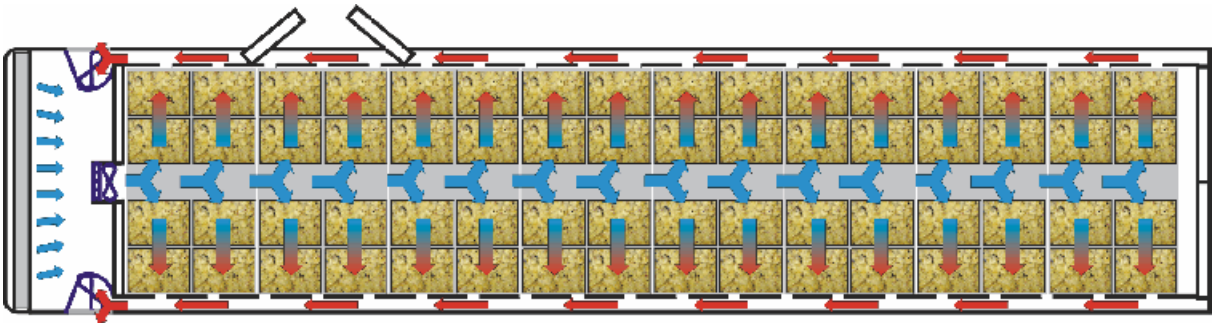
1.0 Introduction

The Sturdy ventilation controller is designed to automatically control indoor air quality including: temperature, relative humidity, carbon dioxide and oxygen in the interior of the trailer under various exterior and interior conditions. The primary purpose of the system is for the control of indoor air quality while shipping live poultry.

This manual outlines the control system and general procedures to follow during operation.

How it works – the basics

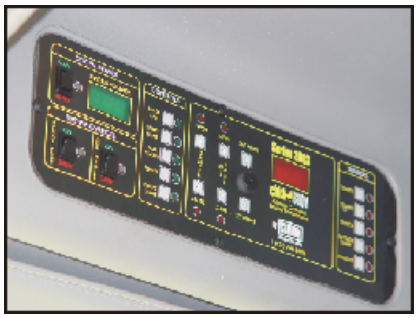
The diagram below demonstrates the air flow path through the chicks, ensuring fresh air and oxygen, evenly and throughout the trailer. The air enters the vehicle through the front damper door, is directed through the cargo area by six inlet fans, and moves through the chicks into the sidewalls. The sidewall air is regulated by engineered gaps in the walls to ensure even air flow throughout the vehicle. The air is then either exhausted completely or in part through the exhaust doors located on the sides of the vehicle.



2.0 General Operation

Control Selection

This system has been installed with the option of controlling from a cab based Dash Panel, or to run from a trailer control (located inside the electrical panel). The system has two dash panels - one located in the cab of the tractor (in most cases), and one inside the electrical panel located on the front of the trailer.



Cab Control Setup

If the system is to be controlled from the Dash Panel located inside the tractor cab, follow the procedure below.

- Ensure that no dash panel is on. **NEVER SWITCH THE PANEL TOGGLE WITH A PANEL ON. DOING SO MAY RESULT IN PERMANENT DAMAGE TO THE DASH PANEL!**
- Switch control toggle on the base of the Electrical panel to "**Tractor Control"**
- The system is ready to be started

Electrical Control System
Master Disconnect

Trailer Control Setup

If the system is to be controlled from the Dash Panel located inside the Electrical Panel, follow the procedure below:

- Ensure that no dash panel is on. **NEVER SWITCH THE PANEL TOGGLE WITH A PANEL ON. DOING SO MAY RESULT IN PERMANENT DAMAGE TO THE DASH PANEL!**
- Switch control toggle on the base of the Electrical panel to "**Trailer Control"**
- The system is ready to be started.

Communications Cables located on the bottom of the Electrical Panel

Control Modes

The control has two modes of operation: AUTO and MANUAL. Selection Between modes is done on the Dash Panel (see photo below). ***NOTE*** There is no Mix Valve required in trailers, and their functionality serves no purpose.

MAIN POWER & Mode Selection Switch

Control "Dash" Panel

Auto Control

The control should be operated in the 'auto' mode during normal operation between the time when the truck is loaded until unloading is completed. During 'auto' control, the user has no direct control over any of the components of the ventilation system, except those that have override capabilities (Spray Pump,

Auto Control cont'd
and Heater). The user should only have to monitor the sensor feedback on the visual display. Several conditions require the user to operate the system manually by switching the control to 'manual'. Refer to the 'manual' section below.

Manual Control
Once the system is turned to 'manual', the operation of each of the ventilation components are operated at the choice of the user. Several of the situations where the user will operate the system on 'manual' control are listed as follows:

- Preheat
- Extreme changes in exterior temperature
    - more than 10 degrees in less than 15 minutes. This may happen during spring and fall, as well as being parked on hot asphalt.
- control or other electrical malfunction
- washing

System Overides
The System overrides are to provide a new element of control to the system. Both overrides offer three options. The first is the "ON" option, which means that these functions are "ON" regardless of the dash panel logic functions. The second position is "OFF", which disconnects these functions from the system regardless of control logic. The third position is "DASH", which allows the functions to be 100% controlled by the logic of the dash panel. *****IMPORTANT*****
On trailers, the AUX HEATER Function, is actually the Power control for the Webasto Heater. This should either be in the "ON" or "OFF" position, not "DASH", as the Webasto heater is driven mainly by the thermostat located in the cargo area.

Preheat
The cargo area should be preheated to target temperature prior to loading. The heater will automatically turn on until the thermostat temperature is reached. The length of time required for preheat will depend on exterior conditions, temperatures and storage of shipping truck.

Preheat cont'd
If the cargo temperature is below target, the time for preheating the cargo area can be decreased by:

- ensuring heater thermostat is set equal to target temperature
- switching the control to 'manual'
- turning on the inlet fan
- fully closing the damper
- switching the control to 'auto' when the cargo area temperature reaches 85°F.

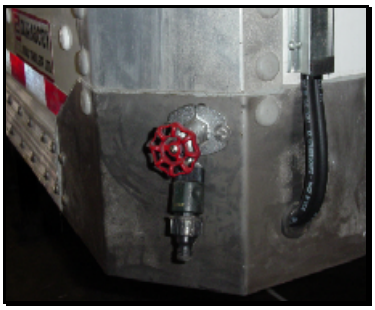
Manual Control
In the event of a control malfunction, turn main switch off, wait 10 seconds, then turn to 'auto' to see if problem has corrected itself. If not, the following procedures should be followed:

- ensure heater thermostat is set equal to target temperature
- switch the control to 'manual'
- turn on the inlet fan
- adjust the damper to suit conditions (see Table 3 on page 14)
- the heater will automatically turn on until the thermostat temperature is reached.
- turn misters on if the interior relative humidity is less than 50% and/or the temperature is more than 90°F.

Washing
The controller can be turned to 'off' during washing. If required, to decrease drying time and to prevent freezing, the following components can be manually operated:

- ensure heater thermostat is set equal to target temperature
- turn on the inlet fan

Mist Tank Refill
The mist tank requires filling when empty. Actual time of mist operation will determine the time required to empty the mist tank. The tank should be refilled prior to loading an empty truck. A spigot is located outside of the front of the unit on the passenger side to fill the mist tank. Attach a water hose and fill the tank. Water will flow out of an overflow hose (and onto the ground) when the tank is full. Additionally, there is a cap on the tank to permit the addition of ice to the water if required.

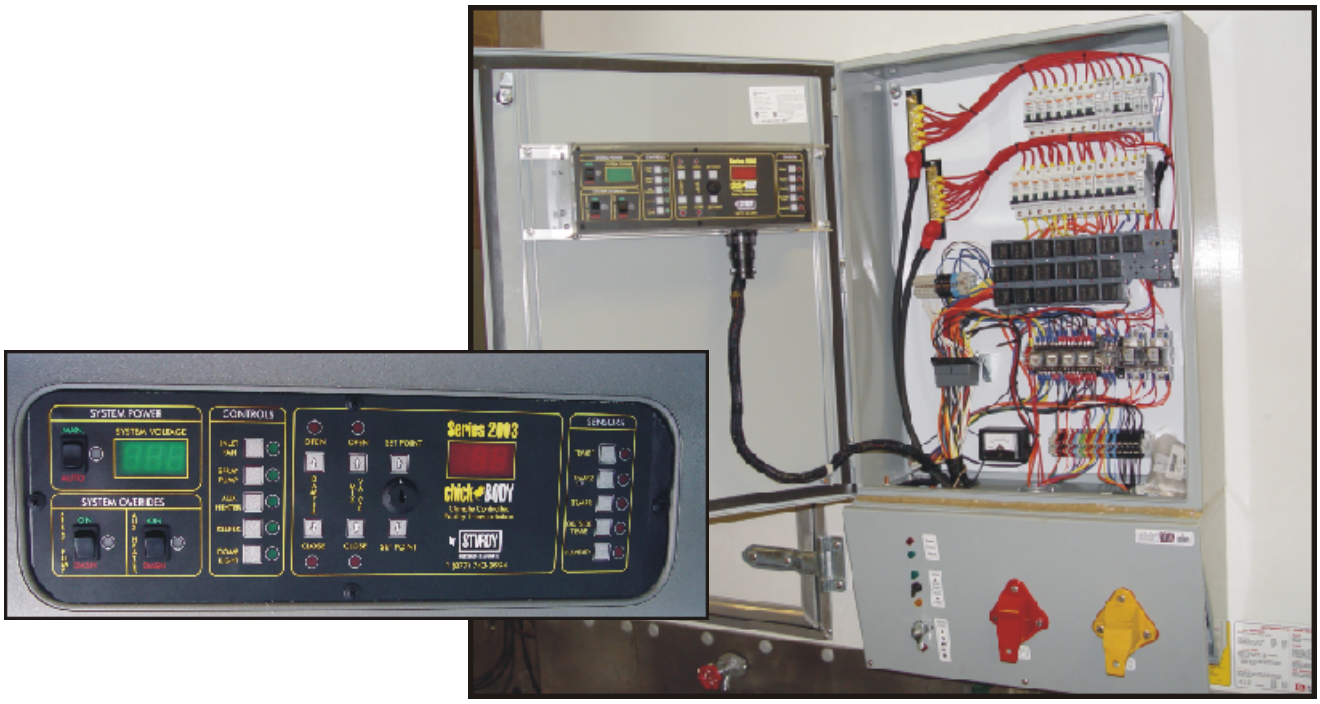


Mist Tank refill Spigot

Mist Tank located inside trailer Compartment. (may vary in appearance)

3.0 Control Logic

The controller operates by a series of conditions dependent on feedback from positioning of components, sensor readings, thermostat setting, and target set points. The controller will adjust system components as required to satisfy the set points.



4.0 Controller Components

Inlet Fans

The inlet fans provide the required airflow for ventilation. There are intake fans located at the front centre of the cargo area and exhaust fans located at the front along the sides. The intake fans blow air down the centre along the length of the cargo area and the exhaust fans suck air from the sides of the cargo area. The 'INLET FAN' switch controls the operation of the intake fans only.

LEFT:
Inlet Fans – There are six inlet fans which provide fresh air to the cargo area. There are two types medium and high capacity fans.

Mist Pump

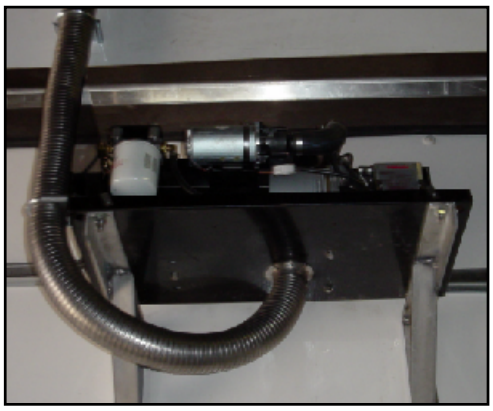
The mist pump provides pressure to operate the misters. Misters are used for two purposes: relative humidity control and evaporative cooling. Mist nozzles are located in front of the intake fans. There are 4 mist nozzles each rated at 1.5 gal/hr for a total of 6 gal/hr. The fresh water holding tank for mist water is 42 U.S. gallons. The holding tank capacity will provide continuous spraying for approximately 7 hours.

LEFT:
Mist Pump – Located on the bottom right hand side of the Water tank.

RIGHT:
Spray Nozzles – Located on the control side of the rad coil.

Heater

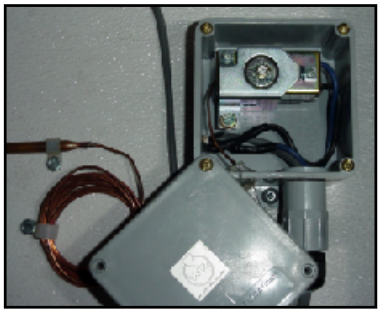
The heater is the Webasto heater located inside the control area of the trailer. This heater is used to heat the trailer when required. The heater is activated when the system is placed in MANUAL or AUTOMATIC mode, and will heat the trailer to the temperature set on the thermostat (see photo on the following page for thermostat location). The heater thermostat should be set to the desired target temperature that is set on the control unit. Note: the heater will run through a "cool down" process for one to two minutes after the system has been turned off.



Webasto Heater - (located inside control area)

Heater cont'd

SYSTEM OVERIDE: This switch must be set in the "ON" position. When "OFF, the heater will not start, and has no Power. If placed in "DASH" mode, the heater will only receive power when the computer determines that the AUX. HEATER should be on (this mode is not recommended



Heater Thermostat – located inside the wall on the curb side of the trailer.

Dome Lights

Five dome lights are located in the cargo and control areas of the truck for lighting. The lights can be turned on during loading/unloading, maintenance, etc..

Damper

The damper is the top/front intake baffle door which regulates the amount of fresh air allowed into the cargo area. Side baffle doors are connected to the top/front by rods so they open and close at the same time. The side doors regulate the amount of exhaust from the cargo area. The damper is operated by an actuator. As the damper opens, more fresh air is brought into the cargo area and more air from the cargo area is exhausted to the outside. As the damper closes, less fresh air is brought into the cargo area and more air from the cargo area is re-circulated. When the control is on 'auto' the damper will not close less than a minimum specified setting (ie., 10%) to ensure oxygen requirements are maintained.

Damper – exterior view

Damper with linear actuator – interior view

Sensors

Four environmental sensors are installed for monitoring and control.

- TEMP.1 - is a temperature sensor located near the front of the cargo area (passenger side).
- TEMP.2 - is a temperature sensor located near the middle of the cargo area (passenger side).
- TEMP.3 - is a temperature sensor located near the back of the cargo area (passenger side).
- OUT.TEMP - is a temperature sensor located outside of the front damper (driver side).
- HUMIDITY - is a relative humidity sensor located just above 'TEMP.2'.

LEFT:
Interior mounted Temperature & Humidity Sensors

RIGHT:
Exterior mounted Temperature sensor (located on front of trailer under the damper scoop)

Displays

Dash Panel (LED Display) – The system has two dash panels. One located in the cab of the tractor (in most cases), and one inside the electrical panel located on the front of the trailer. There are two digital displays. The first is a Systems voltmeter, the second digital display shows the settings or readouts of each of the control components and sensors. The position of the damper (from 0 to 100% open) are also shown on the display.

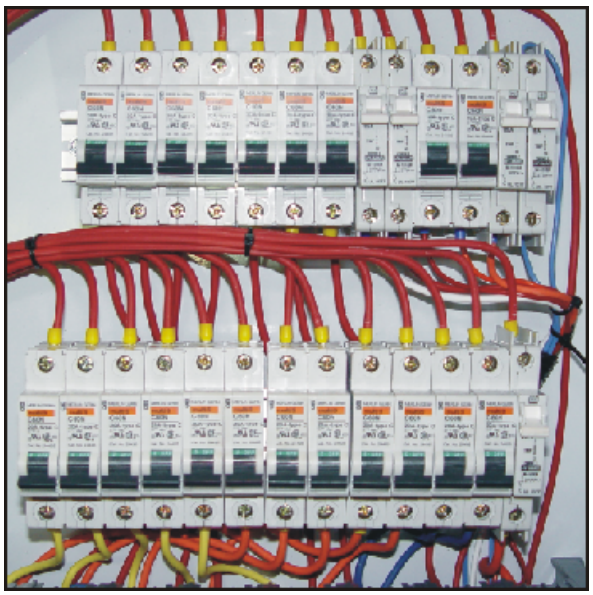
System Voltmeter

LED Display Sensor feedback

Control "Dash" Panel

Electrical Panel Indicator Lights – On the front of the electrical panel there are five lights indicating various system conditions. There is a light for System Power, Heater Power, Heater Status, Control Selection. See Indicator Light Table 2 on page 14 for further detail.

Circuit Breakers – This systems uses standard automotive relays and din rail mounted circuit breakers for system protection. The Webasto heater also has an 30A ATO style fuse for internal protection located in the heater unit. Tripped circuit breakers may be the indication of a problem, reset and turn the system back on. Should the same breaker continue to trip please contact technical support.



CIRCUIT BREAKERS – Located inside the electrical control panel.

Circuit Breakers Layout

Top Circuit Breaker Bar (from Left o Right)
20 Amp Circuit Breaker – Inlet Fan 1
20 Amp Circuit Breaker – Inlet Fan 2
20 Amp Circuit Breaker – Inlet Fan 3
20 Amp Circuit Breaker – Inlet Fan 4
20 Amp Circuit Breaker – Inlet Fan 5
20 Amp Circuit Breaker – Inlet Fan 6
10 Amp Circuit Breaker – Spray Pump
15 Amp Circuit Breaker – Mix Valve (not used)
15 Amp Circuit Breaker – Damper
10 Amp Circuit Breaker – Dash Main Power
10 Amp Circuit Breaker – Dash Relay Power
15 Amp Circuit Breaker – Dome Lights
5 Amp Circuit Breaker – Sensors

Bottom Circuit Breaker Bar (from Left o Right)
20 Amp Circuit Breaker – Outlet Fan 1
20 Amp Circuit Breaker – Outlet Fan 2
20 Amp Circuit Breaker – Outlet Fan 3
20 Amp Circuit Breaker – Outlet Fan 4
20 Amp Circuit Breaker – Outlet Fan 5 & 6
20 Amp Circuit Breaker – Outlet Fan 7
20 Amp Circuit Breaker – Outlet Fan 8
20 Amp Circuit Breaker – Outlet Fan 9
20 Amp Circuit Breaker – Outlet Fan 10
20 Amp Circuit Breaker – Outlet Fan 11& 12
20 Amp Circuit Breaker – Booster Fans Left
20 Amp Circuit Breaker – Booster Fans Right
30 Amp Circuit Breaker - Heater

5.0 Troubleshooting

Several problems have been listed that may occur during normal operation of the shipping truck ventilation system and have been included in the following table. It is generally recommended to first check if the problem is control related by switching to 'Manual' to determine if ventilation components will operate outside of the controller. If a voltage problem exists, however, some components may operate outside of the controller but not operate with the controller.

Table 1: Troubleshooting

#	Problem	Possible Cause	Remedy & Explanation
1	One or more fans stop working.	- tripped circuit breaker. - low voltage to control/fans.	Switch to 'Manual' to determine if system operates outside of controller. Check circuit breaker status. Check voltage meter and locate problem of low voltage and/or charge batteries.
2	Temperature in cargo area below or above target but system does not appear operational or to move toward target.	a) low voltage to controller b) controller computer stalled.	a) Switch to 'Manual' to determine if system operates outside of controller. Check voltage meter and locate problem of low voltage and/or charge batteries. b) Switch controller "OFF" for 10 seconds then turn on again.
3	Temperature in cargo is below or above target but misters not working.	- mist water holding tank is empty. - mist nozzles clogged. - mist pump not operating. - tripped circuit breaker.	Check mist tank and fill if necessary. Check nozzles for dirt and clean if required. Check fuse for mist pump and replace if needed. Switch to 'Manual' to determine if pump is operational outside of control.
4	Temperature below target, damper is closed to minimum. heater not working.	- tripped circuit breaker. - low voltage. - thermostat incorrectly set.	Switch to 'Manual' to determine if heater is operational outside of control. Heater must have a minimum voltage of 10.5V in order to maintain operation. Enter trailer and verify thermostat settings.
5	Ventilation components not responding to control.	- low voltage - tripped circuit breaker	The controller must have a minimum of 10.5V in order to maintain operation. Switch to 'OFF' then 'Auto' to reset.
6	The number '8' displays on the digital readout and display doesn't change when buttons are pushed.	- low voltage	a) Switch to 'Off' b) Start truck and charge batteries c) Switch to 'Manual' and/or 'Auto' and ensure all components are functioning properly. d) Check all battery cable connections.
7	The number '0' displays on the readout for target temperature, and it will not change.	- The system has internally reset the programming.	- turn key to set target temperature, and press the 'up' and down' at the same time.

Table 2: Panel Indicator Lighting Table
These lights are to provide further feedback to the driver of the status of the system. In all cases, if the system is working properly, and any of the lights do not seem to be functioning properly, the system can continue to be used without any harm (please contact service at earliest convenience for further instructions on remedying the problem).

#	Light / *Color*	Normal Status	Explanation
1	System On *Red*	ON On when in MANUAL or AUTO modes.	
2	Heater/System Power *Red*	ON On when the two main breakers have been activated. It also indicates that main 30A heater fuse is good, and the heater is getting power.	It is normal for this light to be on if the breakers are activated. Should this light go off during normal operation check the following; a. Main 30A Heater Fuse b. Breakers
3	Heater Status *Green*	ON (when heater is on) When on, it indicates that the heater is on, and that it is working correctly. This light is fed directly by the Webasto heater.	If the light goes out, check to see that the heater is working properly. This can be done by turning up the thermostat to force the heater to come on, then putting the system in manual mode. Should there be problems with the heater, contact service.
4	Dash Selection *Tractor – Green* *Trailer - Yellow*	One on if the system has power.	

Table 3: Manual Damper Control
Should you need to manually run the system, use the below parameters to set the Damper and Mix Valve.

#	Outside Environmental Conditions	Damper Setting	Mix Valve Setting
1	Outside Temperature is at target temperature or higher.	100%	n/a
2	Outside Temperature is 20°F below target temperature	50%	n/a
3	Outside Temperature is more than 20°F below target temperature.	10%	n/a

6.0 Daily Check List

Table 3: User Daily Checklist

#	Description	Complete
1	Ensure body heating coil is clean. (inspect from both sides)	
2	Fill mist tank.	
3	Fill trailer fuel tank.	
4	Turn Main Panel Disconnect to ON.	
5	Check operation of Outlet fans.	
6	Check operation of mist pump.	
7	Check operation of heater.	
8	Check operation of damper.	
9	Check System Voltage with tractor off and started. Note temperature.	
10	Preheat cargo area minimum 1 hour prior to loading depending on outside temperature. Make sure cargo area temperature is at target prior to loading.	
11	Switch to 'AUTO' once loading is complete.	
12	Check and record temperature and humidity sensor readings.	
13	Check tailgate operation (if applicable) and follow maintenance instructions in manual provided	
14		
16		
17		
18		
19		
20	Switch Main disconnect to off at end of day.	

Inspected By: Date:

7.0 Preventive Maintenance

Every Week

- Check battery terminal connections.
- Clean battery terminals and tighten connections.
- Clean Communications cables & rubber o-rings and apply dielectric grease as required.
- Check fans for operation.

Every Two Weeks

- Start heater and let it run for 15 minutes
- Check battery fluid

Every 3 Months

- Have charging system inspected by a qualified personnel or subcontractor.

Every 12 Months

- Inspect sight glass of antifreeze tank & top up as required until level reaches sight glass.

PANEL LAYOUT IDENTIFICATION

A – CIRCUIT BREAKERS

B – DASH PANEL

C – CONTROL RELAYS

D – MAIN HARNESS CONNECTION

E – DASH PANEL SELECTION RELAYS

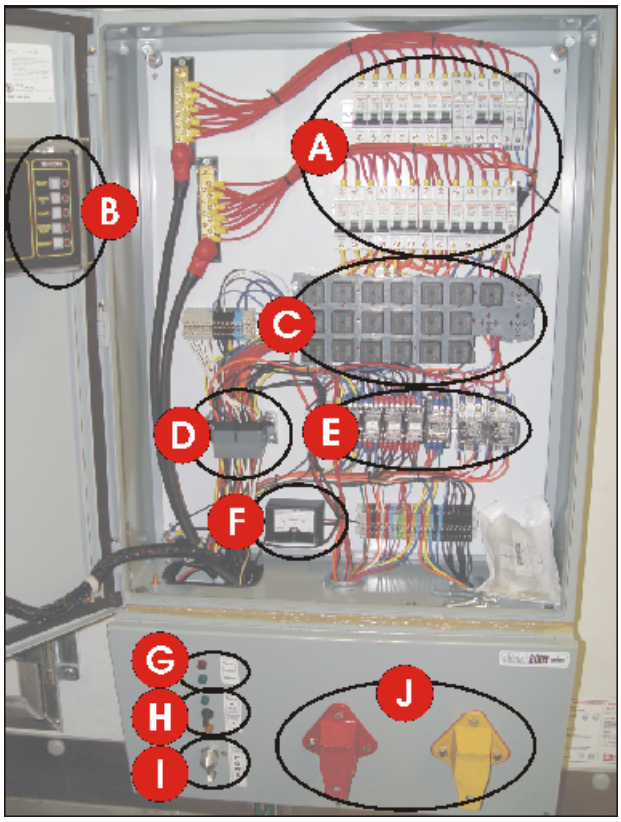
F – VOLTMETER

G – HEATER INDICATOR LIGHTS

H – DASH PANEL SELECTION

I – MAIN POWER DISCONNECT

J – COMMUNICATION PLUGS TO TRACTOR



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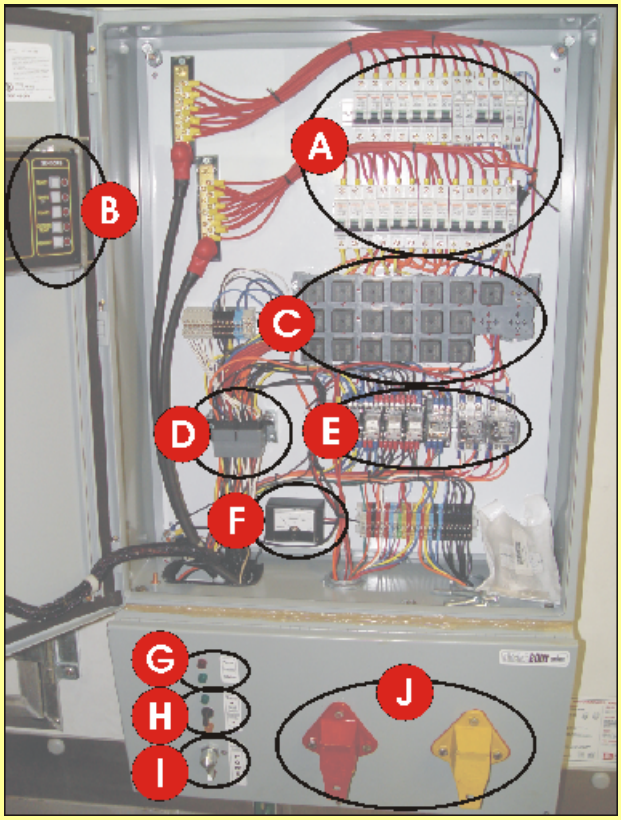

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20 Amp Circuit Breaker – Outlet Fan 8
20 Amp Circuit Breaker – Outlet Fan 9
20 Amp Circuit Breaker – Outlet Fan 10
20 Amp Circuit Breaker – Outlet Fan 11& 12
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30 Amp Circuit Breaker - Heater