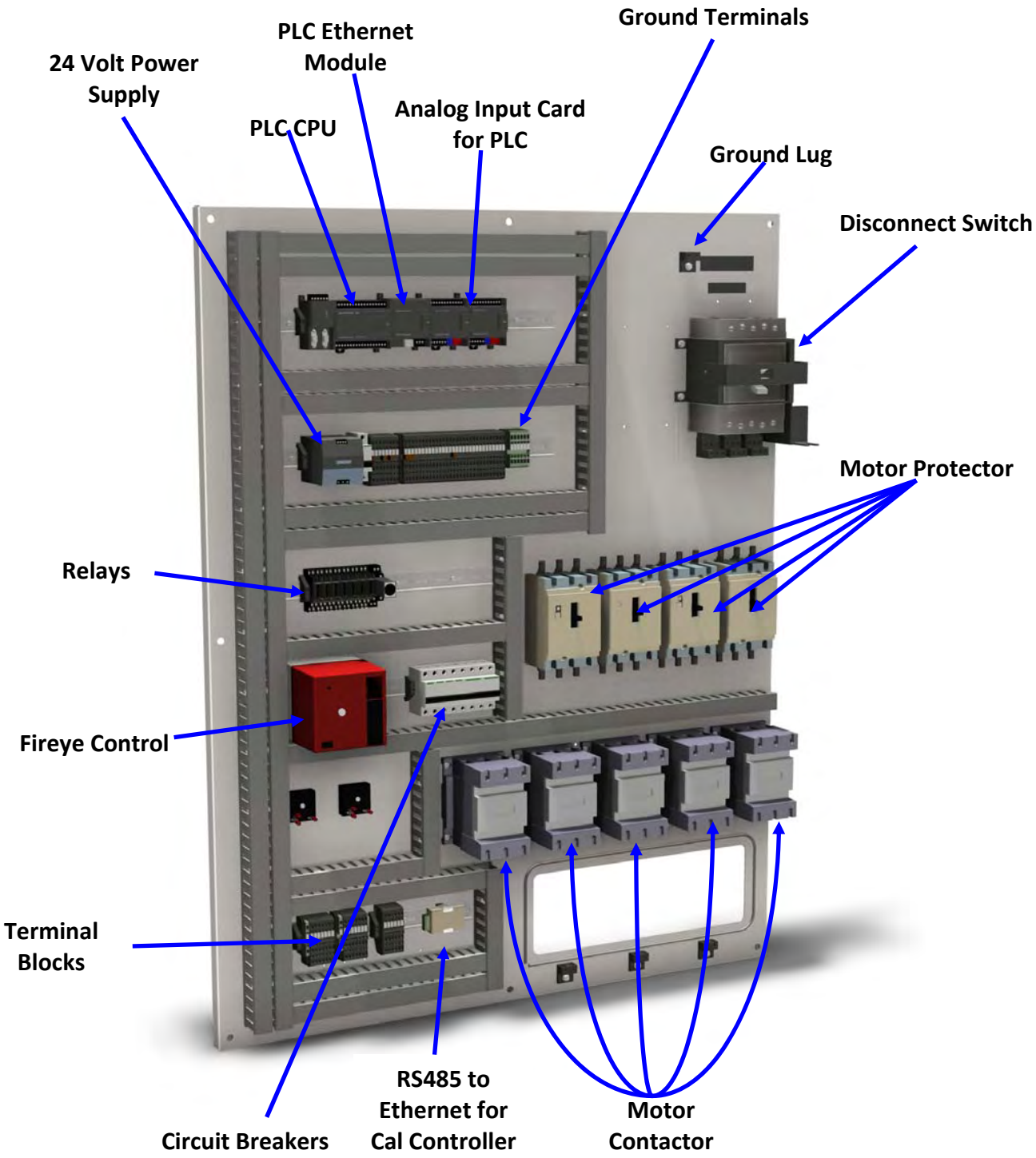


Figure 17: *"18' High Voltage Tri Start Sub Panel"*

Gas Train Components

Strainer
This item contains a wire filter and will collect foreign material that may find its way into the fuel supply line.

Solenoid Valve
The solenoid valve is controlled by the ignition board. 120-volt power will energize the solenoid coil and open the valve to allow fuel to flow to the burner. De-energizing the solenoid coil will stop gas flow within one second and stops gas flow; extinguishing the burner flame.

Control Valve
This valve opens and closes to allow fuel supply to change and to keep the plenum temperature stable. This butterfly gas valve is directly controlled by the Belimo actuator which receives its signal from the cal controller in response to the plenum temperature.

High Pressure Relief Valve
When line pressure becomes too great, the valve automatically opens and relieves excess pressure until the pressure drops. Once pressure drops, the valve will close and seal for proper function.

Low Gas Pressure Switch (Optional CE/CGA Systems Only)
The low gas pressure switch is an adjustable pressure switch that will shut down the burner if pressure drops below the set point. The switch is adjustable, and can be set for any pressure from 0 to 9 psig. The normal low-pressure setting is 50% of the low-end range of manifold pressure.

High Gas Pressure Switch (Optional CE/CGA Systems Only)
The high gas pressure switch is an adjustable pressure switch that will shut down the grain dryer if the pressure rises above the set point on the switch. The switch is adjustable and can be set for any pressure from 0 to 20 psig. The normal high-pressure setting is 50% above high-end range of manifold pressure.

Hand Valve
A mechanically operated ball valve used to manually open and close fuel supply to the burner.

Pressure Regulator

Reduces the pressure regulator pressure input to a controlled and adjustable output. These devices have different configurations and sizes but functionally perform two tasks; pressure reduction and stabilization of output within reasonable ranges.

10’ Tower Gas Manifold Overview

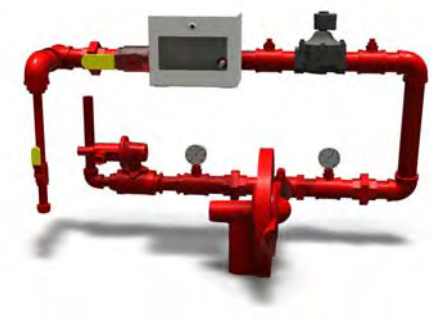


Figure 19: *10' Tower LPG Manifold"*

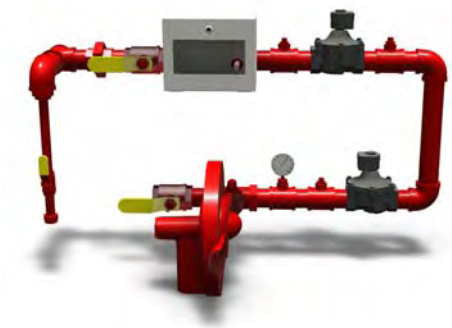


Figure 18: *"10' Tower NG Manifold"*

12’ Tower Gas Manifold Overview

Figure 20: *12' Tower LPG Manifold"*

Figure 21: *"12' Tower NG Manifold"*

18’ Tower Gas Manifold Overview

Figure 22: *"18' Tower NG Manifold"*

10' Tower Gas Supply & Connections

10' Tower LPG

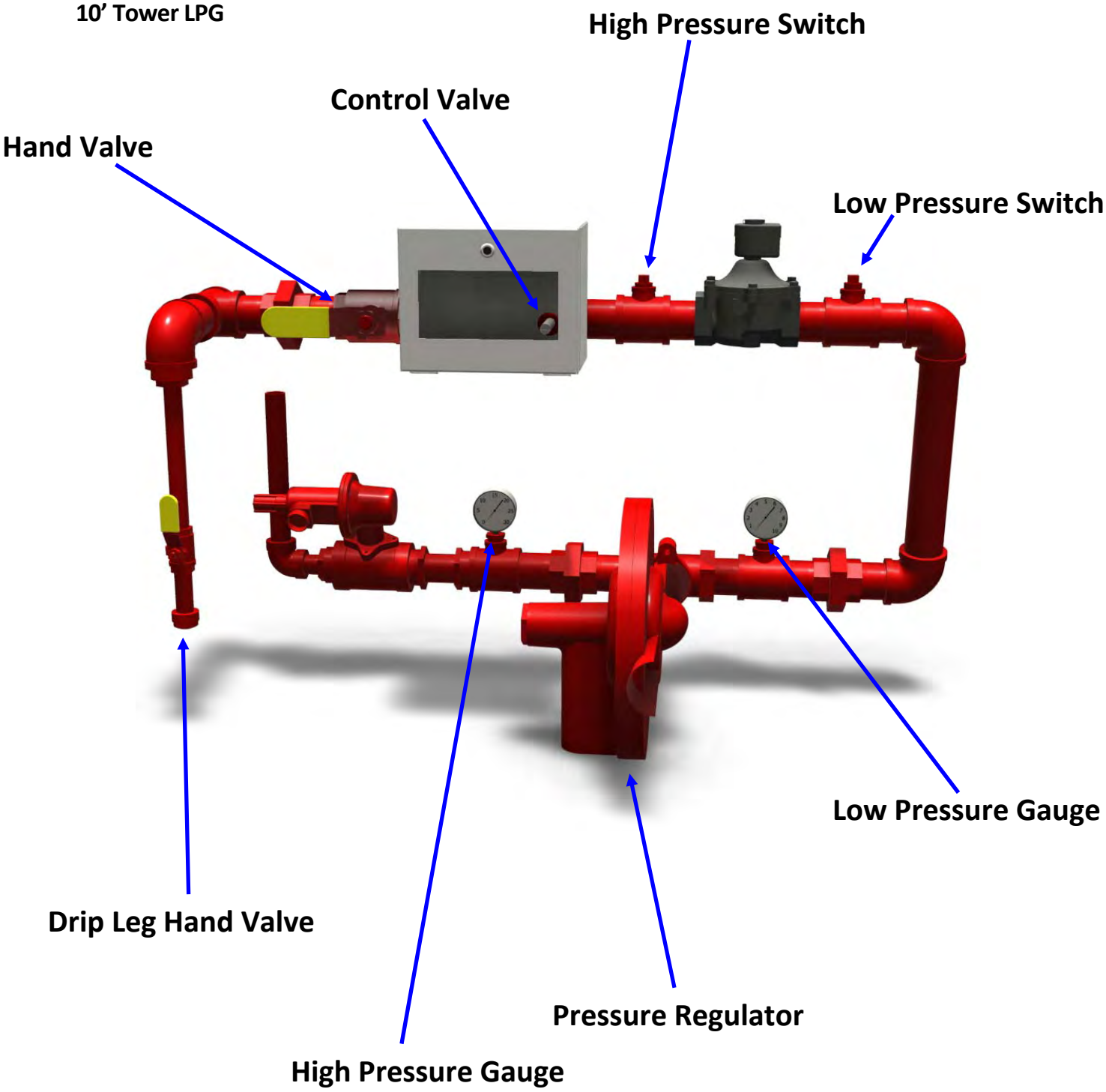


Figure 23: - *"10' LPG Manifold"*

10’ Tower NG

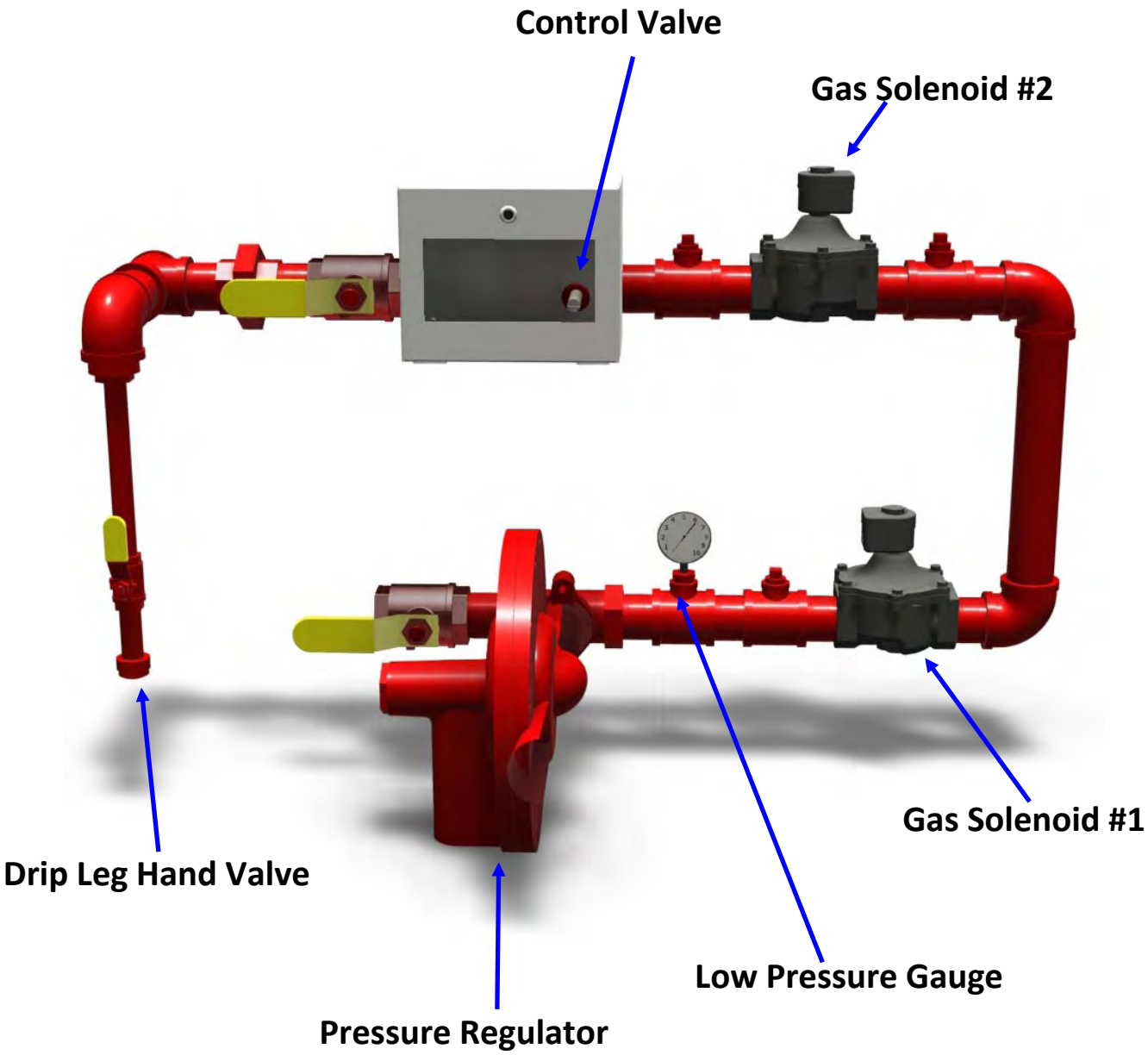
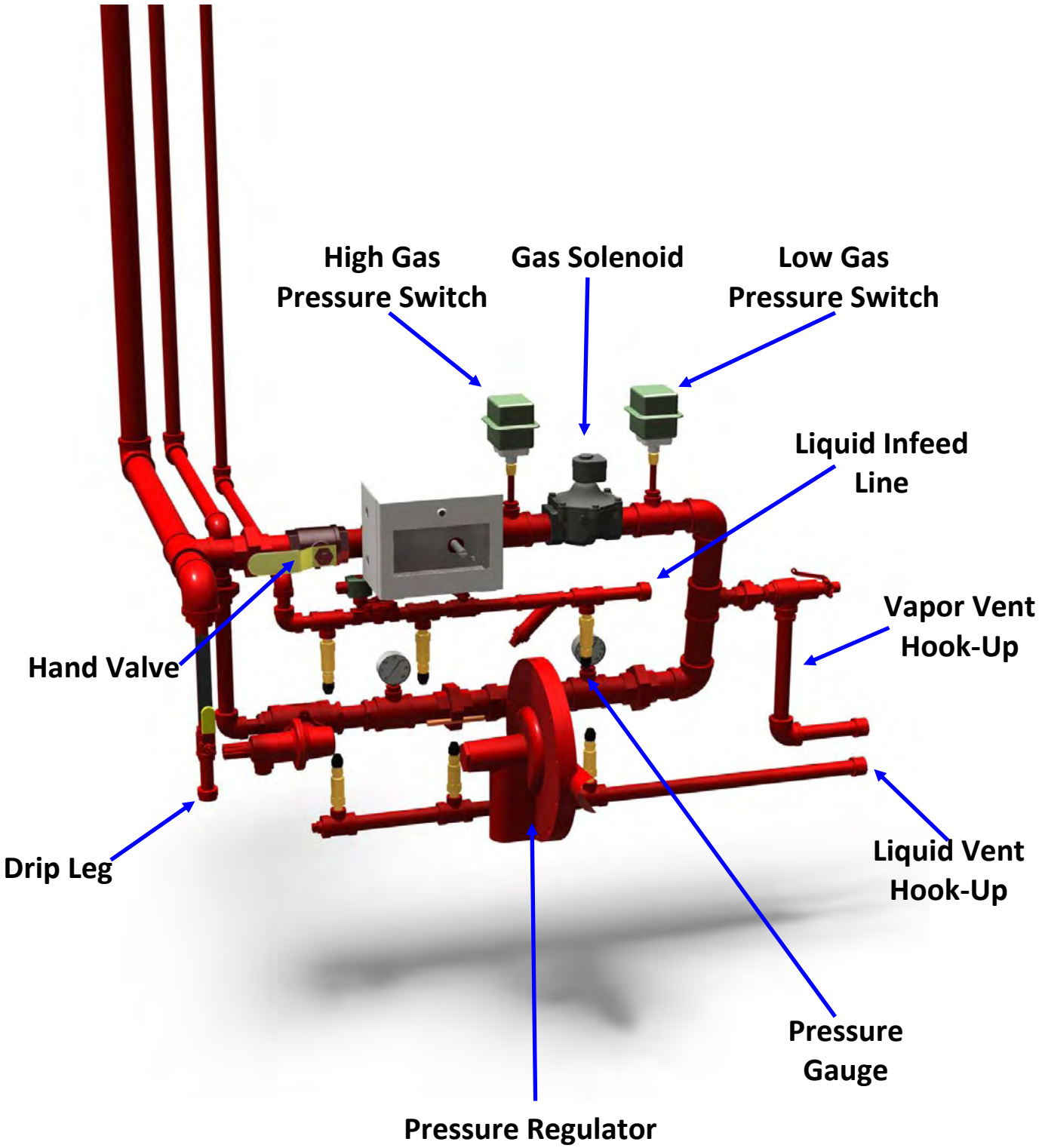


Figure 24: - *“10' Tower Natural Gas Manifold”*

10’ Tower Canadian LPG



12’ Tower Gas Supply & Connections

12’ Tower LPG

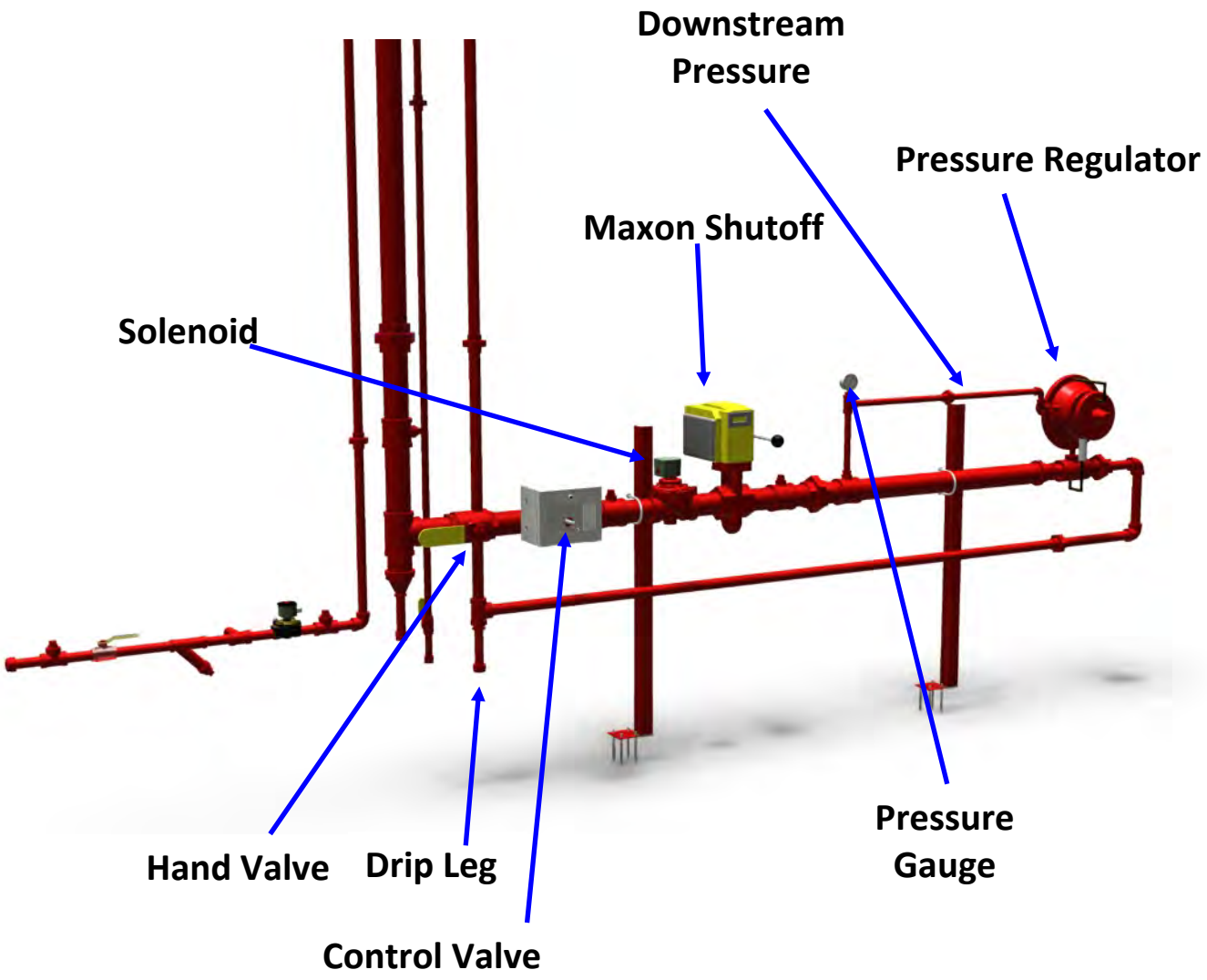


Figure 25: *"12' LPG Manifold"*

12’ Tower NG

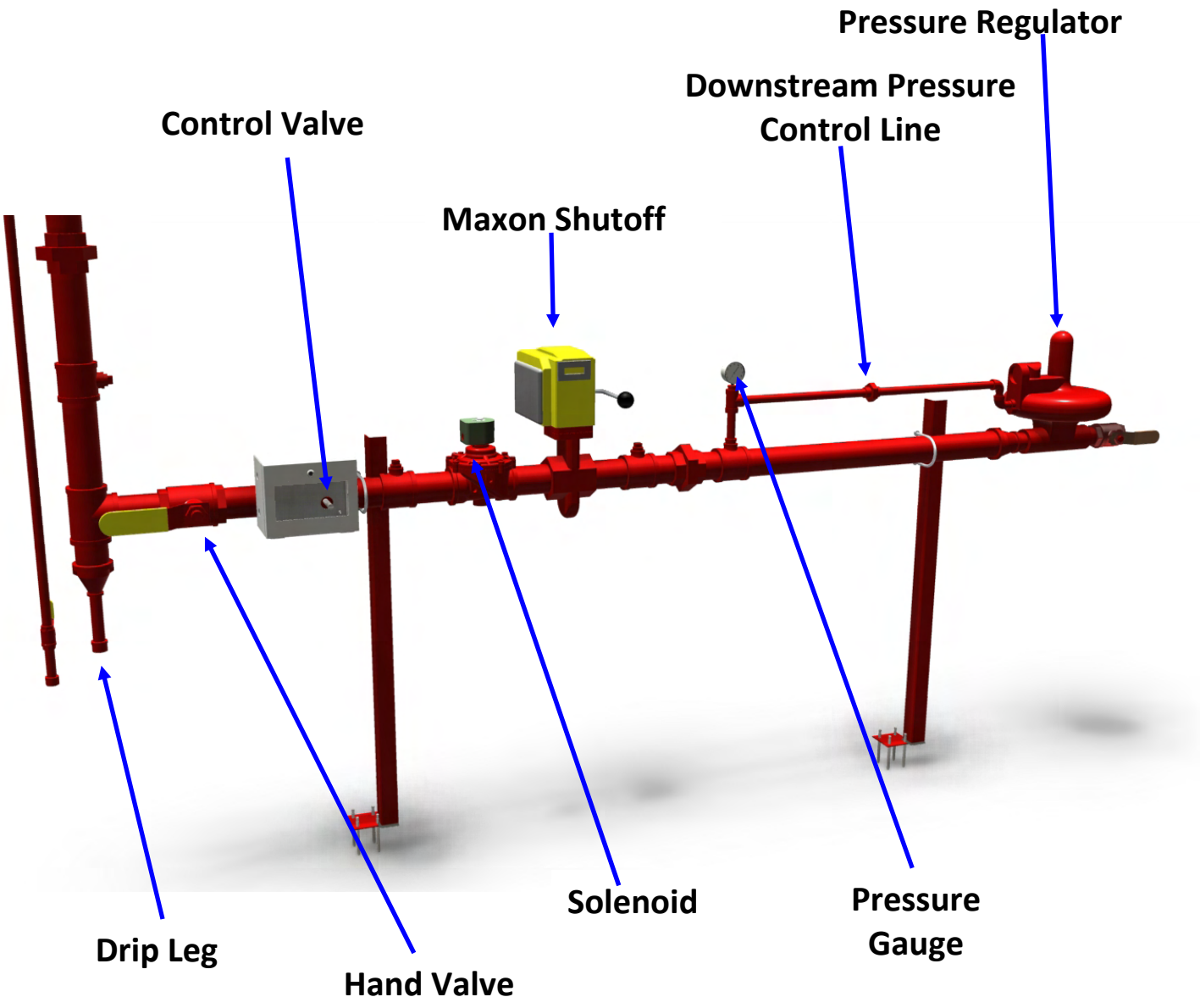


Figure 26: *"12' NG Manifold"*

18’ Tower Gas Supply & Connections

18’ Tower NG

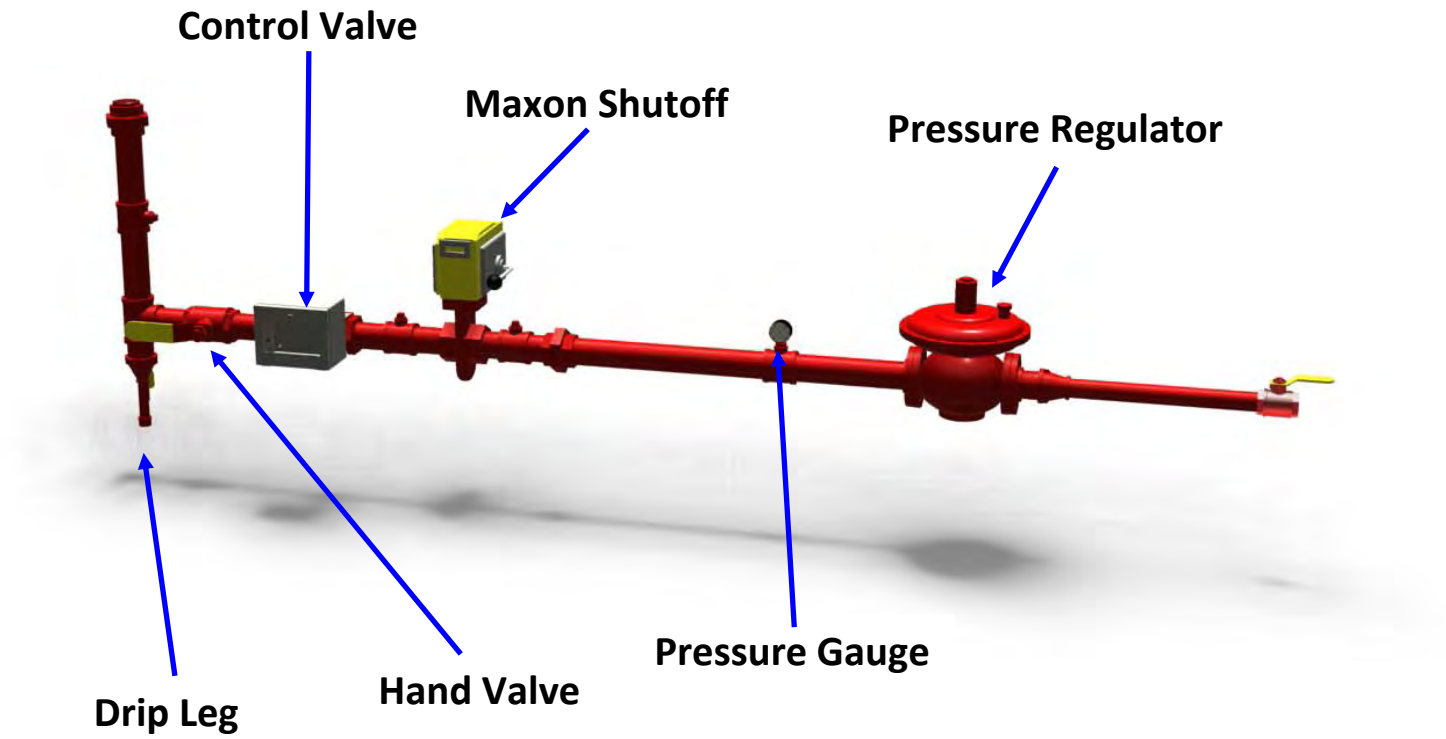


Figure 27: *"18' NG Manifold"*

Proportional Temperature Control

Cal Controller Features

- Displays set point and actual plenum temperature simultaneously.
- Measures plenum temperature with an RTD (Resistance Temperature Device)
- Uses a PID loop to control plenum temperature.
- Has an auto tuning feature to automatically set PID values.
- Gas flow is controlled with a proportional actuator and a butterfly valve.
- The proportional valve (Belimo actuator) opens and closes from 0 to 100% to modulate gas flow and control the plenum temperature.
- Once the actual temperature in plenum chamber nears the set point temperature, the proportional valve starts to close to drive the temperature to the set point.
- The safety circuit for dryer is wired through the controller by means of a relay. The high temperature limit shutdown is 40° over set point.
- The low temperature limit shutdown is 40° below set point.

NOTE: When first starting the dryer, the low temperature shut down is inhibited and does not become active until it reaches a temperature within 40° of set point. If the dryer loses the flame of the burner and temperature drops more than 40°below the set point, the dryer will shut down.

- Diagnostics will display an alarm after shutting down the dryer.
- Red LED lights to the left of the SP display (bottom) indicate alarm (Upper LED is for high temperature, low LED is for low temperature).
- The Green LED (upper left corner) flashes as the control output is calculated and changed.

Figure 29:-*"Temperature Controller (Cal)"*

Figure 28: -*"Belimo Actuator"*

10' Tower Ignition System

Figure 30: *"Ignition Board"*

Figure 31:-*"10' Tower Ignition Box"*

1. Power is supplied to the *Air Pressure Switch* through a fan motor interlock. Once the fan is running, the air pressure switch is energized.
2. The *Air Pressure Light* comes on, indicating air pressure, providing power to the ignition switch.
3. Once the *Ignition Switch* is turned to the "**ON**" position, power is supplied to the input side of the external 10-second timer. The load side of the timer has both a resistor to ground (eliminating excess voltage during timing cycle) and a hot lead to the *Ignition Board*.
4. When the *Ignition Board* is powered up at **L1**, the board starts through the ignition process.
5. The red **LED** light on the *Ignition Board* will flash once when it first receives power, resetting the internal board protection and clearing the memory. There is a one second delay before the board starts the first trial for ignition.
6. Once the board is reset and the memory is cleared, the board will send high voltage out of **E1** (coil) to the spark plug to light the burner and 120 volts output from **V1** to open up solenoid valves and light up gas valve light. This trial for ignition will last for 10 seconds. The trial for ignition ends after 10 seconds as does the high voltage arc and 120 volts out to solenoids from **V1**.
7. If the burner is successfully lit, the board will output between 40 and 60 volts to the *Flame Sense Probe* at the burner. The *Flame Sense Probe* will try to push voltage through the flame and to the chassis ground. Once the circuit from the *Flame Sense Probe* to chassis ground is complete and the signal is strong, the board will keep power at **V1** and the solenoids remain open.
8. If the signal drops down or is interrupted, the board will drop power to **V1** and the solenoid will close, causing the flame to go out.
9. The *Ignition Board* has a second trial for ignition, this trial will occur immediately after dropping out of the burner. This will occur so quickly that the gas valve light will not even flash off between loss of signal and re-trial for ignition. The second trial for ignition will not occur if I the flame is never established. If the flame goes out, the board will show three flashes on the red **LED** light on the *Ignition Board*, indicating lock out condition.
10. If the burner does not light, turn *Ignition Switch* to the **OFF** position and back to the **ON** position. The sequence will begin again

12' & 18' Tower Fireye Flame Controller

Figure 33: *"12' & 18' Tower Ignition Box"*

Figure 32: *"12' & 18' Tower Fireye Control Inside view"*

Figure 34: *"12' & 18' Tower Fireye Control Outside View"*

Indicator Overview

OPR CTRL (Operating Control)

The LED is energized whenever the burner control switch and all other various limit switches are closed and the power is applied to Terminal #7.

INTRLCK (Interlock)

The LED is illuminated whenever the power is detected on Terminal #6, indicating that the air flow switch or other running interlock is closed. If the operating control is closed and the running interlock switch remains open, this LED will flash at a 1 second rate indefinitely for the MEP100 and MEP200 family. Lockout will occur if the switch remains open for 10 minutes in the MEP500 family. This LED will blink when configured as a flame switch and when the flame is detected.

PTFI: LED is illuminated only during the pilot trial for ignition period and the stabilization period when so equipped.

FLAME: LED is on whenever a flame signal is detected and the control is not in a locked out state.

ALARM: LED flashes when an alarm condition is detected and is used as an address indicator. During an alarm condition, the Alarm LED is made to flash at approximately a 1 second rate. The remaining four LED's are illuminated as a coded sequence identifying the reason for the lockout. For instance, for a **LOCK OUT – FLAME FAIL – PTFI, the INTERLOCK, PTFI and FLAME LED'S** will all be lit steady, with the Alarm LED flashing. This remains true if power is removed and then restored in a lock-out condition.

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Section 4

Section 4: Operating Procedures

Start Up Procedure

General

WARNING: Inspect for and remove any foreign material (nuts, bolts, tools, parts, etc.) from the grain columns, sweep system, and heat chamber before filling the dryer with grain.

CAUTION: Lock out and tag out high voltage disconnect when working inside any control cabinet or inside the dryer.

NOTE: BE SURE TO REMOVE THE BURNER COVER!

1. Adjust high limit, and set to 30 to 50 degrees above drying temperature.

2. Make sure that all gas supply is turned off and locked out.

    a. Liquid Propane (**LPG**) Fuel:
    - Turn the LPG liquid line hand valve 90° to the piping to shut off the LPG at the dryer.
    - Turn the vapor hand valve 90° to the piping to shut off the gas to the burner.
    - Open the LPG valve at the source.

    b. Natural Gas (**NG**) Fuel:
    - Turn the NG hand valve 90° to the piping to shut off the NG at the dryer.
    - Open the NG valve at the source.

3. Remove the pipe cap from the vapor line to the burner. Open the hand valve to allow any built up water to drain from the gas lines. Once the water has completely drained, recap the end of the vapor line using Teflon tape and non hardening pipe dope to reseal and close. The gas supply can now be restored.

4. Remove the burner cover located directly on top of the burner in the heat chamber.
5. Make preliminary adjustments to the timers located in the remote cabinet. Adjust the fill timer to 60 seconds and the grain flow timer to 5 minutes. Make sure that arrows on the grain flow timer are set at 1x and M & 5 (for five minutes). This can be easily adjusted with a small flathead screwdriver.
6. Turn the disconnect within the high voltage cabinet to the **ON** position.
7. Turn the power switch to the **START** position. The green **ON** light should energize.
8. Press the fan **START** button and the fan should come on. Once the fan is running at full speed, the dryer is ready to be filled.
9. Turn the fill switch on the remote cabinet panel to the **MANUAL** position to allow the dryer to fill completely.
10. Adjust the air pressure switch (within the VFD box) so the air pressure light illuminates when the dryer is full of grain and the fan is running.

NOTE: If the fan stops for any reason or grain columns start to empty, the air pressure light should turn off. The air pressure switch should be adjusted when the fan is running and the grain columns are full. Turn adjustment screw clockwise until Air Pressure light goes out, then slowly turn counterclockwise until the light comes back on. Add one-half turn counterclockwise.

11. Open the hand valve on the gas train inlet (located downstream of the optional Maxon valve 12' & 18' Towers). Gas pressure should be indicated on the gauge.
12. Turn the temperature control switch **ON**, then turn ignition switch **ON**. This will energize the ignition board and go through a 10 second purge timer. The ignition board will attempt to ignite the burner for 10 seconds (trial for ignition). The gas valve light should be illuminated while the burner is trying to ignite (10 seconds).
13. Once the burner is lit, press * and ▲ on the cal controller to scroll the number to the desired plenum temperature set point. The controller will display two numbers. The upper number is the actual plenum temperature in degrees Fahrenheit or Celsius. The lower number is the set point (**SP**) or desired plenum temperature. The bottom set point number is the only number you can adjust with the arrow key. The plenum temperature may take several minutes to stabilize. The controller is programmed to slow down the temperature rise, the closer the plenum gets to the set point to avoid tripping the high limit device and overshooting the set point. The temperature controller automatically shuts down the dryer if there is an increase or decrease in the temperature of more than 40 degrees from the set point.

14. After allowing the dryer to warm up, start the sweep system by turning the *Takeaway* switch to the **ON** position. Then turn the *Metering* switch to the **ON** position and the discharge light will illuminate. Note that the take away equipment must be running for this to operate.
15. Use the HMI touch screen to adjust the discharge speed. For this, the dryer must be running in manual mode. Increasing the discharge speed will cause the grain to pass through the dryer faster, causing the mid-grain temperature (indicated on the HMI) to decrease and the discharge moisture to increase. Decreasing the discharge speed causes the grain to pass through the dryer slower removing more moisture, causing the mid-grain temperature to rise and the discharge moisture to decrease. Once the drying process has stabilized and the desired discharge moisture has been achieved, you can switch from manual to TruDry mode by pressing the button on the HMI. Make sure that the set point for the mid-grain temperature matches the actual reading when doing this.
16. In TruDry mode the discharge speed will automatically adjust to maintain the desired average mid grain temperature. As the mid-grain temperature increases, the discharge speed will be increased. This will reduce the drying time and cause the mid-grain temperature to decrease and maintain the moisture content. Once in TruDry mode, manual discharge is no longer available.

NOTE: Because the dryer is operated in "Heat and Cool," it will be necessary to recycle the wet grain in the cooling section back through the heat section after drying the first load. The alternative would be starting with dry grain in the cooling section.

17. Test the moisture content of the grain being discharged every 15 minutes until it stabilizes.
18. If the moisture content is too high after it stabilizes, adjust the mid-grain temperature set point to a higher temperature which will cause the discharge rate to decrease. If the discharge moisture is too low, adjust the mid-grain temperature set point down to a lower temperature which will increase the discharge rate.

NOTE: After any adjustments of the mid-grain temperature, wait 1 ½ to 2 hours to make further temperature adjustments since it takes that long for grain to pass through the dryer and for the full effect of the speed adjustment to be noticed.

Air Pressure Switch

General

1. The *Air Pressure* switch senses the static air pressure in the heat chamber when the dryer is full of grain and the fan is running. If the static air pressure drops because of fan failure, the air pressure switch will open stopping the current flow to the ignition switch. The gas solenoid valves will close and the burner will shut down.

2. The *Air Pressure* switch is designed to protect the dryer from fire that may result from fan (air flow) failure while the burner is ignited and a flame is present.

CAUTION: This safety feature is for your protection and protection of the dryer. The air pressure switch (es) should be checked for correct operation at the start of the drying season and periodically during the season.

Checking

1. After the dryer has been filled and before the burner is ignited, the operation of each air pressure switch **MUST** be checked.

2. Start the blower.

3. The *Air Pressure* light on the remote cabinet will light as fan comes up to speed.

4. If the indicator light does not illuminate or come on too soon (before the fan reaches operating speed), the *Air Pressure* switch must be adjusted.

Adjusting

1. Remove the cap on the *Air Pressure* switch. The slotted screw is the adjusting screw inside air pressure switch.
2. Turn the adjusting screw counterclockwise until the *Air Pressure* light comes on. After the *Air Pressure* light comes on, turn the adjusting screw counterclockwise an additional ¼ to ½ turn to allow for normal changes in static pressure.
3. Shut **OFF** the fan. The *Air Pressure* light will go out when the fan stop button is pushed. The control cabinet is wired so that the power flows from the *Fan Start* button to the *Air Pressure* switch.
4. If all air pressure switch adjustment is used and the *Air Pressure* light does not illuminate, the *Air Pressure* switch is defective and must be replaced. Once replaced, check the operation of the new air pressure switch; adjust if necessary.
5. If the *Air Pressure* light is blinking, turn the adjusting screw counterclockwise.

Filling the Dryer

***NOTE*: Always have the fan running before filling the dryer. Either start with dry grain in the cool section or be prepared to recycle wet grain back into the dryer.**

There is an adjustable 0 to 3-minute time delay in the dryer wet fill circuit. The delay is activated when the wet grain filling switch is in the automatic position and the fill light is signaling for grain.

This delay prevents nuisance starting and stopping of the fill system. If the wet grain filling switch is placed in the **OFF** position and back to the automatic position, the delay will recycle.

When the dryer fills with grain up to the level of the rotary bin switch, the dryer has reached its capacity and automatically stops filling.

The grain flow timer will shut down the dryer if there is an insufficient amount of wet grain to fill the hopper. When the fill system starts, the grain flow timer will be activated. When the timer counts down to zero, the dryer will shut down and the grain flow light will be illuminated.

CAUTION: Do not allow anyone to be in the dryer when filling it with grain. Always turn off and lock the electric power supply to the control cabinet before allowing anyone to work in the dryer.

Setting the Grain Flow Timer

Conveyor Fill System (Slave System)

1. Set the adjustable wet fill delay for time desired (0 to 3 minutes) if not already set.

2. Set the *Grain Flow Timer* arrows at the bottom of the timer face to X10 (times ten) and to M (minutes). It may be necessary to remove the timer from its socket to make this adjustment. Now turn the timer control knob to 1 (3x10) or 10 minutes and flip the wet grain switch to **AUTOMATIC**. The fill system will start after the 0 to 3 minutes delay if the fill light is on, signaling for grain

.

3. Check the refill time a minimum of six times. The fill light will come on when the rotary fill switch in the hopper signals for grain and will go off when the hopper is full. The length of time that the fill light is on equals the refill time (**including the 0 to 3 minutes delay**).

4. Average the 6 refill times and reset the grain flow timer to run five minutes longer. For example, if it takes the fill system an average of five minutes to refill the dryer. Set the grain flow timer to run 10 minutes.

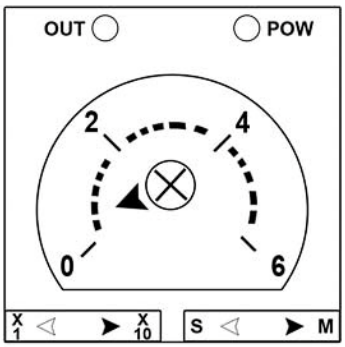


Figure 35: -*"Grain Flow Timer"*

NOTE: The timer does not operate when the fill switch is in the MANUAL or OFF position.

Gravity Feed Tube System (Choke Fill System)

1. Set the timer for refill time desired 2 to 180 at 10 seconds if not already set.

2. Set the grain flow timer arrows at the bottom of the timer to X1 (**times one**) and to M (**minutes**).

3. Grain flow should be set from 2 to 4 minutes.

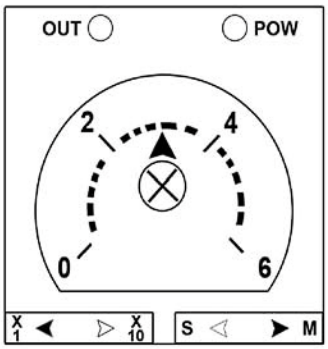


Figure 36: -*"Gravity Feed Timer"*

NOTE: The gravity feed timer will not cycle the fill system. The rotary fill switch is used to shut down the dryer on loss of wet grain only.

Grain Flow Timer Operation

With the grain flow timer set to run five minutes longer than the fill system's refilling time, the timer will work as follows:

1. The timer will start when the fill system starts. The red light on the face of the timer will be illuminated and the timer will start to count down to zero.

2. After the fill system refills the dryer and shuts off, the *Fill light* shuts off and the timer will automatically reset. The red light on the face of the timer will shut off.

3. If there is an insufficient grain supply, the fill system will continue to run beyond the five minute refilling period. When the fill system has run the length of time that was set on the *Grain Flow* timer, the dryer will shut down.

4. The *Grain Flow* light on the remote cabinet panel will be **ON**. The two red lights at the top of the grain flow timer inside the remote cabinet will be on. Flip the *Wet Grain* switch or turn the *Fill* switch to **OFF**.

5. The discharge must be in operation for the grain flow timer to function.

NOTE: The grain flow timer shuts the dryer down when it has run out of wet grain.If equipped (12' & 18' Tower), the main gas supply safety shutoff valve must be opened manually before the burners can be started.

6. Turn the *Power On* switch to the **OFF** position then back to the **ON** position to reset the grain flow timer.

7. Turn the *Fill* switch to **MANUAL**. Restart the fan, burner, and discharge system. Turn the fill switch to the **AUTOMATIC** position. The fill system 0 to 3 minute delay will be activated if the fill light is signaling for wet grain.

Igniting the Burner

1. Start fan by pressing the **green** *Fan Start* button. Check to make sure that the air pressure switch indicator light is **ON**.
2. Open the gas vapor *Hand Valve*.
3. Turn the *Temperature Controller* switch to **ON**. This switch sends power to the temperature controller.
4. Turn the *Ignition* switch to the **ON** position. After a 10 second purge delay, the gas valve light will be **ON** and the burner will attempt to ignite.

NOTE: The 10 second purge is a safety feature that allows the fan to purge the heat chamber of any unburned gases that may remain after the burner has been shut down for any reason.

The ignition board is electronically timed so that the ignition system will spark and hold the solenoid gas valves open for a "trial ignition" period of 10 seconds. If the burner does not light, the system will "lock out," closing the gas solenoid valves.

5. If the LPG gas line freezes, close the gas vapor hand valve and turn the burner switch to **OFF**. After the gas line thaws out, **SLOWLY** open the gas vapor hand valve all the way (handle parallel to the piping).

NOTE: Opening the gas vapor hand valve slowly will prevent possible freezing of the LPG gas line and also prevents the temperature from rising too fast. If the temperature rises too fast, the high limit switch will trip out and the dryer will shut down.

6. Push the reset button on the high limit switch, located in the ignition box.

NOTE: When the high limit switch trips out, the dryer will shut down. The fan and burners will have to be restarted.

7. Turn the Power switch to the **ON** position and release.
8. Start the fan by pressing the green **FAN START BUTTON**. Check to make sure that the indicator light for the air pressure switch is on.
9. Open the gas vapor hand valve halfway.
10. Turn the burner switch to the **ON** position. The gas valve light will come on and the burners will ignite.
11. The gas pressure reading on the pressure gauge should indicate from .75 to 3.0 p.s.i (10 to 20.7 kPa) to maintain the drying temperature during variations in the outside temperature (especially when drying at night).

Setting Drying Temperature

1. With the burner operating, set the drying temperature by adjusting the HMI on the plenum screen or locally on the cal controller.

***NOTE*: After the dryer has been operating for one half hour, check the Cal Controller. The display, in operating mode, shows two numbers. The top number is the actual temperature detected by the sensor, and the bottom number is the current set point temperature. The controller is used to show plenum temperatures.**

Cal Controller

Cal Controller Wiring

The proportional valve (Belimo actuator) is powered from 24 VDC and opens according to a 0 – 10 VDC signal. This signal comes from the temperature controller (Cal Controller). The controller will output 10v when current temperature is significantly lower than the set point temperature. To avoid an overshoot upon initial lighting of the burner, the signal output is wired through one pole of the ignition relay.

The Cal Controller has a high limit of 40° above the set point and a low limit of 40° below the set point. Upon initial power up, the low limit is bypassed (inhibited) until the current temperature is within 40° of the set point. Both the high and low alarms are bypassed when the *Ignition* switch is **OFF**.
With the *Ignition* **OFF**, the controller can be powered off and then turned back on to reset the low temperature inhibit or clear a high temperature alarm latch. After the controller powers up and does not indicate an alarm, ignition can be attempted.

If holding a steady plenum temperature is a problem, check the *Proportional Valve* (Belimo actuator) to make sure it rotates freely. Turn down the gas pressure as low as possible while still maintaining temperature.

Temperature Set Point

All parameters for the Cal Controller can be changed when power is on to the dryer. The disconnect must be powered on, so that the digital display on the unit is powered up. The display, in operating mode, shows two numbers. The top number is the actual temperature detected by the plenum RTD. The bottom number shows the current set point temperature. The controller will adjust the proportional valve output to drive the temperature to the set point.

Temperature Set Point

1. Wait for the unit to power up.
2. Press * and ▼or ▲to change the desired set point.

Changing Levels

1. Hold down ▲▼ together for 3 seconds.
2. Press ▲ or ▼ separately to page through parameters.
3. When LEVL is displayed, press * key with ▲ or ▼ to change level.
4. Press ▲ or ▼ separately to page through the parameters for that level.

Parameters

1. Hold down ▲▼ together for 3 seconds.
2. Press ▲ or ▼ separately to page through parameters.
3. Press the * key with ▲ or ▼ to change a parameter value.
4. Press ▲ or ▼separately to go on to the next parameter.
5. Hold down ▲▼ together for 3 seconds when finished.

Domestic Settings

Function Level	Function Description	Function Name	Setting Default	Setting Tower
LEVEL 5 (On First Power-up)	Temp Input device	**inPt**	*nonE*	***rtd***
	Scale units	unit	*nonE*	***F***
	Output 1 Type	**SP1.d**	*nonE*	***AnLG***
LEVEL 2	Output 1 Level_on	SP1.Pon	*100*	*100*
	Output 1 Level_Prop	SP1.dpr		
	Manual mode	hAnd	*oFF*	*oFF*
	Max Output (heat)	PL.1	*100*	*100*
	Max Output (cool)	PL.2	*100*	*100*
	Ouput 2 Mode	**SP2.A**	*nonE*	***dV.hi***
	Output 2 Options	**SP2.b**	*nonE*	***LtCh***
	Display resolution	diSP	*1*	*1*
	High Scale Limit	**hi.SC**	*varies*	***220***
	Low Scale Limit	**Lo.SC**	*32*	***0***
	Temp Input device	**inPt**	*nonE*	***rtd***
	Scale units	**unit**	*nonE*	***F***
LEVEL 1	Auto tune select	tunE	*Off*	*Off*
	Proportional Band	**bAnd**	*18*	***119***
	Integral time (min)	**int.t**	*5.0*	***0.7***
	Derivative time (sec)	**der.T**	*25*	***oFF***
	Derv Approach Control	dAC	*1.5*	*1.5*
	Cycle Time	**CYC.t**	*20*	***0.1***
	Offset/Man reset	oFSt	*0*	*0*
	Setpoint Lock	SP.LK	*oFF*	*oFF*
	Setting for Output2	**SEt.2**	*0*	***40***
	Band for Output 2	**bnd.2**	*3.9*	***5***
	Cycle Time 2	CYC.2	*on.of*	*on.of*
LEVEL A (Analogue)	Lin Input Scale Max	An.hi	*1000*	*1000*
	Lin Input Scale Min	An.Lo	*0*	*0*
	Lin Input Max	hi.in	*50.0*	*50.0*
	Lin Input Min	Lo.in	*10.0*	*10.0*
	Lin Input resolution	dECP	*0000*	*0000*
	Output 3 Mode	**SP3.A**	*nonE*	***dV.Lo***
	Output 3 Options	**SP3.b**	*nonE*	***hoLd***
	Setting for Output3	**SEt.3**	*0*	***-40***
	SP3 Hysteresis	hYS.3	*3.6*	*3.6*
	Sensor Burn-out	brn.3	*uPSC*	*uPSC*
	Output 3 Operation	rEU.3	*3d*	*3d*

Function Level	Function Description	Function Name	Setting
LEVEL 4		dEr.S	*0.5*
		di.SS	*6*
		no.AL	*oFF*
		ProG	*Auto*
		LoCk	*nonE*
		SEt.L	*oFF*
LEVEL 3	Inverse of SP1.2	SP1.d	AnLG
		SP2.d	rLY
		burn	up.SC
		rEv.d	1r.2d
		rEv.L	1n.2n
		SPAn	*0.0*
		Zero	*0.0*
		ChEk	*oFF*
		rEAD	*
		tECh	*
		Ver	953.1
		rSET	*nonE*
LEVEL P		ProG	*1*
		run	*oFF*
		FAiL	*rSEt*
		St.u	*PV*
		Spru	*hour*
		SEG	*1*
		tYPE	*SPr*
		Sint	*cont*
		PCYC	*cont*
		Sub.P	*nonE*
		SPrr	*100*
		t.SP	*
LEVEL C Comms Option (2011)	Added to 2011 Pinnacle Lite production for remote temperature controllers	Addr	**1**
		bAud**	***19200***
		dAtA	*18n1*
		dbuC	*oFF*

****bAud Defaut Settings are 9600 –M-C Profile Settings 19.2**

Export Settings

Function Level	Function Description	Function Name	Setting Default	Setting Tower
LEVEL 5 (On First Power-up)	Temp Input device	inPt	*nonE*	*rtd*
	Scale units	unit	*nonE*	*C*
	Output 1 Type	SP1.d	*nonE*	*AnLG*
LEVEL 2	Output 1 Level	SP1.P	*100*	*100*
	Manual mode	hAnd	*oFF*	*oFF*
	Max Output (heat)	PL.1	*100*	*100*
	Max Output (cool)	PL.2	*100*	*100*
	Output 2 Mode	SP2.A	*nonE*	*dV.hi*
	Output 2 Options	SP2.b	*nonE*	*LtCh*
	Display resolution	diSP	*1*	*1*
	High Scale Limit	hi.SC	*varies*	*126*
	Low Scale Limit	Lo.SC	*32*	*0*
	Temp Input device	inPt	*nonE*	*rtd*
	Scale units	unit	*nonE*	*C*
LEVEL 1	Auto tune select	tunE	*Off*	*Off*
	Proportional Band	bAnd	*18*	*49*
	Integral time (min)	int.t	*5.0*	*0.7*
	Derivative time (sec)	der.T	*25*	*oFF*
	Derv Approach Control	dAC	*1.5*	*1.5*
	Cycle Time	CYC.t	*20*	*0.1*
	Offset/Man reset	oFSt	*0*	*0*
	Set point Lock	SP.LK	*oFF*	*oFF*
	Setting for Output2	SEt.2	*0*	*23*
	Band for Output 2	bnd.2	*3.9*	*2*
	Cycle Time 2	CYC.2	*on.of*	*on.of*
LEVEL A (Analogue)	Lin Input Scale Max	An.hi	*1000*	*1000*
	Lin Input Scale Min	An.Lo	*0*	*0*
	Lin Input Max	hi.in	*50.0*	*50.0*
	Lin Input Min	Lo.in	*10.0*	*10.0*
	Lin Input resolution	dECP	*0000*	*0000*
	Output 3 Mode	SP3.A	*nonE*	*dV.Lo*
	Output 3 Options	SP3.b	*nonE*	*hoLd*
	Setting for Output3	SEt.3	*0*	*-23*
	SP3 Hysteresis	hYS.3	*3.6*	*3.6*
	Sensor Burn-out	brn.3	*uPSC*	*uPSC*
	Output 3 Operation	rEU.3	*3d*	*3d*

Function Level	Function Name	Setting Default
LEVEL 4	dEr.S	*0.5*
	di.SS	*6*
	no.AL	*oFF*
	ProG	*Auto*
	LoCk	*nonE*
	SEt.L	*oFF*
LEVEL 3	SP1.d	AnLG
	SP2.d	rLY
	burn	up.SC
	rEv.d	1r.2d
	rEv.L	1n.2n
	SPAn	*0.0*
	Zero	*0.0*
	ChEk	*oFF*
	rEAD	*
	tECh	*
	Ver	953.1
	rSET	*nonE*
LEVEL P	ProG	*1*
	run	*oFF*
	FAiL	*rSEt*
	St.u	*PV*
	Spru	*hour*
	SEG	*1*
	tYPE	*SPr*
	Sint	*cont*
	PCYC	*cont*
	Sub.P	*nonE*
	SPrr	*100*
	t.SP	*
LEVEL C Comms Option	Addr	**1**
	bAud**	***19200***
	dAtA	*18n1*
	dbuC	*oFF*

****bAud Defaut Settings are 9600 –M-C Profile Settings 19.2**

Discharging the Dryer

Manual Discharge Mode

The discharge system has two selector switches and one pilot light. The discharge switch on the left (labeled **Takeaway**) is a three-position switch (**OFF**, **ON, START**) that powers the customers relay. The right side discharge switch is labeled **METERING** and is a two-position switch (**OFF** and **ON**) that controls the discharge relay. The motor speed reference is either manual (adjusted on the HMI) or auto input to a variable frequency drive (**VFD**). The switch energizes the VFD relay to give a run signal to the VFD. The Power comes from the first switch so the dryer discharge won't engage unless the takeaway system has been turned on.

Switching from Manual to Automatic Discharge (TruDry)

1. Before switching to TruDry on the HMI, the dryer should be operated in the **MANUAL** mode (MANUAL box pressed on the HMI main screen) to establish a discharge speed setting on the HMI that will unload dry grain at the desired moisture level. When the moisture content of the discharged grain has been consistent for two or more hours, it is time to switch to **TruDry** mode. Be sure the mid-grain temperature set point is at the same temperature as that indicated on the HMI.
2. While the discharge metering is in **MANUAL** mode, (Manual box pressed on the HMI main screen), switch the HMI to the discharge screen and set the mid-grain temperature set point to the same value as the indicated mid-grain temperature.
3. Switch to **TruDry** mode by pressing the TruDry button. Now, the manual speed control is off and the discharge rate is being controlled by the TruDry automatic system, and the mid-grain temperature RTDs. The unloading speed on the HMI should be the same as when the system was in **Manual** mode, but the indicated discharge speed will begin to change automatically. When the moisture content of the incoming grain changes (wetter or drier); the discharge rate will fluctuate automatically.

   If the discharge speed increases because the incoming grain is drier, the discharge indicated speed will increase until the unload speed is automatically adjusted. After adjustment, the unload speed will remain constant until another change is required. The system will automatically change speed, increasing or decreasing to keep the discharge grain at the moisture content that was established when the TruDry control system was in manual mode.

Automatic Discharge Mode

There is a relationship between mid-grain temperature and incoming grain moisture. Any change in mid-grain temperature will mean a change has occurred in grain moisture. If the temperature of the grain decreases, the moisture content will increase. If the temperature of the grain increases, the moisture content will decrease.

The TruDry control on Mathews Company dryers attempts to maintain a uniform moisture content of the grain being discharged from the dryer by changing the discharge speed of the dryer.

The moisture control is sensing grain temperature and reacting to it by slowing down or speeding up the discharge rate of the sweep system.

Moisture Control Setting and Adjustment

The dryer sweep system is driven by a 5HP AC VFD controlled 3 phase 230V AC motor and reduction gear drive.

1. Start the discharge system by turning the spring loaded takeaway switch located inside the remote cabinet, clockwise all the way and releasing it. At this time, the customer takeaway system will be engaged.
2. When the metering switch is in the **ON** position, power flows directly to the AC discharge system drive motor and is controlled by the setting on the HMI. The speed control is adjustable in 0.1% increments
3. When the discharge is in the **TruDry** mode, the speed of the discharge system drive motor is determined by TruDry control system, RTDs, and the mid-grain temperature set point.

When the moisture content of the incoming grain increases, the RTDs sense the change in grain temperature and signals the TruDry control system to slow down the discharge system motor to prevent the discharge of wet grain from the dryer when the moisture is outside of the preset limits or the mid-grain temperature is outside the preset temperature band.

When the moisture content of the incoming grain decreases, the RTDs sense the change in grain temperature and signals to the TruDry control system to increase the speed of the discharge motor to prevent over drying the grain.

Moisture Control Setting and Adjustment

The discharge rate will change to keep moisture content the same as when it was established in manual mode. However, if you want to change the discharge moisture content when operating in TruDry mode, simply increase the mid-grain temperature set point up to a higher temperature for drier grain or down to a lower temperature for wetter grain. When you adjust the mid-grain temperature you will see the discharge speed and discharge rate change to reflect the change in speed.

Switching From Automatic to Manual Discharge

You can switch back to **MANUAL** mode at anytime. Just press the **MANUAL** button on the HMI. The indicated discharge speed will show the manual speed setting. If you want to unload at the same speed in **MANUAL** as you did in TruDry, adjust the manual speed setting to reflect the discharge rate show previously in TruDry.

Shutdown Procedure

End of Day Shutdown

1. To shut off the dryer, close the liquid propane (**LPG**) gas supply valve at the tank or close the natural gas supply valve. Operate burners until the flame goes out, and then turn off the ignition switch.
2. Close the gas vapor hand valve and liquid line intake valve on the dryers equipped with liquid propane (**LPG**) burners.
3. Operate the fan for about 15 to 20 minutes to cool the grain in the dryer, then turn off the blower and flip the Power On switch to the **OFF** position.
4. Turn **OFF** and **LOCK** the electric power supply to the dryer.

Next Day Startup

1. Turn on electrical power supply to the dryer. Then turn the power on switch to the **ON** position. Place the wet grain switch or fill switch into automatic mode and push the **green** button to start the blower.
2. Open the liquid propane (**LPG**) Gas Supply valve at the tank or Natural Gas (**NG**) Supply valve and liquid line Intake valve. Now open the vapor hand valve.
3. Turn **ON** the temperature controller. Allow the temperature controller to stabilize and turn the Ignition to **ON** to start the burners. Allow the mid-grain temperature to reach drying temperature before turning the takeaway switch to the **ON** position. Now, turn the metering switch to the **ON** position and select **MANUAL** mode on the HMI. The discharge speed should be at the same value as when the dryer was last discharging in TruDry.
4. After the dryer has been unloading grain for least one hour at the desired moisture level, the discharge system may be placed in the TruDry mode by press the TruDry button on the HMI screen.

WARNING: Check and clean the inside of the dryer heating and cooling chambers daily, or more often if needed. Dryer fires are caused by poor housekeeping.

Final Shutdown

When the last of the grain to be dried has been put into the dryer, place the discharge auger switch into the **OFF** position to stop the discharge system motor before the grain has dropped below the perforated area in the wet grain holding area of the roof section.

Dry the remaining grain for approximately six minutes per point of moisture to be removed. When the remaining grain is dry, close the liquid propane (**LPG**) gas supply valve at the tank or close the natural gas (**NG**) supply valve.

Operate the burner until the flame goes out. Then place the burner switch to the **OFF** position. Close the gas vapor hand valve (handle 90° to the piping). For liquid propane (**LPG**), close the liquid intake valve and then run the fan for approximately 20 minutes to cool the grain in the dryer.

After cooling, shut off the fan and empty the dryer by placing the takeaway switch to the **ON** position and the HMI in **MANUAL** mode. Wait until the last of the grain has been removed from the sweep system by the dry grain take away equipment. Place the metering switch into the **OFF** position to stop the discharge motor.

Grain tower dryers are not designed to be grain storage devices. Once all the grain has been dried, it needs to be emptied from the dryer and stored in an appropriate facility.

NOTE: Grain stored in a dryer for more than one week may cause damage to the machine.

Section 5

Section 5: Dryer Maintenance

Dryer Cleanout Recommendations

Proper cleaning and maintenance of a grain dryer allows the dryer to perform more efficiently. When the screens of a dryer are clean, the air flow moves freely through the grain walls. As debris builds up inside the dryer, internal problems may arise. The recommended method for cleaning the dryer is air, preferably from a vacuum; however, using a non-metallic brush or broom also works. Be aware that if using water to clean the dryer, the combination of water and residue can form a paste inside the dryer, making the internal surfaces sticky and more difficult to remove.

Internal cleaning of the grain dryer should be performed on a daily basis to prevent the screen perforated surface from becoming clogged. Dirty internal conditions can result in the combustion of debris.

NOTE: Setting the fill timers is very important in preventing internal debris buildup. The recycle fill timer should be set for a short time period.

Cleaning the Outside of the Dryer

- The outside perforated screens of the dryer need to be kept as clean as possible for safety and performance reasons. The perforation of the screens allows heated air saturated with moisture from the grain to discharge from the machine. This process also creates a damp atmosphere on the outside of the screens creating a buildup of fines and dust reducing air flow resulting in loss of capacity and higher cost of drying. In addition, the chamber inside can show static air pressure present when the dryer is not full of grain. **The burners should not be lit when the dryer is not full of grain.** The hot air will flow the path of least resistance and rush out the top of the dryer where grain is not present. This will change the drying condition and characteristics of the drying process. Also, this change can lead to overheating the top of the grain column, and cause damage to the grain and potentially grain combustion.
- The outside screens can be cleaned on a needed basis using brushes. Compressed air or water can be used. This process can be done during the drying process, but may affect the discharge rate. The proper way to clean is to brush down the screens while grain is in process, as this will help push material out of the perforations in the screens. The discharge rate should increase as the dryer is cleaned because more surface area is now being exposed to the heated air passing through the grain columns.

- Cleaning the screens with water is a common method but if the dyer is empty, the potential of water inside the plenum chamber is likely, which may result in additional maintenance inside the dryer. When the outside screens become fully plugged, the inside screens also need to be checked. When air is no longer passing through the grain column, the inside screen will not self clean. If the inside screens plug, they will always create a debris buildup on the outside. The two surfaces are dependent on each other to keep clean from debris. The accumulation of debris on the inside and outside of screens affects both safety and function.

Seasonal Cleanout and Maintenance

NOTE: When cleaning inside the grain dryer, a protective breathing mask is recommended for personal safety.

1. Disconnect all electrical power and gas; this is a lock out and tag out procedure.
2. Do not let grain fines and dust accumulate inside the dryer.
3. Keep the surroundings clean at all times to prevent breeding places for insects and other pests.
4. Using a non-metallic brush or broom, sweep inner screens and channel rings going from top to bottom.
5. Sweep clean the heat floor to remove any debris.
6. Check the burner section to make sure the wires look good and the burner is clean of debris. If burner ports are plugged, clear them with a piece of wire or a drill bit.
7. Open the cooling floor door and sweep any foreign material onto the grain deck floor or remove it from the dryer through the air doors.
8. Clean outer screens and channel rings by sweeping them with a brush or power washing them with water to maintain current dryer capacity.
9. Wipe down and calibrate moisture sensor.
    - If the sensor is reading high, extra fuel is being used to dry the grain.
    - If the sensor is reading lower than actual grain moisture, the risk of spoilage and reduced quality occurs.
10. Inspect any loose bolts or screws; tighten as needed.
11. Re-engage both electrical power and gas fuel supply.
12. Once the dryer is back to normal operation, inspect the columns for grain movement. The grain should be moving down the grain column freely. If not, the dryer should be manually shut down. Empty the dryer to detect whether all columns are moving when discharge is running. This will determine whether there is a problem or not. If all columns are properly moving, fill the dryer and restart the drying process. If grain is not moving, the cause must be determined. Debris buildup near the sweep system can keep grain from exiting the dryer. This must be cleared manually before starting to dry grain in the dryer.

CAUTION: Before starting the following steps, turn off and lock out the electric power supply to the dryer. Place the circuit breaker in the control cabinet into the OFF position and lock the control cabinet doors.

Pre-Season Dryer Check

1. Clean out the heating and cooling chamber.
2. Remove the burner cover from burner. At this time, also check the spark plugs and wires for cracks, heat damage, and loose connections.
3. Check wires in the ignition junction box located in the cooling section ***(10' Tower Only)*** for cracks and loose connections. For 12' and 18' Towers check the ignition junction box located in the heat section of the dryer.
4. Grease fan motor bearings. Apply grease until it comes out the relief port. Use Chevron® SRI-2 grease or equivalent.
5. Check oil in the gear box and apply grease: Oil must be at least 25% over gears; grease top bearing.
6. Grease U-joint on the gearbox drive shaft.
7. Grease belt tightener pivot.
8. Replace the spring tension on the belt tightener.
9. Grease the discharge system jackshaft bearings.
10. LPG – remove the plug at the end of the gas strainer, remove and clean screen. Replace the screen and plug.
11. Unlock the control cabinet door **(be sure power is still OFF)** and check all wires for cracks, nicks and loose connections, especially on high voltage wires. Also be sure to check connections on the earth ground wire lug in the control cabinet and at the copper ground rod next to the dryer.

Post-Season Dryer Maintenance

CAUTION: Before starting the following steps, turn off and lock out the electric power supply to the dryer. Place the circuit breaker in the control cabinet into the **OFF** position and lock the control cabinet doors.

NOTE: During this procedure, wearing a dust mask is strongly recommended.

1. Disconnect all power and turn off the gas supply before proceeding with any post-season maintenance.
2. Place a cover over the burner.
3. Using a non-metallic brush or broom, sweep the inner screen clean, going from top down to bottom.
4. Sweep out the heat floor to remove any debris.
5. Open the cooling floor access door and sweep out all foreign material.
6. Clean off the grain floor along with the sweep arms.

***NOTE*: Be sure to remove grain debris that has built up in the corner edge of the grain floor and sweeps.**

7. Visually inspect the bearings to see if there is any indication of one needing to be replaced and make a note to replace any that need it. Inspect any drive belts and note if any need replacing.
8. Use a power washer on the outer screens if dirt has filled the perforations on the screens.
9. Remove cooling floor sections and remove grain from the bottom of the dryer.
10. Replace the cooling floor sections.
11. Grease the fan motor bearing and fan bearings with Chevron SR1-2 or equivalent.
12. Use a vacuum cleaner to remove any dirt from the control cabinet.

In Case of Fire

1. **Call the Fire Department!**
2. Shut off the electrical and fuel supply to the dryer.
3. Shut down the entire drying operation, including grain flow into and out of the dryer by pressing the emergency stop button.
4. Do not try to cool the fire by running the fans.
5. Never run grain from the dryer into the elevator or storage if a fire is known or suspected.
6. Locate the area of the fire.
7. If the fire can be extinguished with a fire extinguisher, water hose, or by removing the burning material, this should be done right away. Watch the dryer closely for another fire after one has occurred.
8. Emergency discharge slide gates at the bottom of each column as well as easy access gates located near the discharge area permit fast dumping of each individual column.
9. A fire extinguisher should be located at or near the dryer. If a fire seems to be getting out of control, call the fire department. Avoid chopping holes in the dryer if possible.

Lubrication Chart

Item	Lubrication Required	Interval
50:1 Gearbox Oil Level	Fill ¼" over gear with SAE 90 gear lubricant	Maintain proper level. Check every 100 hours
50:1 Gearbox Grease Fitting	Use (5) strokes of gun grease	At beginning and end of season
U-Joints	Use (1) stroke of gun grease	Every 50 hours of operation
Fan Motor(s) & Discharge System 5HP (AC) Motor	Lubricate with SRI-2 (Chevron) grease or equivalent. (Equivalents below)	Prior to operation and at end of season
Motor Bearings	Use Exxon Corp-Plyrex-em product or Chevron, Inc-SRI #2 Grease should be lithium based	At beginning and end of season
Axial Fans	Exxon Polygrease	At beginning of season and between 4,000 and 5,000 hours of operation until end of season
Tower Sweep Gear Box Oil	Mobil SHC-634	At beginning of season and every 100 hours until end of season. Only fill box 1/4" or 25% over gears. NOTE: In extremely dirty conditions, it is recommended to grease more often than every 100 hours.

Section 6

Section 6: Troubleshooting

Safety Circuit

Troubleshooting the Safety Circuit

The contacts for incoming hot and neutral are found in the High Voltage cabinet.

The 120 volt input power to the dryer circuit for dryer controls comes from the bottom side of the transformer and runs to the top of the 8 amp mini-breaker. This breaker should be turned off and the voltage should be checked before turning the mini-breaker on. If the voltage reads anything outside of 125-volts, the supply voltage needs to be checked before powering on the mini-breaker.

Next to the mini breaker is a neutral block, which feeds all neutrals throughout the entire dryer. This neutral is connected to the neutral from the secondary side of the transformer that is standard equipment on all 2010 dryers and later**.**

The incoming neutral line is connected to **TB5** (white wire) and the hot line is on **TB33** (after circuit breaker). The incoming 120-volt supply is an 8 amp mini-breaker.

Using a volt meter, hook one lead to **TB5** and set the meter to AC voltage (sign wave or "V")

- Place the second lead on **TB33**. If 110 or 120-volts show on the meter, then the mini-breaker is good. If no voltage appears on the meter, then the mini breaker is tripped or off.
- Place the second lead on **TB53**. Turn the power switch to the **ON** position. If it shows 120-volts, then move to the next step. If no voltage is read on the meter, then there is a problem with the power on or the safety interlock switch on the remote cabinet door.
- Place second lead on **TB-C5**, if it shows 120-volts, move to the next step. If there is no voltage on the meter, reset all manual motor protectors as the AC drive unit may have went into fault. To reset the AC drive, turn off the mini breaker for the drive. Wait until the AC drive unit screen goes blank. Restore the mini-breaker to the **ON** position and the drive will restart automatically.

- Place the second lead on **TB-C6**, if it shows 120-volts then move onto the next step. If there is no voltage on the meter, then the jumper from **C5** to **C6** has become disconnected. If the end-user has pulled the jumper and installed take away and fill equipment into the safety circuit, check to see if the customer's remote starter equipment needs to be reset.

- Place the second lead on **TB22**, if it shows 120-volts then move onto the next step. If there is no voltage on the meter, then check connection between **TB-C6** and **TB22**.

- Place the second lead on **TB25**, if it shows 120-volts, move onto the next step. If there is no voltage on the meter, then the rotary bin switch on the discharge system has tripped. Check the customer's takeaway system.

- Place the second lead on **TB20**, if it shows 120-volts, move onto the next step. If there is no voltage on the meter, then the high limit has tripped and it must be manually reset on the high limit itself.

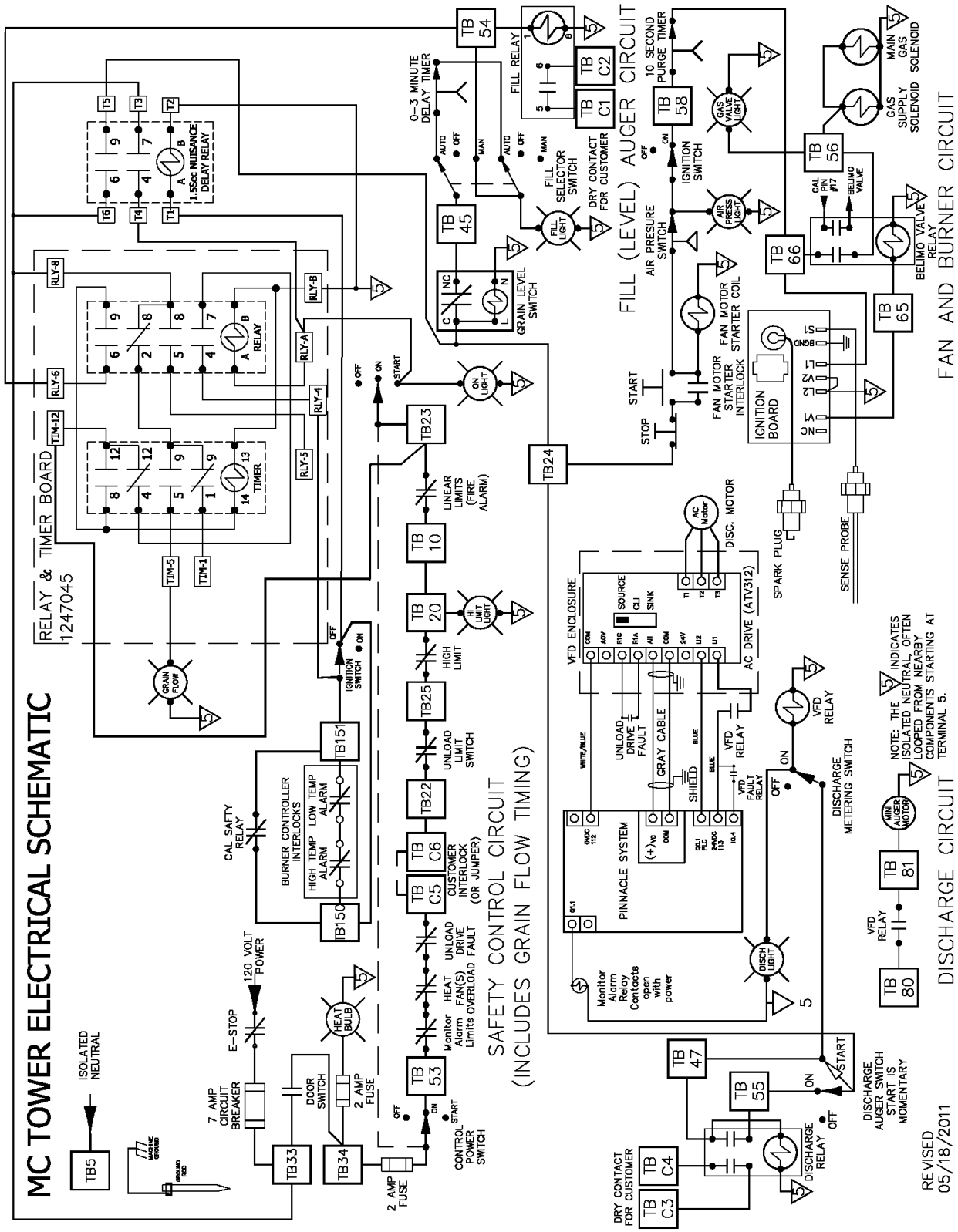
- Place the second lead on **TB10**, if it shows 120-volts, move onto the next step. If there is no voltage on the meter, check the connection between **TB20** and **TB10**.

- Place the second lead on **TB23**, if it shows 120-volts move onto the next step. If there is no voltage on the meter, then the linear limits have overheated and must be checked. When linear limits overheat (218°F), they will automatically reset when the temperature drops below 218°F. If they do not reset, they will need to be replaced. These can be checked by powering off and running continuity test through each linear limit module.

- Place the second lead on **TB24**; if it shows 120-volts, the safety circuit is completed. If there is no voltage on the meter, then there is a problem with the main relay, 0-60 minute timer, or the relay/timer board. There is a DC rectifier on the side of the board. If this goes bad, then the board has seen a spike in voltage and needs to be replaced.

- **TB24** is the main supply distribution point that will feed voltage to the fill circuit, fan/burner circuit, and discharge circuit. These three circuits are all independently powered up.

Safety Circuit Schematic



Customer Connections

Customer connections for remote equipment are in the customer terminal blocks located in the high voltage cabinet. They are labeled:

- **C1-C2** = remote fill equipment
- **C3-C4** = remote discharge equipment
- **C5-C6** = dryer safety circuits for remote starters

C1-C2 C1 and **C2** are a dry set of contacts that close when the dryer fill cycle begins. When this closes, the dryer will start the customer's equipment.

C3-C4 C3 and **C4** are a dry set of contacts that close when the dryer discharge system begins. When this closes, the dryer will start the customer's equipment.

C5-C6 is part of the dryer safety circuit and carries 120 volts as long as the dryer power switch is in the **ON** position. The dryer is delivered with a jumper across **C5** and **C6** to allow complete testing of the safety circuit. The jumper can be removed and the two wires that run from **C5 and C6** can be connected to external motor starter overloads that will be engaged when the dryer is running. Remember that the dryer is providing power from **C5** to **C6** and must be tied to a dry set of contacts on the customers equipment.

NOTE: This is to be done ONLY by a qualified electrician.

Temperature Controller (Cal)

Controller Issues

Always Overshoots the Set Point Temperature:

If the temperature is consistently overshooting the set point and tripping the alarm on the controller, adjustments to the controller are necessary.

- Press the up and down arrows 3 second untill tune is displayed.
- Press the up arrow once untill bAnd is displayed.
- Increasing the proportional band will help with overshoot.
- Hit the up arrow 3 more times until dAC is displayed. The derivative approach control works in conjunction with the proportional band to control overshoot.

NOTE: The three components for controlling overshoot are gas pressure, proportional band, and derivative approach control.

Unable to Reach Set Point Temperature:

If the set point cannot be achieved, even when the valve is 100% open, there is not enough gas pressure to obtain the selected plenum temperature. Adjust the pressure to obtain proper temperature. The controller will start to control the opening of the valve. The closer to the set point, the more the controller will shut the valve until the desired temperature is reached.

Plenum Temperature will not hold satisfactorily:

- Adjust the gas pressure adjustment.
- Free the proportional valve by depressing the black tab and rotating the shaft freely.
- Attempt to tune at the set point.

NOTE: Plenum Temperature must be close to the set point to start this function

- Press both arrow keys simultaneously and hold down for 3 seconds. Display will show *tune off*.
- Press ▲ arrow up until display reads *bAnd-[number]*
- Press * and arrow until number is twenty (20).
- Press down arrow until display reads *tune off*. Press * and up arrow until display shows *tune –At.SP.*
- Hold down both arrows for 3 seconds for the auto tuning function.

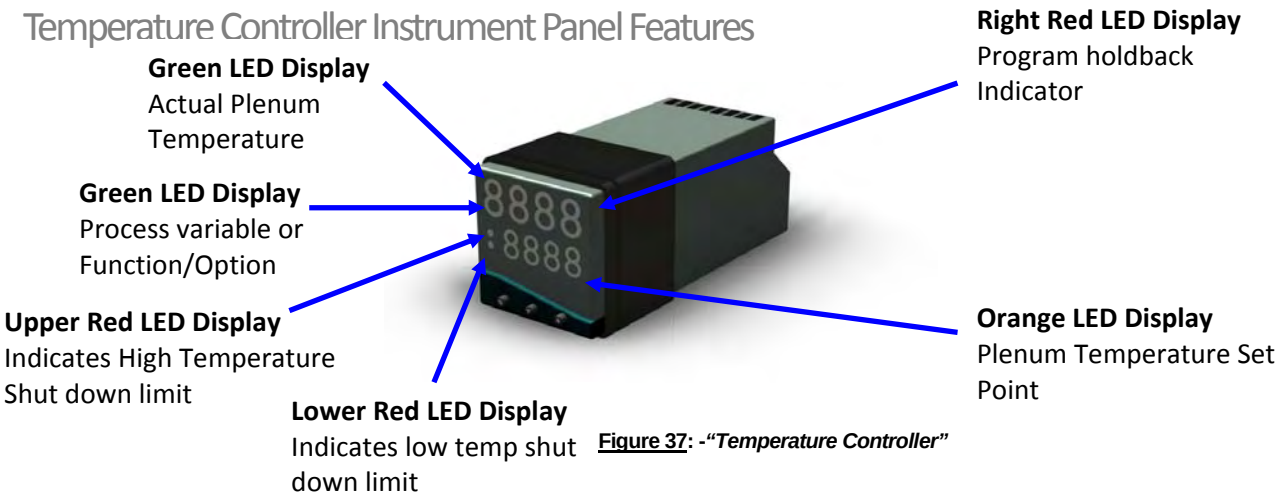


Figure 37: -*"Temperature Controller"*

Adjustments

To enter or exit program mode:	Hold down ▲▼together for 3 seconds
To scroll through features:	Press ▲or▼
To change levels or options:	Press *
To view set point units:	Press *
To increase temperature set points:	Press *▲together
To decrease temperature set points:	Press*▼together
To reset latch alarm or tune fail:	Press ▲▼together briefly

If in danger of becoming "lost in program mode," press the ▼and▲ together for 3 seconds to return to display mode, check the adjustments above and try again.

When in program mode, after 60 seconds of key inactivity, the display will revert to either inPt: none or, if the initial configuration has been completed, the measured value. Any setting already completed will be retained. To inhibit automatic program exit select ProG StAY in level 4.

DIAGNOSTICS

(-AL-) indicates both high and low plenum temperature conditions that shut down the dryer. Reset dryer safety circuit, and reset the controller by the 2 outside buttons.

(iNPT- FAiL) These two words will flash back and forth. This condition is an invalid plenum chamber temperature signal back to the Cal Controller. Check the temperature input device wires to Cal Controller.

(dAtA - FAiL) These two words will flash back and forth. This condition is failure of an internal component on the controller. Controller needs to be replaced.

(tunE - FAiL) These two words will flash back and forth. The Cal Controller could not complete the auto tune process. This will occur when trying to auto tune. Something happened in the process to make the auto tuning process become corrupt. Restart the auto tuning process again to establish a good set of PID values to properly control temperature.

Variable Frequency Drive (VFD)

Keypad:

- **ESC**=Backs out of menus
- **ARROWS**=Scrolls up and down through menus
- **ENT**=Displays data number and saves data

CODES that Display Faults on Drive:

- **OCF**=Over current
- **SCF**=Motor short circuit insulation fault
- **InF**=Internal fault
- **CFF**=Configuration fault
- **SOF**=Over speed
- **OHF**=Drive overload
- **OLF**=Motor overload
- **OSF**=Over voltage
- **ObF**=Over voltage during deceleration
- **PHF**=Line phase failure
- **USF**=Under voltage
- **CrF**=Charging circuit

Figure 38: -*"Variable Frequency Drive (VFD)"*

AC Drive Parameters

Code	Description	M-C Setting	Factory Default
ACC	Acceleration Time	5 Sec	3 Sec
dEC	Deceleration Time	5 Sec	3 Sec
LSP	Low Speed	5.0 Hz	0 Hz
HSP	High Speed	72 Hz/60 Hz	60 Hz
itH	Motor Thermal Current	12.2 Amps	11 Amps
Ufr	IR Compensation	25	20
FLG	Frequency Loop Gain	20	20
StA	Frequency Loop Stability	20	20
SLP	Slip Compensation	100	100
tdC1	Auto DC injection time	0.5 s	0.5 s
SdC1	Auto DcC injection Current	7.7	7.7
tdC2	2nd level Dc injection time	0 s	0 s
SdC2	2nd level DC inject current	5.5	6.1
JPF	Skip frequency	0 Hz	0 Hz
JF2	2nd skip frequency	0 Hz	0 Hz
SP2	Speed present 2	10 Hz	10 Hz
Sp3	Speed present 3	15 Hz	15 Hz
SP4	Speed present 4	20 Hz	20 Hz
CL1	Limiting Current	15	16.5
tLS	Low Speed operating time	0(disable)	0(disable)
Ftd	Motor Frequency Threshold	60	60
ttd	Motor Thermal Threshold	100	100
Ctd	Motor Current Threshold	12.2	11
SdS	Scale Factor for SPd 1/2/3	30	30
SFr	Switching Frequency	4k Hz	4k Hz

Level	Code	Description	M-C Setting	Factory Default
drC	bFr	Motor Frequency	60 Hz	50 Hz
	UnS	Nominal Motor Voltage	230	230
	FrS	Nominal Motor Frequency	60	50 Hz
	nCr	Nominal Motor Current	12.2	8
	nSP	Nominal Motor Speed	1725	1715
	COS	Motor Power Factor	0.88	0.88
	rSC	Cold State Stator Resist	nO	nO
	tUn	Auto Tune		nO
	tUS	Auto Tune Status	dOnE	tab
	UFT	Voltage/Freq ration	nO	nO
	nrd	Random Switching Freq	yES	yES
	SFr	Switching Frequency	4kHz	4kHz
10'/12'	tFr	Max Output Frequency	80Hz/72Hz	72Hz
	SSL	Suppress Speed Loop	nO	nO
	SCS	Save Parameter Config	nO	nO
	FCS	Restore Factory Settings	nO	nO
	tCC	Type Of Control	2C	2C
	tCt	Type of 2 Wire Control	trn	trn
	rrS	Reverse	nO	LI2
	CrL3	Current Input Low	4 mA	4 mA
	CrH3	Current Input High	20mA	20 mA
	AOIt	Analog Output Config	IOU	OA
	dO	Analog /Logic Output	Ofr	nO
	r1	Relay R1	FLt	FLt
	r2	Relay R2	nO	nO
	SCS	Configuration Backup	nO	nO
	FCS	Reset Configuration	nO	nO
	stC	Stop Control		
	Stt	Normal Stop Type	nSt	rMP
SUP		Monitoring Parameter	FrH or LCr	FrH

General Parameters

Minimum Discharge Rate

1. Press the jog dial once and turn right one click until SEt is displayed.
2. Press the jog dial and turn right two clicks to display LSP.
3. Press the jog dial to display data. The data displayed is in units of hertz (Hz). The range is 0 to 60 Hz.
4. Rotate the dial to change the number. The higher the number the faster the discharge. Factory settings should be at 5 Hz.
5. Press and hold the jog dial untill the value flashes to save.
6. Press “ESC” three times to return to rdY.

Maximum Discharge Rate

1. Press the jog dial once then turn to the right until SEt is displayed
2. Press the jog dial once, turn to the right three clicks to display HSP.
3. Press the jog dial once. The data displayed is in units of hertz (Hz). The range is 0 to 60 Hz.
4. Rotate the dial to change the number. The higher the number the faster the discharge. Factory settings should be at 60 Hz.
5. Press and hold the jog dial untill the value flashes to save.
6. Press “ESC” three times to return to rdY.

Current Limit of Discharge Rate

1. Press the jog dial once then turn to the right until SEt is displayed
2. Press the jog dial once then turn to the right two click to display drC.
3. Press the jog dial once then turn to the right one click to display nCr. The data displayed is unit of AC amps.
4. Arrow down the menu until “**nCr**” appears. The data displayed is in units of AC amps.
5. Press and hold the jog dial untill the value flashes to save.
6. Press “ESC” three times to return to rdY.

Acceleration for Discharge

1. Press the jog dial once and turn right one click until SEt is displayed.
2. Press the jog dial once untill ACC is displayed.
3. Press the jog dial once to display data. The data that is displayed is in units of seconds.
4. Rotate the dial to change the number. The higher the number the faster the drive will accelerate to full speed. Factory settings should be at 5 sec.
5. Press and hold the jog dial untill the value flashes to save.
6. Press “ESC” three times to return to rdY.

Deceleration of Discharge

1. Press the jog dial once and turn right one click until SEt is displayed.
2. Pres the jog dial once and turn right one click unit until dEC is displayed.
3. Press the jog dial once to display data. The data that is displayed is in units of seconds.
4. Rotate the dial to change the number. The higher the number the longer it will take to decelerate the drive. Factory settings should be at 5 sec.
5. Press and hold the jog dial untill the value flashes to save.
6. Press “ESC” three times to return to rdY.

Variable Frequency Drive (VFD) Fault Menu

VFD for Discharge System

Fault Code	Description of Fault	Action to resolve
CrF	Pre-charge circuit damage	Reset drive (power down)
InF	Internal fault	Replace drive unit
OCF	Over current fault	Drive is undersized for load, check set & drC
SCF	Motor short circuit	Wiring shorted to ground, check continuity
SOF	Over speed fault	Instability
tnF	Auto tuning fault	N/A
COF	N/A	N/A
EPF	External Fault	Fault outside drive
LFF	Loss of reference signal	Check wiring connection, check signal source
Obf	Overvoltage during deceleration	Overhauling load or stopping to quickly
OHF	Drive overload	Ambient temperature is too high, check motor amps
OLF	Motor overload	Thermal Protection trip, let motor cool, check itH
OPF	Motor phase fault	Loss of phase to motor, check connections
OSF	Overvoltage during steady state	Line voltage too high
PHF	Input Phase Failure	Motor leads not wired in proper order for ratation
SLF	Serial link failure modbus	N/A
CFF	Configuration fault	Reload parameters
CFI	Configuration fault with serial port	N/A
USF	Under voltage	Lost input power to drive

AC Soft Starter for Blower 10' & 12' Towers Only

Fault Menu

Fault Code	Description of Fault	Action to resolve
InF	Internal Fault	Disconnect and reset power, replace drive unit
OCF	Over current Fault	Drive is undersized for load, check Set & drC
PIF	Phase Inversion	Motor leads not wired in proper order for rotation
PHF	Input Phase Failure	Loss of phase to drive or motor
EEF	Internal Memory Fault	Disconnect and reset power, replace drive unit
CFF	Configuration Fault	Reload parameters
CFI	Configuration Fault With Serial Port	N/A
FrF	Line Frequency Is Out of Tolerance	Fault outside drive
USF	Under Voltage	Lost input power to drive
CLF	Control Line Failure	Lost power to CL1/CL2, check mini breaker
EtF	External Fault	Fault outside drive
OLC	Current Overload	Check amp draw values & blower for easy rotation
OLF	Motor Overload	Thermal protection trip, let motor cool, check ItH
ULF	Motor Under load	Not enough load for motor size
LrF	Locked Rotor Fault	Blower is not rotating, locked in position

Parameters

Menu	*Parameter*	*Description*	*MC Setting*	*Default*
SEt	In	Nominal Motor Current	REF	Varies
	Ilt	Current Limit	400	400
	ACC	Acceleration Ramp Time	15	15
	t90	Starting Torque	50%	20%
	StY	Stop Type	F	F
	dEC/EdC	Deceleration Ramp Time	N/A	N/A
	brC/EbA	Brake Torque	N/A	N/A
PRO	tHP	Thermal Protection	CL	10
	ULL	Motor Under load	OFF	OFF
	LUL/tUL	Motor Under load Threshold	N/A	N/A
	tLS	Excessive Start Time	OFF	OFF
	OIL	Current Overload Active	OFF	OFF
	LOC/tOL	Current Overload Threshold	N/A	N/A
	PHr	Phase Protection	123	nO
	tbS	Time Before Start	300	2
	PHL	Phase Loss Threshold	5	10
	PtC	Monitoring Probes	OFF	OFF
	ArS	Automatic Restart	OFF	OFF
	rtH	Reset Motor Thermals	nO	nO
drC	tLI	Torque Limit	OFF	OFF
	bSt	Voltage Boost	50%	OFF
	SSt	Small Motor Test	OFF	OFF
	CLP	Torque Control	On	On
	LSC	Stator Loss Compensation	50	50
	tiG	Decel Gain	40	40
	CSC	Cascade Activation	OFF	OFF
	Uln	Line Voltage	Per Dryer	460
	FrC	Line Frequency	60	Aut
	rPr	Reset Operating Time	nO	nO
	FCS	Factory Control Settings	nO	nO
IO	L13	Logic Input	LIA	LIA
	L14	Logic Input	LIL	LIL
	Ipr/tPr	Preheating level/Time	N/A	N/A
	L01	Logic output 1	tAI	tAI
	L02	Logic Output 2	rnl	rnl
	r1	Relay 1 Assignment	r1F	r1F
	r3	Relay 3 Assignment	tAL	rnl
	AO	Analog Output	Ocr	OCR
	O 4	Output Configuration	O2O	O2O
	ASC	Analog Scaling	200	200

Menu	Parameter	Description	Default
St2	In2	Nominal Motor Current 2	Varies
	IL2	Current Limit 2	400
	AC2	Acceleration Ramp Time 2	15
	t92	Starting Toque 2	20%
	dE2/Ed2	Decel Ramp Time 2	N/A
	tL2	Max Torque Limit 2	OFF
	tl2	Decel Gain 2	N/A
COP	Add	Address (RS232)	0
	tbr	Comm Speed (kbps)	19.2
	For	Comm Format	8n1
	tLP	Serial Link Timeout	5
	PCT	Remote Keypad Link	OFF
SUP	N/A	Support Display Selection	LCr
*Menus above are not typically adjusted (Use Defaults)			

Soft Start Current Values

Motor	Voltage	REF (Reference Current)	CL
50	460	60	15
75	460	82.4	15
100	460	113	20
50	230	120	15
75	230	165	15
100	230	226	20
50	208	128	15
75	208	182	15
100	208	250	20
40	230	95.2	15

Changing Soft Starter Parameters

Motor Current

1. Press the ▼ key until "**SEt**" appears on display.
2. Press ENT to display "**In**".
3. Press "**ENT**" to display data. The data displayed is in units of AC amps.
4. Arrow up or down to change the number. Set the number to match the motor name place AC amps. Factory setting should match the motor name plate.
5. Press "**ENT**" once to save the value, once it is at desired setting.
6. Press "**ESC**" three times to display **"rdY"**.

Current Limit

1. Press the "▼" key until "**SEt**" appears on display.
2. Press ENT and then press the down arrow once to display "**lLt**".
3. Press "**ENT**" to display data. The data displayed is in units of percentage of the motor amps.
4. Arrow up or down to change the number. The number should be 450% of the motor full load amps. Factory settings should be at 450%.
5. Press "**ENT**" once to save the value, once it is at the desired setting.
6. Press "**ESC**" three times to display **"rdY"**.

Acceleration Time for Bypass Contactor Takeover

1. Press the "▼" key until "**SEt**" appears on display.
2. Press ENT and then press the down arrow twice to display ACC.
3. Press "**ENT**" to display data. The data displayed is in units of time (seconds).
4. Arrow up or down to change the number. The number represents the time from when the soft starter begins the fan rotation until the bypass contactor takes over. Factory setting is 15 seconds.
5. Press "**ENT**" once to save the value once it is at the desired setting.
6. Press "**ESC**" three times to display **"rdY"**.

Starting Torque

1. Press the "▼" key until "**SEt**" appears on display.
2. Press ENT and then press the down arrow three to display "**T90**".
3. Press "**ENT**" to display data. The data displayed is in units of percentage.
4. Arrow up or down to change the number. The number represents the starting applied motor torque in percentage. Factory setting should be 50%.

Thermal Protection

1. Press the "▼" key until "**PrO**" appears on display.
2. Press ENT to display **"tHP"**.
3. Press "**ENT**" to display data.
4. Arrow down until the unit displays "**tHP**". The data displayed is in units of classification.
5. Arrow up or down to change the number. The number that appears is the rated classification of the soft starter unit. Factory setting should be 20.
6. Press "**ENT**" once to save the value once it has reached the desired setting.
7. Press "**ESC**" three times to get back to the "**rdY**" display.

Voltage Boost

1. Press the "▼" key until "**drC**" appears on display.
2. Press ENT to display **"tL1"**.
3. Press "**down arrow**" once to display **"bSt"**.
4. Press **"ENT"** to display data.
5. Arrow up or down to change the number. The number represents the percentage of motor voltage available from the motor and fan start up. Factory setting should be 50%.
6. Press "**ENT**" once to save the value, once it is at the desired setting.
7. Press "**ESC**" three times to get back to "**rdY**" display.

Ignition Board

Problem: DIFFICULTY IN LIGHTING BURNER

Possible Cause/Solution:

1. Ensure gas supply to the dryer is **ON** and the hand valves are open.
2. Fan must be **ON** to achieve air pressure light.
3. Ignition switch set to the **ON** position. This applies 120 VAC at **L1** (0 volts at **L2** Neutral) of the ignition board.
4. In some cases ignition switch powers on an external pre-purge timer (10 seconds). Check for power to and from timer.
5. After pre-purge time, the ignition board should power out 120 VAC at **V1** (**V2** neutral) for a trial ignition period to open the solenoids and gas valve light. The normal trial time is 10 seconds. If the trial is not successful, voltage outputs stops.
6. Check the gas solenoid operation by listening for a click/snap or feeling the vibration as they open. If the solenoid doesn't open, check the wiring and coil for damage, bad connections, etc.
7. Check the spark plug (igniter) for spark. Check the high voltage wire for damage, good connections.
8. Replace the ignition board.

Problem: BURNER LIGHTS BUT DOESN'T STAY LIT

Possible Cause/Solution:

(NOTE: This is most likely due to the flame sensing)

1. Ensure flame sense probe is located in the flame.
2. Inspect the sense wire for damage and for loose or wet connections.
3. Check that sense wire is routed separately from the high voltage ignition wire.
4. Check the ignition board (B.GND) is grounded separately from all other connections. Sharing a ground connection can cause problems.
5. Clean sense probe with fine steel wool.
6. Burner may have to be grounded at the burner body directly to the burner housing.

Fireye Flame Controller Troubleshooting

Lockout Codes

Message		*Description*	*OP CTRL*	*Air Flow INTLCK*	*PTFI*	*FLAME*	*ALARM*
DEC	HEX						
6	6	Lockout Line Frequency Noise Detected	●	○	○	●	*
7	7	Lockout Flame Fail - PTFI	○	●	●	●	*
15	OF	Lockout Fault Unknown	●	●	●	●	*
16	10	Lockout Amplifier High Count Fail	○	○	○	○	*
19	13	Lockout Flame Fail - MTFI	○	○	●	●	*
20	14	Lockout False Flame - STAND BY	○	●	○	○	*
21	15	Lockout INTLCK Open	●	●	●	○	*
22	16	Lockout INTLCK Closed	○	●	●	○	*
24	18	Lockout Chassis Opto	●	●	○	●	*
37	25	Lockout Flame Fail - AUTO	○	●	○	●	*
39	27	Lockout Fuel Valve State Change	○	○	○	●	*
54	36	Lockout Check Chassis	○	○	○	●	*
55	37	Lockout Check Programmer	○	○	●	○	*
56	38	Lockout Check Amplifier	●	○	○	○	*
58	3A	Lockout Amplifier Auto Check Fail	●	○	●		*
59	3B	Lockout Check BROWN FUSE	●	○	●	●	*
76	4C	Lockout Check Scanner	●	●	○	○	*

○ = Not Lighted

● = Lighted

*** = Flashing**

Diagnostic Messages

	Possible Cause	*Solution*
Check Programmer	Voltage on Terminal 5 improper time	Inspect wiring to main fuel valve
	Welded watchdog relay	Replace MEC chassis
	Internal diagnostic failure	Replace MEP programmer
Check Chassis	Voltage on Terminal 3 or 4 at improper time	Inspect wiring to pilot valve and igniter
	Welded watchdog relay	Replace MEC chassis
Chassis Opto	Opto - Coupler(s) short circuited	Replace MEC chassis
Amplifier High Count Fail	Amplifier signal level high	Replace amplifier module
Amplifier Auto Check Fail	Flame signal too high	Use orifice in sight pipe
	Internal amplifier diagnostic fault	Replace amplifier module
Check Scanner	Defective shutter	Inspect scanner wiring, replace scanner
	UV tube false firing	Replace UV tube or scanner
Check Blown Fuse	No power detected on terminal 3	Inspect defective pilot valve or igniter
	Defective fuse	Replace fuse
Line Frequency Noise Detected	Spikes detected on AC Mains	Check for SCR motors or DC drives
		Inspect ground system
Fuel Valve State Change	Terminal 5 (main fuel) detected on during PTFI	Check external wiring or replace MEC chassis
Check Amplifier	Amplifier not passing diagnostic test	Replace amplifier module

Common Start-Up Problems

Problem: Main gas valve is opened and main burner will not come on.

Possible Cause/Solution:

1. The handle on the Maxon main gas shutoff valves should offer some resistance when they are opened. If they don't check the latching solenoid inside the valve by removing the cover from the side of the valve opposite the handle.
2. Check for water in the gas line by opening the drain valve.
3. Check the hand valve in the feedback line to the main gas regulator. It should be partially open.

Problem: Dryer will not reach operating temperature, or it reaches it slowly.

Possible Cause/Solution:

1. Low gas pressure. Increases gas pressure on the main gas regulatory.
2. Check for water in the gas train by opening the drain valve.
3. Make sure the dryer is completely full of grain by entering the heat plenum chamber and looking for daylight in one of the grain columns.
4. Gas parts in the burner need to be cleaned. Clean by drilling with a #47 drill bit.
5. Make sure that the gas butterfly valve is being driven wide open by the modulating motor. If not, check the motor or motor linkage.

Problem: Blower motor(s) will not start.

Possible Cause/Solution:

1. Check that the fan circuit breaker and the fan switch are on. Also, check for a defective switch or bad wire connections.
2. If a lighted switch does not light, the air switch needs adjustment, or the bulb may be burned out.
3. Verify closing of the fan motor contactor. Check voltage on the load side of the contactor.
4. Inspect the contactor for defective contact or a burned out coil.
5. Inspect connections, and check voltage applied to the motor leads to determine if the motor is defective.
6. If the motor starts slowly, check for low voltage during starting due to excessive voltage drop in power supply wiring.

Problem: Burner will not fire.

Possible Cause/Solution:

1. Check gas supply for possible obstruction or closed valves. Refill tank; replace or repair parts as required.
2. Inspect gas solenoid valves for defective coils or improper wiring. Replace the valve or coil if the valve will not open with proper voltage applied (115 volts).

Problem: Burner will not fire, but gauge shows gas pressure.

Possible Cause/Solution:

1. Check that the igniter is properly gapped and has a strong spark.
2. Inspect the porcelain and electrodes for damage or cracking. Clean or replace if necessary.
3. Machine does not have chassis ground.

Problem: Uneven drying, some kernels appear brown while others are under dried. Uneven heat exiting from dryer columns.

Possible Cause/Solution:

1. Check plenum thermostat temperature setting. Some varieties of grain are more sensitive to higher operating temperatures. It may be necessary to lower the plenum operating temperature to accommodate this.

Problem: Grain is not moving through columns.

Possible Cause/Solution:

1. Check the dryer for fine material buildup inside the columns.
2. Avoid leaving the dryer columns full for long periods at a time (2-3 days) while not operating the dryer, or during rainy weather.
3. Empty the dryer and clean regularly. Do not allow fine material to gather in the plenum chamber.

Start Up and Dryer Operation

Procedure

1. Set **HIGH LIMIT Switch.**

2. Start of Operation of Dryer: Light bulb in the remote cabinet will turn on.

   If not, check:
   - Main disconnect
   - Fuse is not functional or 7A circuit breaker tripped
   - TB33 for connection (110 Volts)
   - 115 Volt bulb and socket in the remote cabinet

3. Switch control switch to **ON** position. High Limit light should be **ON**.

   If not, check:
   - **RUN-START** in **START** position
   - Overload circuit through starters
   - AC drive and fuses or circuit breaker
   - Back door limit switch
   - High Limit reset
   - Soft starter
   - Burner resets
   - Cal Controller

4. Switch control switch to **START** position, **POWER ON**.

   If not, check:
   - Main relay
   - Refer to safety circuit troubleshooting

5. Push fan start button. Fan should start and run.
   If not, check:
   - Main power voltage through disconnect and breaker to starter.
   - Starter
   - Soft Starter
6. Turn fill switch from **OFF** to **MANUAL**.

7. Adjust 2 to 3 minute delay fill timer to desired setting.

8. After dryer has filled with grain, switch fill switch to **AUTO** position.

9. Grain flow timer is the only circuit in **AUTO** position.

10. Set grain flow timer for 2 to 10 minutes:***NOTE:*** **DRYER IS NOW FILLED AND READY TO DRY GRAIN**

11. Air Switch light should light
    If not, check for:
    - Dyer not full of grain
    - Air pressure switch is not adjusted

12. Switch the Cal Controller on and allow time for the controller to reset and display values. The controller will display the plenum temperature and the selected set point.
    If not, check for:
    - Controller power **(TB141)**

13. Switch ignition to the **ON** position. After the 10 second purges timer times out, the gas valve light will turn **ON**. This will ignite the burner.
    If not, check:
    - Purge timer
    - Ignition board:
      1. L1 is hot, L2 is neutral (110 volt power to unit)
      2. V1 is hot, V2 is neutral (110 volt power to solenoids)
      3. S1 is voltage to flame sense probe
      4. **BGRD** is grounded to the chassis
      5. E1 is **HIGH VOLTAGE** to electrode **(DANGER! NEVER TEST WITH A METER)**

14. Switch the takeaway switch to the **ON** position. The customer takeaway system should start.
    If not, check:
    - Check takeaway relay

15. Switch the metering switch to **ON**. The sweep arm should start up and run.
    If not, check:
    - AC drive fault settings
    - AC drive parameter settings
    - AC drive fuses or circuit breaker
    - Check motor
    - Drive belts

16. Grain flow timer has a 1 to 60 minute range.

Section 7

Section 7: Notes