

Figure 1  
ZS-20 Front Panel

The diagram shows the front panel of the ZS-20 Zone Station. It features a central display area with the brand name 'PAL-TECH', location 'WILLMAR, MINNESOTA', model 'ZS-20', and title 'ZONE STATION'. To the left of the display is a vertical column of eight indicator lights for various sensors. To the right is an 'ALARM' indicator light. Below the display is a control section with three rows of indicator lights for 'TEMPERATURE', 'REL. HUMIDITY', and 'AMMONIA', each with 'ACTUAL' and 'TARGET' options. This section also includes a central column of four buttons: 'LAMP TEST', an up arrow, a down arrow, and 'ENTER'. To the right of these buttons are two rows of buttons: the top row has 'RIDGE CLOSE', a blank circle, 'ACK. ALARM', and 'DIS.'; the bottom row has 'ACTUAL', a blank circle, 'AVERAGE', 'LAST WEIGHT', 'GROUP SIZE', 'ZERO', 'ACCEPT', and 'REJECT'. A 'CLOCK' button is located at the bottom center.

☐ HI HEAT

☐ LO HEAT

☐ HEAT START

☐ CIR. FANS

☐ NW FAN 1

☐ NW FAN 2 (ALARM)

☐ SE FAN 1

☐ SE FAN 2 (LIGHTS)

**PAL-TECH**  
WILLMAR, MINNESOTA  
ZS-20  
**ZONE STATION**

☐ ACTUAL  
**TEMPERATURE**  
☐ TARGET

☐ ACTUAL  
**REL. HUMIDITY**  
☐ TARGET

☐ ACTUAL  
**AMMONIA**  
☐ TARGET

**LAMP TEST**

**RIDGE CLOSE**

**ACK. ALARM**  
**DIS.**

**ACTUAL**

**AVERAGE**

**LAST WEIGHT**  
**ACCEPT**

**GROUP SIZE**

**ZERO**

**REJECT**

**ENTER**

**CLOCK**

## I. ROLE OF THE ZS-20 IN A PAL-TECH ENVIRONMENTAL CONTROL SYSTEM

The PAL-TECH system monitors and controls the environment of poultry and livestock buildings to promote improved growing performance. The microprocessor (computer) system is designed and manufactured in West Central Minnesota by PAL-TECH, a division of Willmar Poultry Co.

At the heart of the system is the microcontroller unit. This unit is called the **Zone Station** and is located out in the production facility. It monitors the building environment and compares it to the desired environmental conditions that you have loaded into its memory. It is then capable of activating external equipment such as natural ventilation, fans and heaters to adjust the conditions to the target levels. All of this is done automatically instead of by the mechanical or manual methods usually used. The benefit of the Zone Station is that it adapts to changing conditions quickly and maintains a more stable environment.

The next control level, the **Barn Management Center**, is a microprocessor that collects environmental data from each Zone Station in the barn. In addition, it collects management data on weather conditions, water and feed use, and electricity and propane use.

While direct control of the environment usually remains in the Zone Stations, with a Barn Management Center you are able to make changes in target settings at one location. The changes are then automatically communicated to the various Zone Stations in the barn.

The highest level of control is achieved with a **Farm Management Center**. This is a personal computer that receives the environment and management information collected by each Barn Management Center. By compiling and analyzing this data, you can explain, predict and improve the performance of future flocks. Information can also be sent from the Farm Management Center back to the Barn Management Centers.

These various levels of monitoring and control are called a "distributed control" system. This means that each level controls the lower levels that are less complex. However, in the event that a "higher intelligence" level is not working, each lower level is capable of making its own control decisions. Changes in target settings can be made at any level because information flows both directions between the different levels.

The first step to control your barn environment more efficiently and improve growth performance is the installation of the Zone Station. The following sections will describe operation, installation, and trouble-shooting for the ZS-20 Zone Station. In addition, the various options that are available are described.

## II. OPERATING YOUR ZS-20 ZONE STATION

### A. Familiarizing yourself with the ZS-20 front panel

The ZS-20 is enclosed in a protective casing with a sealed membrane so that it can operate in harsh environmental conditions. The display panel on the front of the unit allows you to monitor actual conditions and to make changes in target conditions. (See Figure 1 of ZS-20 Front Panel.) When your ZS-20 is installed and operating, a four digit number will be displayed in the read-out area at the top and center of your unit. The lower half of the panel is divided into five sections: temperature, relative humidity, ammonia, alarm, and weight. The indicator lights in each section light up, depending on which information is being displayed in the read-out area. The black circles are touch pads which you use to control your unit.

#### **\*Temperature/Relative Humidity/Ammonia**

When you start your ZS-20, it will automatically display the actual temperature and this indicator light will be lit. Push the black touchpad in the temperature section once to activate the target temperature indicator light. The ZS-20 will display this value in the read-out section.

Pushing the touchpad in the Relative Humidity section will activate a read-out of the actual humidity. Pushing this touchpad once again will display target humidity. A read-out for ammonia values is activated in the same way.

#### **\*Alarm**

This section has two touchpads. The touchpad labeled "RIDGE CLOSE" is primarily used to lock the ridge in a closed position. For example, this may be used to prevent rain from entering through the ridge. When the "RIDGE CLOSE" touchpad is pressed, the read-out area will flash "0" at the far left side. To deactivate the "RIDGE CLOSE" feature, press the pad a second time.

The second unlabeled touchpad in the alarm section is used if an optional alarm output is installed in your unit (See Sec. VI.6.).

#### **\*Weight**

This section of the panel is used if the optional poultry roost scale is installed in your unit (see sec. VI.3).

#### **\*Clock**

Press the touchpad labeled "CLOCK" to display the current time in military format (i.e. 24 hour clock time).

### \*Lamp Test

This touchpad allows you to check for burned-out indicator lights on the ZS-20 front panel. When the "LAMP TEST" touchpad is pressed, the twelve indicator lights on the lower half of the front panel will light up along with the alarm light and all of the segments and decimal points of the read-out area. The lamp test does not affect the operation of the ZS-20 unit's measurements or control.

(Note: the eight lights on the upper left side of the unit will not come on during this test).

### B. Setting the target values on your ZS-20

To change a target value for your ZS-20, first press the touchpad next to the section that you want to alter until the target indicator light for that area is lit. Next, press the up or down arrow touchpads until the correct value is displayed in the read-out area. Finally, press the "ENTER" touchpad to load this value into the ZS-20's memory. (The read-out area will then automatically change to display the actual temperature reading.)

For example, to change the relative humidity of your barn from 60% to 55%, press the touchpad in the relative humidity section of the keyboard until the target relative humidity indicator light is lit. The old target value of 60 will appear in the read-out area of the ZS-20. Now, press the down arrow touchpad five times until 55 appears in the read-out area. Press the "ENTER" touchpad and your unit will automatically control the humidity of the barn to 55%.

When you operate your ZS-20 for the first time, you will need to set the clock to the actual time in military format. First, push the "CLOCK" touchpad. Then, use the arrow pads to adjust the time displayed in the read-out area until it is correct. Press the "ENTER" touchpad to lock this time into the unit's memory.

### C. Calibrating your ZS-20

After installation, you will need to "read" the accurate temperature to your unit. To do this calibration, you will first need an accurate thermometer with you in the barn. Allow the thermometer to adjust to barn temperature. Press the temperature touchpad until actual temperature is indicated in the read-out area. Press the touchpad again and hold for five seconds. When you release the touchpad, both the actual and target indicator lights will be lit. If the displayed temperature is lower than the reading on your thermometer, press the up arrow touchpad until the accurate temperature is displayed in the read-out area. If the read-out value is higher than the thermometer, press the down arrow touchpad. When the correct temperature is displayed,

press the "ENTER" touchpad and the ZS-20 will "read" this accurate value into it's memory.

The ZS-20's memory can be changed by twenty degrees with this calibration. If an even greater change should be needed, a qualified serviceman must make an adjustment to the sensor package on your unit.

The same steps are followed when calibrating the relative humidity and ammonia levels.

### III. HOW THE ZS-20 CONROLS THE BARN ENVIRONMENT

#### A. Natural Ventilation

The ZS-20 can operate natural ventilation systems to control the barn environment by opening and closing vents automatically in response to the temperature of the air inside the barn. The ridge and side wall vents pulse open and closed slowly and in a particular sequence to provide more accurate control of the air temperature.

If the barn temperature rises one degree above the target temperature, the ZS-20 will begin to open the ridge vent. The air solenoid valve that provides the air pressure to push the ridge's air cylinder open is pulsed open for a varied amount of time every 15 seconds. As long as the temperature remains at least one degree above target, this ridge air solenoid will be pulsed open.

If the temperature remains at one degree above target for more than two minutes OR if the temperature continues to rise to two degrees above target, the south or east side wall vents (depending on the orientation of the barn) will begin to open. This is accomplished by the ZS-20 pulsing the air solenoid valve open, releasing air into the side wall vent air cylinders. The increased pressure in the air cylinders pushes the side wall vents open.

If the temperature reaches three degrees above target, the north or west side wall vents will begin to pulse open in the same manner as the ridge and south (east) wall vents.

When opening or closing a vent, the ZS-20 will activate the solenoid valves every 15 seconds. As the valve moves in one direction, it will pulse each time for a longer duration until it is finally on continuously and fully open or closed. This will assure that when the vents are to remain open or closed they will be held tightly.

If the zone-to-zone communication option has been installed, the sequence of vent activation will be changed to provide better coordination of ventilation in the barn (See Sec. VI.1.).

A safety feature that the ZS-20 provides in natural ventilation is its ability to sense when the air pressure in the valves is marginal and to take corrective action. The air pressure switch in the natural ventilation zone controller tells the ZS-20 when the line pressure drops below 60 PSI. The ZS-20 reviews its recent history of action to determine if it has been opening or closing the vents more often. It then activates the valves to move in whichever direction has been more dominant while it still has adequate pressure to move the vents. The result of this action is to enable the barn's temperature to remain as close to the target as possible until air pressure can be restored.

### B. Heating

The ZS-20 can control auxillary heating equipment to respond to any of three conditions in the following way:

1) low temperature--if the barn temperature drops to four degrees below the target temperature, the ZS-20 will activate the outputs for high-heat, low-heat, and heat start (if the heat ignition option is installed--See Sec. VI.4.). The heat outputs that are activated are indicated by the lights on the upper left side of the front panel.

When the temperature increases to two degrees below target, the high heat output will shut off. The low heat will not shut off until the temperature reaches the target setting.

2) high relative humidity--the ZS-20 will reduce the relative humidity in the barn by activating the heaters when the humidity level rises to four percent above target.

When the humidity drops to two percent above target, the high heat output will shut off. The low heat will continue to reduce humidity until it has returned to the target value.

3) high ammonia level--this is an optional control (See Sec. VI.2.).

If either high relative humidity or high ammonia levels activate the heaters, the barn will reach a maximum temperature of four degrees over target. If the temperature reaches this level, the heaters will shut off and will not re-ignite until the temperature has dropped to two degrees above target.

### C. Circulation Fans

The circulation fans are activated for two reasons. First, when the heaters are activated to control temperature, humidity, or ammonia levels, the circulation fans will also be activated. The fans help the heaters to be more efficient by forcing the warm air down to the litter to remove moisture.

Second, the circulating fans are activated when the outside conditions are warm. When the barn temperature exceeds the target level by more than 10 degrees, the circulating fans aid in cooling the poultry or livestock.

The front panel light labeled "CIR. FANS: lights up when the fans are activated to operate.

### D. Exhaust Fans

The ZS-20 has outputs to control four exhaust fan circuits by a relay or motor starter; these in turn supply the appropriate line voltage to the fan motors. The front panel lights in the upper left side light up when the fans are operating.

The sequence of fan operation in response to temperature is:

As temperature climbs over target:	Fan Circuit activated:
2 degrees	SE Fan #1
3 degrees	SE Fan #2
4 degrees	NW Fan #1
5 degrees	NW Fan #2
As temperature drops toward target:	Fan Circuit deactivated:
3 degrees above	NW Fan #2
2 degrees above	NW Fan #1
1 degree above	SE Fan #2
At Target	SE Fan #1

If either the intermittent light--dual temperature--purge option or the alarm output option have been installed, the SE Fan #2 or NW Fan #2 control circuit outputs are not available to operate these fans (See Sec. VI.5. & 6.).

## IV. INSTALLATION

### A. Mounting the ZS-20 Unit

The ZS-20 should be installed in the middle of the zone that it will controlling, toward the edge of the south or east wall (depending on the orientation of the barn). Attach the unit to a post or a wood mounting panel with four screws through the

plastic feet on the back. In addition, it is helpful to mount the unit at eye level so that it is easy to read and operate.

#### **B. Wiring the ZS-20 Unit**

In order to control the building environment, the ZS-20 is wired to various types of less complex equipment. The amount and type of wiring needed will depend on the number of pieces of external equipment and options that are installed.

##### Sensor Package (SP-20)

Connect the sensor package at the top 9-pin receptacle labelled "SENSOR" on the outside right of the ZS-20 box. Various configuration packages are available but all SP-20s are connected in the same way.

If an optional brooding sensor is used with the system, the two wires from this sensor are wired to the terminal block near the bottom of the sensor package.

Note: the shield is attached to the left terminal and the inner wire to the right.

##### Options Wired to Outside Receptacles

###### **\*Dust Sensor**

When the dust sensor becomes available, it will be attached to the 4-pin receptacle labelled "DUST". This is located directly below the sensor package (SP-20).

###### **\*Natural Ventilation Zone Controller**

This option controls the solenoid valves which operate the side and ridge vents. Attach the cable to the receptacle labelled "SOLENOIDS" directly under the dust sensor receptacle.

###### **\*Weight**

A roost scale which can automatically weigh live poultry can be attached and controlled by the ZS-20. This is plugged into the bottom receptacle labelled "ROOST". Complete installation instructions and parts are included in the roost scale kit.

##### Options Wired to the ZS-20 Cover (See Figure 2)

###### **\*Zone-to-Zone Communication**

If more than one ZS-20 is installed in the barn, you will need to install a communication cable between the units and also to the optional Barn Management Center (BMC-30). The cable is connected to the terminal block (TB1) on the printed circuit board inside the cover of the ZS-20 (See figure 2). Use the top two positions on the four position terminal block for the connection to a two-wire cable (20-2 jacketed cable). The units are wired together so that all of the top terminals connect to



each other and all of the next-lower terminals connect to each other (See Drawing 9).

Options Wired to the ZS-20 Base (See Figure 3)

**\*Battery Backed Power Supply (BBPS-20)**

This option may be wired to provide continued operation and control of all DC-powered equipment during a power outage. It will supply several hours of power, depending on the amount of equipment it controls. The BBPS-20 is connected to the ZS-20 with a 12-2 cable (See Drawing 1). The +24 volt DC wire (black) is connected to TB3-1 and the 24 volt DC return (white) wire is connected to either the TB3-2 or TB3-3.

**\*Heating Equipment**

The ZS-20 can control heating equipment which is electrically activated by either 120-volt AC or 24-volt DC. The heating outputs that are used determines:

- 1) the position of the jumper plug on the base circuit board (See Figure 3 and Table 1 for a description of the jumper positions)

Table 1 - Jumper Positions

<u>Output</u>	<u>Position</u>
Hi Heat	Bottom jumper
Lo Heat	Second jumper from the bottom
Heat Start	Third jumper from the bottom
Circulation fans	Top Jumper

If 120-volt AC outputs are wired, jump the plugs from the center pin to the left pin. If 24-volt DC outputs are used, jump the plugs from the center pin to the right pin.

- 2) the set of terminals they are connected to inside the ZS-20 (See Drawings 2 & 3 for two examples of heater wiring)

Table 2 - 24 Volt DC Connections

TB3-1	Battery backed power supply
TB3-2 or 3	24-volt DC return (white)
TB3-4	Hi heat (+) 24-volt DC
TB3-5	Lo heat (+) 24-volt DC
TB3-6	Heat Start (+) 24-volt DC
TB3-7	Circulation fans (+) 24-volt DC
TB3-8	Factory-wired on some units-- do not remove

The total load of all 24-volt DC outputs cannot exceed 1 amp unless the optional Battery Backup Power Supply is installed.

Switch 26 - See Table V (Page 11)  
 Switch 34 - See Table VI (Page 11)

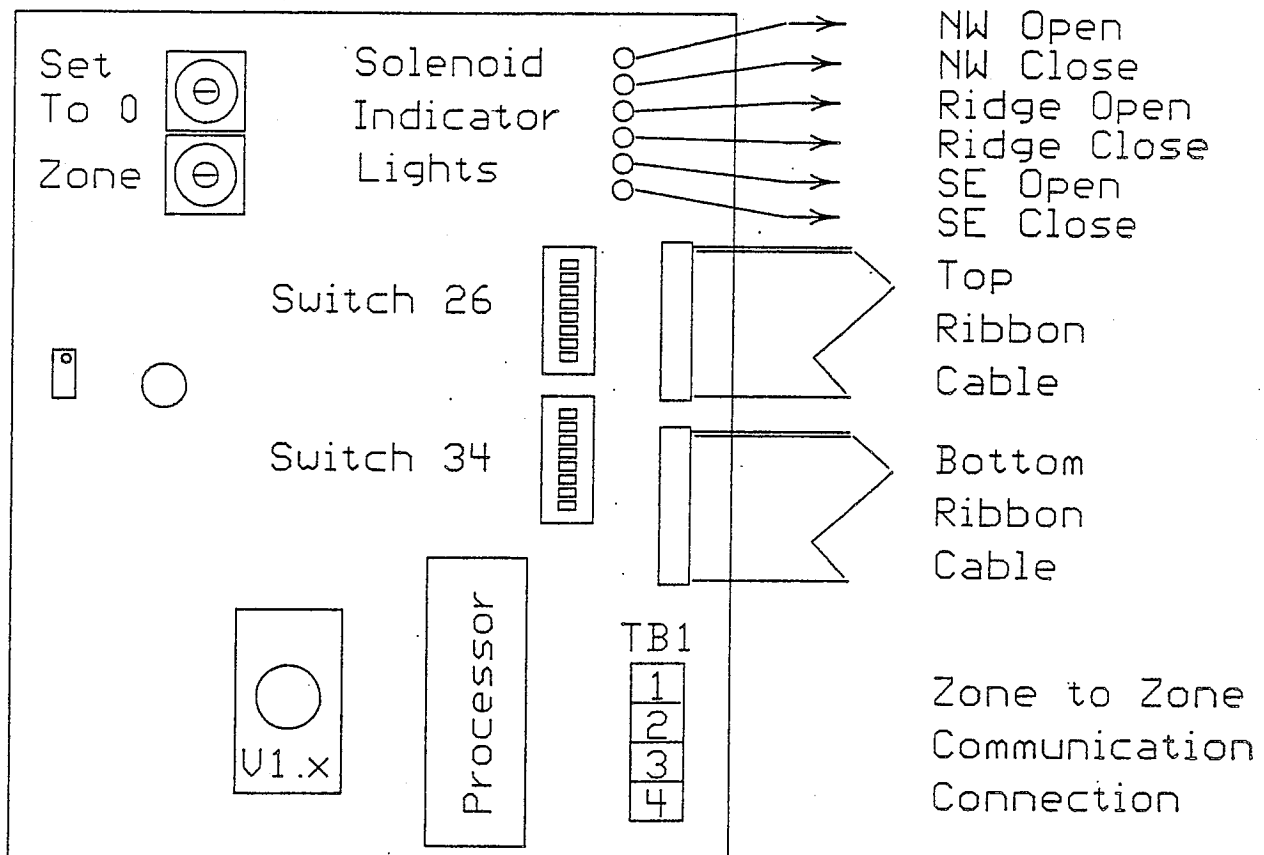


Figure 2  
 ZS-20 Cover

Table 3 - 120 Volt AC Connections

TB2-1 or 2	120-volt AC common
TB2-3	Hi heat 120-V.A.C.
TB2-4	Lo heat 120-V.A.C.
TB2-5	Heat start 120-V.A.C.
TB2-6	Circulation Fans 120-V.A.C.
TB2-7	NW Fans 120-V.A.C.
TB2-8	NW Fan 2 (or alarm) 120-V.A.C.
TB2-9	SE Fans 120-V.A.C.
TB2-10	SE Fan (or light) 120-V.A.C.

All 120-volt outputs are fused at 3 amps each. In most cases, an auxiliary relay is needed to activate the heaters.

**Note:** An output is needed when connecting heaters with an electronic ignition. This output is labeled "Heat Start" and must be factory-installed to be activated. (See Drawing 4)

**\*Circulation Fans**

This option is wired in the same manner as the heaters--using the appropriate terminals (See Drawing 5).

**\*Exhaust Fans**

These fans are also wired in the same manner as the heaters but can only be wired to 120-volt AC. (See Drawing 6 for typical wiring). If either lighting control or alarm output options are used, the corresponding fan #2 output is not available.

**\*Lights**

If the intermittent light--dual temperature--purge software option is installed, an output terminal from fan control (SE Fan #2) is transferred for use in this control. Because of the 3-amp output limit on the ZS-20, a relay must usually be installed. (See Drawing 7 for an example of light wiring.)

**\*Alarm**

If the alarm software option is installed, an output terminal from fan control (NW Fan #2) is transferred for use in this control. Because of the 3-amp output limit on the ZS-20, a relay must usually be installed. (See Drawing 8 for an example of alarm wiring.)

**C. FUSES**

The fuses for the ZS-20 are located in a vertical row near the left side of the base panel (See Figure 3 and Table 4 for placement). They are placed in sockets to allow easy replacement in case a fuse is blown.

TB2 - See Table III (Page 9)  
 TB3 - See Table II (Page 8)  
 F1-F9 - See Table IV (Page 10)  
 Jumpers - See Table I (Page 8)

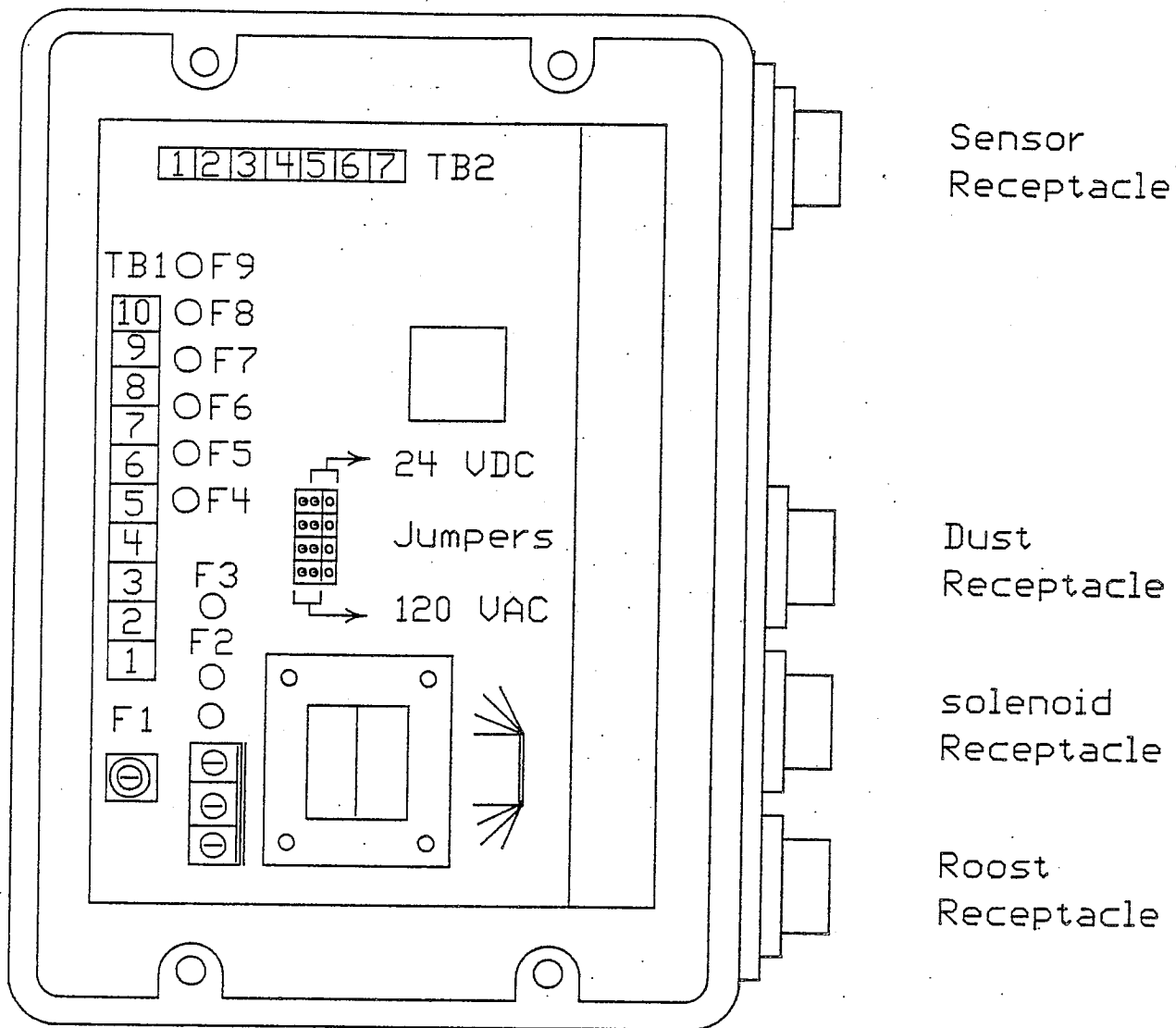


Figure 3  
 ZS-20 Base

Table 4 - Fuse Function and Placement

<u>Fuse</u>	<u>Function</u>	<u>Amp</u>
F1	ZS-20 24-Volt DC Power Supply	0.5 sloblow
F2	Hi heat 120-VAC hot output	3
F3	Lo heat 120-VAC hot output	3
F4	Heat Start 120-VAC hot output	3
F5	Circulation fans 120-VAC output	3
F6	NW Fan 1 120-VAC hot output	3
F7	NW Fan 2 (or alarm) 120-VAC hot output	3
F8	SE Fan 120-VAC hot output	3
F9	SE Fan 2 (or lights) 120-VAC hot output	3

**CAUTION:** Always disconnect 120 VAC power before working inside the ZS-20. Severe electrical shock or death may result from contact with live electrical components inside the unit.

#### D. ADDRESS SWITCHES

If more than one ZS-20 is installed, the units must be set to individual identification numbers to be able to communicate with each other. The numbers are set on the two yellow 16-position rotary switches near the top edge of the inside cover of the ZS-20 (See Figure 2).

Set the top switch to "0". Set the bottom switch to a different number corresponding to each zone of the barn that the ZS-20 is installed in.

If more than one ZS-20 is installed, each unit can control its zone independently if the bottom rotary switches are set to position "0".

#### E. MANUAL TESTING PROCEDURE

After initial installation is complete, each piece of equipment that the ZS-20 controls can be tested manually to make sure that it is working correctly. The two DIP switches located on the inside cover of the ZS-20 can be used to manually override the automatic controls (See Figure 2 for location and Tables 5 & 6 for switch positions and corresponding functions).

Flip each switch "ON" to check the equipment manually. The switches must then be left "OFF" for normal automatic operation.

Table 5 - SWITCH 26

Switch #1	ON	Opens SE Doors
Switch #2	ON	Closes SE Side Doors
Switch #3	ON	Open Ridge
Switch #4	ON	Closes Ridge
Switch #5	ON	Opens NW Side Doors
Switch #6	ON	Closes NW Side Doors
Switch #7		MUST REMAIN OFF
Switch #8		MUST REMAIN OFF

Table 6 - SWITCH 34

Switch #1	ON	High Heat (either 120-VAC or 24-VDC)
Switch #2	ON	Low Heat (either 120-VAC or 24-VDC)
Switch #3	ON	Heat Start (either 120-VAC or 24-VDC)
Switch #4	ON	Circulating Fans (either 120-VAC or 24-VDC)
Switch #5	ON	NW Fan #1 (120-VAC)
*Switch #6	ON	NW Fan #2 or alarm (120-VAC)
Switch #7	ON	SE Fan #1 (120-VAC)
**Switch #8	ON	SE Fan #2 or lights (120-VAC)

\* This output may be installed to activate an optional remote alarm bell or siren (See Section VI.6.).

\*\* This output may be installed to activate an optional intermittent light--dual temperature--purge option (See Section VI.5.).

After the manual testing is successfully completed and all DIP switches are returned to the "OFF" position, the ZS-20 will automatically control the barn environment. If a malfunction should occur, check to make sure all of the equipment is wired correctly and refer to Section V on trouble shooting.

## V. TROUBLE SHOOTING

If a malfunction in your system occurs, use the following trouble-shooting guide to determine if the problem is in the ZS-20 or in the output equipment. Because the ZS-20 is designed with three major components (the sensor package, the cover, and the base), a problem in the unit can be isolated. The malfunctioning component can then be quickly replaced, minimizing down-time and also limiting the amount of electronic repair knowledge needed.

## V. TROUBLE-SHOOTING GUIDE

PROBLEM	TROUBLE-SHOOTING STEPS	ACTION
Equipment that is controlled by the ZS-20 does not operate.	<p>1. Check the fuse that corresponds to the output that is not working (Refer to Figure 2 and Table 4).</p> <p>A. If the fuse is good, check manual operation of the output by turning "ON" the DIP switch that corresponds to the output. (Refer to Figure 2 and Tables 5 &amp; 6).</p> <p>i) If the output works:</p> <p>ii) If the output doesn't work. check the wiring to the output to make sure it is correct. If the wiring is correct:</p> <p>B. If the fuse is bad, check the wiring to the output to make sure it is correct. If the wiring is correct:</p> <p>C. Check to make sure the output load is not shorted or bad. Turn on the output with the corresponding DIP switch.</p> <p>i) If the fuse blows:</p>	<p>Replace the ZS-20 cover.</p> <p>Replace the ZS-20 base.</p> <p>Replace the fuse with a 3-amp micro fuse.</p> <p>Replace the ZS-20 base.</p>

## PROBLEM

## TROUBLE-SHOOTING STEPS

## ACTION

The ZS-20 is not controlling the natural ventilation system properly (i.e. the vents do not open or close properly).

1. Open the zone station by loosening the 4 corner screws.

2. Check the solenoid indicator lights in the upper right corner of the inside cover (Refer to Figure 2). Three lights should be on or should flash on every 15 seconds.

A. If the lights are not flashing:

B. If the lights are flashing, check the cable between the zone and the solenoid box.

C. If the cable is properly installed, check the air system for:

- i) proper air pressure 70 - 85 PSI
- ii) air leaks

D. If the air system is correct, open the solenoid box by loosening the 4 screws. Three lights inside the box should be flashing on every 15 seconds.

i) If the lights are not flashing:

Replace the ZS-20 cover.

Repair if indicated.

Check the cable for proper installation.



E. If the lights are flashing, remove the cable and try to operate the doors and the ridge with the manual over-ride button inside the solenoid box.

F. If no movement results with the manual over-ride, check the air pressure in the cylinder.

i) If the air pressure is good:

Replace the solenoid valve.

The actual temperature display is not accurate

1. Calibrate the ZS-20 with an accurate thermometer (See Sec. II.C. of the operations manual).

2. If the actual temperature display is still not accurate:

Replace the ZS-20 sensor package.

3. If the actual temperature display is still not accurate:

Replace the ZS-20 cover.

4. If the actual temperature display is still not accurate:

Replace the ZS-20 base.

The relative humidity reading is not accurate.

1. Calibrate the ZS-20 with an accurate psychrometer (See Sec. II.C. of the operations manual.)

2. If the relative humidity reading is still not accurate:

Replace the ZS-20 sensor package.

3. If the relative humidity reading is still not accurate:

Replace the ZS-20 cover.

4. If the relative humidity reading is still not accurate:

Replace the ZS-20 base.

## VI. SOFTWARE OPTIONS

### A. Zone-to-Zone Communication

When more than one ZS-20 is installed in a barn, an option can be installed that lets the units communicate with each other and with the optional Barn Management Center. This option allows the zones to work together more efficiently by:

1. **information transmission**--Monitoring and control information is transmitted between the zones and the Barn Management Center .

For example, a change in target level made at any of the zone stations will automatically be transmitted to all of the other stations. This eliminates the need to readjust every ZS-20 when a change in target level is made.

2 **inter-zone ventilation**--The zones are able to assist each other in controlling the environment more uniformly.

For example, assume the actual temperature in zone 1 rises to one degree above target. The ZS-20 in zone 1 will instruct the ZS-20 in zone 3 to open its ridge and/or activate its exhaust fans. If the actual temperature in zone 1 rises to two degree above target OR it has been one degree above target for more than two minutes, the ZS-20 in zone 1 begins to open its side vents. The cool outdoor air will enter zone 1 to lower its temperature. At the same time, the ridge vent and exhaust fans of zone 3 will move the warmer air down the length of the barn to help in drawing out excess moisture. When zone 1's temperature has returned to target, the ZS-20 in zone 1 closes its side vents and instruct zone 3 to close its ridge and/or shut off its fans.

Note: If you have only two zones in a barn, they should be given the addresses of "1" and "3" (See Sec. III.D.).

The change in operating sequence when zone-to-zone communication is installed is as follows:

#### No Zone-to-zone Communication

<u>Degrees Above Target</u>	<u>Response</u>			
	<u>Opposite Zone Ridge</u>	<u>SE Wall</u>	<u>NW Wall</u>	<u>Own Ridge</u>
0	No effect	Close	Close	Close
+1	No effect	Close	Close	Open
+2	No effect	Open	Close	Open
+3	No effect	Open	Open	Open
+4	No effect	Open	Open	Open

### With Zone-to-zone Communication Control

<u>Degrees Above Target</u>	<u>Response</u>			
	<u>Opposite Zone Ridge*</u>	<u>SE Wall</u>	<u>NW Wall</u>	<u>Own Ridge</u>
0	Close	Close	Close	Close
+1	Open	Close	Close	Close
+2	Open	Open	Close	Close
+3	Open	Open	Open	Close
+4	Open	Open	Open	Open

\* The opposite zone exhaust fans will be turned on when its ridge is instructed to open.

#### **B. Ammonia Control**

This option allows control of the ammonia levels in the barn. When the actual ammonia level exceeds the target level by more than 10 parts per million, the ZS-20 will activate the high heat, low heat, and heat start (if installed). This increased temperature will then activate the exhaust fans or the ridge vents to open. The movement of warm air through the barn will lower the ammonia level.

When the ammonia level has dropped to 5 ppm, the ZS-20 will turn off the high heat. The low heat will continue to function until the ammonia level has dropped to the target level.

If the actual temperature exceeds the target temperature by four degrees or more, the heaters will NOT be turned on (regardless of how high the ammonia level gets). If high ammonia levels continue, the target temperature can be lowered to reduce the ammonia in the barn air. This is helpful because as the temperature decreases, less ammonia is released from the litter.

Note: Sensor package SP-20-02 is needed for the ammonia control option. It will not work with the SP-20-01.

#### **C. Roost Scale**

The roost scale option allows the ZS-20 to weigh live poultry as follows:

Place the weight platform on the barn floor in the traffic area of your birds. Press the "ZERO" touchpad in the "WEIGHT"

section of the front panel for at least 3 seconds and then release. This sets the ZS-20 scale accuracy. It should be pressed whenever the platform is empty and clean but doesn't read "0.0" as an actual weight.

You must enter an approximate average flock weight whenever a new flock of birds are placed in a barn. First, push the unmarked touchpad in the "WEIGHT" section of the front panel until the "average" indicator light is lit. Then, use the arrow keys to adjust the read-out number to display the average weight. It is important that your estimate is realistic to be able to get accurate readings.

When a bird steps onto the weight platform, the ZS-20 scans the weight until it gets a stable reading. It compares this reading with the current average flock weight that you entered into its memory. If the reading is within 20% of the flock average, the ZS-20 uses it to update the average flock weight. If the reading is over 20% more or less than the average weight (which can occur if more than one bird is on the platform), the ZS-20 rejects the weight.

Pushing the unmarked touchpad until the "last" indicator light is on will display the last accepted or rejected weight in the read-out area. Pushing the touchpad again will display the number of accepted weights that have been recorded since the last time the "ZERO" touchpad was pressed; the "accept" indicator light will be on. When the "reject" indicator light comes on after pushing the unmarked touchpad, the read-out area will display the number of rejected weights that the ZS-20 has recorded.

The weight platform will function as an ordinary scale and display current readings when the "ACTUAL" touchpad is pressed. This allows you to observe weights as birds move on and off the scale.

The "GROUP SIZE" touchpad will display the number of readings that the ZS-20 uses to calculate the average weight. The group size is pre-set to 50 but can be changed by pressing the arrow keys until the desired group size is displayed. Press "ENTER" to load the change into the ZS-20 memory.

#### D. Heat ignition

This option is usually used for control of a heater that has electronic spark ignition. The ZS-20 will turn the heat ignition on for 50 seconds. After shutting it off, the high heat and low heat outputs will remain on. (Refer to Drawing 4 and Table 3 for appropriate termination blocks for wiring.)

#### E. Intermittent Light - Dual Temperature - Purge

The benefits of this patent-pending option are to increase growth rate, improve feed conversion, and to aid in removing dust from poultry buildings.

The intermittent light sequence of one hour of light and three hours of darkness is pre-programmed at the factory. The sequence runs continuously, with the first hour of light beginning at 3:00 AM. (The SE Fan #2 control is converted from fan to light control with this option.)

As the birds feed during the light hours, the ZS-20 automatically lowers the temperature to five degrees below the target level. The lower temperature stimulates the birds to eat more which increases their growth.

The birds are also more active during the light hours and create more dust. Because the ventilation system is open to lower the temperature, it also provides better air movement for dust removal.

After the lights go off, the ZS-20 waits 10 minutes to allow the birds to quiet down. It then activates the "purge" function and opens all of the ridge and side wall vents while activating its exhaust fans. This dramatically increases ventilation to remove any built-up dust. After 10 minutes or until the temperature drops to 10 degrees below target, the ZS-20 closes the vents and shuts off the exhaust fans. (If the barn temperature is above target, the purge cycle will not occur until the next darkness period.)

During the dark periods, the ZS-20 continues to control the temperature in the barn at the target level. The birds can tolerate higher temperatures when it is dark because of their lower activity level. This combination of higher temperature and less activity results in improved feed conversion.

The various setpoints used in the intermittent light--dual temperature--purge option are pre-programmed in the ZS-20 at the factory. These can be individually adjusted with the optional Barn Management Center.

#### F. Alarm Output

This option allows the ZS-20 to turn on a horn or buzzer alarm for any of the following: high or low temperature, high or low humidity, or low air pressure. (The NW Fan #2 control is converted from fan to alarm control with this option). When any of these conditions occur, the alarm light on the upper right side of the ZS-20 will light up and an alarm code will flash on the left side of the read-out area.

*Alarm enabled means Comm. problem + Ridge override*  
0. - With no Alarm enabled - Ridge override

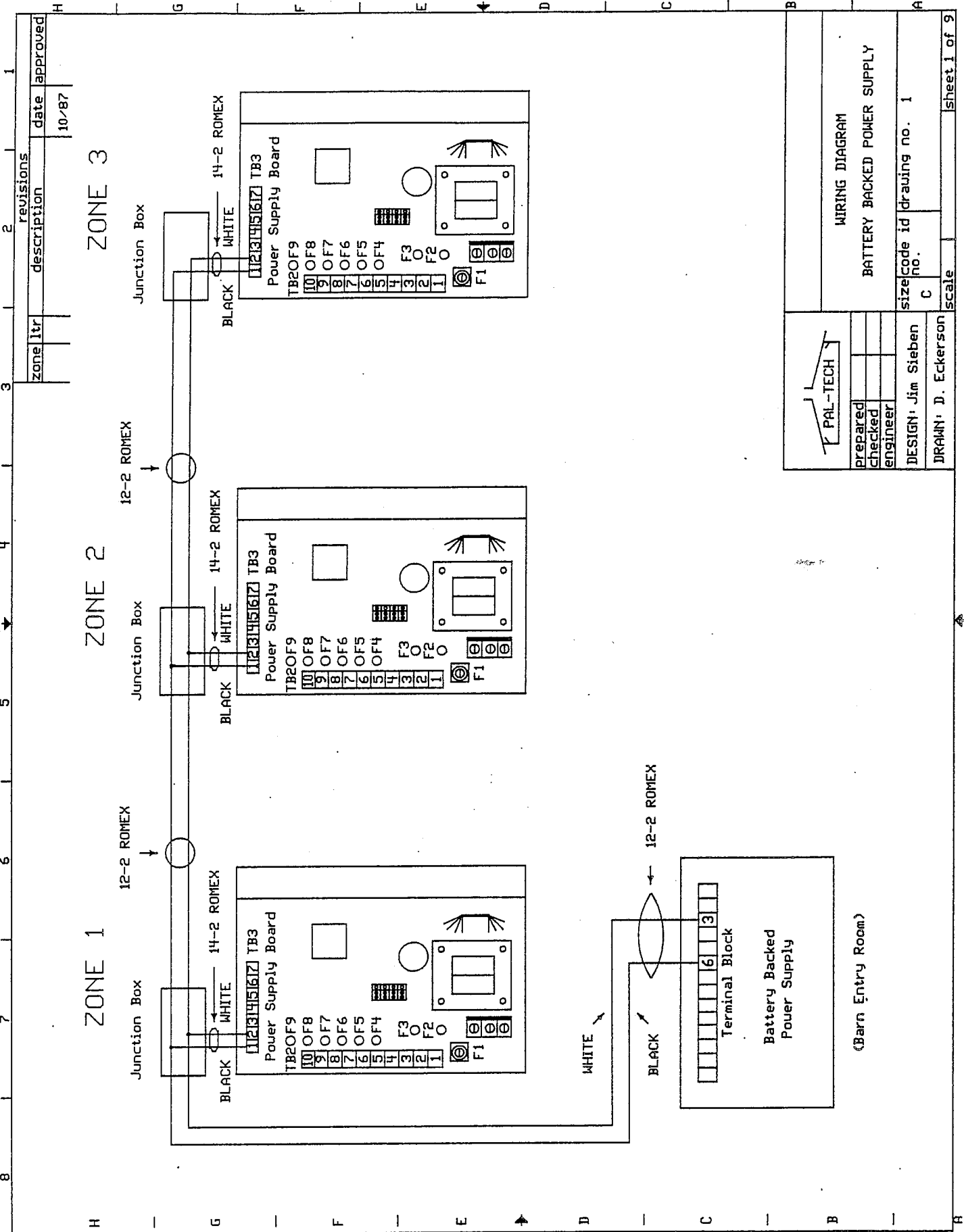
The alarm codes are:

1. High temperature
2. Low temperature
3. High humidity
4. Low humidity
5. Low air pressure
- 6. Comm. alarm

When an alarm has sounded, it can be temporarily shut off by pressing the unmarked touchpad in the "ALARM" section. The acknowledge ("ACK") indicator light will then be lit. If the alarm condition has not been corrected in five minutes, the alarm will sound again. You can continue to temporarily shut the alarm off for five minutes by pressing the unmarked touchpad when the alarm re-sounds to remind you of the alarm condition. To shut the alarm off permanently (even though an alarm condition still exists), press the unmarked touchpad twice. The disable ("DIS") indicator light will then be lit. The alarm sound will be disabled until the touchpad is pressed again OR until the alarm condition is corrected.

Remember: the alarm will not remind you of the alarm condition as long as it is disabled.

The alarm for temperature or humidity can be programmed to sound at different variances from the target level. This procedure is similar to the calibration of temperature (See Sec. II.A.3.): press the touchpad in the section that you want to change, then press it again for five seconds and release. Press the touchpad once more. Actual and target indicator lights in that section will flash on and off and the previously set variance will be displayed in the read-out area. Use the up and down arrow pads to adjust the variance number to the desired level. Press the "ENTER" touchpad to load the new variance into the ZS-20 memory.

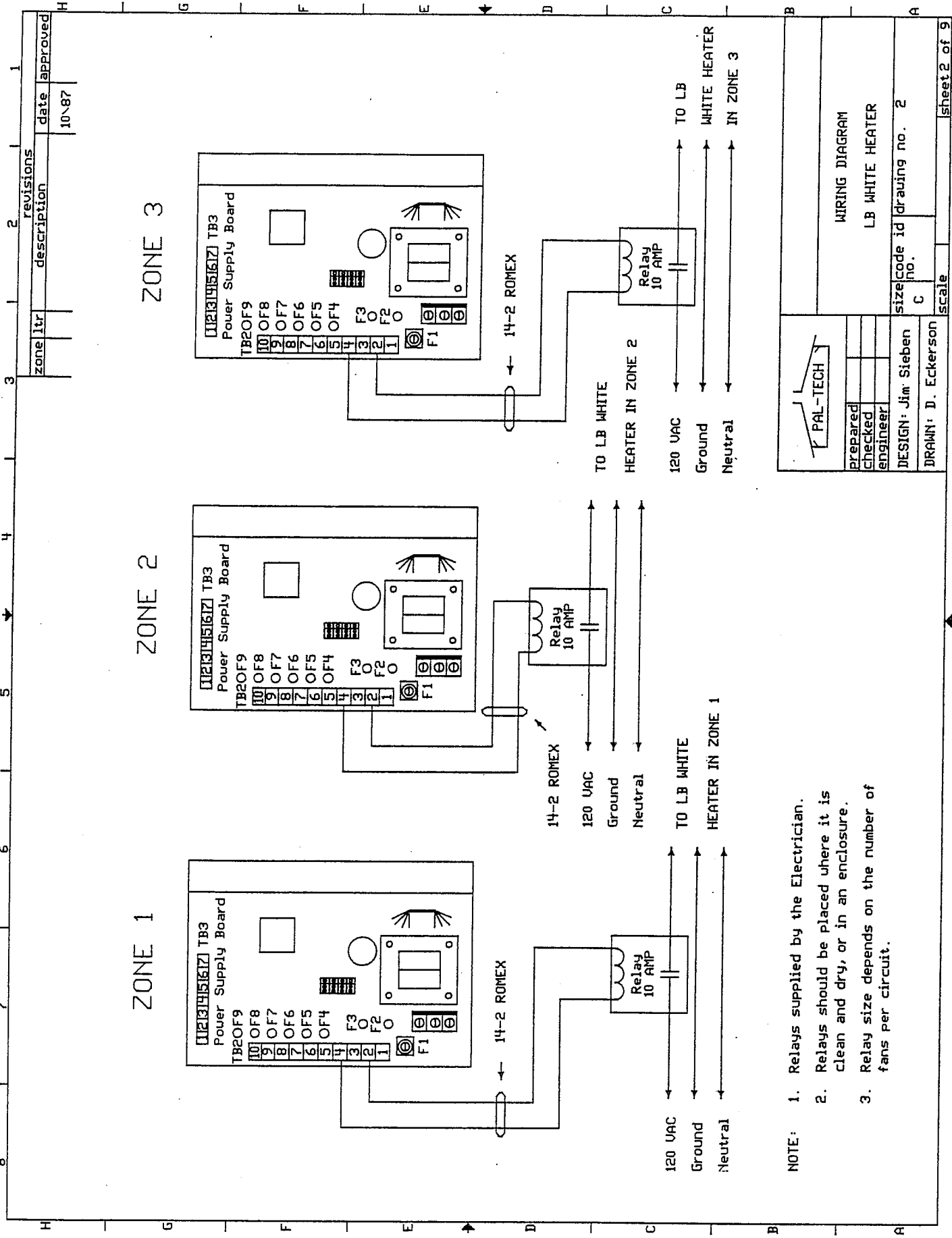


revisions	
zone ltr	description
	date approved
	10/87

PAL-TECH		WIRING DIAGRAM	
prepared	checked	BATTERY BACKED POWER SUPPLY	
engineer			
DESIGN: Jim Sieben		size	code id drawing no. 1
DRAWN: D. Eckerson		no.	
scale		sheet 1 of 9	



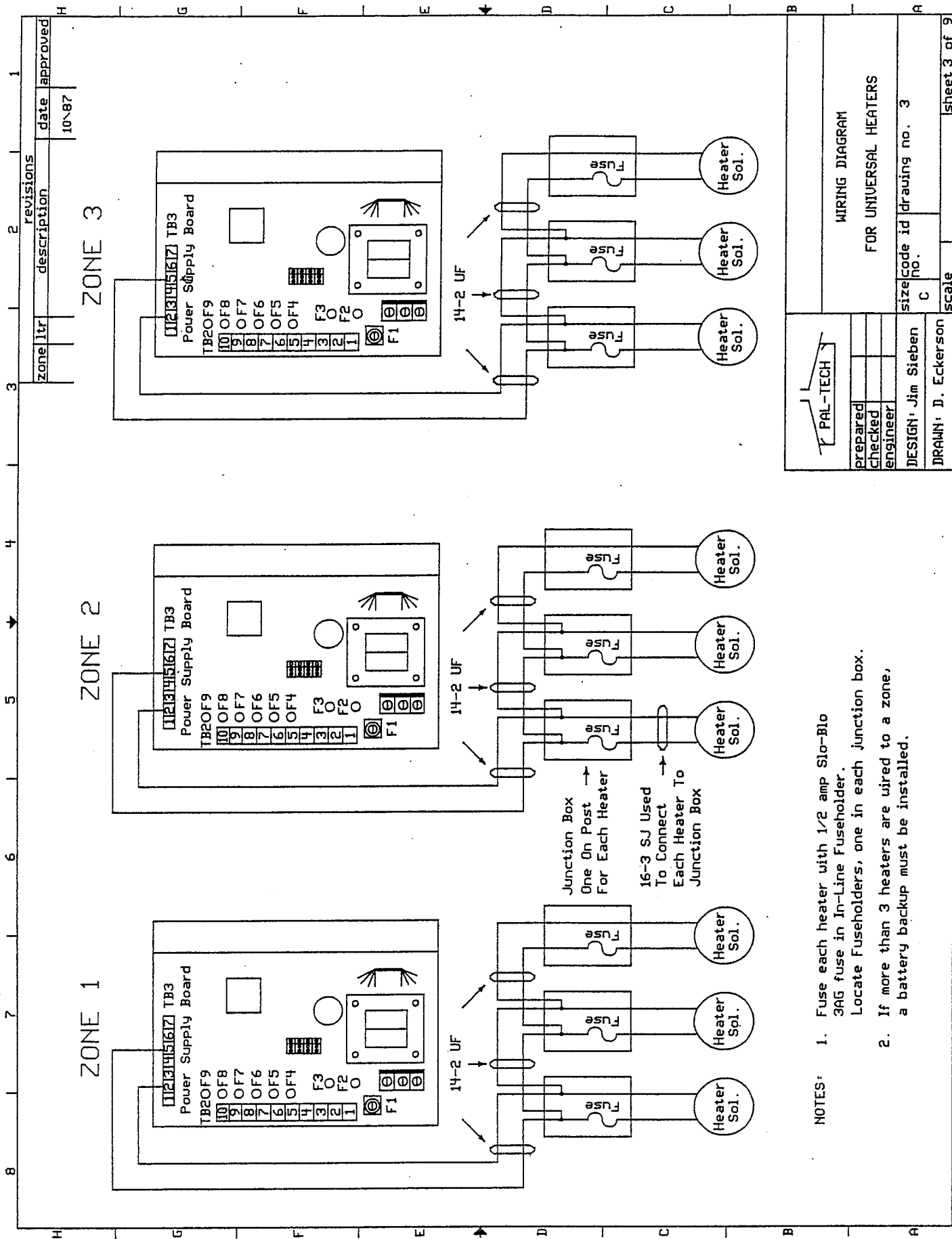




NOTE: 1. Relays supplied by the Electrician.  
 2. Relays should be placed where it is clean and dry, or in an enclosure.  
 3. Relay size depends on the number of fans per circuit.

PAL-TECH		WIRING DIAGRAM	
prepared		LB WHITE HEATER	
checked			
engineer			
DESIGN: Jim Sieben		size	code id drawing no. 2
DRAWN: D. Eckerson		no.	
		scale	sheet 2 of 9

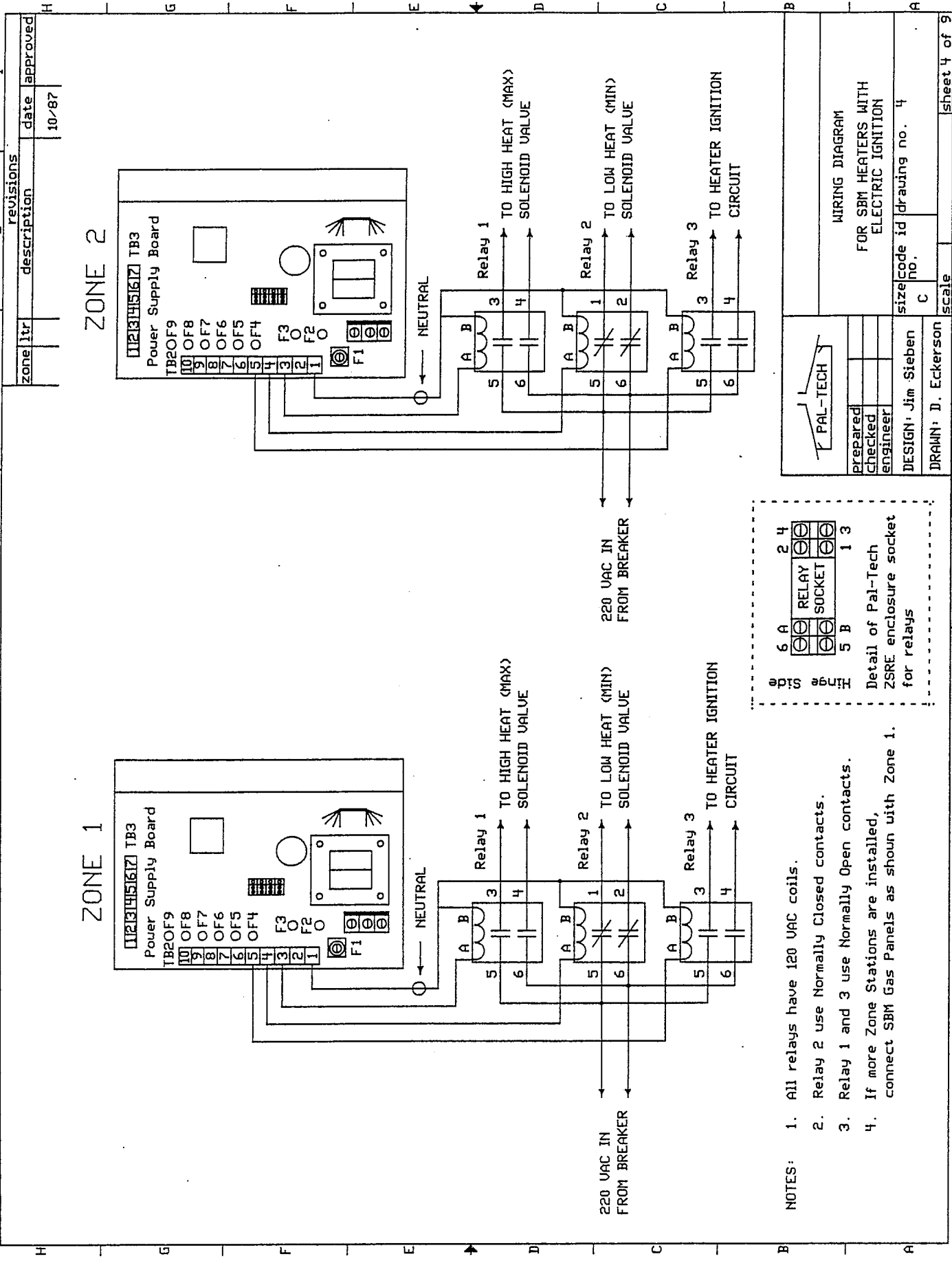




- NOTES:
1. Fuse each heater with 1/2 amp Slo-Blo 3AG fuse in In-Line Fuseholder. Locate Fuseholders, one in each junction box.
  2. If more than 3 heaters are wired to a zone, a battery backup must be installed.

PAL-TECH		WIRING DIAGRAM	
prepared	checked	FOR UNIVERSAL HEATERS	
DESIGN: Jim Sieben	size	code	id drawing no. 3
DRAWN: D. Eckerson	C	no.	3
scale		sheet 3 of 9	

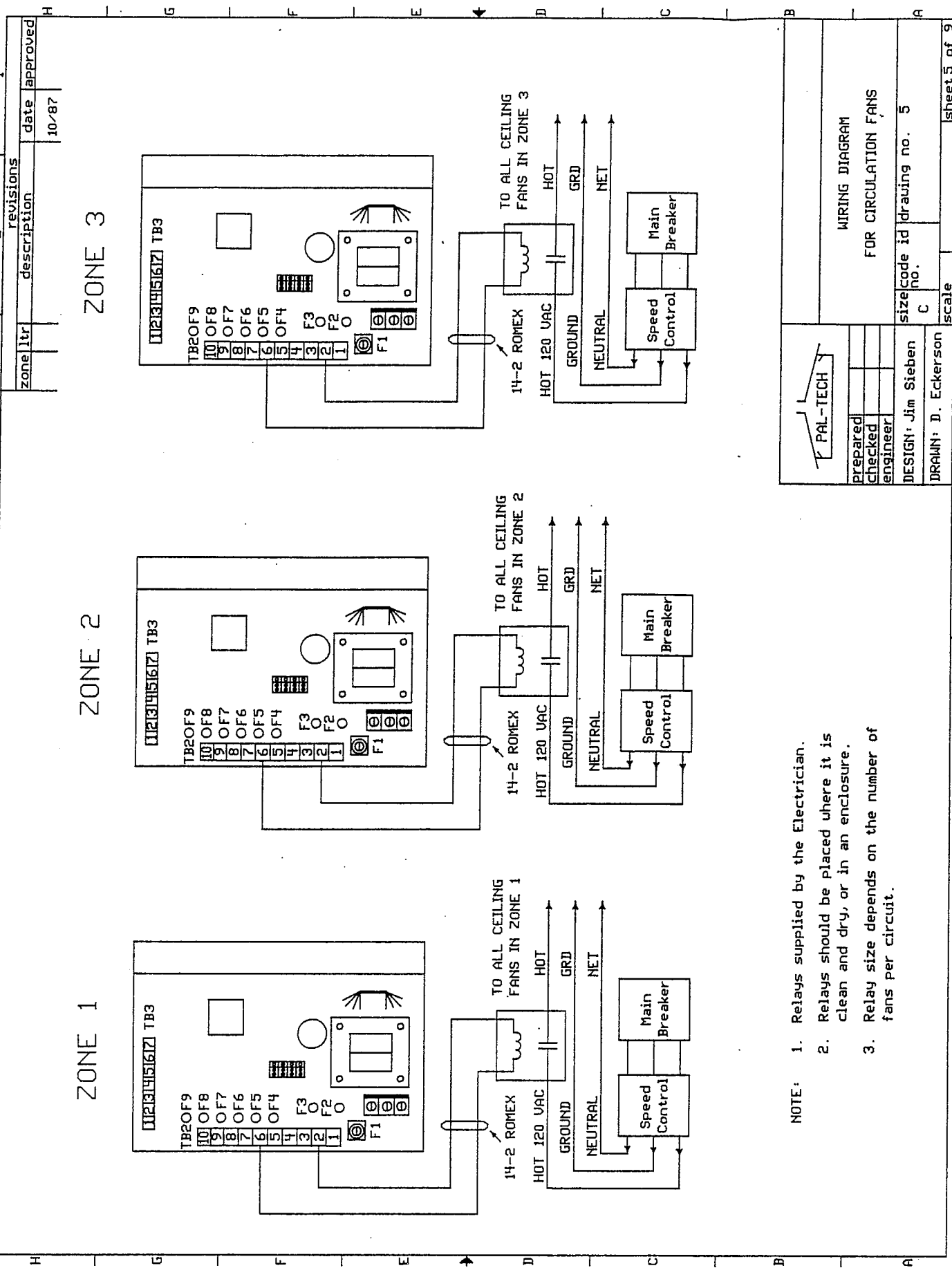




- NOTES:
1. All relays have 120 UAC coils.
  2. Relay 2 use Normally Closed contacts.
  3. Relay 1 and 3 use Normally Open contacts.
  4. If more Zone Stations are installed, connect SBM Gas Panels as shown with Zone 1.

PAL-TECH		WIRING DIAGRAM	
prepared	checked	FOR SBM HEATERS WITH ELECTRIC IGNITION	
DESIGN: Jim Sieben	size code id drawing no. 4		
DRAWN: D. Eckerson	scale C	sheet 4 of 9	





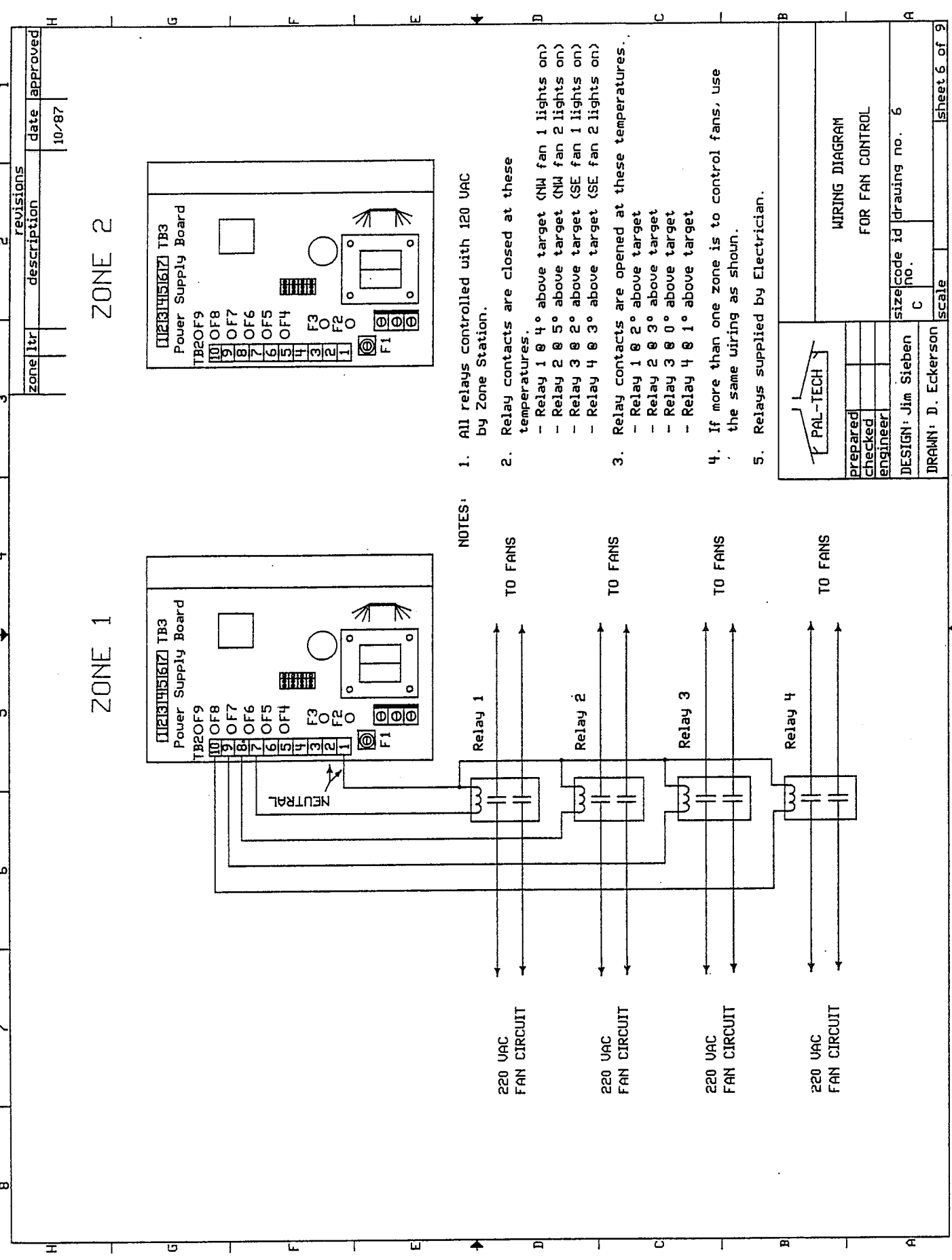
NOTE:

1. Relays supplied by the Electrician.
2. Relays should be placed where it is clean and dry, or in an enclosure.
3. Relay size depends on the number of fans per circuit.

PAL-TECH		WIRING DIAGRAM	
prepared	checked	FOR CIRCULATION FANS	
engineer	DESIGN: Jim Sieben	size code id drawing no.	5
DRAWN: D. Eckerson		scale	sheet 5 of 9





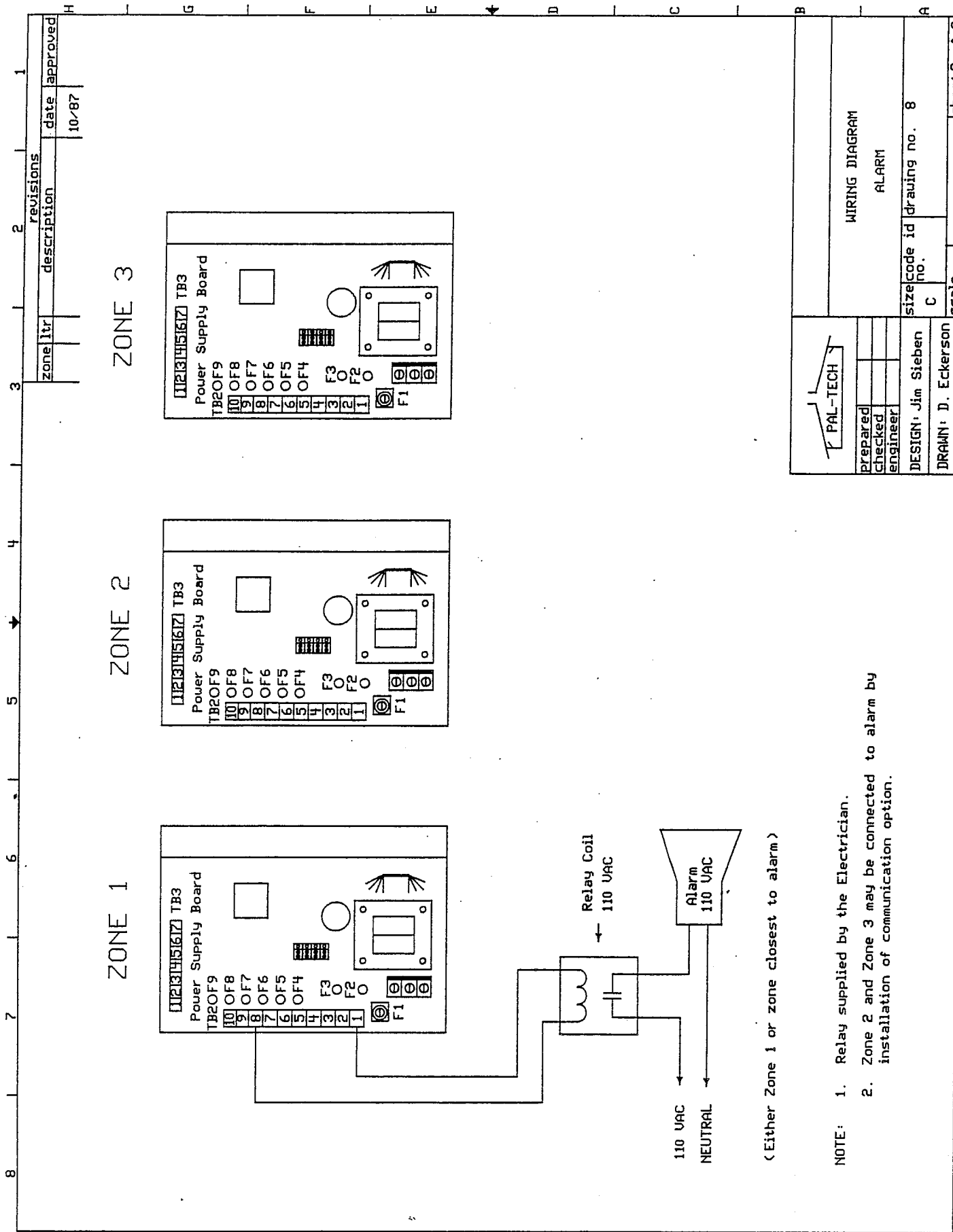


PAL-TECH		WIRING DIAGRAM FOR FAN CONTROL	
prepared	checked	size	code id
engineer	no.	C	6
DESIGN: Jim Sieben		DRAWN: D. Eckerson	
scale		sheet 6 of 9	







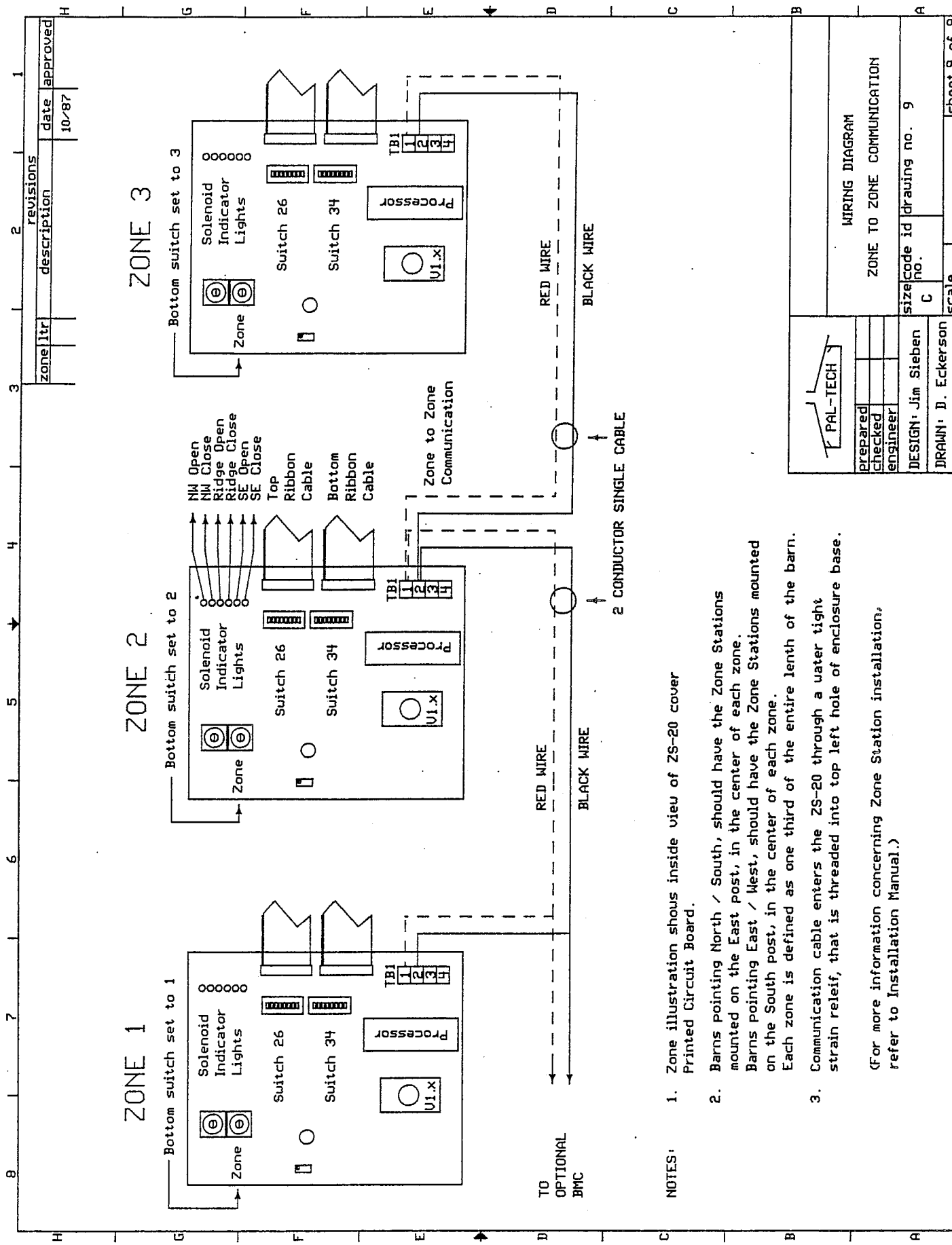


NOTE: 1. Relay supplied by the Electrician.  
 2. Zone 2 and Zone 3 may be connected to alarm by installation of communication option.

(Either Zone 1 or zone closest to alarm)

PAL-TECH		WIRING DIAGRAM	
prepared		ALARM	
checked			
engineer			
DESIGN: Jim Sieben		size code	id drawing no. 8
DRAWN: D. Eckerson		no. C	
scale		sheet 8 of 9	





zone ltr	description	revisions	date	approved
			10-87	

PAL-TECH		WIRING DIAGRAM	
prepared		ZONE TO ZONE COMMUNICATION	
checked			
engineer			
DESIGN: Jim Sieben	size code id drawing no. 9		
DRAWN: D. Eckerson	scale		
		sheet 9 of 9	





**TURKEY PRODUCTION TIPS  
FOR ZONE STATION OPERATORS  
by Dr. Jim Sandstrom**

**I. INTRODUCTION**

The PAL-TECH ZS-20 Zone Station was gradually developed and programmed under actual production conditions. We feel that most problems in the operation of the basic computer program have been eliminated. Therefore, if your own unit appears to be mismanaging your barn, it is imperative that you ASK FOR HELP. The majority of field problems can be identified and solved through telephone conversations with the PAL-TECH service group. If you can't find it in the manual, please call us. The better you know your system, the happier we will both be.

The PAL-TECH control system will allow you to have better barn conditions year-round than any other control system available. However, the Zone Station is only a tool and needs input from you, the grower. You can manipulate the environment through simple changes in settings to give your birds the temperature and litter conditions that fit your production style.

Because the system is new, even many of our experienced customers have asked for the specific settings they should use to raise a flock. The Zone Station has not changed the requirements of the bird. Our first response is always:

"Look at the birds and then give them what they want."  
There aren't any perfect settings; what might be right for someone else, somewhere else, may not be right for you. Determine for yourself what temperature and humidity is best each day until you become comfortable with the controls. Setting thermostats, timers and winches has never been easy (and they didn't come with charts for 'perfect' settings either).

However, we want to make you comfortable with your new PAL-TECH Zone Station. So, we have included a temperature and humidity guideline plus a few suggestions to give you a good starting point (See page 5 of this supplement).

**II. BROODING WITH THE ZS-20**

A. Start each new brood in a barn that has been thoroughly washed and fumigated with formaldehyde. Don't brood on used litter. The Zone Station may be washed right in the barn, but avoid using intense high pressure spray along the seams and plugs, especially at the edge of the face panel. REMOVE THE SENSOR PACKAGE from the barn before washing.

B. When operating stoves and heaters before birds are placed in the barn, put the brooding sensor up at eye level to monitor room temperature.

C. Calibrate the temperature sensor to match a large, accurate glass thermometer before every brood. One thermometer should be located at each zone. The brooder sensor is slower to react to temperature changes than a thermometer, so give it an adequate amount of time before calibrating. Always calibrate the sensor at eye level.

DO NOT CALIBRATE THE SENSOR WHILE IT IS UNDER THE HEATER.

D. Several hours before a new brood arrives, warm the barn to 60 - 70 degrees while the sensor is raised. Immediately after placing birds, drop the brooder sensor into the proper location under the stove and increase the target temperature on the ZS-20 to about 95 degrees.

This allows the birds to find the location of the "hot spot", which usually needs to happen within the first few hours. If the overall barn temperature is too warm, birds may not learn to settle near the "hot spot". Then the advantage of "hot spot brooding" versus "warm room brooding" will be lost for about the next seven days.

In summer brooding, it is sometimes difficult to have the barn cool enough to create this temperature differential on the first day. If you have SBM heaters, it may then be necessary to turn the heaters on manually. This is done by adjusting the target upward to make the stoves start, and then switching off the 220 volt breaker which controls the stoves at the breaker panel. This will cause the stoves to burn continuously on low. Caution: remember to change back to automatic control before the birds get uncomfortable and are driven away from the hot spot. (4 - 12 hours is usually sufficient.)

E. When the birds are about one week old, remove the brooder sensor from under the stove and hang it by the Zone Station. Move the target temperature down to the desired room temp (about 85°).

F. Calibrate humidity sensors using a sling psychrometer or other wet bulb/dry bulb device. For multi-zone set-ups, make sure the sensors match closely.

G. Choose a target humidity that is realistically close to the actual barn humidity for the first day or two, until the litter begins to reach the desired moisture content. This may mean you will set the target at 50% relative humidity (or less) in order to achieve a slight amount of forced ventilation.

After this initial stabilizing period, set the humidity target up or down daily until you get a setting that is comfortable for your barn, variety of litter, and outdoor weather. In our barns at Willmar Poultry Co., we find that 55-60% is the normal range during brooding. This allows us to keep the litter fairly crisp without over ventilating and wasting fuel.

H. During rainy or hot, humid weather, the incoming vented air will contain too much moisture for efficient litter drying. In order to prevent excessive fuel use, it is necessary under these conditions to adjust the humidity target up to around 80-90% until the weather changes.

I. If you are brooding or growing in a partial barn situation (where one zone is partitioned off temporarily), it may be necessary to re-set the zone stations so that they can operate independently. Instructions on setting individual zone addresses is found in the Installation section of your Operations Manual. It is important for each Zone Station to "know" where it is in the barn and whether or not it should communicate with other Zone Stations.

J. If your brooder barn is equipped with PAL-TECH ridges and door vents, the door chains should be adjusted to restrict the door movement according to bird age and season. Day-old birds in winter climates will only need 2 - 3 inches of door opening. Older birds in mid-summer, on the other hand, will require fully open vents. Restricting air flow with chain length will let you control the environment more uniformly when there is a big difference between indoor and outdoor temperatures.

K. Sometimes you may need to close the barn ventilation --for spray vaccination or other reasons. To do this, turn the target temperature up, which will close the ridge and side vents. Then, disconnect the solenoid control box cable from the side of the Zone Station. Now the vents will remain closed until the cable is re-connected. You may also need to adjust the target temperature back down to shut off the heaters. With a fan system, simply break the circuits to the fans at the electric panel.

### III. FINISHING MARKET BIRDS WITH THE ZS-20

A. During the 4 - 10-week age period, the suggested humidity target is slightly higher than during brooding. On our own farms, 60-63% has been successful. The humidity target can be adjusted as often as necessary to maintain desirable litter conditions. We prefer wood shavings litter that is dry enough to stay loose on the surface without caking, and with a minimum of tilling. When you squeeze a handful of litter, it should fall apart without packing into a solid ball. However, there should be enough moisture to feel damp to the touch and not crisp underfoot.

B. During the summer months, you will lose the ability to dry your litter on demand using the barn heaters. It is costly to run supplemental heat for drying when the intake air is already warm and moist. Therefore, heating equipment may be manually shut down when it gets warm in the spring, and then restarted in the fall.

C. Probably the most difficult idea to accept is that it is cheaper and easier to keep a barn dry at higher temperatures. The Zone Station lets you do this efficiently--it will not burn any more fuel than is necessary to keep the humidity at the target setting. Keeping the barn at higher temperatures results in less air lost through ventilation because the warmer air can hold and remove more moisture. Because less air is ventilated, less energy is needed to heat the fresh air back up to target temperature. We recommend keeping temperatures at the high end of the bird's comfort zone during cold weather.

D. When young birds (4 - 6 weeks) are moved into a barn with deep litter, ammonia can be a major problem. This is especially harmful to winter tom turkeys. Lowering the target temperature will help in two ways: 1) The ventilation rate will increase, and 2) the rate of ammonia production will decrease. It may take several days for the ammonia production to decrease after lowering the temperature, but then it can be adjusted back up to normal levels. This should also be done if tilling is necessary.

E. When turkeys reach the age of 10 - 12 weeks, the litter begins to dry even without much supplementary heat (this can sometimes occur at an even younger age). Dust removal and body heat removal begin to take priority over moisture removal. If you have a moisture-adding system installed in your barn, you may want to have the Zone Station begin controlling it at this stage.

F. The usual method of reducing dust as the birds mature is to decrease the temperature in the barn. This is easy with the Zone Station but it may have a negative effect on feed conversion. You can also remove dust by using some of the options available with the Zone Controller and/or Barn Management Center. These include: intermittent light - dual temperature - purge, automatic (timed) litter sprinkling, or fogging to raise humidity.

G. In three-stage (tom turkey) operations, you may want to use different programming options for different stages of growth. For example, the inter-zone ventilation (end-to-end) option works well during the second stage, whereas the purge option works best in the finishing stage. These options can be part of customized Zone Station program. If you use a Barn Management Center on your farm, these options can be activated whenever you desire.

H. The "Ridge Close" feature is helpful during loadouts if it is raining and water is entering through the ridge. First, the Zone Station by the loader is temporarily set to the "0" position on its address switch (See Sec. IV.D.). Then, press the "RIDGE CLOSE" touchpad to lock that part of the ridge closed. The rest of the barn can continue to ventilate dust, if necessary. (Remember, however, to set it back or you'll have trouble!)

## BASIC ZS-20

### SUGGESTED TARGET SETTINGS

General Guideline Only - Conditions Will Vary

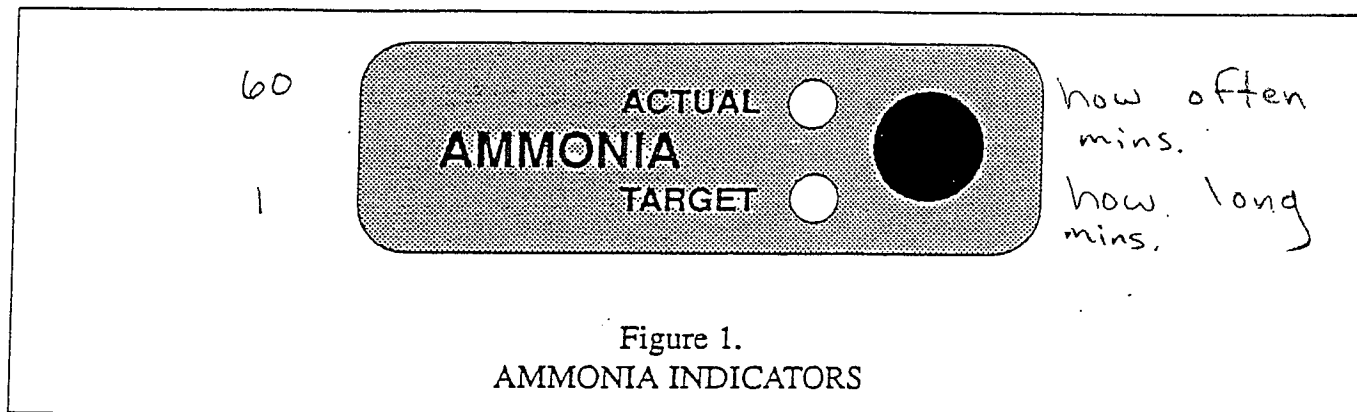
<u>Age (weeks)</u>	<u>Temperature</u>	<u>Humidity</u>
0 - 1 wks	95° - 90°  Sensor under stove while birds in rings. Create a hot zone when first placed. Adjust to bird comfort by appearance.	55 - 60%  Keep litter crisp when possible. Raise target if raining or hot and humid.
1 - 4 wks	85° - 75°  Place sensor by zone station when birds are loose from rings. Turn off individual stoves gradually as age and weather permit.	60%  Adjust to keep litter from caking, especially if droppings get loose. Raise while raining or hot and humid.
4 - 10 wks	80° - 70°  Warmer temp. in this period best for moisture removal. Use cooler temp. for ammonia control.	63%  Litter should be kept moist to touch, but not pack when squeezed. Tilling can be minimized through proper humidity control.
10 - 20 wks	72° - 55°  Hens warmer than toms. Heaters should only run at end of light and purge cycles.	65% - 70%  Use dust purge and sprinkling if available.



## USING THE CYCLE TIMER

Your ZS-30 contains a cycle timer that causes it to periodically run FAN 1 and open your building's curtain, door, and ridge vents to remove hot, humid, dusty, or ammonia-laden air from your building. (As a safeguard, the cycle timer will turn off FAN 1 and close any open curtains, doors, or ridges if building temperature drops more than 10° (or the amount that you specified when purchasing your unit) below target levels.)

The cycle timer has two settings: a *timer interval* setting which specifies the number of minutes (up to 255) that the timer will wait before resetting itself and a *run time* setting which specifies the portion of the timer interval (up to 25.5 minutes) that FAN 1 will run and your building's curtain, door, and ridge vents will open.



- |   |   |
|---|---|
| * Press the black key in the AMMONIA portion of your ZS-30's front panel.                   | When you press this key, the ACTUAL indicator will light and the present timer interval will appear on the display.   |
| * Use the arrow keys on the front of your ZS-30 to set the timer interval.                  | Holding down one of the arrow keys will cause the value on the display to either increment or decrement. You can enter timer interval of up to 255 minutes.   |
| * Press the ENTER key.  | This causes your ZS-30 to resume normal operation.  |
| * Press the black key in the AMMONIA portion of your ZS-30's front panel.                   | When you press this key, the ACTUAL indicator will light and the present timer interval will appear on the display.   |
| * Press the black key in the AMMONIA portion of your ZS-30's front panel again.             | Pressing the key a second time will cause the TARGET indicator to light and your ZS-30's current run time setting to appear on its display.   |
| * If necessary, use the arrow keys on the front of your ZS-30 to set the run time interval. | The maximum run time setting you can enter is 25.5 minutes. (Note: your ZS-30 will automatically insert a decimal point before the last number of the setting you enter, so be sure to allow for this when making entries.) |
| * Press the ENTER key.  | As you press the ENTER key, your ZS-30 will resume normal operations.   |





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