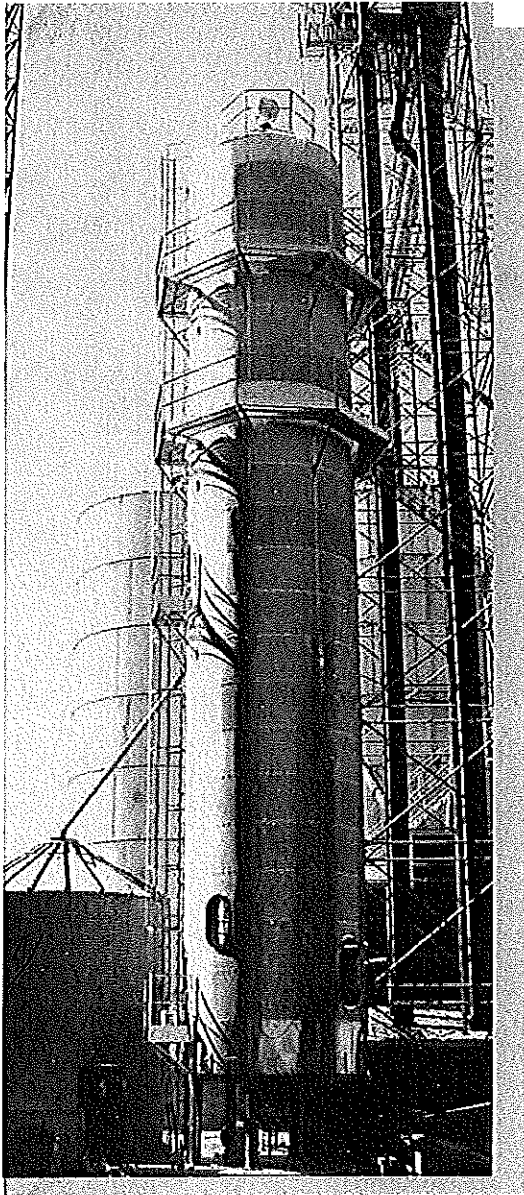




TOWER DRYER



**MODEL
2000, 2250,
3000, 3500 &
4000**

**OPERATOR'S
MANUAL**

Mathews Company

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Section 1

Equipment Overview

INTRODUCTION

To the Owner-Operator

This manual was prepared to provide owners and operators of the M-C Models 2000, 2250, 3000, 3500, and 4000 Grain Dryer (starting with serial number 58406) with Operating Instructions and Maintenance Information that will enable them to keep their M-C Grain Dryer operating at peak efficiency.

Before operating your Grain Dryer read the Start-Up and Operating Instructions. Check each item referred to and become familiar with the controls, adjustments and settings required to obtain efficient operation.

To keep the dryer operating at peak efficiency it is suggested that it be cleaned, lubricated, belt tension adjusted and the ignition system, Fill System and unloading system be tested each year 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 can be made 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 warranty, but it is also our way of knowing who has purchased M-C equipment so that we can keep in touch with you.

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 shown in Figure A. For future reference record the model and serial number in the blank spaces of the plate shown in Figure A.

PANEL LISTING SPECIFICATIONS			
MODEL 2000	CONTROL VOLTAGE 110	SERIAL NUMBER	#58746
MAXIMUM CONTROL CABINET OPERATING AMPS 7			
LARGEST BLOWER MOTOR HP 100	RPM 1750		
SHORT CIRCUIT CURRENT RATING IN AMPS 10KA			
THERMAL TRIP SETTING FOR LARGEST MOTOF 76 Amps			
MATHEWS COMPANY 500 INDUSTRIAL AVE. CRYSTAL LAKE, IL., U.S.A. PRODUCTION DATE May-06			

Panel Listing

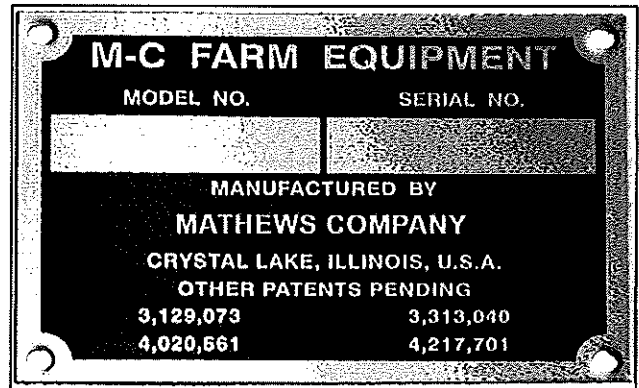


Figure A— Model and Serial Number

M-C GRAIN DRYER			
MODEL 2000	CONTROL VOLTAGE 110	SERIAL NUMBER	#58746
VOLTAGE 460	PHASE 3	HZ 60	MAX. OPER AMPS 180.0
FAN BLOWER MOTOR HP 100	AC	RPM 1750	
AC DISCHARGE MOTOR HP 3	AC	RPM	VARIABLE
FUEL NATURAL GAS YES LIQUID PROPANE			
MAXIMUM ALLOWABLE SUPPLY PRESSURE			60 PSIG
MAXIMUM INPUT BTU			21780000 BTU
NORMAL INPUT BTU			12,870,000 BTU
MANIFOLD PRESSURE AT MAXIMUM INPUT			1.25 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 May-06			

High Voltage Cabinet Decal

SAFETY PRECAUTIONS



This symbol is used to call your attention to instructions concerning your personal safety. Be sure to observe and follow these instructions.

1. Read and understand the operation manual before attempting to operate the unit.
2. Keep ALL guards, access doors, covers, safety decals and safety devices in place and securely fastened. NEVER operate system while guards are removed.
3. Keep all untrained personnel away from system components and control panel 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 a padlock when performing any service or maintenance work on the fan or heater 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 tests with "live" circuits, be extremely careful and follow all established safety practices.
10. Routinely check for any developing gas plumbing 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.

NOTE: To provide clear illustrations some of the covers, guards, and shields were removed.

Lock out / Tag out Procedure Requirements

The purpose of a lock and 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. Each worker has the only key to the lock.
2. Check to be sure that no one is operating the machinery BEFORE turning off the power. The machine operator is informed before the power is turned off. Sudden loss of power could cause an accident.
3. Steam, air, and hydraulic lines should be bled, drained, and cleaned out. There should be no pressure in these lines or in reservoir tanks.
4. Any mechanism under load or pressure, such as springs, should be released and blocked.
5. 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 worker who placed the lock should remove his/her lock.
6. All energy sources which could activate the machine must be locked out.
7. The main valve or main electrical disconnect must be tested to be sure that the power to the machine is off.
8. 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.
9. CAUTION: Return disconnects and operating controls to the off position after each test.
10. Attach accident prevention tags which give the reason for placing the tag, the name of the person placing the tag, how he/she may 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 and durable, and should have the name of the employee on it. In addition, locks can be color-coded to indicate different shifts or types of crafts.

When more than one worker is servicing a piece of equipment that must be locked out, a lockout adaptor can be used which allows all the workers to place their locks on the disconnecting means. After the work is completed, each worker removes his/her lock and the machine is then returned to service.

Tags

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 who is working on the equipment and how that person may be reached.
- date and time the tag was put in place.

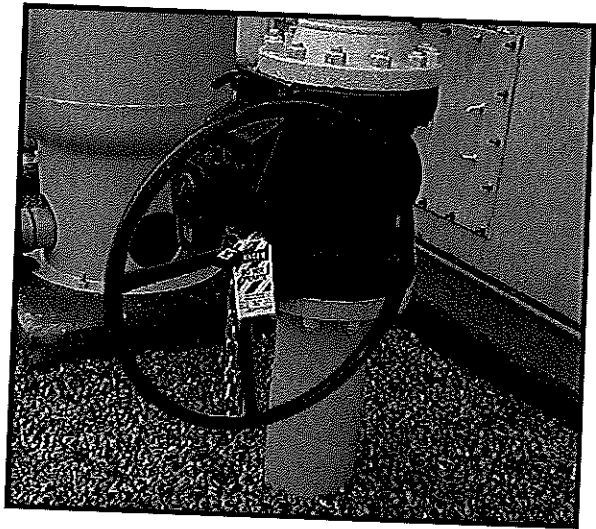
Tagout devices shall be capable of enduring at least 50 pounds of pull, and a non-reusable type.

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 and always used. 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, steam, 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.

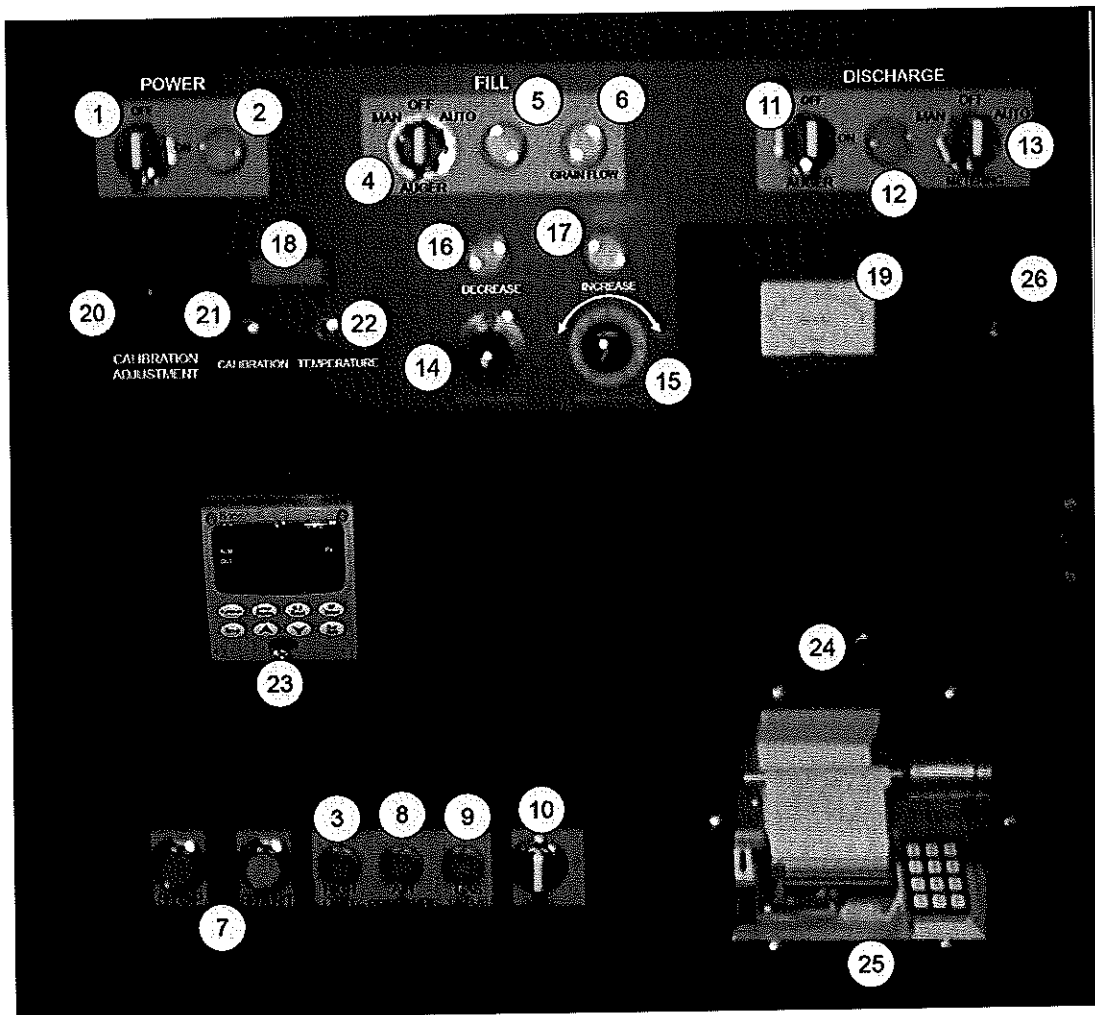


Gas Lockout & Tagout



Electrical Power Lockout and Tagout

REMOTE CABINET BUTTONS, DIALS, LIGHTS, METERS, & SWITCHES



Ref. 1 – Power On Switch

When this spring loaded switch is turned to the ON position, the power on light will be on if the rear discharge overload door is closed, all magnetic starter overload relay blocks are closed, and the relay is activated. High limit lights will also be on. If not, push the reset button on the high limit switch.

NOTE: If there is a momentary loss of electricity, the dryer will shut down and the dryer will have to be restarted by turning power on switch to the ON position again.

Ref. 2 – Power On Light

Indicates power on switch has been turned on, discharge overload door and starter overloads are closed, and dryer relay is activated.

Ref. 3 – High Limit Light

Indicates power switch has been turned on and high limit switch is closed.

Ref. 4 – Wet Grain Fill Switch

When switch is in the MANUAL position, the wet hopper fill equipment will start immediately when the rotary FILL switch in the hopper signals for grain and stops when the hopper is full.

When the switch is in the AUTOMATIC position, the rotary FILL switch will start the fill equipment automatically after the preset time on the delay and stop fill equipment when hopper is full.

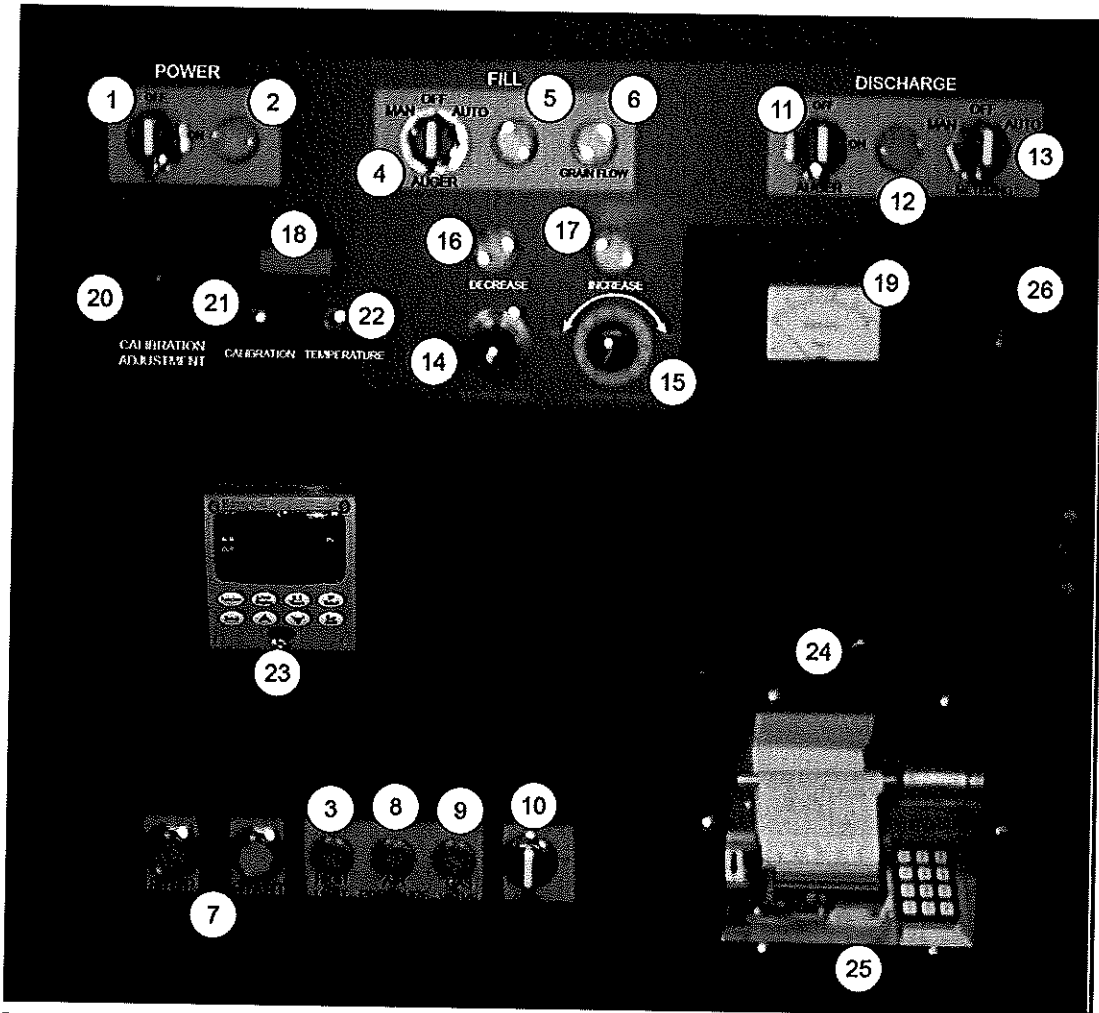
Ref. 5 – Fill Light

Indicates that the grain level in the hopper is low and the rotary FILL switch in the hopper has closed activating the customer supplied fill equipment.

Ref. 6 – Grain Flow Light

Indicates low grain level in wet hopper. Light comes on when Grain Flow Timer reaches zero and dryer is shut down.

REMOTE CABINET BUTTONS, DIALS, LIGHTS, METERS, & SWITCHES



Ref. 7 – Fan Start-Stop Buttons

Green Button starts and Red Button stops the fan.

Ref. 8 – Air Pressure Switch

Indicates that the air pressure switch is closed, the fan motor magnetic starter is engaged, and the dryer is full of grain.

Ref. 9 – Gas Valve Light

Indicates ignition board terminal V1 is powered to open solenoid valves for burner ignition. Light remains lit as long as flame sense probe continues sensing burner flame and terminal V1 is powered. If sensing is lost, board will lockout and shut down solenoid valves and gas valve light.

Ref. 10 – Burner Ignition Switch OFF/ON

After a (10) second delay, Ignition Board terminal V1 is energized to open gas solenoids for burner ignition. Gas Valve Light will also be energized. If Burner does not ignite in (10) seconds, Ignition Board will lock out, de-energizing the gas solenoid valves and gas valve light. Switch will have to be turned to OFF then back to ON for another try at burner ignition.

Ref. 11 – Discharge (Unload) Auger Switch

Turn this spring loaded switch to the ON position to start discharge auger. If there is a momentary loss of electricity, the dryer will shut down and the dryer will have to be restarted.

Ref. 12 – Discharge Auger Light

Indicates that the customer takeaway system is operating.

Ref. 13 – Discharge Metering Switch

When the switch is turned to the MANUAL position, the AC drive motor will run constantly and the speed of the sweep will be controlled by the Manual Drive Speed Control Dial.

When this switch is in the AUTOMATIC position, the Moisture Control Board will speed up or slow down the AC motor automatically.

Ref. 14 – Manual AC Drive Speed Control

This manual speed control is used to adjust the speed of the AC motor that drives the grain sweep arm and changes discharge speed when discharge metering switch (Ref. 13) is in the MANUAL POSITION only. Be sure to disengage lock before turning dial.

Ref. 15 – Moisture Control Balance Dial

This balance dial is used to equalize the Moisture Control Decrease and Increase Indicator Lights before turning the discharge metering switch to AUTOMATIC.

Once in AUTOMATIC the dial is used to make small adjustments in the moisture content of the discharged grain.

Ref. 16 – Moisture Control Decrease Light

Indicates that the discharge rate is decreasing if Moisture Control is in AUTOMATIC.

Ref. 17 – Moisture Control Increase Light

Indicates that the discharge rate is increasing if Moisture Control is in AUTOMATIC.

Ref. 18 - Digital Display Meter

Displays discharge grain moisture constantly, grain temperature and calibration setting when respective display button is pushed.

Ref. 19 – Discharge Meter

Indicates the rate of discharge when discharge metering switch is in MANUAL or AUTOMATIC.

Ref. 20 – Calibration Adjustment Dial

Turn dial to change calibration.

Ref. 21 – Calibration Display Button

Push button to display amount added or subtracted (-9.9 to +9.9) from the discharge grain moisture shown on the digital display meter (23).

Ref. 22 – Temperature Display Button

Push button to display temperature of grain moving over discharge Moisture Sensor.

Ref. 23 – Temperature Controller

Controls the Modulating Valve that regulates the amount of gas supplied to the burner. Digital Display shows temperature and percent that modulating valve is open. Contains both plenum high and low shutdown $\pm 40^\circ$ from set point.

Ref. 24 – Printer ON/OFF Switch

Turns printer on or off.

Ref. 25 – Printer

Provides printed record of time, day, discharge grain moisture, temperature, and average moisture content.

Ref. 26 – Hour Meter

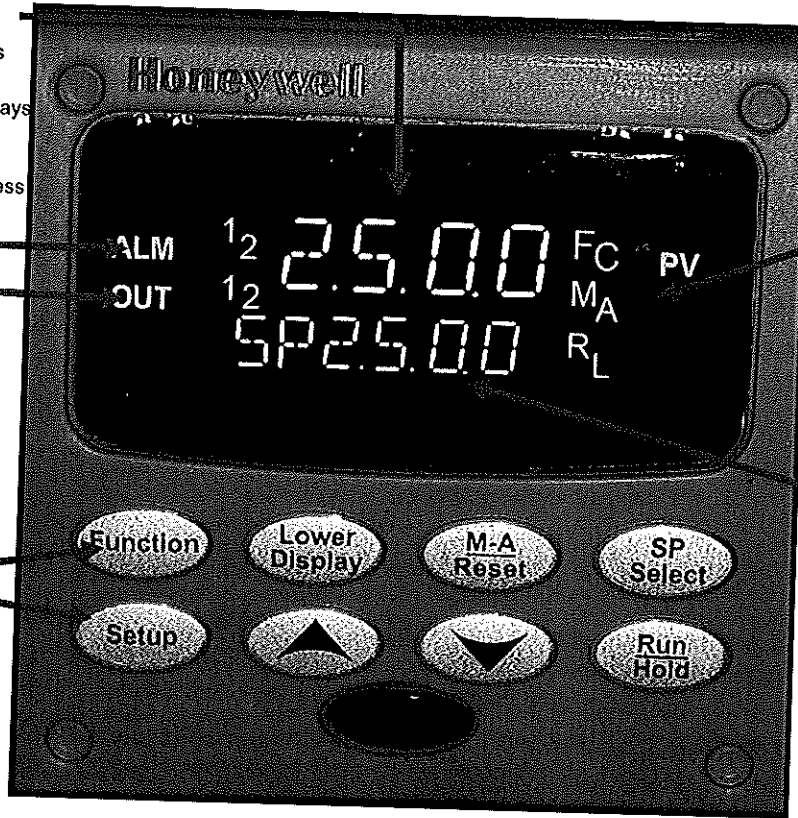
Records hours of dryer operation.

Operator Interface and Key Functions

- Upper Display -- Four Digits
- Normal Operation-Process Variable
 - Configuration Mode - displays parameter value or selection
 - TUNE - Accutune in progress

ALM - Alarm conditions

OUT - Control Relay 1 or 2 on



F - Fahrenheit being used

C - Centigrade being used

M or A - Manual/Auto display

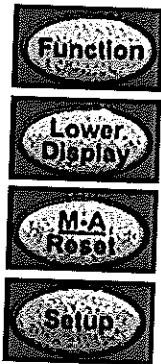
R - Remote or Local SP2 setpoint active

L - Local setpoint active

Lower display - six (6) alphanumeric characters

- Normal Operation - display is blank unless configured for default prompt of PV or Setpoint
- Configuration mode - displays functions and parameters.

Keys



Used with Set Up Key to elect individual functions of selected Set Up group

Returns Controller to normal display from Set Up mode. Toggles various operating parameters for display.

Selects Manual or Auto mode. Resets the Limit Controller relay.

Places controller in the Configuration Set Up group select mode. Scrolls through the configuration Set up groups.



Hold Key to cycle through configured setpoints.

Increases setpoint or output values. Increases the configuration values or changes functions in Configuration mode groups.

Decreases setpoint or output values. Decreases the configuration values or changes functions in Configuration mode groups.

Enables Run/Hold of the SP Ramp or Program. Acknowledges a latched alarm or diagnostic message.

Key Error Message

When a key is pressed and the prompt KEYERR appears in the lower display, it will be for one of the following reasons:

- Parameter is not available,
- Not in Set Up mode, press Set UP key first,
- Key malfunction.

Moisture Monitor and Printer

As soon as electric power is supplied to dryer, the Moisture Monitor and Printer will be activated. The Printer is equipped with an on and off switch to control its operation.

Moisture Monitor Instructions

- The Digital Display Meter shows grain moisture constantly and should read approximately 6% when Sensor is in open air (no grain passing over Sensor), see Figure 8.
- Push Grain Temperature Button and the display meter will show Temperature of Grain on the sensor, see Figure 8.
- Push Calibration Button and the display meter will show the amount added to or subtracted from the displayed moisture (-9.9 to +9.9), see Figure 8.

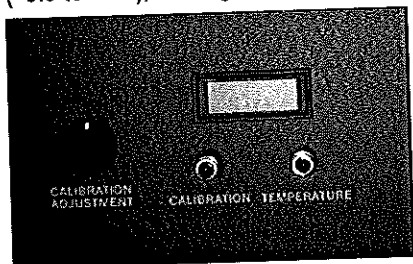


Figure 8

- The Moisture Monitor may need to be calibrated to compensate for different grains and sensor configurations. Make sure that the calibration is set at zero before comparing the displayed moisture values with the samples tested with a reliable moisture tester. See Figure 9, Moisture Monitor Sampling Chart.

- If the displayed moisture value is less than from a moisture tester, push the "Display Calibration" and turn the calibration knob to display the actual difference (+ Value).
- If the displayed moisture value is more than from the moisture tester value, push the "Display Calibration" and turn the calibration knob to display the actual difference with a minus sign (- Value).



CAUTION: Use a safe sampling procedure. Do not sample from a hopper with an unguarded auger. Keep hands, feet and clothing away from rotating parts.

- The following sampling guidelines are recommended:

- Take samples when the displayed moisture values are not changing rapidly.

- Observe the moisture display when the sample is taken. Record both the displayed values and tested values for at least six (6) samples and take the average of each.
- Take samples from the Grain Sampler located on the left side of the Unload (Discharge) Auger Box.

Question: Where would you set the moisture offset, +0.3 or 0.6?

Answer: Most would want to set it to +0.3 which would make it match the point of sale's moisture reading.

Moisture Monitor Sampling					
The chart shows grain moisture readings (from a real situation) as they should be taken to obtain a realistic moisture value.					
Time	M-C Monitor		Dole		Elevator
	Temp.	Moisture	Temp.	Corrected Moisture	Moisture
9:33AM	112	14.4%	109	14.7%	
9:36AM	112	14.4%	111	14.4%	
9:38AM	108	16.0%	107	17.5%	
9:40AM	110	14.6%	109	14.7%	
9:43AM	108	15.9%	104	17.3%	
9:50AM	111	14.5%	107	15.0%	
Total		89.8%		93.6%	
Average		15.0%		15.6%	15.3%

Printer

The printer provides a printed record of:

- Time.
- Mode.
- Grain Discharge Moisture.
- Grain Discharge Temperature.
- Ambient Temperature from Weather Station.
- Average Discharge Moisture.
- Relative Humidity from Weather Station.
- Calibration (Moisture Offset).
- Bin # that is being filled with dry grain.

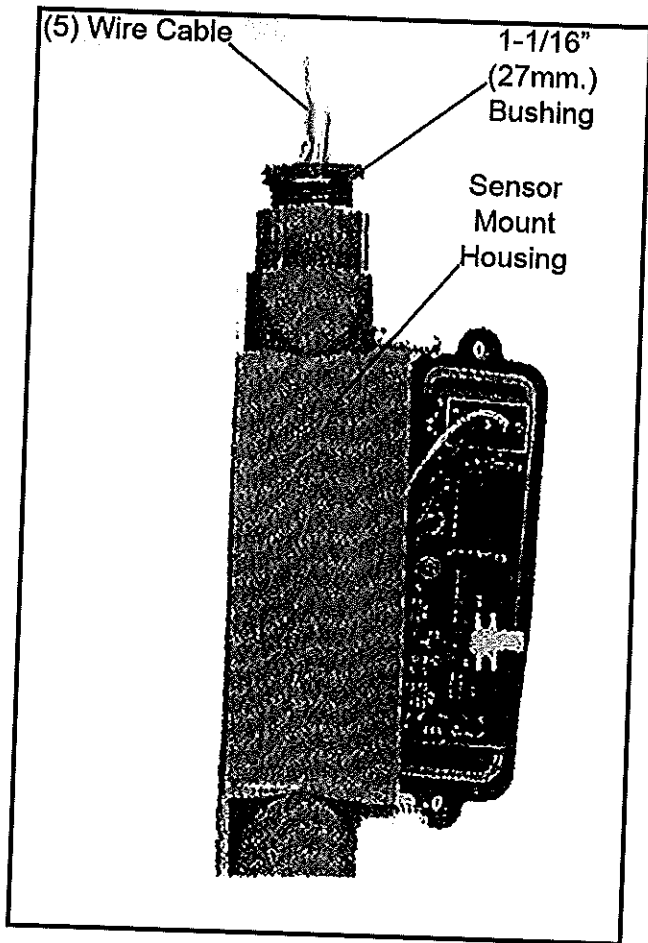


Figure 10 — Weather Sensor

A Weather Sensor is supplied with the Printer, but must be installed by customer when dryer installation is completed, see Figure 10.

The Weather Sensor is not required for the proper operation of the Monitor or Printer.

It is recommended that the Sensor be located about (20) ft. (6.1m.) from the heat and humidity of the dryer.

There are (5) colored wires connected to the Weather Sensor Circuit Board that will have to be connected to the (36) Pin Black Connector (Number Side) that is attached to the top of the Monitor and Printer Interface Board Holder in the Control Cabinet. The (5) wires are:

- White to terminal 11,
- Black to terminal 10,
- Brown to terminal 9,
- Green to terminal 8, and
- Red to terminal 7.

If the Remote Cabinet is a sufficient distance from the heat and humidity produced by the dryer, the Weather Sensor can be mounted to the outside bottom of the Remote Cabinet.

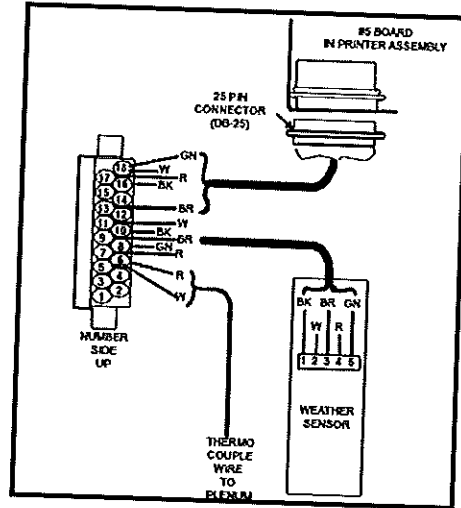


Figure 11

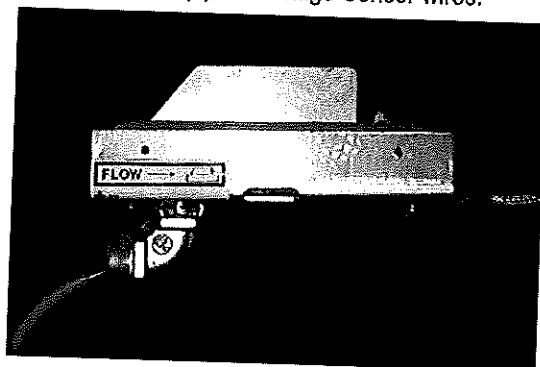
A 1-3/32" (27.8mm.) diameter hole will have to be drilled in the bottom of the Remote Cabinet. The special 1-1/16" (27mm.) threaded bushing is then placed into the hole with the thread end to the bottom.

The (5) wire cable from the Sensor Board is pulled up through the bushing and the Mount Housing is secured to the bottom of the cabinet by turning the bushing into the mount housing until tight. Now place the (5) wires listed above into their correct terminals and tighten, see Figure 11.

If the Remote Cabinet is located too close to the dryer, a location away from the dryer is recommended (about 20 ft. (6.1m.) if possible. Once a suitable location is selected, secure the Weather Sensor Mount Housing.

A length of (5) wire cable will probably have to be spliced and soldered to the 8 ft. (2.44m.) cable supplied with the Weather Sensor to reach the distance selected from the dryer. Be sure to allow 36" (92cm.) from the bottom of the remote cabinet to the (36) Pin Black Connector at the top inside of the cabinet. See Figure 11.

The (5) wire cable should be placed into a separate 3/8" (9.5mm.) flexible liquatite conduit or a 1/2" (12.7mm.) metal conduit from Sensor Mount Housing to the bottom of the Control Cabinet. No high voltage (115V) wires are to be placed in same conduit as the (5) low voltage Sensor wires.



Moisture Sensor

PRINTER DEFINITIONS

Printer Module and Printout

A "cold start" occurs when batteries are not installed or are weak and need replacing (approximately every 2 years).

This data needs to be entered for operation.
If entry is not accepted, the question is repeated.

Acceptable number inputs are:

MM	= Month	01	thru	12
DD	= Day	01	thru	31
YY	= Year	01	thru	99
HH	= Hour	01	thru	12
MM	= Minute	01	thru	60

Prints out your entered information.

Automatically set at five minutes.

Can be set from two minutes through 30 minutes.

Automatically set at "1."

Can be numbered up to "999."

Menu is printed when any key is pushed.

Data entered at cold start.

Battery backup, even with power loss.

Enter if other grain is run

1	-	Corn
2	-	Milo
3	-	Rice
4	-	Wheat
5	-	Soybeans
6	-	Sunflower
7	-	Other

Weather station input at time of printing. Reads "0" when not hooked up.

Header always printed after two hours of running time, moisture limit change, and moisture offset change.

Anytime you want to go to the menu, hit any key on the keyboard. This will interrupt the printing and print the menu.

NOTE: After you are finished using the menu, press "1" to again begin the readout. This will not affect the averaging, unless you had reset the averaging.

```

COLD START - CHECK BATTERIES
ENTER THE DATE      MMDDYY
DAY? - SUN=1 M=2 T=3 W=4 T=5 F=6 SAT=7
ENTER THE TIME      HHMM (12 HR FORMAT)
ENTER 0 FOR AM OR 1 FOR PM
DATE THURSDAY 08-17-89    TIME 08:36A
ENTER 0 TO CHANGE OR # TO ACCEPT
CURRENT INTERVAL IS 5 MINUTES
ENTER 2-DIGITS OR # TO ACCEPT
CURRENT BIN IS # 1
ENTER 3 DIGIT NUMBER OR # TO ACCEPT
    
```

```

GRAIN TYPE? - CORN=1 MILO=2 RICE=3
WHEAT=4 SOYBEAN=5 SUNFLOWER=6 OTHER=7

DATE THURSDAY 08-17-89    TIME 08:54A
1 TO BEGIN PERIODIC READOUT
2 TO CHANGE PRINT INTERVAL--NOW 5 MIN.
3 TO AVERAGE---BEGAN 08-17-89 AT 08:36A
4 TO CHANGE BIN NUMBER--NOW 1
5 TO CORRECT DATE/TIME
6 TO CHANGE GRAIN TYPE--NOW CORN
    
```

```

R.H. 67% CALIBRATION 0.0 PLENUM 00
HIT ANY KEY FOR MENU
CORN
          MACH          GRAIN GRAIN
          AMB  AVE
TIME  MODE  MOIST  TEMP  MOIST
-----
---09:09A  MON           15.0   77
76 14.8
09:10A MON   15.2     77  76   14.8
09:10A MON   14.6     77  76   14.8
    
```

Sample Printer Readout

Time:
Set at cold start.
Reset by menu input.

Mode:
MON = Monitor

03-11-98		SETPOINT 0.0		BIN # 6	
R.H. 67% CALIBRATION		0.0		PLENUM 00	
HIT ANY KEY FOR MENU					
TIME	MACH MODE	GRAIN MOIST	GRAIN TEMP	AMB TEMP	CORN AVE MOIST
-----	-----	-----	-----	-----	-----
09:09A	MON	15.0	77	76	14.8
09:10A	MON	15.2	77	76	14.8
09:10A	MON	14.6	77	76	14.8

Not used

Moisture Offset:
Direct reading from the control panel calibration.

Not used

Ambient Temperature:
From weather station input at time of reading

Average Moisture:
Gives a running average of all readings since start of averaging time.
Starts when unit is started after Cold Start or when reset from menu.

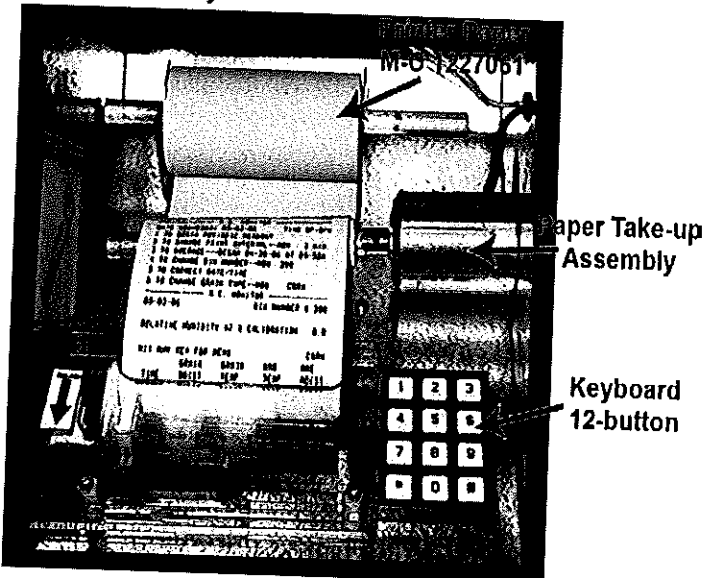
Grain Moisture:
Actual grain moisture at the sensor— temperature compensated

Grain Temperature:
Actual grain temperature at the sensor.

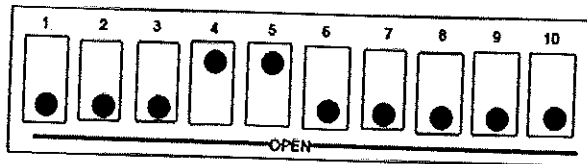
NOTE: To find when last average began, push any key from Line 3 of menu. Push "4" to restart printing.

NOTE: Replace batteries ever year. Use two "AA" alkaline batteries. Turn off power to unit, replace the batteries, then turn on power and reprogram if "Cold Start" notation is printed.

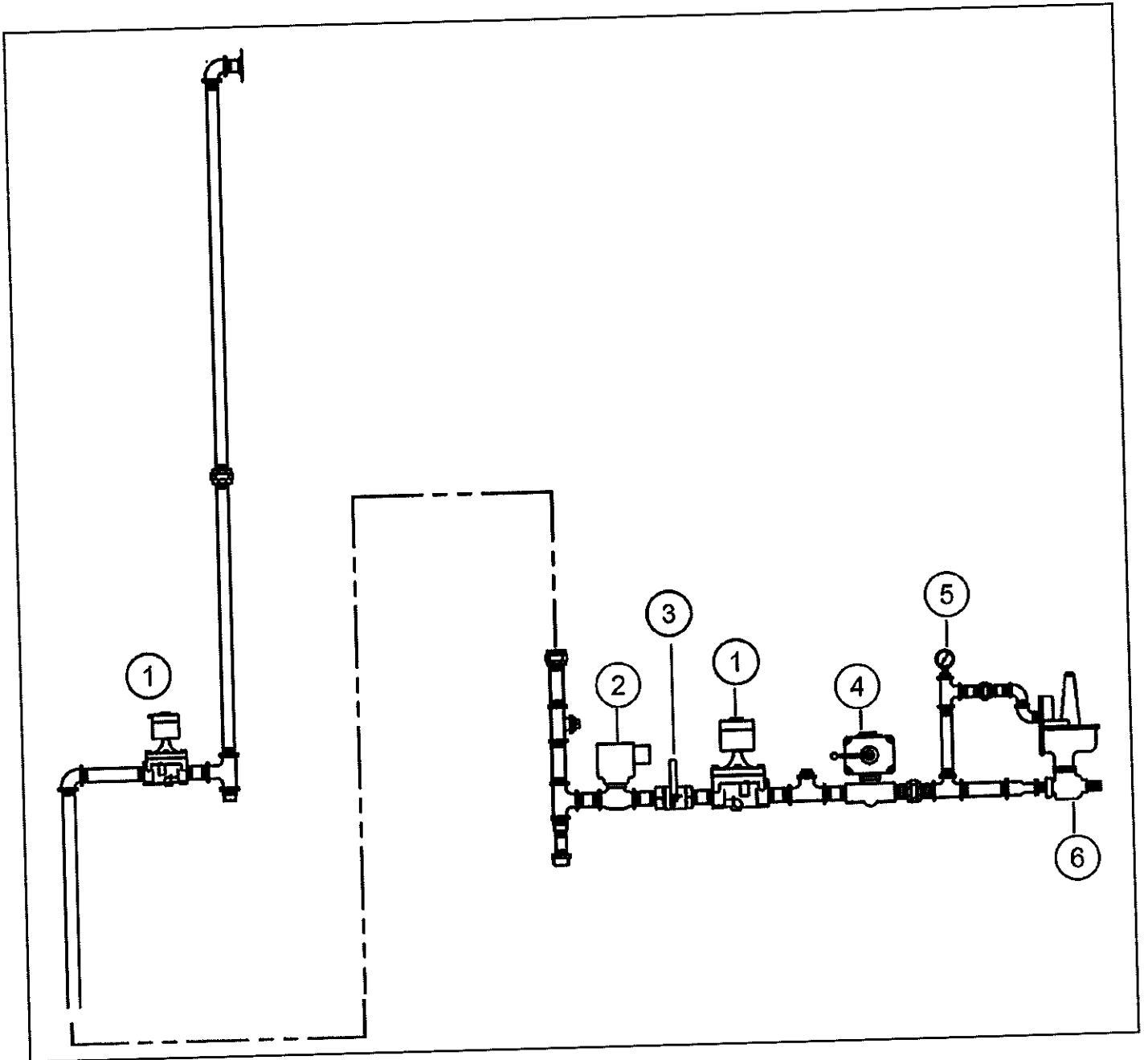
Printer Assembly



DIP SWITCH SETTING ON MONITOR BOARD

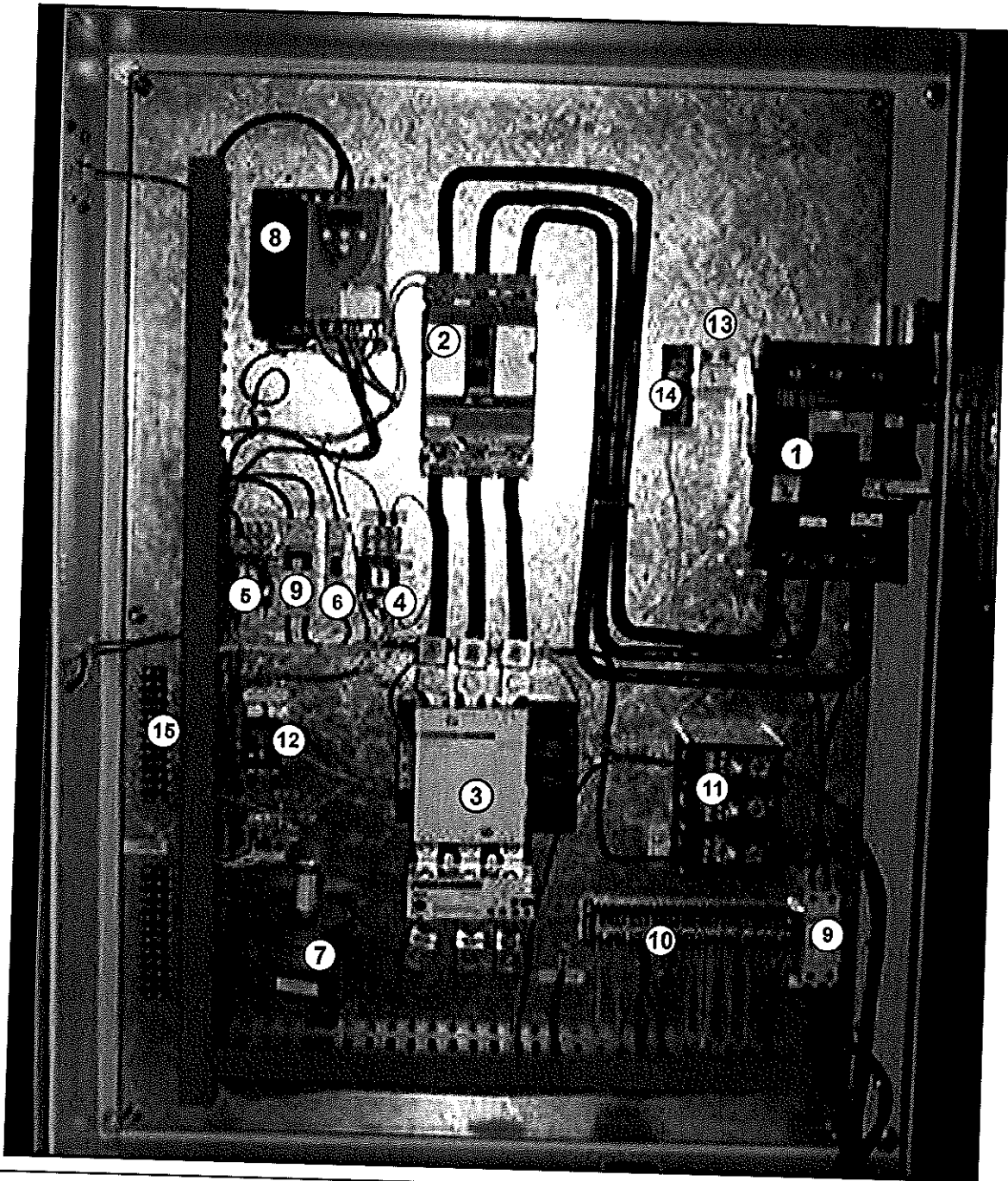


Gas Train Assembly



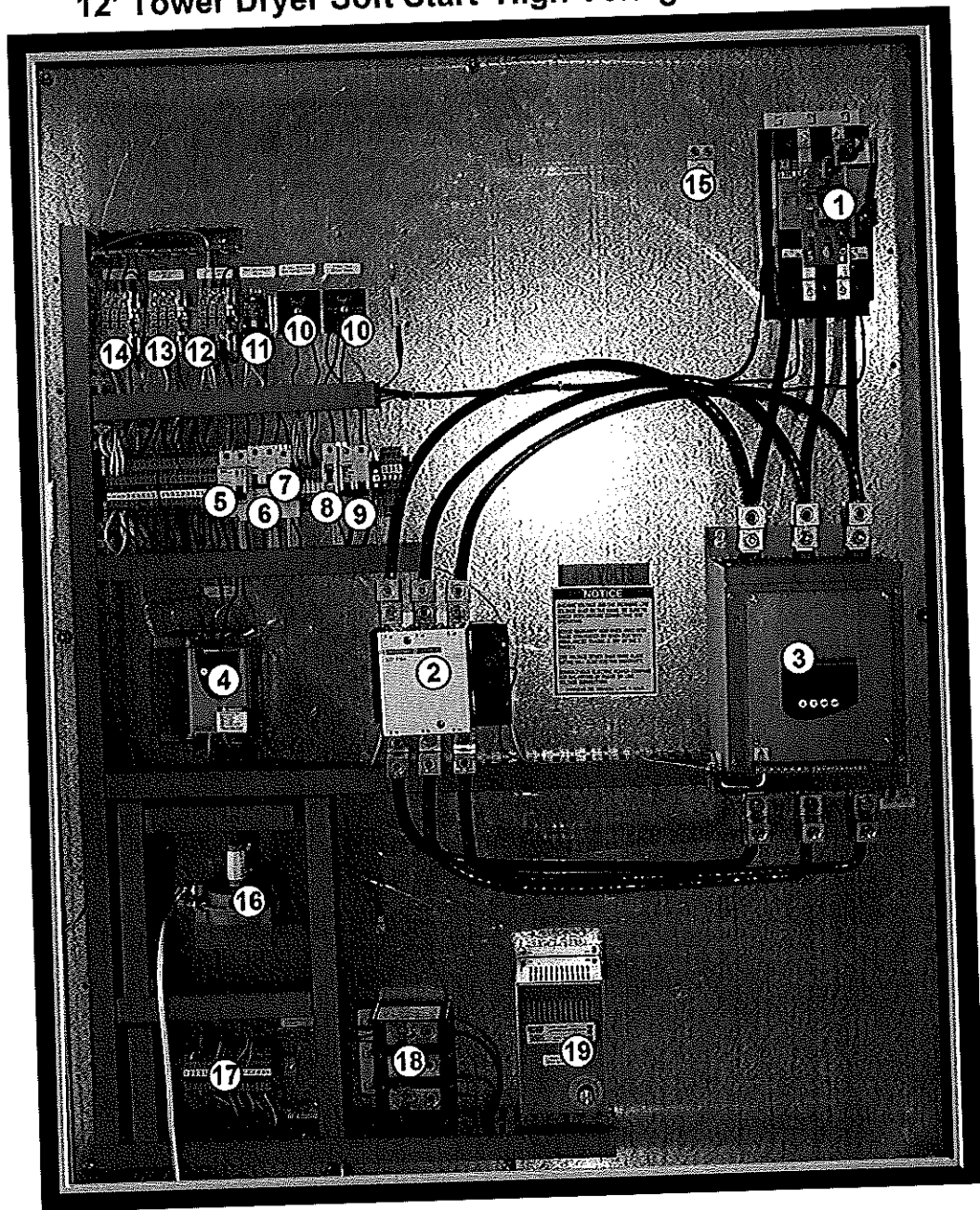
Ref.	Description
1	Solenoid Valve
2	Proportional Valve and Actuator
3	Shut off Valve
4	Manual Reset
5	Pressure Gauge 0-3 psig (0-20 kpa)
6	Pressure Regulator

12' Tower Dryer Direct Start High Voltage Cabinet



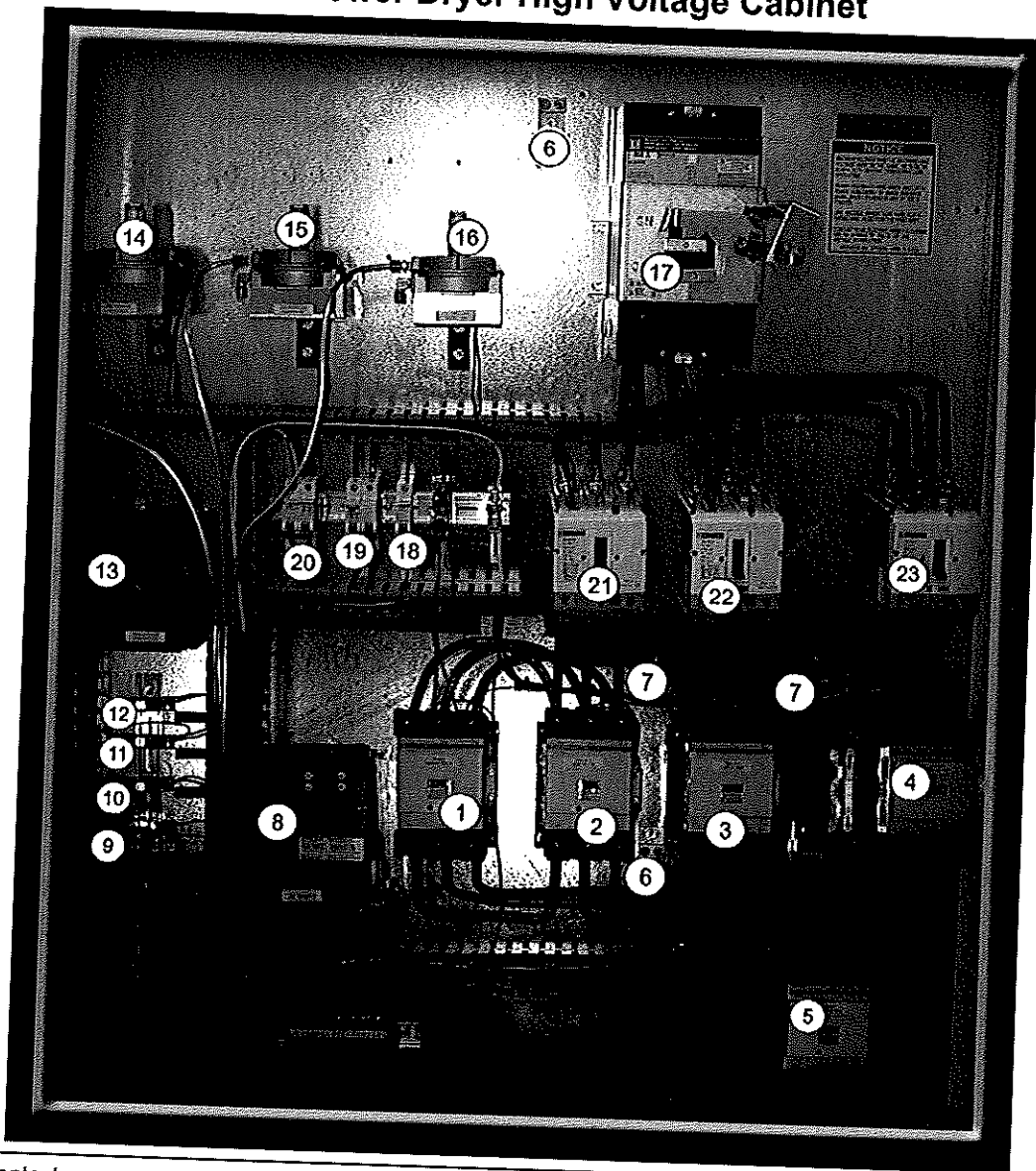
1	Disconnect Switch	9	Double Pole AC Drive Circuit Breaker
2	Manual Motor Protector	10	24 & 120 Volt Terminal Block
3	Motor Contactor	11	Distribution Block
4	Discharge Relay	12	Fill Relay
5	Alarm Relay	13	Ground Lug
6	Circuit Breaker 7 amps -120 Volt	14	Isolated Neutral Block
7	Air Pressure Switch	15	Signal Wire Terminal Blocks
8	3 HP AC Drive Unit		

12' Tower Dryer Soft Start High Voltage Cabinet



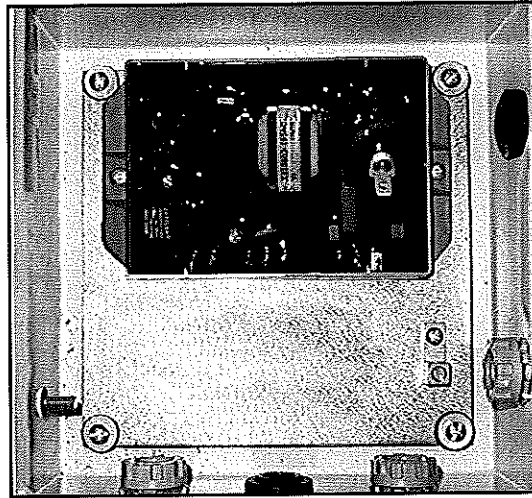
1	Disconnect Switch	11	Fill Relay
2	Motor Contactor	12	Fan Control Relay
3	Soft Starter	13	Alarm Relay
4	3 HP AC Drive Unit	14	Discharge Relay
5	Double Pole 460v Transformer Circuit Breaker—25 Amps	15	Ground Lug
6	Double Pole Cabinet Heater Circuit Breaker—4 Amps	16	Air Pressure Switch
7	Single Pole Soft Starter Circuit breaker—1/2 Amp	17	24 & 120 Volt Terminal Block
8	Circuit Breaker 7 amps -120 volt	18	Distribution Block
9	Double Pole AC Drive Circuit Breaker—30 Amp	19	Cabinet Heater
10	Time Delay		

18' Tower Dryer High Voltage Cabinet



1	Start Contactor	12	Fill Relay
2	Fan #1 Contactor	13	Ignition Module
3	Fan #2 Contactor	14	Air Pressure Switch #1
4	Fan #3 Contactor	15	Air Pressure Switch #2
5	Start Contactor B	16	Air Pressure Switch #3
6	Ground Lug	17	Disconnect Switch
7	Time Delay	18	8 Amp circuit Breaker
8	3 HP AC Drive Unit	19	2 Pole 25A, 277 VAC Circuit breaker
9	Discharge Relay	20	2 Pole 30A, 277 VAC Circuit breaker
10	Alarm Relay	21	Fan # 1 Protector
11	Fan Control Relay	22	Fan # 2 Protector
		23	Fan # 2 Protector

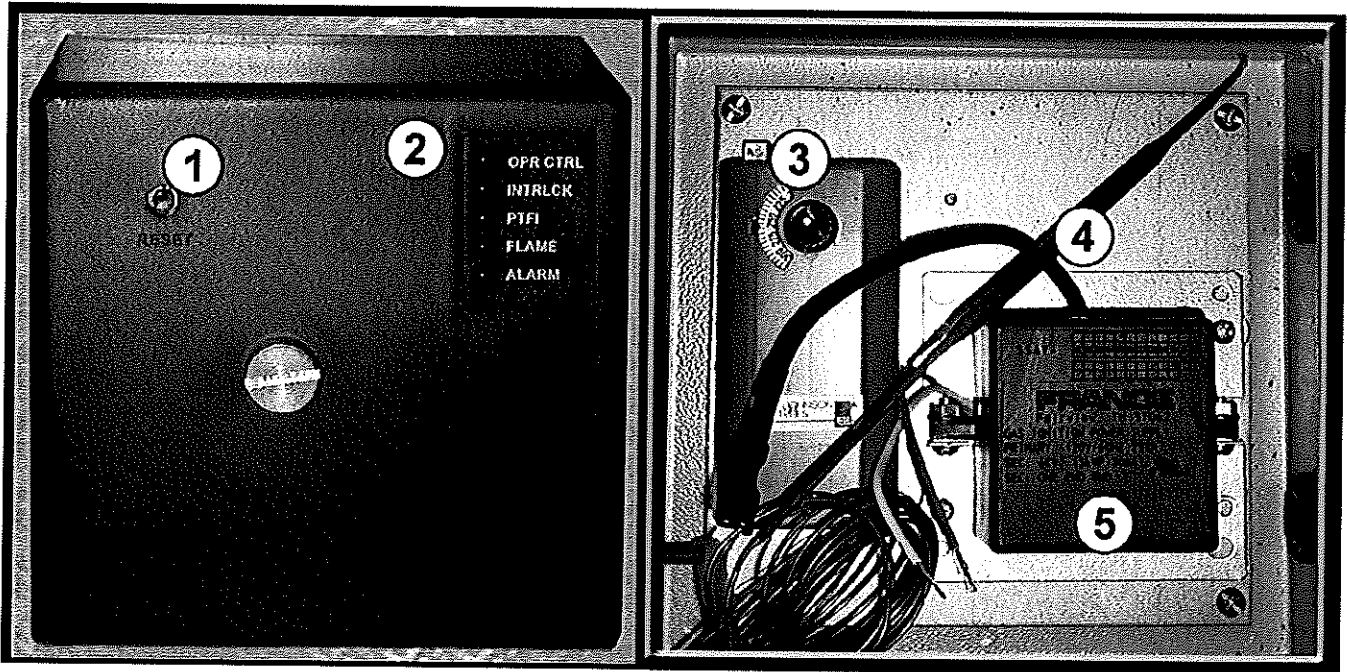
TOWER DRYER IGNITION SYSTEM



Example: 12' Tower Dryer Ignition Module

1. Power is supplied to the Air Pressure Switch through a fan motor interlock. Once the fan is running, the Air Switch is powered up.
2. The Air Pressure Light comes on, proving air flow. This then provides power to the Ignition Switch.
3. Once the Ignition Switch is turned to the "On" position, power up 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 Ignition Board.
4. When the Ignition Board is powered up at L1 and neutral is L2, the board starts through lighting procedure
5. The Red LED light on the ignition board will flash once when it first receives power. This is to reset the internal board protection and clear memory. This is a 1-second delay before the board starts the first trial for ignition.
6. Once the board is reset and memory is cleared, the board will send high voltage out of E1(coil) to the spark plug in order to light burner and 120 volts output from V1 to open up solenoid valves & 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 Flame Sense Probe at burner. The Flame Sense Probe will try to push voltage through flame and to chassis ground. Once the circuit from 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 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 we never establish a flame.
10. When we lose flame, the board will show 3 flashes on the Red LED light on the Ignition Board.
11. If burner does not light, to restart the ignition process. Turn Ignition Switch to Off position and back to On position. This will start the sequence over again.

IGNITION MODULE 3500 and 4000



1	Reset Button
2	LED Indicator Lights
3	Temperature Range
4	Flame Scanner
5	120 VAC Gas Ignition power Supply

LED Indicator Lights

OPR CTRL (Operating Control):

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

INTRLCK (Interlock):

LED is illuminated whenever power is detected on Terminal #6, indicating 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 flame 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 LEDs are illuminated as a coded sequence identifying the reason for the lockout. For instance, for a LOCKOUT - 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 locked out condition.

While in the Idle or Off state, the LEDs are made to flash sequentially to show the operational status of the control every minute. The LEDs can be tested by pressing and releasing the Reset push button, while in the Idle or Off state.

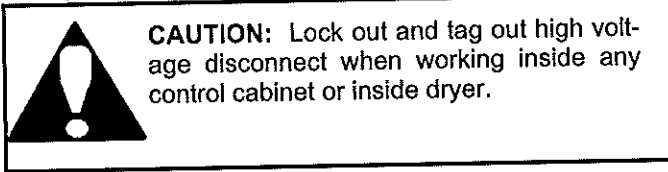
Section 2

Operation

START-UP PROCEDURE

General

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



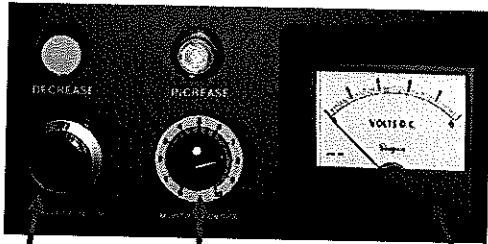
BE SURE TO REMOVE BURNER COVER!



Example: Burner Cover

1. Adjust High Limit and Cold Limit Thermostat inside cooling section of dryer. Items are located inside 12" x 12" cabinet. Set High Limit at 30 to 50 degrees above drying temperature. Set Cold limit at 120 or below. Recommended setting are to avoid nuisance shutdown. Cold thermostat is not included on Dryers manufactured after 01/01/2006.
2. Make sure that all gas supply is turned off and locked out.
 - A. Liquid Propane (LP) Fuel:
 - Turn the LP liquid line hand valve 90° to the piping to shut off the LP at the dryer.
 - Turn the vapor hand valve 90° to the piping to shut off the gas to the burner.
 - Open the LP 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 end cap off of drip leg and open hand valve to allow any built-up water to drain from gas lines. Once water has completely drained, shut hand valve off and recap end of drip leg. Gas supply can now be restored.
4. Burner cover must now be removed from burner. This is located directly on top of burner in heat chamber.
5. Turn all rotary switches in remote cabinet into the "OFF" position. Turn Low Temperature Shutdown switch to "START" position. No switch will exist in dryers manufactured after 01/01/2006.
6. Make preliminary adjust to timers located in remote cabinet. Adjust Fill Timer to 60 seconds and Grain Flow Timer to 5 minutes. Make sure that arrows on Grain Flow Timer are set at 10x and M (minutes). This can be easily adjusted with a small Flathead screwdriver.
7. Turn disconnect on high voltage cabinet to "ON" position.
8. Turn Power switch to start position, "ON" light should energize.
9. Depress Fan Start button and fan should come on. Once fan is running at full speed, dryer is ready to be filled.
10. Turn Fill switch to Manual position and allow dryer to completely fill. Once dryer is filled, turn Fill switch to Automatic position.
11. Adjust air pressure switch (located inside high voltage cabinet) so that air pressure light energizes when dryer is full of grain and fan is running. Note: If fan stops for any reason or grain columns start to empty, air pressure light should de-energize. To adjust air pressure switch, perform when fan is running and grain columns are full. Turn adjustment screw clockwise until Air Pressure light goes out, then slowly turn counterclockwise until light comes back on. Then add one half turn CCW.
12. Open hand lever on Maxon Valve to "OPEN" position. Valve is located on gas train along side dryer base, valve has a sight gas to indicate status of valve (OPEN or SHUT).
13. Open hand valve on gas train that would be located downstream of Maxon valve. We should indicate gas pressure on gauge located on gas train.
14. Turn Ignition switch to "On" position. This will energize the ignition board and go through a 10-second purge time. Then ignition board will attempt to light burner for 10 seconds (trial for ignition). The gas valve light should be energized while burner is trying to light (10 seconds).
15. Honeywell gas controller should display "M" for manual and 30% for percentage of opening of valve. If burner does not light on second trial for ignition, then adjust manual percentage plus or minus up to 10% change of opening. This is a trial-by-error process to achieve the right air to gas mixture for your installation.

16. Once burner is lit and gas valve light is energized for longer than 10-seconds, press the Auto/Man key on Honeywell controller. The "M" will change to "A" for automatic control. Then using arrow keys scroll number up to desired plenum temperature. Once in automatic position, controller will display two numbers. Upper number is actual plenum temperature in Fahrenheit. Lower number is set point (SP) or desired plenum temperature in Fahrenheit. Bottom number SP is the only number you can adjust with arrow keys.
17. The plenum temperature may take up to 30 minutes to stabilize. The controller is programmed to slow down the rate that temperature is increasing, the closer the plenum gets to set point. This is to avoid tripping high limit device and over shooting temperature.
18. Once the plenum has reached desired temperature, turn Low Temperature Shutdown switch to the "RUN" position. If burner flame is extinguished for any reason, plenum will lose temperature and dryer will shut down. Dryers built after 01/01/2006 will not contain a Run Switch. The Honeywell automatically shutdown dryer if there is a loss or gain in the temperature of more than 40 degrees from set point.



SCR Speed Control Dial Moisture Control Discharge Meter

19. Once you are satisfied with grain discharge moisture content, it is time to balance discharge (+, -) lights. First turn Moisture Control knob until both discharge lights go out simultaneously. This is the dryer discharge set point. It is now time to turn Manual/Auto switch from Manual to the Automatic position. The Discharge Speed Meter should not change speed while changing from Manual to Automatic position on switch.
20. Once you have dryer discharge in automatic mode. The discharge speed will change to maintain desired grain moisture content. When the minus light (-) is on, the system is decreasing speed to maintain moisture content. When the plus (+) light is on, the system is increasing speed to maintain moisture content. Once in Automatic mode the manual speed control dial is no longer functional.

22. To change moisture content while remaining in automatic, use the Moisture Control knob. The knob is graduated 0 to 10, 0 end being the wetter value and 10 being a dryer value. If you want to change the discharge moisture content, simply turn the Moisture Control dial up to a higher number for drier grain and minus (-) light will come on. If we turn the Moisture Control dial down to a lower number for wetter grain and the plus (+) light will come on.

FILLING THE DRYER

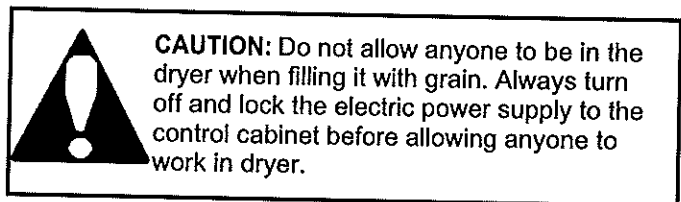
Description

NOTE: Always have the fan running before filling the dryer!

There is an adjustable 0 to 3 minute delay in the dryer wet fill circuit. The delay is activated when the Wet Grain Filling Switch is in the AUTOMATIC position and the Filling (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 and back to the AUTOMATIC position, the delay will recycle.

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 Empty Lamp will light.



NOTE: Either start with dry grain in the cool section or be prepared to catch wet grain and recycle it back into the dryer.

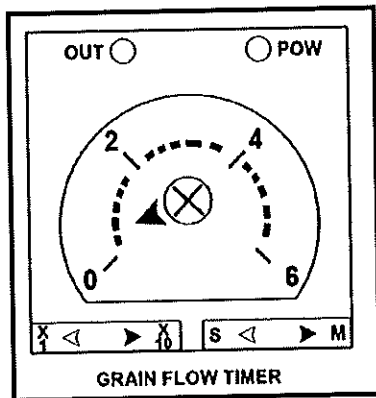
1. Set the adjustable 0 to 3 minute fill switch delay to time desired.
2. Flip the Wet Grain Toggle Switch or turn the Fill Dial Switch (Remote Cabinet) to the MANUAL position (bypassing the 0 to 60 minute Low Grain Timer). The Filling (Fill) Light will now be On.
3. After desired time (0 to 3 minutes) is reached on the Rotary Fill Switch Delay, the fill system will start to fill the dryer with wet grain until it reaches the Rotary Fill Switch in the hopper. When the rotary switch opens from the pressure of the wet grain, the fill system stops and the Filling (Fill) Light goes out.

Setting the Grain Flow Timer

IMPORTANT: If the timer has not been set, the dryer will shut down when the Wet Grain Toggle or Fill Dial Switch (Remote) is flipped or turned from MANUAL TO AUTOMATIC.

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 minute delay if the Filling (Fill) Light is on signaling for grain.



Example: Timer Setting for Conveyor Fill System

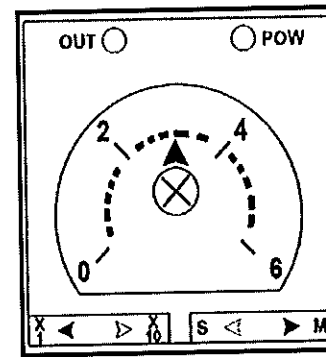
3. Check the refill time a minimum of 6 times. The Filling (Fill) Light will come ON when the rotary fill switch in the hopper signals for grain and will go OUT when the hopper is full. The length of time that the Filling (Fill) Light is on is the refill time (including the 0 to 3 minute delay).
4. Average (6) refill times and reset the Grain Flow Timer, to run 5 minutes longer. For example, if it takes the fill system an average of 5 minutes to refill the dryer, set the Grain Flow Timer to run 10 minutes.

NOTE: The timer does not operate when the Wet Grain Toggle Switch or Fill Dial 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 face to X1 (times one) and to M (minutes).
3. Grain flow should be set from 2 to 4 minutes.

NOTE: This will not cycle the fill system. The Rotary fill switch is used to shutdown dryer on loss of wet grain only.



Example: Timer setting for Gravity Feed Tube System

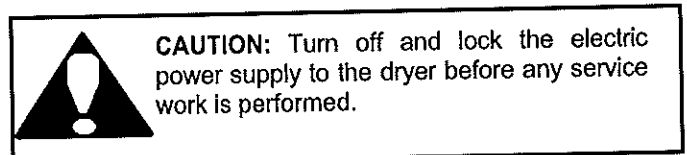
Grain Flow Timer Operation

With the Grain Flow Timer set to run 5 minutes longer than the fill system 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 on and the timer will start to count down to zero.
2. After the fill system refills the dryer and shuts off, the Filling (Fill) Light will go out and the timer will automatically reset. The red light on the face of the timer will be out.
3. If there is an insufficient grain supply, the fill system will continue to run beyond the 5 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 Remote Cabinet Panel will have the Grain Flow light On. The (2) 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 (Remote) to OFF.

NOTE: The Grain Flow Timer shuts the dryer down when it has run out of wet grain.



NOTE: If equipped - the main gas supply safety shut-off valve must be opened manually before the burners can be started.

5. Turn Power On Switch to the OFF position, then to the ON position to reset the Grain Flow Timer.
6. Flip the Wet Grain Switch or turn the Fill Switch (Remote) to MANUAL. Restart the fan, burner, and discharge system. Flip the Wet Grain Switch or turn the Fill Switch (Remote) to the AUTOMATIC position. The fill system 0 to 3 minute delay will be activated if the Filling (Fill) Light is signaling for wet grain.

Starting the Burner

NOTE: Be sure Low Temp Shutdown Switch is in START position.

1. Start fan by pressing the Fan Start Button (Green). Check to make sure that Air Switch Indicator Light is ON.
2. Open the gas vapor hand valve.
3. Flip or turn the High/Low Switch to LOW. Always start burner with High/Low Switch in LOW!
- 3A. Flip or Turn (Remote) the Burner Switch to the ON position. After a (10) second purge delay, the Ignition Indicator Light will be ON and the burner will light. Once the Burner has been operating for about (15) minutes and the heat chamber is warm, flip or turn the High/Low Switch to HIGH.

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 a burner has been shut down for any reason.

4. After the flame is established, 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 LP gas line and also prevent 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.

5. If the LP gas line freezes, close the gas vapor hand valve and flip or turn (Remote) the Burner Switch to OFF. After the gas line thaws out repeat steps 3 and 4 but open the gas vapor hand valve slower.

NOTE: 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 (10) seconds. If the burner does not light, the system will "lock out," closing the gas solenoid valves.

6. Flip or turn (Remote) the Burner Switch OFF then ON again; a new trial for ignition will take place.

NOTE: If the burner fails to light, turn OFF and LOCK electric power to dryer. Close liquid LP intake valve and gas vapor valve. Now check wires to electrodes and ignition boards looking for loose, burned or broken wires or poor connections. Also check ignition switch with a continuity tester.

7. Push the reset button on the High Limit Switch located in the center of the Standard Control Cabinet, in the lower right hand corner of the Motor Control Cabinet on Models 10520 to 101050 equipped with the optional Remote Cabinet Controls, and in a special 12x10x5" junction box located in Section #2 of 101275 dryers.

NOTE: When the High Limit Switch trips out, the dryer will shut down. The fan and burners will have to be restarted.

8. Push Control Circuit Switch up to START or turn Power On Switch to ON position and release.
9. Start the fan by pressing the FAN START BUTTON. Check to make sure that the indicator light for Air Pressure Switch is on.
10. Open the gas vapor hand valve half way.
11. Flip or turn (Remote) the Burner Switch to the ON position. The Gas Valve light will light and the burners will ignite.
12. The gas pressure reading on the Low Pressure Gauge should indicate from .75 to 1.5 (10 to 20.7 kPa.) to maintain the drying temperature during variations in the outside temperature (especially when drying at night).

Setting Drying Temperature

NOTE: Temperatures shown are initial settings and may have to be adjusted for local crop and weather conditions.

1. With the burner operating, set the drying temperature by adjusting the Honeywell.
2. Press the * Key with the up and down Arrow to change the desired set point (Drying Temperature).

NOTE: After the dryer has been operating for one half (1/2) hour, check the Honeywell. The display, in operating mode, shows (2) numbers. The top number is actual temperature detected by the sensor, and the bottom number the current Set Point temperature. The Controller is used to show drying temperatures.

Drying Temperatures			
Model	Corn	Sorghum & Wheat	Sunflowers, Oats, Barley, Soybeans
	Dry & Cool	Dry & Cool	Dry & Cool
2000	210	160	130
2250	210	160	130
3000	210	160	130
3500	210	160	130
4000	210	160	130

Operation of the Discharge System with the Automatic Moisture Control System

The dryer sweep system is driven by a 3HP variable speed 3 phase 230V AC motor and reduction gearbox drive.

1. The discharge system is started by placing the Discharge System Start/Run/Off spring loaded toggle switch up to the START position and releasing it so it moves down to the RUN position. The Remote Cabinet has a spring loaded Auger Switch that is turned clockwise all the way and released. At this time the discharge light will be ON.
2. When the Moisture-Matic Control Switch or Metering Switch (Remote) is in the MANUAL position, power flows directly to the 3HP AC discharge system drive motor. The speed of the discharge system drive motor is controlled by the setting on the Manual Speed Control Dial and appears on the Discharge Speed Meter. The Speed Control Dial is graduated from (0) slow to (10) fast.
3. When the Moisture-Matic Control Switch or Metering Switch (Remote) is in the AUTOMATIC position, the speed of the discharge system drive motor is determined by the Moisture Control Board, Thermistors, and setting of the Auto Set Point Dial.

When the moisture content of the incoming grain increases, the Thermistors sense the change in grain temperature (cooler) and signal the Automatic Moisture Control Board to slow down or stop the discharge system motor to prevent the discharge of wet grain from the dryer when moisture is above setting of the Auto Set Point Dial.

When the moisture content of the incoming grain decreases, the Thermistors sense the change in grain temperature (warmer) and signal the Automatic Moisture Control Board to increase the speed of the discharge motor to prevent the over drying of the grain.

Automatic Moisture Control System

There is a direct relationship between grain temperature and grain moisture. Any change in grain temperature will mean a change in grain moisture. If the temperature of the grain goes down, the moisture content will have increased. If the temperature of the grain goes up, the moisture content will have gone down.

The automatic moisture control on M-C Dryers maintains uniform moisture content of the grain being discharged from the dryer by changing the unloading speed of the dryer.

The moisture control is sensing grain temperature and reacting to it by slowing down or speeding up the unload rate of the metering rolls.

Drying Grain

1. Flip all of the toggle switches or dial switches (Remote Cabinet) to the OFF position.
 2. Drain drip leg
 3. Remove burner cover
 4. Push Disconnect Switch on Motor Control Cabinet up to the ON position. Power will be supplied to dryer controls.
 5. At Remote Cabinet turn spring loaded Power On Switch clockwise all the way and release. The Power On and High Limit Light will light.
 6. Start Fan
 7. Turn the Fill Switch to the MANUAL position. Set Grain Flow Timer. The Fill Light will be on if dryer is not full of grain.
 8. With dryer full of grain, turn Fill Switch to AUTOMATIC. Air Switch Light will stay light.
 9. Start Burners by turning Burner Switch to ON. Ignition Lights will light. Be sure Low Temp Shutdown Switch is in the START position or burners will not light if built before 1/1/06.
- NOTE: As the dryer is operated "Dry 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 or start with dry grain in the cooling section.**
10. Running on continuous heat, it will take approximately (6) minutes per point of moisture being removed to dry the first load.
 11. When the first load is dry, push the Discharge System Spring Loaded Toggle up to the START position and release to the RUN position. With the Remote Cabinet turn the spring loaded dial Auger Switch to ON and release. The Discharge Light will be ON.

12. Flip the Moisture-Matic Switch down to the MANUAL position or turn the Metering Switch (Remote) to the MANUAL position. The discharge system drive motor will start and the dryer will begin unloading grain.
13. Test moisture content of the grain being discharged every (15) minutes until it stabilizes.
14. If the moisture content is too high after it stabilizes, turn the Manual Speed Control Dial down to a lower number to decrease the unloading speed. If it is too low, turn the speed control up to a higher number to increase the unloading speed.

NOTE: After any adjustment of the discharge speed, wait 1½ to 2 hours to make further speed adjustments since it takes that long for grain to pass through the dryer and for the full effect of the speed adjustment

Switching from Manual to Automatic

1. Before placing the Moisture-Matic or Metering Switch (Remote) into AUTOMATIC, the dryer should be operated in the MANUAL position to establish a setting on the Manual Speed Control Dial that will unload dry grain at the desired moisture content. When the moisture content of the discharged grain has been consistent for (2) or more hours, it is time to switch to AUTOMATIC. Be sure the Set Point Dial or Moisture Control Dial is set at 0.
2. While the Moisture-Matic or Metering Switch (Remote) is in MANUAL, turn the Auto Set Point Dial or Moisture Control Dial (Remote) clockwise to balance the Moisture Control System to the point where both the (-) Decrease and (+) Increase Lights are off. At this point the Moisture Control System is calibrated to the moisture content established in the MANUAL position.
3. Now flip the Moisture-Matic Switch up to the AUTOMATIC position or turn the Metering Switch to AUTOMATIC on the Remote Panel.

Now the Manual Speed Control is OFF and the discharge rate is being controlled by the Moisture Control Board, Thermostats, and the setting on the Auto Set Point Dial or the Moisture Control Balance Dial on the Remote Panel.

The unloading speed on the discharge meter should be the same as when the switch was in MANUAL, but the meter will begin to change automatically.

When the moisture content of the incoming grain changes (wetter or drier), the discharge rate will change automatically. If the speed slows down because the incoming grain is wetter, the (-) Decrease Light will come on and the discharge meter indicator will drop until the unload speed is auto-matically adjusted. When the adjustment is completed, the (-) Decrease Light will go out and the discharge meter indicator and the unload speed will remain constant until another change is required.

If the discharge speed increases because the incoming grain is drier, the (+) Increase Light will come on and the discharge meter indicator will move up until the unload speed is automatically adjusted. When the adjustment is completed, the (+) Increase Light will go out and the discharge meter indicator and the unload speed will remain constant until another change is required.

The system will automatically change speed (+) increase or (-) decrease to keep the discharge grain at the moisture content that was selected when the Moisture Control System was in the MANUAL position.

Moisture Control Setting and Adjustments When in Automatic

The discharge rate will change to keep moisture content the same as when in manual. However, if you want to change the discharge moisture content when operating in automatic, simply turn the Auto Set Point Dial or Moisture Control Dial (Remote) up to a higher number for drier grain or down to a lower number for wetter grain. When you turn the dial either the (+) Increase Light or the (-) Decrease Light will come on and you will see the discharge meter indicator change to reflect the change in speed.

SCR Speed Dial Settings			
Model	Crop and Drying mode	Moisture Removal	
		20%-15%	25%-15%
2000	Corn—Dry & Cool	6.0	3.0
2250	Corn—Dry & Cool	7.0	3.5
3000	Corn—Dry & Cool	5.5	2.7
3500	Corn—Dry & Cool	6.5	3.5
4000	Corn—Dry & Cool	7.5	4.1

Low Temperature Shutdown if built before 1/1/2006

A thermostat is used to monitor the air temperature in the heat chamber. When the air temperature drops below the setting on the Low Temp Thermostat, the dryer will shut down and only the 115V Power On Light, Control Circuit On Light, and the High Limit Light will be lit on the Standard Cabinet Control Panel. The Remote Cabinet Panel will only have the High Limit Light lit.

The recommended setting on the Low Temp Thermostat is 140°F (60°C). **ALWAYS PLACE LOW TEMP SHUTDOWN SWITCH INTO START POSITION BEFORE STARTING BURNERS.** If heat chamber air temperature is below setting on Low Temp Thermostat, burners will not light unless Low Temp Switch is in the START position.

End of Day Shutdown

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

Next Day Start-Up

1. Turn on electrical power to dryer. Turn Power On Switch (Remote) to ON, place Wet Grain Switch or Fill Switch (Remote) into AUTOMATIC, place Low Temp Shutdown Switch into START, and push Green Button to start fan.
2. Open liquid propane (LP) gas supply valve at tank or natural gas (NG) supply valve and liquid line intake valve on dryers equipped with liquid propane burners. Now open the vapor hand valve.
3. Start burners. Allow thermometer to reach drying temperature before placing the Discharge System Switch up to the START position and release to RUN position or turn Discharge Auger Switch to On and release (Remote). Now place Moisture-Matic Switch or turn Metering Switch to MANUAL.
4. After the dryer has been unloading grain for at least (15) minutes, the Moisture-Matic Switch or Metering Switch (Remote) can be placed into AUTOMATIC.
DO NOT ATTEMPT TO RE-BALANCE THE MOISTURE CONTROL SYSTEM.

Going Back to Manual

You can switch back to MANUAL at any time. Just flip the Moisture -Matic Switch or turn the Metering Switch (Remote) to the MANUAL position. At this time the Moisture Control System will be off and the discharge system speed will be controlled by the Manual Speed Control Dial. The discharge meter will indicate the manual speed setting. If you want to unload at the same speed in manual as automatic, adjust the Manual Speed Control Dial until the discharge meter needle is at the same reading as in automatic.

When operating in MANUAL the (+) Increase and (-) Decrease Lights may be lit. However, they are only indicating what would happen if you were in AUTOMATIC based on the set point of the moisture control knob. When in MANUAL you can balance the (+) Increase and (-) Decrease Lights, but unless you go to the AUTOMATIC position nothing will change. In the MANUAL position the discharge rate can only be changed by adjusting the Manual Speed Control Dial.



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

Final Shut Down

When the last grain to be dried has been put into the dryer, place the Discharge System Switch or Discharge Auger Switch (Remote) 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 this remaining grain for approximately (6) minutes per point of moisture to be removed. When grain is dry, close the LP gas supply valve at the tank or close the natural gas supply valve.

Operate the burner until flame goes out, then place Ignition Switch or Burner Switch (Remote) into the OFF position. Close gas vapor hand valve (handle 90° to the piping). LP Gas - Close the liquid intake valve. Run the fan approximately (20) minutes to cool grain in the dryer.

After cooling, shut off fan and empty dryer by placing the Discharge System Switch into the RUN position or Discharge Auger Switch (Remote) to ON. Wait until the last of the grain has been removed from the dryer discharge auger by the customer's dry grain take-away equipment. Now place Discharge System Switch or Discharge Auger Switch (Remote) into the OFF position to stop the discharge motor.

Section 3

Maintenance

Cleanout Recommendations

Proper cleaning maintenance of a grain dryer allows the dryer to perform more efficiently. When the screens of a dryer are clean, the air flow moves easier through the grain wall. As debris builds up inside the dryer, the likelihood for internal problems increases.

The recommended tool for cleanout is air — preferably from a vacuum; however using a non-metallic brush or broom is also recommended. Should water be used for cleanout, be aware that some residue can form a paste inside the dryer, sticking to internal surfaces and becoming difficult to fully remove.

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

Note: Setting the Fill Timers is very important in preventing internal debris build-up. The re-cycle Fill Timer (0-180) should be set as short a time frame as possible. The Grain Flow Timer needs to have time frame decreased. The time frame needs to be near 5 minutes at maximum.

Seasonal Daily Clean Out 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, bees wings, and dust accumulate inside the dryer
3. Keep the surroundings clean at all times, to prevent breeding places for insect pests.
4. Inspect any loose bolts or screws. Tighten as needed
5. Using non-metallic brush or broom, sweep inner screens and channel rings clean going from top to bottom.
6. Sweep clean the Heat Floor to remove any debris from floor.
7. Check burner section to make sure wires look good and burner is clean of debris.
 - If burner ports are plugged, clear them with a piece of wire or drill bit
8. Open the Cooling Floor Door and sweep any foreign material onto Grain Deck Floor or remove it from Dryer through Air Doors.

8. Clean Outer Screens and Channel Rings if necessary, by means of sweeping with a brush or power washing with water to maintain current dryer capacity.
9. Wipe down and calibrate moisture sensors
 - If sensors are reading high, extra fuel is being used to dry the grain
 - If the sensors are reading lower than actual grain moisture, the risk of spoilage and reduced quality occurs
11. Inspect any loose bolts or screws. Tighten as needed
12. Re-engage both electrical power and gas fuel supply back on.
13. Once the dryer is back to normal operation, inspect the columns for grain movement. The grain should be moving down the grain column and if it is not freely moving the grain dryer should be manually shutdown. Empty the dryer to detect if all columns are moving when discharge is running. This will assure you of whether there is a problem or not. If all columns are properly moving, fill dryer and restart drying process. If grain is not moving, a cause must be determined. Build up in debris near metering system can hold grain from exiting the dryer. This must be cleared manually before starting to dry grain through the dryer.

Preseason Check

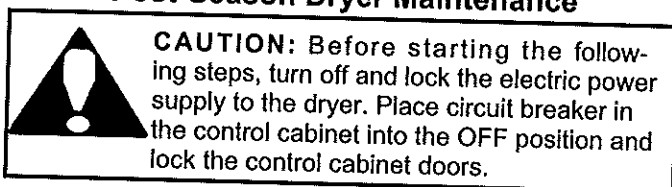


CAUTION: Before starting the following steps, turn off and lock the electric power supply to the dryer. Place circuit breaker in the control cabinet into the OFF position and lock the control cabinet doors.

1. Clean out heating and cooling chambers.
2. Remove weather cover from burner. At this time also check spark plug and wire for cracks, heat damage and loose connections.
3. Check wires in 17 x 14 x 8½" Ignition Board Box(es) located in upper cool section for cracks and loose connections.
4. Grease fan motor bearings. Apply grease until it comes out relief port. Use Chevron SRI-2 grease or equivalent.
5. Check oil in 50:1 gearbox and grease.
 - A. Oil must be at least ¼" over gears.
 - B. Grease top bearing.
6. Grease U-Joint on 50:1 gearbox drive shaft.

7. Grease Belt Tightener Pivot.
8. Replace spring tension on Belt Tightener.
9. Grease 1" discharge system Jackshaft Bearings.
10. LP Gas - Remove Plug at end of Gas Strainer, remove and clean Screen. Replace Screen and Plug.
11. Unlock control cabinet door (**Be Sure Power Still OFF**) and check all wires for cracks, nicks and loose connections, especially on High Voltage Wires. Also be sure to check connections on earth Ground Wire Lug in control cabinet and at copper Ground Rod next to dryer.

Post-Season Dryer Maintenance



NOTE: During this procedure, it is strongly recommended to be wearing a dust mask

1. Disconnect all power and turn off the gas supply before proceeding with any post-season maintenance!!!
2. Place supplied weather cover over burner
3. Using a non-metallic brush or broom, sweep inner screen clean going from top down to bottom.
4. Sweep out the Heat Floor to remove any debris from the floor.
5. Open the cooling floor access door, sweep out all foreign material.
6. Clean off the grain floor along with the sweeps 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 bearings to see if there is any indication of one needing replaced and make a note to replace ones that are suspicious. Inspect any drive belts and chains to note if any need replacing. Lubricate chains for the winter.
8. Use power washer on the outer screens if dirt has filled the perforations.
9. Remove cooling floor sections and remove grain from the bottom of dryer.
10. Remove cooling floor sections and remove grain from the bottom of dryer.
- 11.

7. Replace the cooling floor sections.
8. Grease fan motor bearings and fan bearings with Chevron SR1-2 or equivalent.
9. Use vacuum cleaner to remove any dirt from control cabinet.
10. Place supplied weather cover over burner.

In Case of Fire

1. Shut off the electrical and fuel supply to the dryer!
2. Shut down the entire drying operation, including grain flow into and out of the dryer. The emergency controls may have already done this.
3. Do not try to cool a fire by running the fan(s).
4. Never run grain from the dryer into the elevator or storage if a fire is known or suspected.
5. Locate the area of the fire.
6. 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
7. 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 grain column.
8. 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. Try to keep them from chopping holes in the dryer.

3HP AC DISCHARGE DRIVE SPEED CONTROL

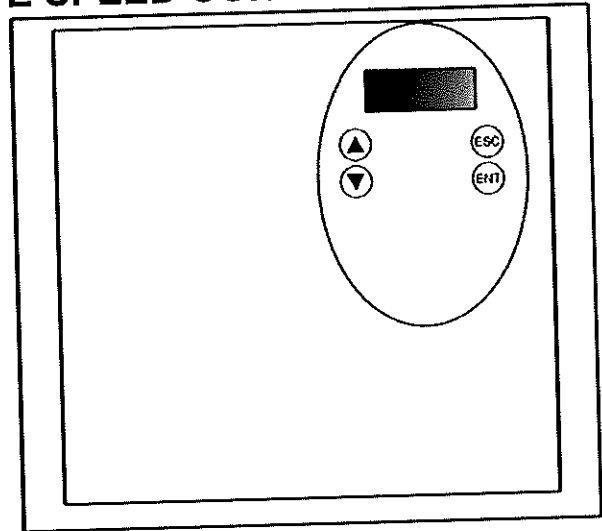
Keypad Instructions:

Keys are:

- **ESC** - Backs out of menus
- **ARROWS** - Scroll up and down through menus
- **ENT** - Displays data numbers and saves data

Codes That Display Faults On Drive

- OCF = Overcurrent
- 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



Example: 3 HP AC Drive

AC Drive Parameters

MENU	Parameter	Description	Value
SEt	ACC	Acceleration time	5sec
	dEC	Deceleration time	5sec
	LSP	Low Speed	2.5hz
	HSP	High Speed	60hz
	IIH	Motor Thermal Current	8.0
	UFR	IR Compensation	50
	FLG	Frequency loop gain	20
	StA	Frequency loop stability	20
	SLP	Slip Compensation	100
	tdC1	Auto DC injection time	0.5 s
	SdC1	Auto DC injection current	
	tdC2	2nd level DC injection time	0 s
	SdC2	2nd level DC inject current	
	JPF	Skip frequency	0 Hz
	JF2	2nd skip frequency	0 Hz
	SP2	Speed preset 2	10 Hz
	SP3	Speed preset 3	15 Hz
	SP4	Speed preset 4	20 Hz
	CLi	Limiting Current	12.0
	ILS	Low Speed operating time	0 (disable)
Ftd	Motor Frequency Threshold		
Itd	Motor Thermal Threshold		
Ctd	Motor Current Threshold		
SdS	Scale Factor for SPd1/2/3		
SFR	Switching frequency	4 kHz	

MENU	Parameter	Description	Value
drC	bFr	Motor Frequency	60 Hz
	UnS	Nominal motor voltage	230
	FrS	Nominal motor frequency	60
	nCr	Nominal motor current	8.0
	nSP	Nominal motor speed	1769
	COS	Motor power factor	0.86
	rSC	Cold State Stator Resist	nO
	tUn	Auto Tuning	nO
	tUS	Auto Tune status	tAb
	UFt	Voltage/Freq ratio	n
	nrd	Random switching freq	yES
	SFR	Switching frequency	4 kHz
	tFr	Max output frequency	60 Hz
	SSL	Suppress speed loop	nO
	SCS	Save parameter config	nO
	FCS	Restore factory settings	nO
	I-O	tCC	Type of control
tCt		Type of 2 wire control	tm
rrS		Reverse	LI2
CrL3		Current input Low	n/a
CrH3		Current input High	n/a
AOIt		Analog output config	IOU
dO		Analog/logic output	OFR
r1		Relay R1	FLt
r2		Relay R2	nO
SCS		Configuration backup	nO
FCS	Reset the configuration	nO	
FU n	StC-	Stop Control	
	Stt	Normal Stop Type	nSt
SUP		Monitoring parameter	FrH or LCr
			Freq. or Current

Changing Settings on AC Drive

How to increase or decrease minimum discharge rate

1. Press "ESC" key until "SEt" appears on display
2. Arrow down until unit displays "LSP"
3. Press "ENT" to display data
4. The data displayed is in units or hertz, our range is 0 to 60 Hz.
5. Arrow up or down to change the number. The higher the number the faster the discharge. Factory setting should be at 5.0 Hz.
6. Press "ENT" twice to save valve, once desired setting is reached.
7. Press ESC twice to return to "SEt" display

How to increase or decrease maximum discharge rate

1. Press "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "HSP".
3. Press "ENT" to display data.
4. The data displayed is in units of hertz, our range is 0 to 60.
5. Arrow up or down to change the number. The higher the number, the faster the discharge. Factory setting should be at 60.0 Hz.
6. Press "ENT" twice to save the valve, once desired setting is reached.
7. Press ESC twice to return to "SEt" display

How to increase or decrease current limit of discharge rate.

1. Press the "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "drC."
3. Press "ENT" to display data (Motor Control Data).
4. Arrow down the menu until "nCr" appears.
5. The data displayed is in units of AC amps.
6. Arrow up or down to change the number. This will increase the amount of amps the motor can draw to drive the discharge system. The higher the number, the more torque the motor has. (Factory setting is 10 amps, but could be increased to 12 amps if discharge will not start up).
7. Press "ENT" twice to save valve, once desired setting is reached.
8. Press "ESC" to return to "SEt" display.

How to increase IR Compensation for discharge

1. Press the "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "drC."
3. Press "ENT" to display data (Motor Control Data).
4. Arrow down the menu until "Ufr" appears.
5. The data is always displayed in units of percentage.
6. Arrow up or down to change the number. The range is from 0 to 200%. This is used to optimize torque while adjusting speed. This should be only readjusted if discharge rate can not be held steady in manual mode. Factory set should be at 50%.
7. Press "ENT" twice to save valve, once desired setting is reached.
8. Press "ESC" to return to "SEt" display.

How to increase or decrease Acceleration for discharge

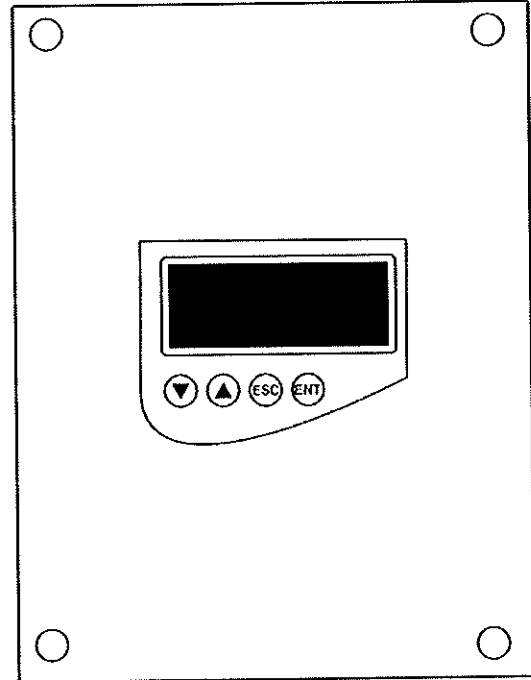
1. Press the "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "ACC."
3. Press "ENT" to display data.
4. Data displayed is in units of seconds.
5. Arrow up or down to change the number. The higher the number, the faster the speed of discharge. Factory setting should be at should be at 5 seconds.
6. Press "ENT" twice to save valve, once desire setting is reached.
7. Press "ESC" to return to "SEt" display.

How to increase or decrease Deceleration for discharge

1. Press the "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "dEC."
3. Press "ENT" to display data.
4. Data displayed is in units of seconds.
5. Arrow up or down to change the number. The higher the number, the faster the speed of discharge. Factory setting should be at should be at 5 seconds.
6. Press "ENT" twice to save valve, once desire setting is reached.
7. Press "ESC" to return to "SEt" display.

SOFT STARTER PARAMETERS

MENU	Parameter	Description	Value
SEt	In	Motor Current	REF
	lIt	Current Limit	400
	ACC	Time to full speed	15
	t90	Starting torque	50%
	S Y	Stop type	-F-
	dEC/EdC	Decel ramp time	*
	brC/EbA	Brake torque	*
PRO	tHP	Thermal protection	CL
	ULL	Motor underload	*
	LUL/tUL	Motor underload thresh.	*
	ILS	Excessive start time	*
	OIL	Current overload active	*
	LOC/tOL	Current overload thresh.	*
	PHr	Phase protection	*
	tbS	Time before start	*
	PHL	Phase loss	*
	PIC	Monitoring probes	*
	ArS	Automatic restart	*
rIH	Reset motor thermals	*	
St2	In2		*
	IL2		*
	AC2		*
	t92		*
	dE2		*
	Ed2		*
	tL2		*
drC	IL1	Torque limit	*
	bSt	Voltage boost	50%
	SS1	Small motor test	*
	CLP	Torque control	*
	LSC	Stator loss compensation	*
	tIG	Decel gain	*
	CSC	Cascade activation	*
	UIn	Line Voltage	? volt
	FrC	Line Frequency	*
	rPr	Reset operating time	*
	FCS	Factory control settings	*
IO	L13/L14	Logic inputs	*
	IPr	Preheating level	*
	tPr	Time before preheating	*
	L01/L02	Logic inputs	*
	1	Relay 1 assignment	*
	2	Relay 2 assignment	*
	3	Relay 3 assignment	tAl
	AO	Analog output	*
	O 4	Output configuration	*
	ASC	Analog scaling	*
*	Default Value or Not Used		



Example: Soft Starter

MENU	Parameter	Description	Value	
COP	Add		*	
	tbr		*	
	FOR		*	
	tLP		*	
	Pct		*	
	*	Default Value or Not Used		
	Motor	Voltage	REF (Reference Current)	CL
	50	460	61	15
	75	460	82.4	15
	100	460	113	20
	50	230	122	15
	75	230	165	15
	100	230	226	20

CHANGING SOFT STARTER PARAMETERS

Parameters for Soft Starter Unit can be changed with power on to dryer. The disconnect must be powered on, so that the digital display on the unit is powered up

How to set Motor Current

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

How to set Current Limit

1. Press the "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "ILt".
3. Press "ENT" to display data.
4. The data displayed is in units of percentage of motor amps.
5. Arrow up or down to change the number. The number should be 450% of motor full load amps. Factory setting should be 450%.
6. Press "ENT" twice to save value, once it is at desired setting.
7. Press "ESC" to get back to the "SEt" display.

How to set acceleration time for by-pass contactor take-over

- Press the "ESC" key until "SEt" appears on display.
- Arrow down until unit displays "ACC".
- Press "ENT" to display data.
- The data displayed is in units of time (seconds).
- Arrow up or down to change the number. The number that is the time from when the soft starter begins fan rotation until by-pass contactor takes over. Factory setting is 15 seconds.
- Press "ENT" twice to save value, once it is at desired setting.
- Press "ESC" to get back to the "SEt" display.

How to set Starting Torque

1. Press the "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "T90".
3. Press "ENT" to display data.
4. The data displayed is in units of percentage.
5. Arrow up or down to change the number. The starting applied motor torque in percentage. Factory set should be 50%.
6. Press "ENT" twice to save value, once it is at desired setting
7. Press "ESC" to get back to the "SEt" display

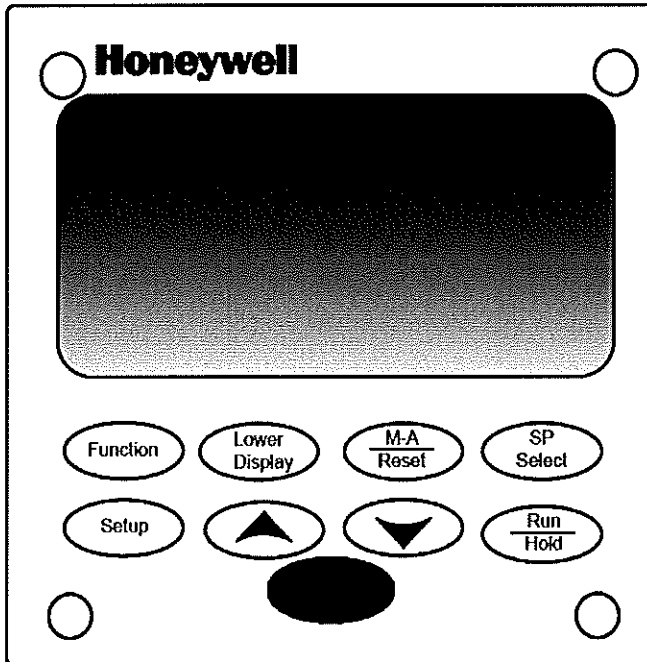
How to set Thermal Protection

1. Press the "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "PRO".
3. Press "ENT" to display data.
4. Arrow down until unit displays "tHP".
5. The data displayed is in units of classification.
6. 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.
7. Press "ENT" twice to save value, once it is at desired setting
8. Press "ESC" to get back to the "SEt" display.

How to Voltage Boost

1. Press the "ESC" key until "SEt" appears on display.
2. Arrow down until unit displays "drC".
3. Press "ENT" to display data.
4. Arrow down until unit displays "bSt".
5. The data displayed is in units of AC voltage by percentage.
6. Arrow up or down to change the number. The number is percentage of motor voltage available for motor and fan start-up. Factory setting should be 50%.
7. Press "ENT" twice to save value, once it is at desired setting
8. Press "ESC" to get back to the "SEt" display.

HONEYWELL CONTROLLER PARAMETERS



Example: Honeywell Controller

Operation	Key	Result
Enter Set Up Mode	Set Up	Lower Display = LOCK (This is the first Set Up Group title)
Select any Set Up Group	Set Up	Displays the other Set Up group titles in sequence. The arrow keys can also be used to scan the Set Up groups in both directions. Stop at the Set Up group title that describes the group of parameters you want to configure.
Select a Function Parameter	Function	Displays the other function prompts of the Set Up group in sequence.
Change the value or selection	Up or Down Arrow keys	Increments or decrements the value or selection that appears for the selected function prompt. If you change the value or selection of a parameter while in Set Up mode then decide not to enter it, press M-A/RESET once—the original value or selection is recalled.
Enter the Value or Selection	Function	Enters value or selection made into memory after another key is pressed.
Exit Configuration	Lower Display	Exits configuration mode and returns indicator to the same state it was in immediately preceding entry into the Set Up mode. It stores any changes you have made. If you do not press any keys for 30 seconds, the indicator times out and reverts to the mode and display used prior to entry into Set Up mode.

Changing the Honeywell Controller parameters

Set up Group :

To go through the set up groups press the **SET UP** button until desired set up group is reached.

Function Prompts :

1. Once reaching the desired set-up group, press the **FUNCTION** key to go through the function prompts.
2. When reaching the correct function prompt, press the up or down arrows to the desired value.
3. Once a value is selected, press the **DISPLAY / LOWER DISPLAY** button to save.

To Accutune:

1. Press **Auto Man** button upper right hand corner of screen displays **MAN** (Manual) or **A** (Auto) until **A** is displayed.
2. Press the **LOWER DISPLAY** button until **SP** is visible at the bottom middle portion of the screen. Press the up or down arrow until the value to the right of **SP** is your desired plenum temperature in degrees F.
3. Press the **SET UP** button until **ACCUTUNE** is displayed in the middle of the screen.
4. Press the **FUNCTION** button until **ACCUTUNE** is displayed in the middle of the screen.
5. Press the up or down arrow until **TUNE** is displayed below **ACCUTUNE**.
6. Press the **LOWER DISPLAY** button until the word **TUNE** is displayed at the bottom middle of the screen. Press the up or down arrow until the word **TUNE RUN** is displayed. Press the up arrow and the **LOWER DISPLAY** button simultaneously.

Key Error Message

If a key is pressed and the prompt **KEYERR** appears in the lower display, it will be for one of the following reasons:

- Parameter is not available
- Not in Set Up mode, press **[SET UP]** key first
- Key malfunction

Lubrication

Lubrication is applied to all required areas before leaving the factory; however, a lubrication schedule should be maintained as described below.

Avoid mixing greases. Bearings are filled with lithium based grease before leaving the factory

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.
SCR Gearbox	Mobil SHC-634 or equivalent	Maintain proper level. Check every 100 hours.
U-Joints	Use (1) stroke of gun grease.	Every 50 hours of operation.
Fan Motor(s) & Discharge System 3HP (DC) Motor	Lubricate with SRI-2 (Chevron) grease or equivalent. (Equivalents below.)	Prior to operation and 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.
Cent Fan Bearings	Use only #2 consistency lithium based grease with high quality mineral oil with rust and oxidation inhibitor. Use Shell Alvania #2, Mobil Mobilux #2 or Texaco Multifak #2.	At the beginning of the season and every 100 hours until end of season.
Axial fans	Exxon Polygrease	At the beginning of the season and between 4,000—5,000 hours of operation until end of season.
Unload Auger bearings	Use Shell Alvania #2, Mobil Mobilux #2 or Texaco Multifak #2.	Grease every 100 hours. NOTE: In extremely dirty conditions once daily to weekly
Metering roll bearings	Use grade #2 mineral oil lithium or lithium complex base grease	Front bearings greasing is at beginning and end of season. Internal bearings are brass and do not need lubrication.
Unload auger gearbox oil:	Mobil SHC-634 or equivalent.	
Tower sweep gearbox oil	Mobil SHC-634	At the beginning of the season and every 100 hours until end of season. Only fill box 1/4 " over gears NOTE: In extremely dirty conditions, it is recommended to grease sooner than every 100 hours.

Fan and Discharge Motor Greases	Fan Motor Bearings Greases
Chevron SRI-2 Standard Oil of California Aeroshell #16 Shell Oil Company Hi Temp Texaco, Inc. Andok 260 Humble Oil Rykon #2 American Oil	Shell – Alvania No. 2 Texaco – Premium RB2 Mobil – Mobilith SHC 100 Amoco – Rykon Premium 2

Lubrication schedule for ball bearing pillow blocks:

- For 2000 Dryer:
 Every two months use 2.0 oz. grease to spherical roller bearing (split) pillow blocks.
- For 2250 Dryer:
 Every month use 2.0 oz. grease to spherical roller bearing (split) pillow blocks.
- For 18' Dryer:
 Every two months use 0.75 oz. grease to spherical roller bearing (split) pillow blocks.

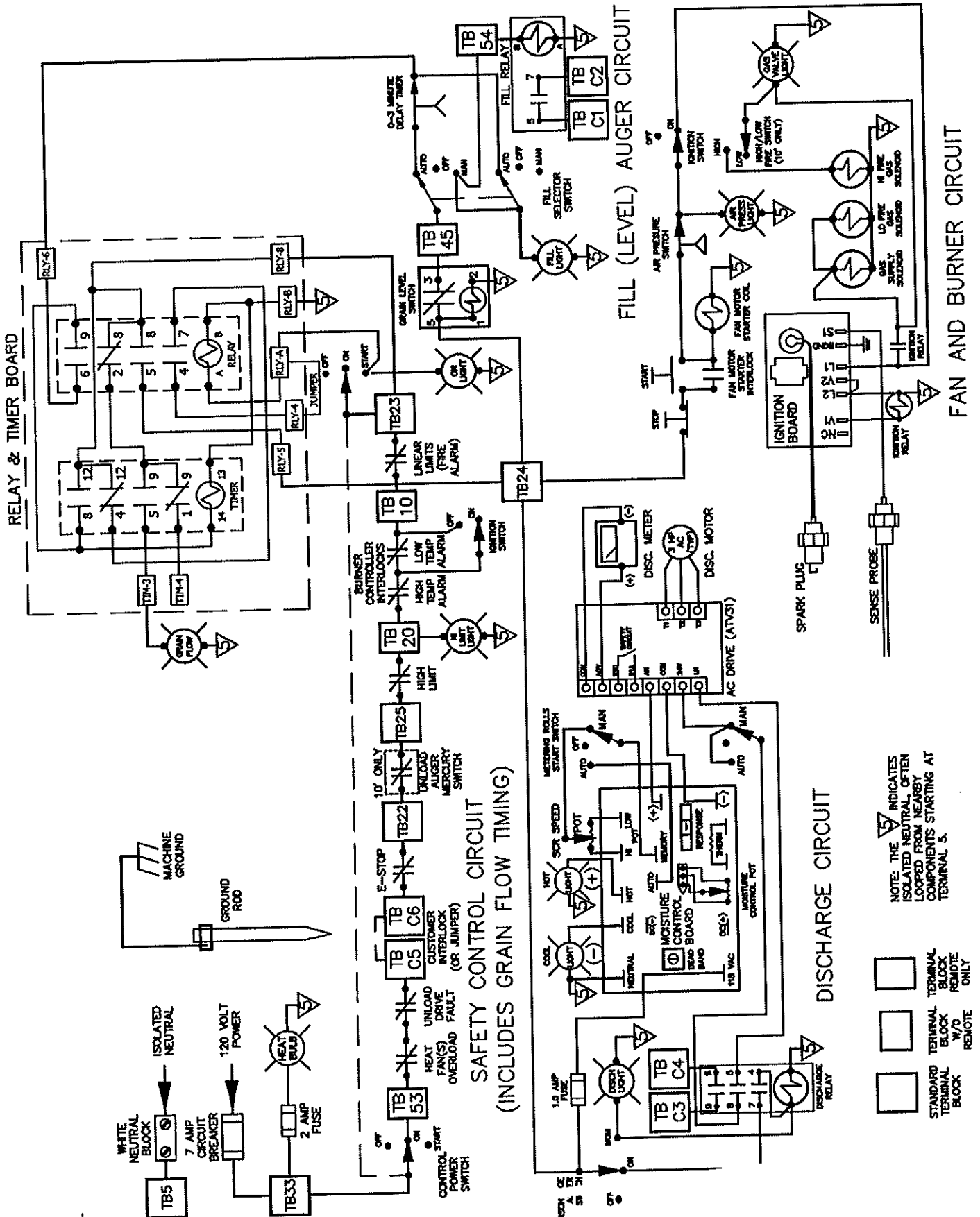
NOTE: Lubrication to be used is a grease NLGI grade 2.

NOTES

Section 4

Troubleshooting

Troubleshooting the 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 either the bottom side of the disconnect or the transformer (depending on voltage) and runs to the 7 or 6 amp mini-breaker. This breaker should be turned off and voltage should be checked before turning mini-breaker on. If voltage reads anything outside of 110 to 120 volts, the supply voltage needs to be checked before powering on mini-breaker.

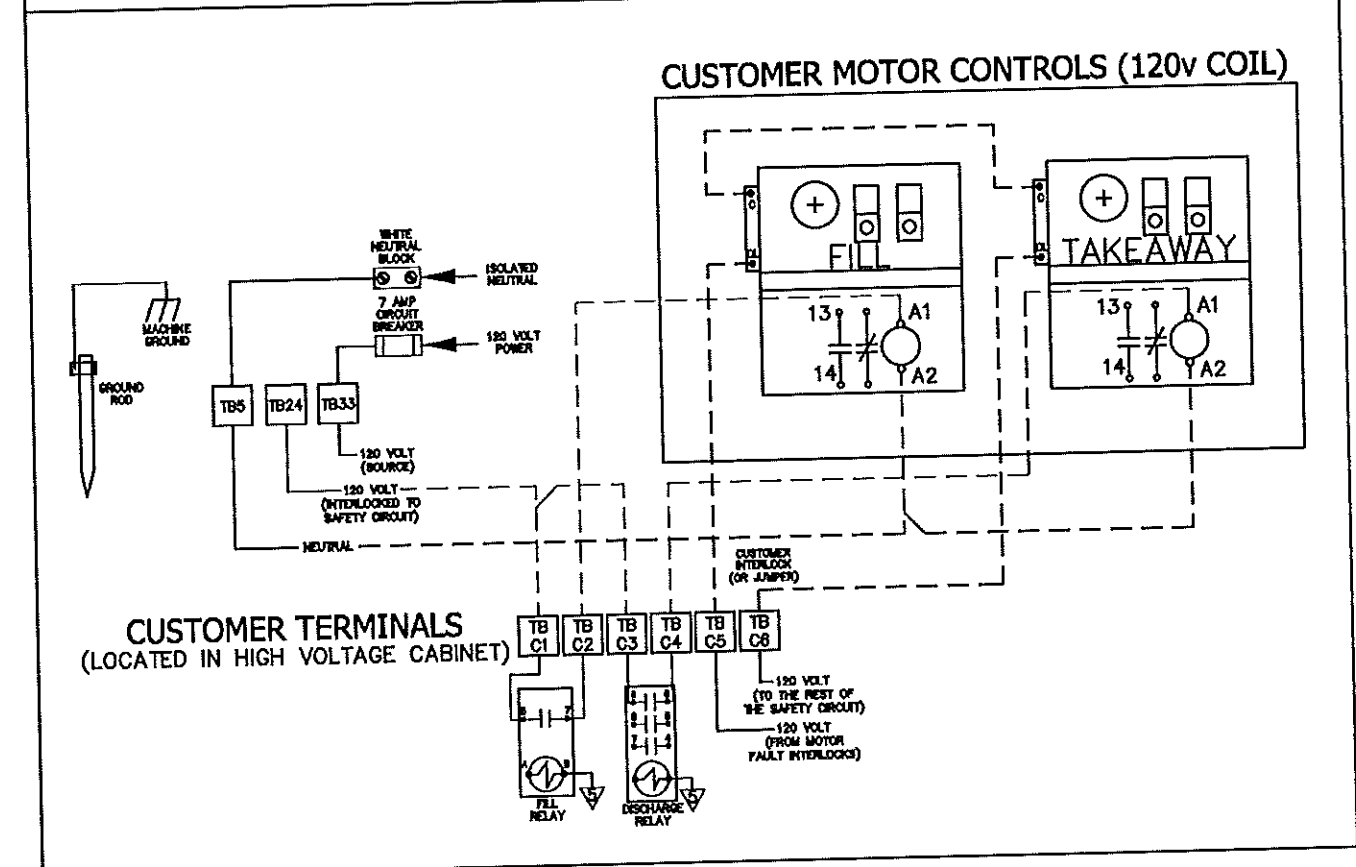
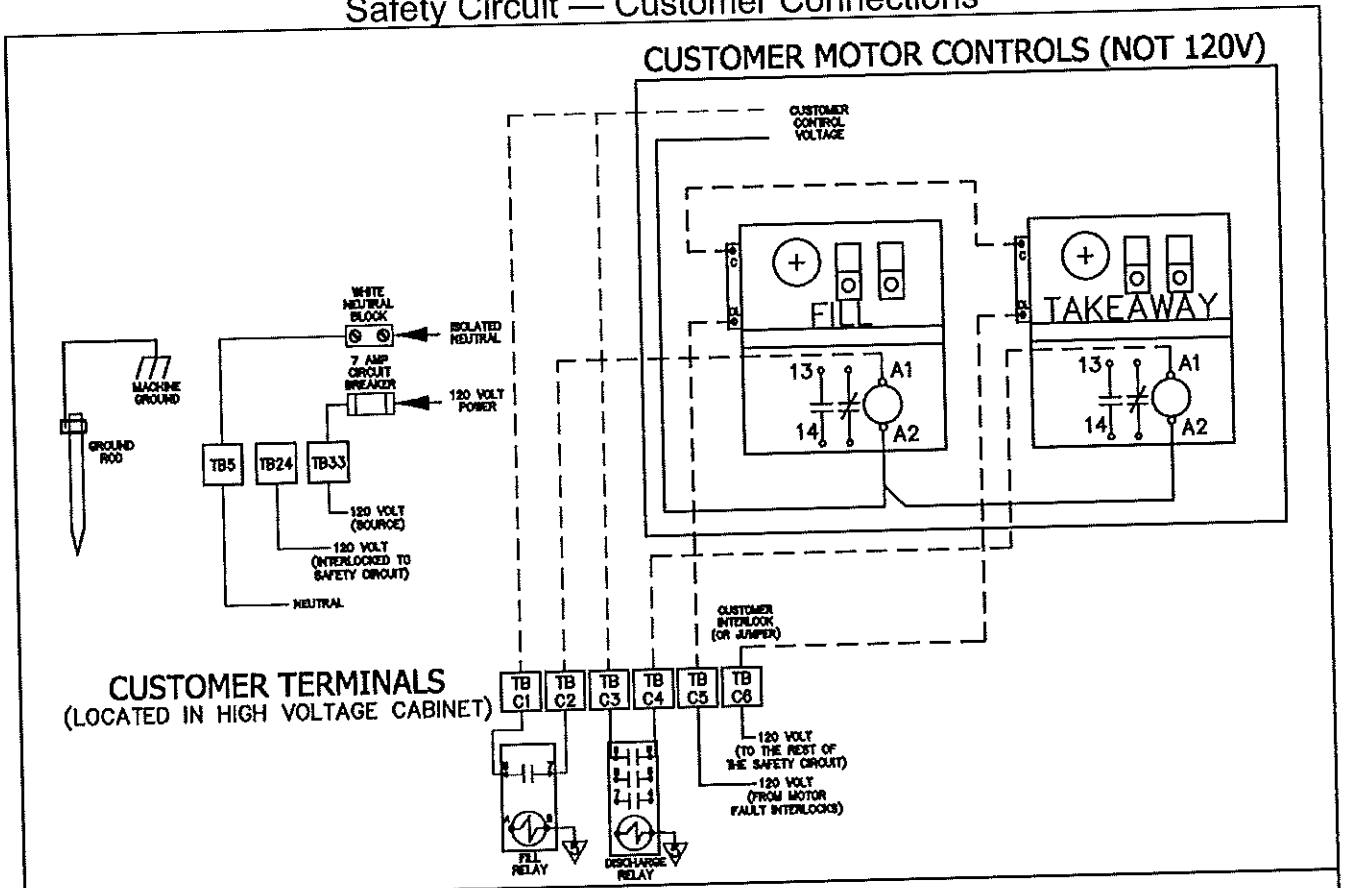
Next to the mini-breaker is a neutral block, this neutral block feeds all neutrals throughout the entire Dryer. The Electrician needs to supply neutral feed line to neutral block.

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 a 7amp mini-breaker

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

- Place second lead on TB33, if 110 to 120 volts show on meter then mini-breaker is good. If no volt appears on meter then mini-breaker is tripped.
- Place second lead on TB53, turn power switch to On position. If 120-voltage is good move to next step. If no volt is read on meter there is a problem with the power on switch.
- Place second lead on TB-C5, if 120-voltage is good move to next step. If there is no voltage on meter, reset all Manual Motor Protectors or AC Drive Unit might have faulted out. To reset AC Drive turn mini-breaker 30amp for drive off. Wait until AC Drive Unit screen goes dead. Then restore mini-breaker to on position and drive will automatically reset.
- Place second lead on TB-C6, if 120-voltage is good move onto next step. If there is no voltage on meter then jumper from C5 to C6 has become disconnected. If customer has pulled jumper and install take-away and fill equipment into safety circuit, check to see if customer's remote starter equipment needs to be reset.
- Place second lead on TB22, if 120-voltage is good move to next step. If there is no voltage on meter, E-stop switch is not functioning properly.
- Place second lead on TB25, if 120-voltage is good move to next step. If there is no voltage on meter, Mercury switch on discharge system has tripped and door is raised or Mercury switch is faulty.
- Place second lead on TB20, if 120-voltage is good move to next step. If there is no voltage on meter, High Limit has tripped and must be manually reset on the front of the switch.
- Place second lead on TB10, if 120-voltage is good move to next step. If there is no voltage on meter, Honeywell Controller could have alarm fault on screen. This must be reset by powering down Honeywell Controller and powering Honeywell Controller back up. Alarm message should be cleared from screen. The Honeywell Control contacts power up a safety relay and relay could be nonfunctional. Relay may need to be replaced.
- Place second lead on TB23, if 120-voltage is good move to next step. If there is no voltage on meter, Linear Limits have overheated and must be checked. When Linear Limits over heat (218 degrees F) they will automatically reset when temperature drops below 218 degrees. If they do not reset they will need to be replaced. These can be checked with power off and run continuity test through each Linear Limit module.
- Place second lead on TB24, if 120-voltage is good then safety circuit is completed see addition note. If there is no voltage on meter, there is a problem with either Main Relay, 0-60 Minute Timer or Relay/Timer Board. There is a 180-volt varistor on the side of the board. If this goes bad, the board has seen a spike in voltage and needs to have the board replaced. If board is good replace either timer or Main Relay.
- TB24 is the main supply distribution point that will feed voltage to Fill Circuit, Fan/Burner Circuit and Discharge Circuit. These three circuits are all independently powered up.

Safety Circuit — Customer Connections



Safety Circuit — Customer Connections

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

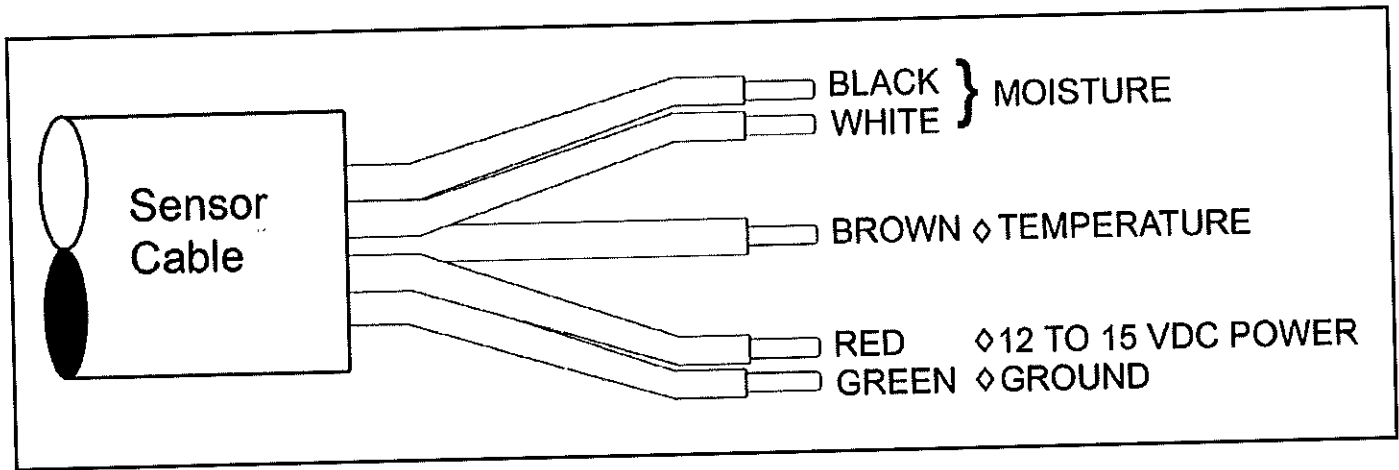
- C1 – C2 which are remote fill equipment
- C3 – C4 which are remote discharge equipment
- C5 – C6 which are dryer safety circuit for remote starters

C1 – C2 are a dry set of contacts and are for customer to supply power to C1 and C2 would run back to customers fill starter and pull in starter. C1 and C2 contacts close when the dryer fill cycle begins. When this closes the dryer will start customer's equipment running, provided that remote fill equipment has a good power source.

C3 – C4 are a dry set of contacts and are for customer to supply power to C3 and C4 would run back to customers discharge starter and pull in starter. C3 and C4 contacts close when the dryer discharge system begins. When this closes the dryer will start customer's equipment running, provided that remote discharge equipment has a good power source.

C5 – C6 are part of the dryer safety circuit and carry 120-volts as long as the dryer power switch is in the "On" position. The Dryer originally is delivered to customer with a jumper across C5 – C6 to allow complete testing of safety circuit. The jumper can be removed and two wires run from C5 & C6 to any motor starter overloads that will be engaged when dryer is running. This will attach through a normal closed path of contacts that will open when motor starters trip under thermal condition are exceeded. This will drop out entire dryer when this pathway opens. Remember that dryer is providing power from C5 to C6 and must be tied to dry set of contacts on customers equipment. **This is to be done ONLY by a trained Electrician .**

Moisture Monitor Troubleshooting Guide



If the moisture temperature is reading incorrectly:

1). Check Sensor:

- Remove Monitor Board and then re-insert it to reset the Monitor Board.
- Disconnect the 5 wires from sensor
- If the sensor is disconnected and the display reads -110° Fahrenheit and 33% moisture, then the monitor board connections are good. The sensor needs to be looked at.
- Connect the 5 wire leads to the sensor. The display should read approximately ambient air temperature and 5 to 7% moisture. This reading should be taken with sensor in a free air condition, having no contact with the grain.
- Make sure the sensor is clean and ground strap is connected. If everything is intact, sensor may need to be replaced.

2). Check Display:

- Check DC voltage across black and green wire, should be the same as display with decimal place moved one place to the left

(Example: 15.5% display will read 1.55 dcv.)

3). Check Monitor:

- Check voltage to power supply and output of power supply. Output should be 12.3 to 12.7 volts DC between red and green, blue and green wires.
- Check dipswitches on monitor board. All switches should be "open" except for #4 and #5.

4). Check Printer:

- Check voltage to printer, via the red and green wires to printer unit. Should be from 5 to 5.2 dcv. If not, adjust pot on power supply unit until voltage is correct.
- Check printer fuse to make sure it is a AGC 1-amp and **not** MDL 1-amp. Slow blow fuse (MDL) will not let printer function properly.
- If time is incorrect, replace batteries on printer board
- If voltage is correct, remove 26-pin connector from side of printer unit. Jumper from #2 to #3 and press any key 40 times. If printer unit is operating correctly, printer will print out 40 digits and fill one entire line.
- If printer does anything else or nothing at all, the printer unit is bad.
- If printer functions properly, then check connection or replace printer board.

Moisture Monitor Troubleshooting Guide

PROBLEM	PROBABLE CAUSE	SOLUTION
Monitor reads approximately -110 degrees and 33% moisture	<ol style="list-style-type: none"> 1. Sensor may be dirty 2. Ground strap is not hooked up 	<ol style="list-style-type: none"> a. Verify sensor is clean b. Check that ground strap is hooked up c. Replace sensor
Moisture readings to change, temperature readings are high negative	<ol style="list-style-type: none"> 1. Sensor leads are broken or not hooked onto the terminal 	<ol style="list-style-type: none"> a. Tighten terminal screws b. Replace sensor
Moisture readings are intermittently high then low	<ol style="list-style-type: none"> 1. Sensor ground strap is not hooked up 2. Sensor cable leads are broken 3. Terminal leads where sensor is hooked are loose 	<ol style="list-style-type: none"> a. Hook up strap b. Replace sensor c. Tighten screws
Moisture readings are consistently high or low	<ol style="list-style-type: none"> 1. Calibration needs adjustment 	<ol style="list-style-type: none"> a. Adjust to correct calibration
Blowing control fuses	<ol style="list-style-type: none"> 1. Check surge absorber for signs of smoke 2. Leads may be shorted or loose 3. Check for any bad component 	<ol style="list-style-type: none"> a. Replace surge absorber if damaged b. Isolate and correct any shorted or loose leads c. Isolate and replace any bad components

Printer Troubleshooting Guide

PROBLEM	PROBABLE CAUSE	SOLUTION
Blowing control fuses	<ol style="list-style-type: none"> 1. Check for loose or shorted leads 2. Any component that is bad can cause this - check by isolating one component at a time. 	<ol style="list-style-type: none"> a. 1. Isolate and correct b. 2. Replace bad component
Printer spaces several lines but nothing is printed	<ol style="list-style-type: none"> 1. Paper installed with the wrong side up 2. Wrong type of paper is being used. 3. Print head is unplugged or bad. 	<ol style="list-style-type: none"> a. Turn over paper. b. Install correct type of paper.
Printer spaces one line, nothing more.	<ol style="list-style-type: none"> 1. Computer control card not seated correctly or bad. 2. Number 5 conductor cable is loose or installed in error. 	<ol style="list-style-type: none"> a. Insert the computer card or replace card. b. Refer to decal for correct wiring at the computer jack. Insert the 25 pin jack at the printer
Printer does not space, no night light and the paper take-up motor is not working.	<ol style="list-style-type: none"> 1. No DC power or no AC power or not hooked up 	<ol style="list-style-type: none"> a. If 5V DC is missing, replace the power supply or repair loose or broken power leads (red and green) or (white and violet)
Printer does space but has night light.	<ol style="list-style-type: none"> 1. Printer motor not plugged in. 	<ol style="list-style-type: none"> a. Plug in the flat, grey cable on the printer and check if broken.
Prints characters that are unintelligible.	<ol style="list-style-type: none"> 1. Computer not working 	<ol style="list-style-type: none"> a. Power down and retry.
Top part of characters are missing.	<ol style="list-style-type: none"> 1. Plastic guard too close 	<ol style="list-style-type: none"> a. Raise the plastic shield.
Part of each character are missing.	<ol style="list-style-type: none"> 1. Head cable loose or print head bad. 	<ol style="list-style-type: none"> a. Reset the flat brown cable or replace the printer.
Paper take-up not rolling up the paper.	<ol style="list-style-type: none"> 1. Loss of power or bad motor on aluminum shaft binding against the motor. 	<ol style="list-style-type: none"> a. The orange and the orange/white wire loose or broken. Re-tighten or replace the motor assembly or adjust the aluminum shaft by loosening the Allen screw.

Single Fan Tower
General troubleshooting
Start-up and Running of Dryer

	PROCEDURE	TROUBLESHOOTING
1.	Set HIGH LIMIT and LOW TEMP Thermostats	
2.	Start of Operation of Dryer: 115 volt light should be ON.	If not, check a. Check main disconnect b. Fuse is not functional or 7A circuit breaker tripped c. TB33 for connection (110 volts) d. 115 volt bulb and socket
3.	Switch Control Switch to ON position. HIGH LIMIT light should be ON	If not, check: a. RUN-START in START position b. Overload circuit through starters c. AC drive and fuses or circuit breaker d. Back door Mercury Switch e. High Limit reset f. Soft Starter g. Burner Resets h. CAL or Honeywell controller
4.	Switch Control Switch to START position, POWER ON and FILL lights ON	If not, check: a. FILL light will only come on when FILL switch is in MANUAL or AUTO position and calling for grain b. Main Relay c. Rotary Fill Switch is not calling for grain d. Grain Flow Timer elapsing (EMPTY light)
PRIMARY CIRCUIT IS NOW COMPLETE (SAFETY CIRCUIT), TB24 IS ENERGIZED		
5.	Push Fan Start Button. Fan should start and run	If not, check: a. Main power voltage through disconnect and breaker to starter b. Starter, or c. Soft Starter
6.	Switch Fill Relay ON to MANUAL Fill Relay closes to provide 110 volts to customer supplied fill equipment	
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 only in the circuit in AUTO position	
10.	Set Grain Flow Timer for 2 to 10 minutes	
DRYER IS NOW FILLED AND READY TO DRY GRAIN		
11.	Air Switch Light should light	If not, check: a. Dryer not full of grain b. Air pressure Switch not adjusted c. Filter is dirty

Single Fan Tower
General troubleshooting
Start-up and Running of Dryer

	PROCEDURE	TROUBLESHOOTING
12.	Switch Ignition to ON position. After 10 Second Purge Timer times out, #1 Ignition light comes ON. This will ignite both (or three) burners	If not, check a. Purge Timer b. Ignition board as follows: c. L1 is hot, L2 is neutral (110 volt power to unit) d. V1 is hot, V2 is neutral (110 volt power to solenoids) e. S1 is voltage to Flame Sense Probe f. BGRD is grounded to the chassis g. E1 is HIGH VOLTAGE To Electrode (DANGER! Never test with meter)
13.	Switch Honeywell controller from manual to automatic after 30 seconds of having burner lit along with setting plenum temperature. controller will bring plenum temperature up to selected set point and stabilize	If not, check: a. Controller b. Controller parameter settings c. Has controller been AUTO TUNED?
14.	Switch RUN-START switch to RUN (If before 01/01/2006)	
15.	Switch Discharge System Switch to START position. The Sweep arms should start	If not, check a. AC Drive fault settings b. AC Drive parameter settings c. AC Drive fuses or circuit breaker d. Voltage Output to motor. Should be 230 volt, 3 phase e. 3HP motor f. Drive Belts
16.	Grain flow Timer has a 1 to 60 minutes range. Set the M-C Control board response switch to 2. Set Grain flow timer according to manual.	
17.	Use Potentiometer to adjust sweep speed. Adjust speed until moisture content of grain is the desired percentage. After running dryer long enough to stabilize moisture output, dryer is ready for Automatic Mode	
18.	Use Moisture Control Potentiometer to balance lights so that both are OFF. Before switching to Automatic Mode, set Response Selector. Responses 1, 2, 3: 1 being fastest response, 3 being the slowest response from Thermistors to change speed in Sweep System.	
19.	Switch Discharge System into Automatic at this point	If not, check a. Auto/Manual Switch for wiring problem b. 1.0 Amp Fuse c. AC Drive and Motor

Dryer Troubleshooting Guide

PROBLEM	PROBABLE CAUSE
Main gas valve is opened main burner will not come on.	<ol style="list-style-type: none"> 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. The solenoid should energize when a pilot is established. If it does not, check for faulty electrical connections or a faulty solenoid. 2. Check for water in the gas line by opening drain valve. 3. Check the hand valve in feed back line to the main gas regulator. It should be partially open.
Dryer will not reach operating temperature, or it reaches it slowly.	<ol style="list-style-type: none"> 1. Low gas pressure. Increase gas pressure on main gas regulator. 2. Check for water in gas train by opening drain valve. 3. Make sure dryer is completely full of grain by entering the heat plenum and looking for daylight in one of the grain columns. 4. Gas parts in 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 motor or motor linkage.
Blower motor(s) will not start.	<ol style="list-style-type: none"> 1. Check that the fan circuit breaker and the fan switch are on. Also, check for defective switch or bad wiring connections. 2. If lighted switch does not light, an air switch needs adjustment, or the bulb may be burned out. 3. Verify closing of fan motor contactor. Check voltage on load side of contactor. 4. Inspect contactor for defective points 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 motor starts slowly, check for low voltage during starting due to excessive voltage drop in power supply wiring.
Burner will not fire.	<ol style="list-style-type: none"> 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 valve or coil if valve will not open with proper voltage applied (115 volts).

Dryer Troubleshooting Guide (Continued)

PROBLEM	PROBABLE CAUSE
Burner will not fire, but gauge shows gas pressure.	<ol style="list-style-type: none"> 1. Check that the igniter is properly gapped and has a strong spark. 2. Inspect the porcelain and electrodes for damage or cracking. Replace or clean if necessary. 3. Machine does not have chassis ground
Uneven drying-Some kernels appear brown while others are under dried. Uneven heat exiting from dryer columns.	<ol style="list-style-type: none"> 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.
Grain is not moving through columns.	<ol style="list-style-type: none"> 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. Keep the dryer clean! Do not allow fine material to gather in the plenum chamber.

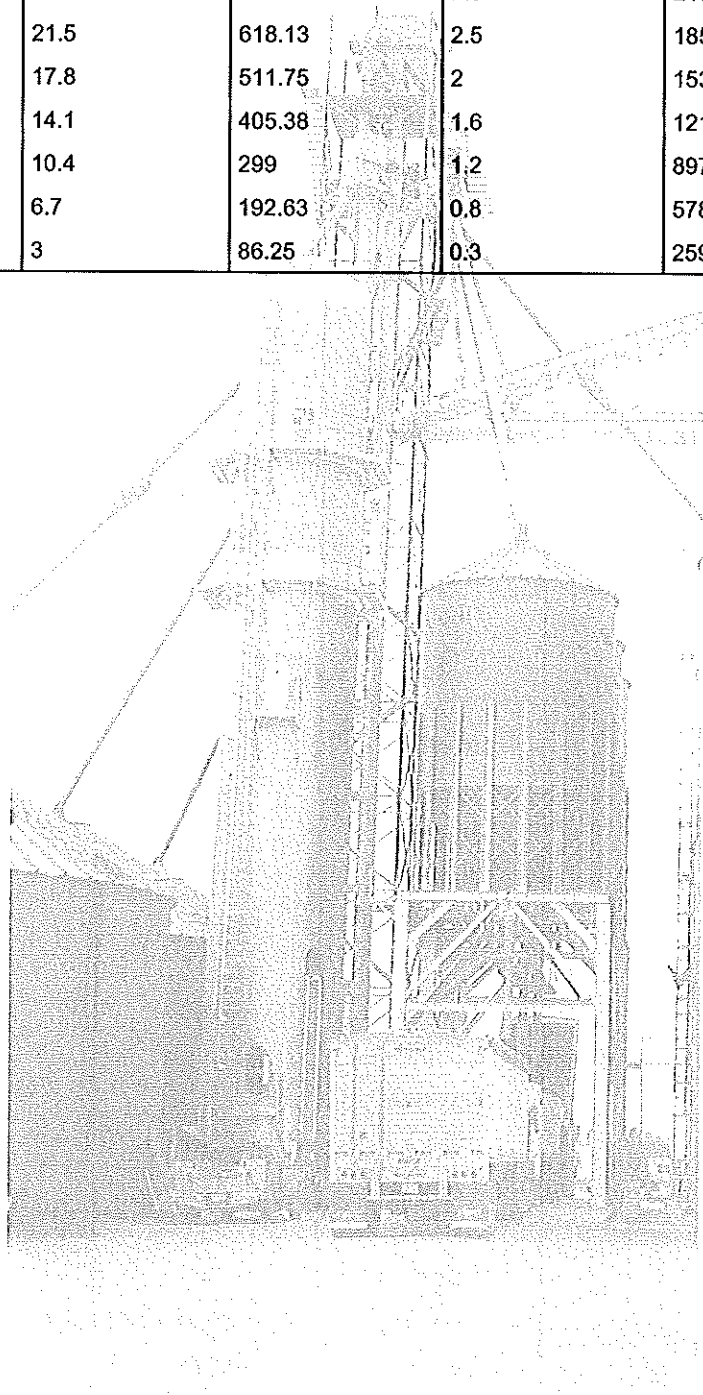
Ignition Board Troubleshooting Guide 12' Tower

Problem	Possible Cause and Solution
<p>Difficulty lighting the burner</p>	<ul style="list-style-type: none"> a. Ensure gas supply to the dryer is on, hand valves are open b. Fan must be on to achieve air pressure light. c. Ignition switch set to on, applies 120 VAC at L1 (0 volts at L2-Neutral) of the ignition board. d. In some cases (towers), ignition switch powers an external pre-purge timer (10 seconds). Check for power to and from timer. e. After pre-purge time, the ignition board should power out 120 VAC at V1 (V2 neutral) for a <i>trial for ignition</i> period to open the solenoid(s) and gas valve light. The normal trial time is 10 seconds. If trial is not successful, voltage output stops. f. Check gas solenoid operation by listening for click/snap or feeling the vibration as they open. If solenoid doesn't open, check the wiring and coil for damage, bad connections, etc. g. Check the spark plug (igniter) for spark. Check the high voltage wire for damage, good connections. h. Replace the ignition board.
<p>Burner lights but doesn't stay lit</p> <p>NOTE: This is most likely due to flame sensing.</p>	<ul style="list-style-type: none"> a. Ensure flame sense probe is located in the flame. b. Inspect the sense wire for damage, loose or wet connections. c. Sense wire must be routed separate from the high voltage ignition wire. d. Check that the ignition board (B.GND) is grounded separately from all other connections. Sharing a ground connection can cause problems. e. Clean sense probe with fine steel wool f. Burner may have to be grounded at the burner body to the burner housing

12' Tower Dryer Specifications				
MATHEWS COMPANY	Units	MC	MC	
Model Number of Dryer	Inches	2000	2250	
Drying CFM	CFM	90,000	109,000	
Cooling CFM	CFM	45,000	54,500	
Fan HP	HP	100	100	
Fan RPM	RPM	900	822	
Fan RPM				
Maximum Burner Capacity (MBTU)	MBTU	21.78	26.38	
Typical Heat Use @ 60° F. (MBTU)	MBTU	11.88	14.39	
Typical gas pressure usage at manifold	psig	0.5 to 1.25 psi	0.5 to 1.25 psi	
Maximum Natural gas supply	psig	60 psi	60 psi	
Maximum LP gas supply	psig	250 psi	250 psi	
Tower Diameter	Ft & In	11' 8"	11' 8"	
with Walkways	Ft & In	17'-9"	17' 9"	
Overall Height	Feet	75'-4"	87' 4"	
Grain Column Width	Inches	12	12	
Grainwall Height	Feet	63'	75'	
Heat Holding (bu)	Bushels	1211	1453	
Cool Holding (bu)	Bushels	485	566	
Total Column Holding (bu)	Bushels	1696	2019	
Peak Holding (bu)	Bushels	249	249	
Total Dryer Holding (bu)	Bushels	1945	2268	
Unload Capacity	Bu/Hr	3200	3200	
Electrical Load				
230 Volts	Amps	320	320	
460 Volts	Amps	167	167	
Discharge Drive	HP AC	3	3	
Sweep	Arms	4	4	
BPH Capacity (20%-15%)	Bu/Hr	2000	2250	
BPH Capacity (25%-15%)	Bu/Hr	1175	1322	

12' Tower Dryer Discharge Data

POT SETTING	MOTOR FREQ	MOTOR RPM	SWEEP RPM	LINER OUTPUT BU/HR
10	40	1150	4.6	3450
9	36.3	1043.63	4.2	3131
8	32.6	937.25	3.7	2812
7	28.9	830.88	3.3	2493
6	25.2	724.5	2.9	2174
5	21.5	618.13	2.5	1854
4	17.8	511.75	2	1535
3	14.1	405.38	1.6	1216
2	10.4	299	1.2	897
1	6.7	192.63	0.8	578
0	3	86.25	0.3	259



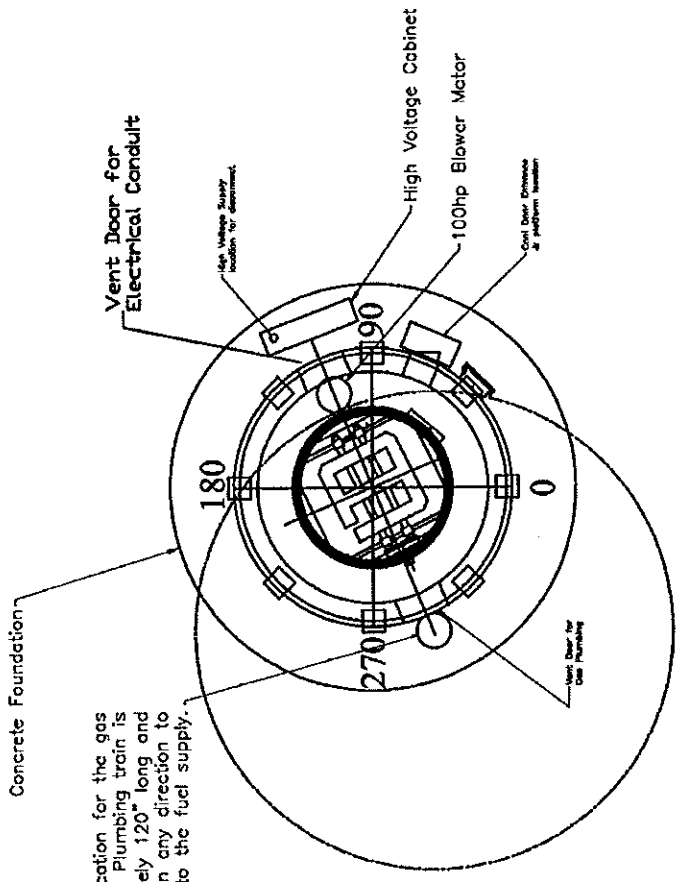
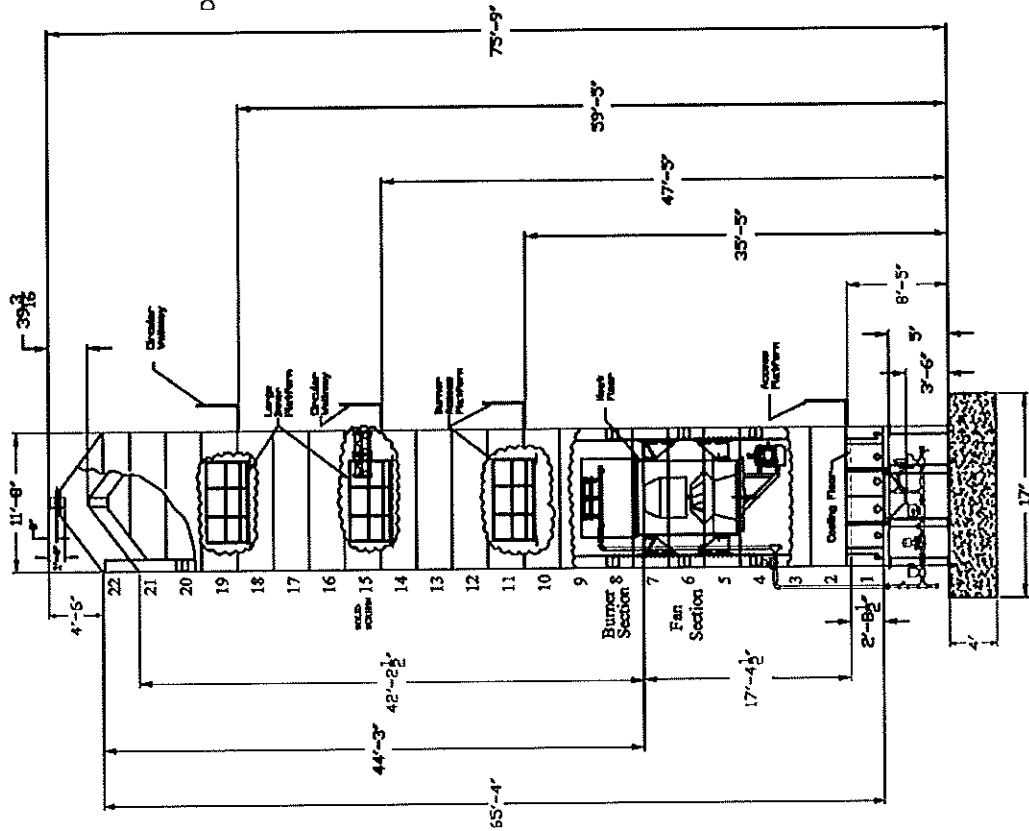
18' Tower Dryer Specifications				
MATHEWS COMPANY	Units	MC	MC	MC
Model Number of Dryer		3000	3500	4000
Drying CFM	CFM	153,000	165,000	193,000
Cooling CFM	CFM	73,440	79,200	92,640
Fan HP	HP	(3) 50HP	(3) 60hp	(3) 75hp
Fan RPM	RPM	1040	1090	1209
Maximum Burner Capacity (MBTU)	MBTU	33.66	36.30	42.46
Typical Heat Use @ 60° F. (MBTU)	MBTU	20.20	21.78	25.48
Tower Diameter	Ft & In	17' - 6"	17' - 6"	17' - 6"
with Walkways	Ft & In	23' - 2"	23' - 2"	23' - 2"
Overall Height	Feet	82' - 11"	88' - 11"	97' 11"
Grain Column Width	Inches	12	12	12
Grainwall Height	Feet	70' - 5"	76' - 5"	85' - 5"
Heat Holding (bu)	Bushels	1996	2246	2497
Cool Holding (bu)	Bushels	790	790	916
Total Column Holding (bu)	Bushels	2786	3036	3413
Peak Holding (bu)	Bushels	808	808	808
Total Dryer Holding (bu)	Bushels	3594	3844	4221
Unload Capacity	Bu/Hr	6000	6000	6000
Electrical Load				
230 Volts	Amps	460	499	574
460 Volts	Amps	224	256	293
Discharge Drive	HP AC	3hp	3hp	3hp
Sweep	Arms	6	6	6
BPH Capacity (20%-15%)	Bu/Hr	3000	3500	4000
BPH Capacity (25%-15%)	Bu/Hr	1800	2100	2400
CFM/bu of Heated grain		77	73	77

18' Tower Dryer Discharge Data

POT SETTING	MOTOR FREQ	MOTOR RPM	SWEEP RPM	LINER OUTPUT BU/HR
10	60	1725	2.3	5175
9	54.5	1566.88	2.1	4701
8	49	1408.75	1.8	4226
7	43.5	1250.63	1.6	3752
6	38	1092.5	1.4	3278
5	32.5	934.38	1.2	2803
4	27	776.25	1	2329
3	21.5	618.13	0.8	1854
2	16	460	0.6	1380
1	10.5	301.88	0.4	906
0	5	143.75	0.2	431

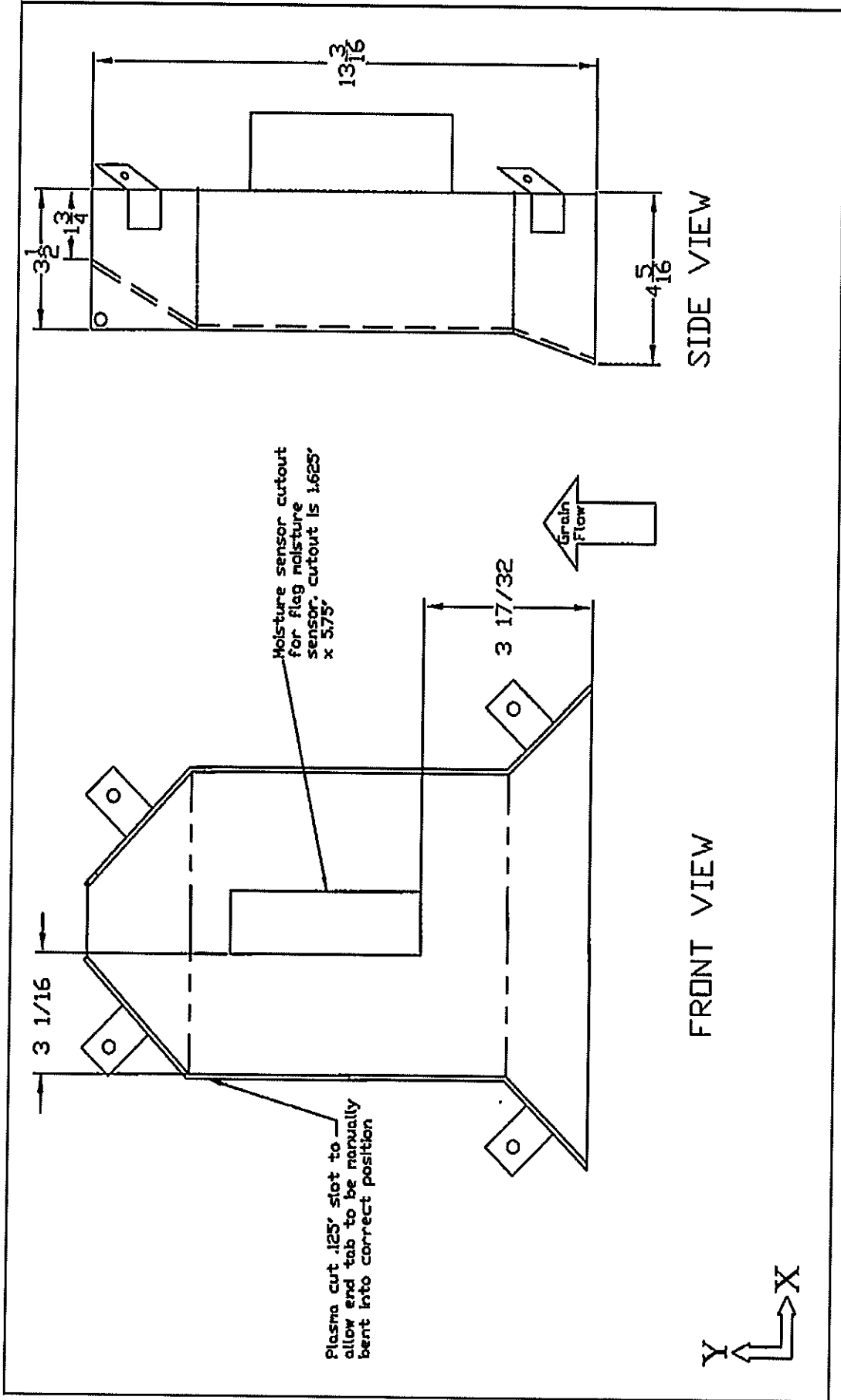


2000 TOWER

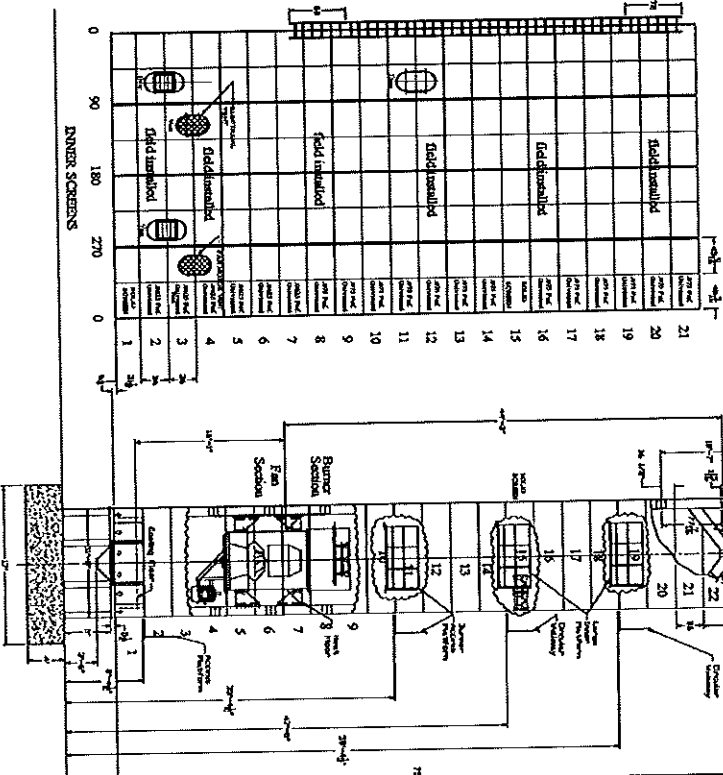


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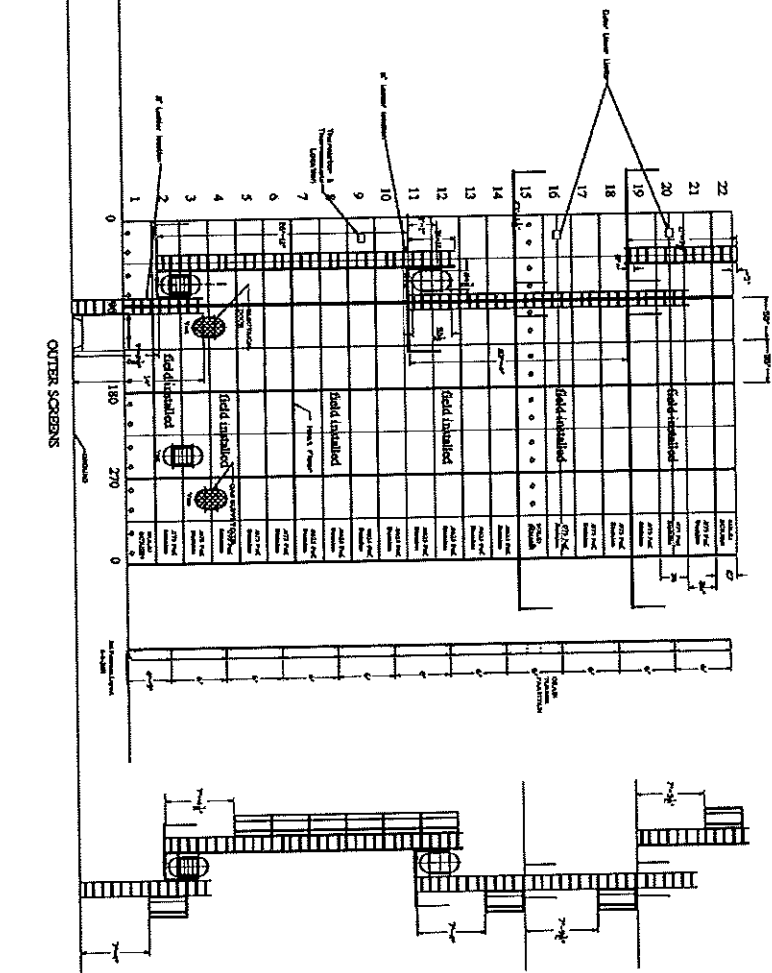
MOISTURE SENSOR FUNNEL



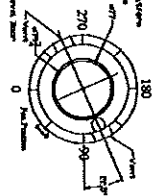
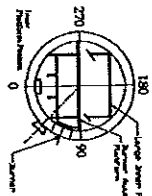
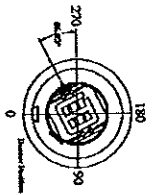
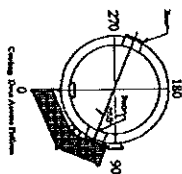
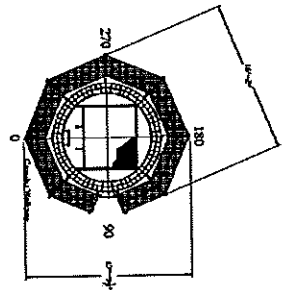
Quantity = 6 of 6' Ladders Inside
 Quantity = 1 of 5' Ladders Inside

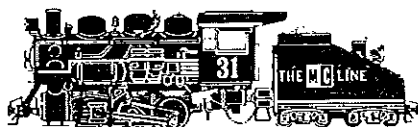
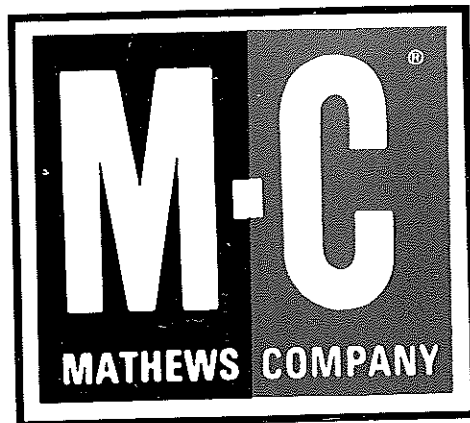


Quantity = 12 of 6' Ladders Outside
 Quantity = 2 of 8' Ladders Outside



2000 TOWER





Iron Horse Quality