

Provel T7 Thermoformer User's Guide

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Introduction

The Provel T7 Thermoformer is a fully automated prosthetic limb socket forming machine designed to use industry standard socket preforms. Thermal process control is achieved thru the use of an infrared sensor measuring preform temperature. The T7 is constructed of stainless steel and features a high efficiency oven, built-in clamp ring and table storage, and an illuminated forming area. Clamp rings and tables are provided for 16, 18, and 25 cm preforms. The T7 monitors door position, carriage position, oven temperature, oven over-temperature, drive motor load, drive speed, and vacuum system function. Carriage travel can only occur when the door is closed.

Precautions

Always wear protective gloves when handling hot preforms or clamp rings. Never remove access panels or attempt to service the thermoformer without disconnecting electrical power. Read the entire user's guide carefully before using the thermoformer. It is the responsibility of the user to ensure that adequate ventilation is provided for operation of the thermoformer. The use of unapproved preforms can cause damage to the thermoformer, may create a health hazard, and will void the warranty.

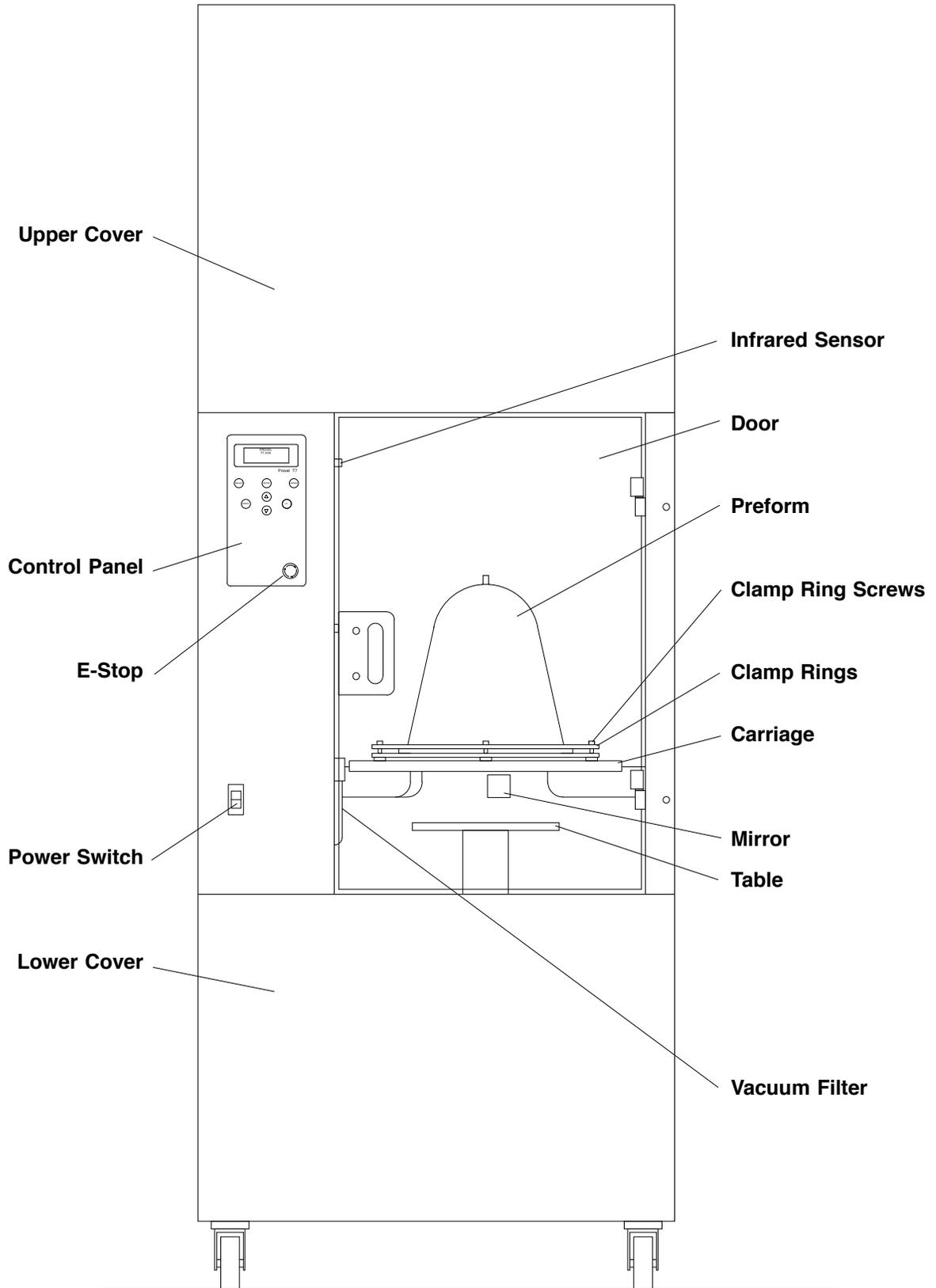
Cleaning

Detergent based spray cleaners can be used to clean exterior surfaces. The acrylic door can be cleaned with a clean, soft cloth and a solution of detergent in water. Do not use solvents or abrasive cleansers.

Maintenance

The lead screws must be kept clean and well lubricated with the grease supplied with the machine. Never operate the carriage with dry lead screws. If vacuum is weak at the forming table, clean the filter. Disconnect power, unscrew filter bowl, unscrew filter element, clean filter, empty bowl, and reassemble. Never remove any access panel without disconnecting power. The polished aluminum infrared sensor mirror must be kept clean. Use a clean, soft cloth and a solution of detergent in water. Do not use solvents or abrasive cleansers.

T7 Thermoformer



Operation

Operation Summary

Turn power on.
Select preform.
Load preform, close door.
Press start. Preform will move to oven after preheat.
Load model, close door.
Remove socket and model.

Manual Motion

Press UP or DOWN arrow keys to raise or lower the carriage. The carriage automatically stops at the end of travel limits. The carriage will not move unless the door is closed. UP and DOWN keys are disabled during automatic operation.

Oven Preheating

The oven must reach the set temperature before a thermoforming cycle can begin. This will normally require 8-10 minutes when starting from room temperature.

Changing Preform Target Temperature

It may be necessary to change the default target temperature to compensate for local conditions or processing variations from batch to batch of preforms. Temperatures from 100° to 180°C may be set. Even a .5° change can be significant. See Default Settings for recommended temperatures. Although it is possible to adjust oven temperature, it is preferable to adjust the target temperature to obtain the desired preform temperature. See Early And Late Forming below.

Oven Temperature Limits

The oven temperature range is 120 to 230° C. The oven temperature must always be at least 20°C higher than the preform temperature to allow efficient heat transfer. The controller will not allow oven temperatures greater than 70°C higher than target temperature. Best results will be obtained by adjusting the preform target temperature. The default target temperatures are starting points for use with the default oven temperature. Changing the oven temperature will require a new target temperature.

Thermoforming

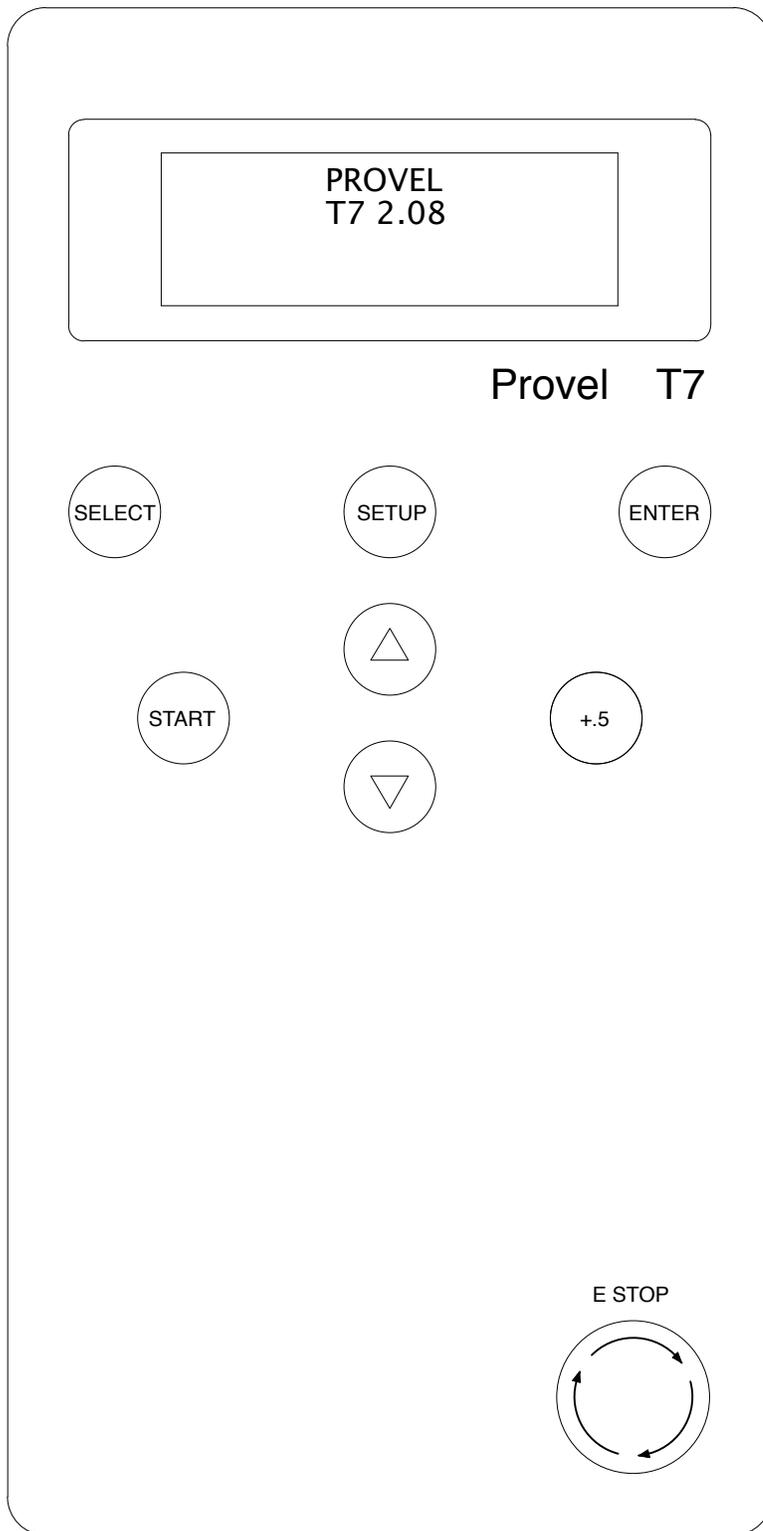
Press START to begin an automatic thermoforming cycle. The display will show preform, vacuum delay, oven temperature, and preform target temperature. The vacuum pump will start when the preform reaches target temperature, and will continue for 7 minutes after forming. When the preform target temperature is reached, the carriage will move down to forming position. After a 1 second or other selected delay, the vacuum valve will open, and the vacuum timer will start. Press E-STOP to stop carriage motion, vacuum, and turn the oven off. Pressing E-STOP during automatic operation will cancel the forming cycle and require starting over with a preform at room temperature. If the carriage is unable to move to forming position because the door is open, an alert will sound and the oven will shut off. Oven temperatures over 240°C will cancel the forming cycle and require starting over with a transform at room temperature.

Early And Late Forming

The forming sequence can be started before the preset target temperature has been reached by pressing START. Press +.5 to add a half a degree to the target temperature as needed. The actual target temperature used will appear on the display at the end of each forming cycle. Edit stored target temperature in Setup if the modified target temperature is preferable.

Status Messages

CLOSE DOOR	Door must be closed for carriage motion. Preheat cycle: alarm will sound and carriage will move up when door is closed. Preform heating, alarm will sound, oven will shut off, process will be cancelled. After door is closed, move carriage using Down button. If door is open at the end of the forming cycle, carriage remains in forming position. When door is closed, carriage will move up.
LOAD MODEL	Process will stop if model not loaded before target temperature reached.
E STOP	Pressing E Stop will end the automated process. E Stop must be released for carriage motion.
PROCESS STOPPED NO MODEL	Model was not loaded. Process cancelled. Oven will shut off. Carriage will move preform out of oven.
DRIVE FAULT	Drive error detected.
OVER TEMPERATURE	Oven temperature has exceeded 240°C. The oven will shut off.
MOVE CARRIAGE TO HOME POSITION	Carriage must be homed before cycle can start.
MOVING DOWN	Carriage moving down. Limit will stop carriage at end of travel.
MOVING UP	Carriage moving up. Limit will stop carriage at end of travel.
FORMING	Vacuum cycle.
MOVING HOME	Carriage returning home.
TIME OUT	Process will stop if target temperature is not reached within allowed time limit. Make sure mirror is clean and reaching hard stop with carriage up.



Control Panel

SELECT : Select preform or value.

SETUP : Edit preform temp, reset defaults, adjust display.

ENTER : Accept entry, return to idle screen.

△ : Move carriage up, change value in Setup.

▽ : Move carriage down, change value in Setup.

START : Start auto cycle, Go Now after preform reaches oven.

+.5 : Add .5° to target temp.

E-STOP : Twist to release.

```

SELECT PREFORM
OVEN 25C
(SELECT) (SETUP)

```

Idle Screen
 Press SELECT to choose preform. Current oven temperature is displayed. Bottom line displays key press options.

```

PREFORM VAC DELAY
18CP1 1 SEC
^^^
(SELECT) (^v) (ENTER)

```

Select Preform
 Press SELECT to move cursor. Use Up, Down arrow keys to change value. Vac Delay allows 1, 5, or 9 second vacuum onset delay for manual manipulation of preform on model before vacuum is applied.

```

PFM DLY OVEN TARGET
18CP1 1 220C 168.0C
OVEN 27C
START) (SELECT) (SETUP)

```

Ready
 Press START to preheat oven and begin automated forming cycle.

```

PFM DLY OVEN TARGET
18CP1 1 220C 168.0C
OVEN 209C
PREHEATING OVEN

```

Auto Cycle Preheating
 After oven reaches temperature, Preform moves to oven and timer counts down. If door is left open, alarm will sound to prompt user.

```

PFM  DLY  OVEN  TARGET
18CP1 1  220C  168.0C
                PFM  128.5C
LOAD MODEL

```

Auto Cycle Heating Preform

Approaching target temp. With 40° remaining, display prompts user to load model if the door has not been opened and closed.

```

PFM  DLY  OVEN  TARGET
18CP1 1  220C  168.0C
VAC  25.7  PFM  167.0C
(START)                (+.5)

```

Auto Cycle Heating Preform

Vacuum pump starts before target temperature is reached. Press +.5 to increase target temperature .5°C. Press START to start forming cycle now instead of waiting for preform to reach target temp.

```

PFM      DLY      TIME
18CP1    1        414
VAC  27.0
FORMING

```

Auto Cycle Forming

Time will show vacuum time remaining in seconds.

```

PREFORM OVEN  TARGET
18CP1    220C  168.0C
                ^^^ ^
(SELECT) (^  v) (SETUP)

```

Setup

Press SETUP to change preform target temp, set backlight and display contrast or reset defaults. Pressing SETUP advances thru editable settings and default reset options.

MOVE CARRIAGE TO
HOME POSITION
(^v) (ENTER)

Home Carriage

If carriage has been moved from home after cycle completion, it must be returned to home before beginning an automated cycle.

ACTUAL TARGET TEMP
18CP1 168.0C
(ENTER) (SETUP)

Modified Target Temperature

Displays actual target temp used if modified with +.5 key or pressing START to begin forming before target temp reached.

RESET PREFORM 18CP1
TO FACTORY DEFAULTS
(START) TO RESET
(SETUP) (ENTER)

Reset Factory Defaults

From Idle or Ready screen, press SETUP twice to reach screen allowing factory default time and temp to be restored for selected preform. Press SETUP from this screen to reach screen allowing defaults to be restored for all preforms.

0123456789ABCD
0000000010010
TT20.0C OT20.0C
VACUUM 0.0

Test Mode

Test Mode can be used for troubleshooting. Displays status of switches, sensor and oven temp, and vacuum. Access by turning power on while pressing SETUP.

Preforms & Models

Preform Selection

Socket preforms are available in 16, 18, and 25 cm sizes. Size the preform for the smallest table which will accommodate the model. Use of a larger preform than necessary will increase the tendency for webbing during vacuum forming. Do not reheat preforms that have already been formed. A stretched preform can be long enough to damage the fan when entering the oven. Never reheat a preform that measures more than 390 mm from the top of the upper clamp ring to tallest part of the preform.

Preform Draw Length

Size (cm)	16	18	25
Minimum Draw Length (mm)	340	350	450
Maximum Draw Length (mm)	540	540	540

Draw lengths in excess of 540 mm can interfere with IR sensor mirror operation.

Preform Loading

Install the appropriate table for the pattern to be formed, and secure the preform to the carriage with the matching clamp rings. Using a preform that does not match the table selected can damage the machine.

Take care to center the preform in the upper clamp ring for table alignment. Clamp ring adjustment screws should be adjusted to allow full rotation of the upper clamp ring to the ends of the keyhole slots with light pressure on the preform. Do not tighten the screws with a wrench. Adjust the screws if necessary. Close the door.

Models

Polyurethane foam or plaster models can be used. A nylon or stockinette sheath applied to plaster models will help avoid air entrapment. The model should not overhang the table, or the model may shift or be damaged as the carriage descends, and the preform may not seal to the table for vacuum forming. When forming check sockets use a nylon or stockinette sheath with silicone to prevent adhesion to the model.

Model Loading

Adjusting the model to achieve sufficient draw length and angulation of the pattern to minimize reentrant features of the model will reduce the tendency for webbing. Length and angle adjustment can be accomplished with spacers if necessary. The spacer should be of slightly smaller diameter than the model. If the spacer is too small it may cause excessive thinning of the preform and subsequent perforation and loss of vacuum. Center the model on the table.

If the door has not opened and closed during the heating cycle, when the preform is within 40° of the target temperature, a pattern loading reminder alert will sound until the door is opened and closed. If the target temperature is reached and the door has not been opened and closed, the preform will descend from the oven to loading position, but no vacuum will be drawn and the oven will shut off.

Troubleshooting

Preform Webbing

Raise the model on the table 1 or 2 inches.
Use smallest possible preform diameter.
Adjust model angulation to minimize reentrant features.
Increase target temperature slightly.
Flare the proximal end of the model before carving.

Preform Thinning

Use a larger preform.
Reduce draw length.

Vacuum Loss

Use a larger diameter spacer below model to avoid excessive thinning if perforation occurs in this area.
Smooth any sharp edges that may perforate the preform.

Poor Vacuum

Ensure the preform is heated enough to allow the carriage to reach the lower limit switch for a good seal to the forming table.
Confirm the correct table is installed .
Check for obstructions at the table vacuum inlet.
Clean vacuum filter.

Cold Preform

Confirm that temperature settings are correct.
Increase target temperature as necessary.

Collapsed or Torn Preform

Confirm that temperature settings are correct.
Decrease target temperature as necessary.
A collapsed preform should be removed from the clamp rings before it cools into a shape that may make removal difficult.
Always wear gloves when handling hot materials.

No Carriage Motion

The door must be closed for carriage motion.
Make sure the E-Stop switch is not pressed.
If a preform stalls the carriage, move the carriage away from the pattern, and remove the model. If the carriage remains stalled when manual motion is attempted, turn the power off and remove the preform. It may be necessary to loosen or remove the clamp ring screws.
Always wear gloves when handling hot materials.

Carriage Noise

Lubricate carriage drive screws with lubricant supplied.
Adjust carriage drive nut set screws just enough to take up clearance if loose.
Do not overtighten.

Default Settings

Size	Preform	Target	Oven
16	CHK	134C	170C
16	CP1	163C	220C
16	CP2	163C	220C
16	EX1	163C	220C
16	EX2	163C	220C
18	CHK	125C	170C
18	CP1	165C	220C
18	CP2	165C	220C
18	EX1	165C	220C
18	EX2	165C	220C
25	CHK	109C	170C
25	CP1	163C	220C
25	CP2	163C	220C
25	EX1	163C	220C
25	EX2	163C	220C

Specifications

Overall Size 66 x 80 x 216 cm (26 x 31.5 x 85 in)

Minimum Ceiling 224 cm (88 in)

Weight 182 kg (400 lbs)

Power 230 VAC 15A, 50/60 Hz

Capacity 25 cm diameter x 54 cm (9.7 in diameter x 21.2 in)

Preform Sizes 16, 18, 25 cm

Oven 158-228° C

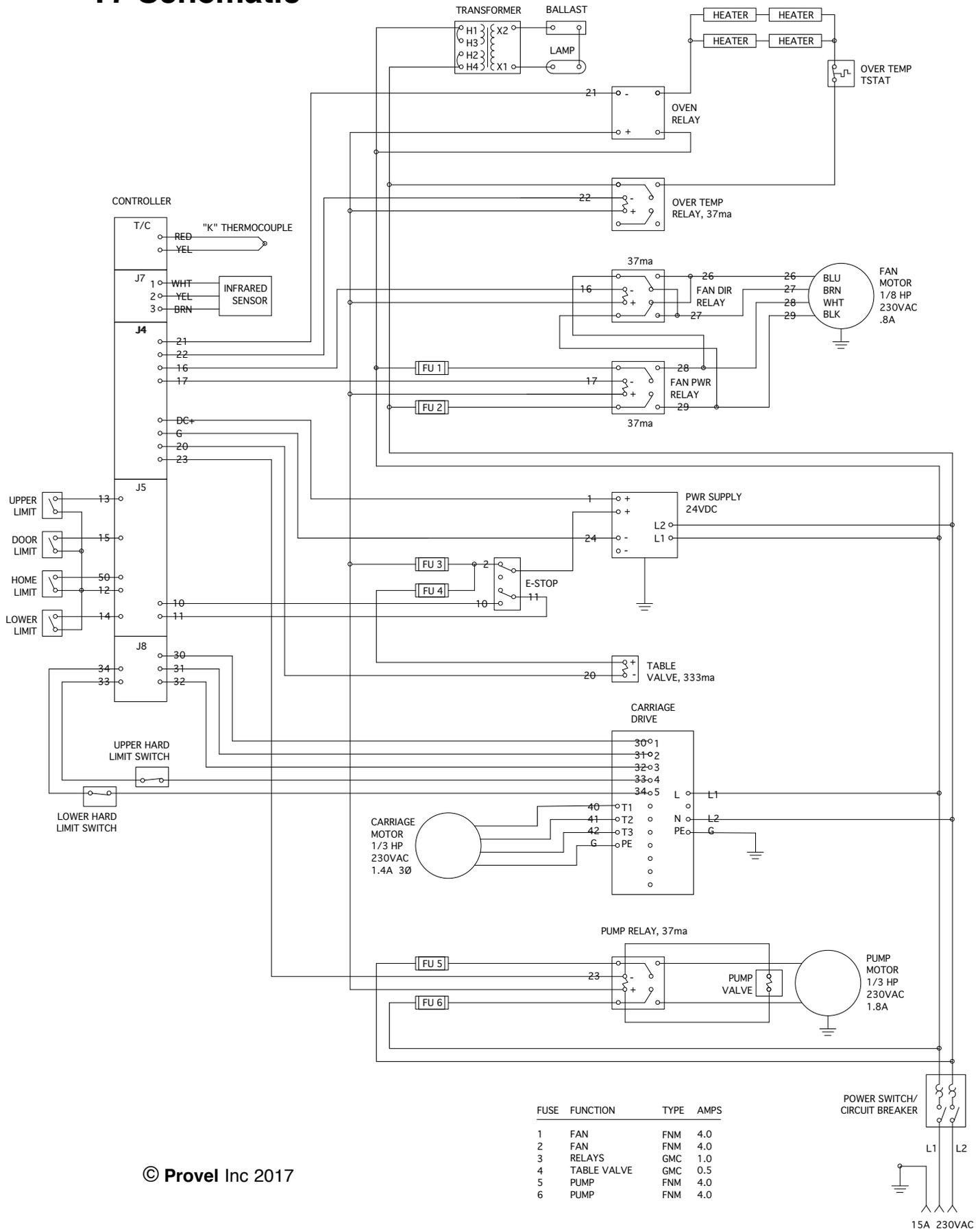
Vacuum 27 in Hg

Fuses	Vacuum Pump	FNM-4
	Fan	FNM-4
	Valve	GMC-1

Provel Inc

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509.857.2009
www.provel.us

T7 Schematic



FUSE	FUNCTION	TYPE	AMPS
1	FAN	FNM	4.0
2	FAN	FNM	4.0
3	RELAYS	GMC	1.0
4	TABLE VALVE	GMC	0.5
5	PUMP	FNM	4.0
6	PUMP	FNM	4.0

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