T Series Direct Drive

Operation, Startup and Maintenance Manual

Engineered for Reliability & Performance

Project Name: _____

Completion Date: _____

Model Number	Serial Number

THERMOTECH ENTERPRISES

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Field Startup Check list. Return to Thermotech to activate Warranty.

Introduction and Definitions

This manual is intended as a guide to the proper operation and maintenance of Thermowheel ® T Series assembled energy recovery units. Please read these instructions prior to operating the equipment.

Thermowheels ® are designed to operate effectively for a minimum of 25 years. By following these instructions carefully you will attain the same high level of reliability. Thermotech Enterprises is not responsible for units that are damaged by improper operation or maintenance.

Definitions:

 Danger Symbol - This indicates procedures that if not followed correctly could lead to serious injury or death

 Warning Symbol - This indicates procedures that if not followed correctly could result in severe damage to the unit and potentially void the warranty.

Bearing - 2 or 4 bolt pillow block tapered roller bearing supports the load of the rotor.

Casing - The steel structure and sheet metal panels that enclose the rotor.

Hub - The central connection point for the spokes. The hub's shaft ride in the bearings.

Media - The corrugated aluminum or stainless steel substrate that provides for the heat and or moisture transfer.

Motor Mount - The direct drive is mounted with a torque arm to the casing.

Purge - The purge is an angled radial seal that uses a small amount of outside air to flush the media.

Quarter Panel - The sheet metal panels that direct the airflow through the wheel.

Rem/loc button - A control on the VFD that puts the drive in remote or local control.

Rim - The outer aluminum metal encasing the media.

Rotor - The rotating portion of the heat recovery wheel.

Seals - The combination rubber and aluminum sections that seal the airstreams.

Spokes - The radial supports connecting the hub to the rim.

Speed Reducer - The speed reducer is integral to the direct drive and turns down the motor RPM.

TE - Thermotech Enterprises.

Start-up Procedures

Pre Start-Up Checks:

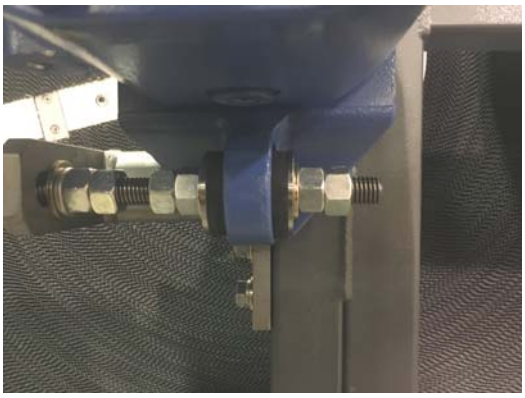
Prior to start-up, check that all foreign objects, debris and tools are removed from the AHU and the fans are off. Thermotech is not responsible for damage to the wheel or other components if the start-up procedure is not followed.

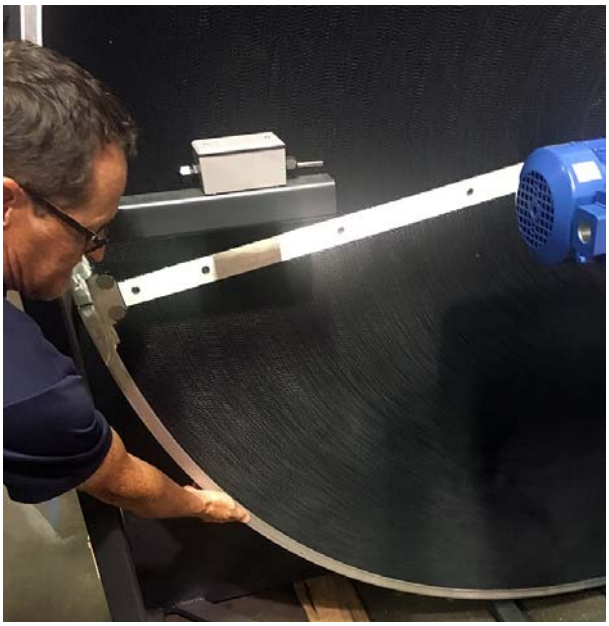
Factory Service Start-Up Procedure for T Series Energy Recovery Wheels

There is a startup checklist that must be followed and each item completed to ensure proper wheel operation. Please refer to the checklist and once completed return the check list to Thermotech Enterprises. The checklist is provided as a pdf. If you do not have a checklist contact TE and one will be provided.

Direct Drive:

1. Torque Arm installed on bracket with some play between rubber bushings.





Rotor: Hand Rotation Test.

2. Rotate the wheel a minimum of one full revolution. The seals are non-contact. If the wheel does not rotate freely it may be due to the wheel being in contact with the seal. If seal drag is noted refer to the seal adjustment procedure on page 8.If the wheel cannot be turned by hand contact TE.

3.Refer to page 5 start drive at minimum speed and note if there is any rub between rotor and seals. If wheel does not turn contact the Thermotech factory.

Purge Angle:

5. If the unit is supplied with an adjustable purge, determine the proper purge angle from the ordering code on the unit nameplate or the specific data for your project. Insure proper purge angle setting is correct by visual inspection. The minimum purge angle is 1 degree. There are 10 adjustment points in one degree increments. Refer to page 9 and verify that the purge angle adjustment bolt is in the correct adjustment hole.

Initial Lubrication:

6. Grease bearings using Dow Corning Molykote BR2-plus Lithium based high pressure grease. Apply the grease to the fitting while turning wheel until a slight amount of grease is purged. Remove visible grease residue from the bearing. The bearings are filled with grease prior to shipment. This step may be required if the units have been idle on the job site for more than 6 months.

VFD and Motor pre-checks:

8. If the unit is provided with a VFD, verify the motor is wired for the correct voltage provided by the VFD.

Final Pre-Start-Up Guide:

 During the following procedures the AHU systems fans will be on and the heat wheel drive will be energized. Only qualified personnel with experience in the operation of large rotating machinery should be involved with these procedures.

 Only qualified personnel with experience in the operation of high voltage motors and drives should be involved with these procedures. TE recommends that you become familiar with the operational manual for the ABB drive and the Carel controller manual. TE is not responsible for damage caused by improper operation and or programming of these components.

The following procedures contain references to the ABB ACS 320 and Carel pC0^{xs} Manuals. If your system is utilizing a different VFD and or controller, the start-up procedure should be performed by personnel with experience in the systems and components utilized. This guide can then be used as a frame work for start-up only. Specific programming and the steps involved may be changed for the system to operate effectively.

Hard copies of the manuals are shipped in the NEMA 4 case provided for certain units utilizing the full control system.

PDF copies of these documents are available at: ABB.com and Carel.com

Start-Up and VFD parameter checks:

The specific parameters for your product are pre-programmed at the factory and are available in appendix A . There should be no reason to change these parameters. The following checks should be made and are for the ABB ACS320 drive only. Different drives may require alternative checks and parameters.

The following steps should be performed with the fans on and set to maximum airflow in both airstreams. This will maximize the torque requirement of the motor.

9. After insuring that no personal injury or damage to the wheel will happen when wheel begins to turn, move the circuit breaker in the control panel to the on position. At this time the wheel should start in <30 seconds.

ABB ACS 320 Drive

10. Press the off button on the VFD until off is displayed. Press the start button. Reduce the speed by pressing and holding the down arrow till the 2.0 HZ is displayed in the top right of the screen. Wait until the top line lowers to 2.0 HZ

11. Amp draw should not exceed 80% of the motor's Full Load Amperage x Service Factor from the motor name plate (80% of parameter 9906). If it is too high, lower parameter 2603 by small increments, until the current is at or under 80%. Speed of the wheel should be from 1/5 to 1/2 RPM. If this parameter is too low, the wheel may not have enough torque to rotate at minimum Hz. and may need to be raised, not to exceed 80%. ((FLA x SF) x 0.80)

12. Press and hold the up arrow until the HZ shown in the top right reaches maximum (parameter 2008). The HZ output takes up to 60 seconds to catch up. Wheel speed should now be approximately 20 RPM for enthalpy and 12 RPM for sensible wheels.

13. Check amp draw to insure this does not exceed FLA x SF on motor name plate (parameter 9906). Reduce wheel speed down to min. and back to max. At no time should amp draw exceed this value.

14. Press the auto button until it displays auto. The speed of the wheel is now controlled remotely by the temperature controller. Note: to return to hand operation press stop then hand.

15. There are jumpers on the front of the drive. The left hand jumper selects analog input 1. the low position is for 0-10v output from the controller. The high position is for 4-20ma operation.

16. A jumper will be installed on the IO terminal board between terminals 24v (9) and DI 1 (12) this jumper is to be removed if a remote signal is used for start stop. Dependent on the specific options selected this remote start stop may be supplied as part of the control panel or be provided and wired by others. Where a Carel controller is used this provides start/stop and the jumper is moved to the control panel (terminals 6 and 7).

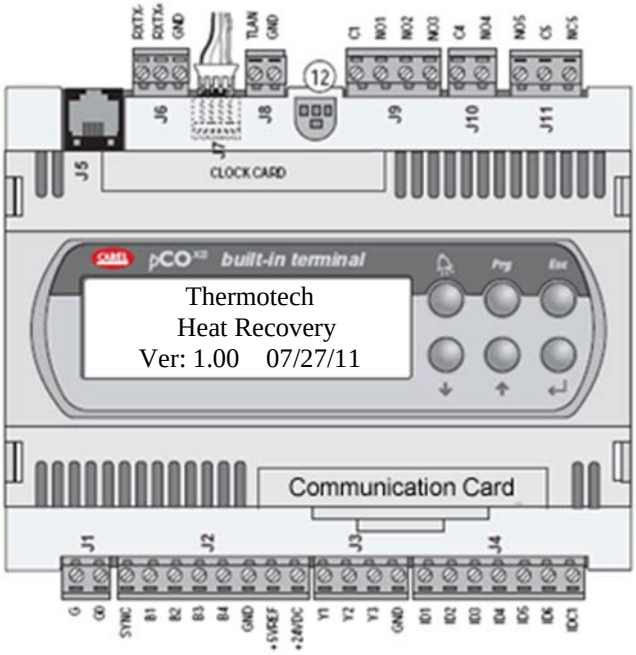
Caution: Always disconnect main power source before working on wheel, as wheel will restart automatically after power loss when power is restored.

Start-Up and Temperature Controller Checks:

The Carel pC0^{xs} is pre-programmed at the factory and is set to provide the correct sequence of operation as described on page 7 of this manual. There should be no need to change or modify any of the programming. Thermotech is not responsible for damage or improper operation caused by unauthorized re-programming.

If there is a requirement for programming changes it is strongly suggested that you contact TE before making any changes. Programming of the controller should only be performed by personnel who are thoroughly familiar with the Carel pC0^{xs} manual. A guide detailing the specific programming for this controller is available from TE on request.

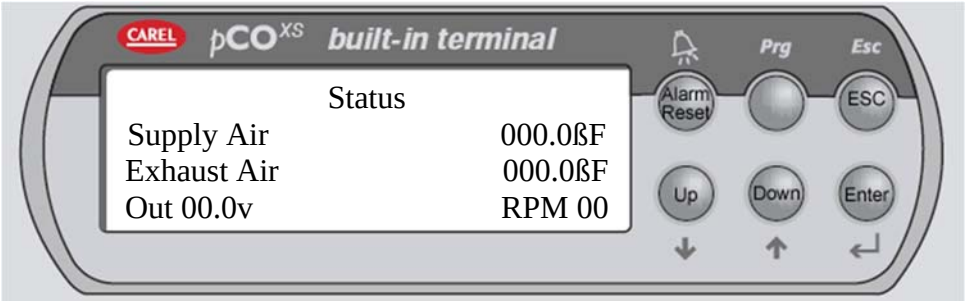
17. Verify sensor wiring B1=outside air, B2=supply air, B3=return air, and B4=exhaust air are connected to the correct terminals at the Carel controller.



Carel pC0^{xs} controller with start-up menu displayed.

Carel Controller Display Screen:

The Carel pC0^{xs} controller can provide convenient readouts of the systems current operating conditions.



Carel pC0^{xs} controller with main menu 1 displayed.

- Start-Up menu: This is the first screen that appears when the controller is powered on.
- Main Menu 1: This screen is accessed by pressing the ESC key. It shows the supply temperature, exhaust temperature, current analog output voltage and the current RPM of the wheel, providing the optional rotation sensor is included.
- Main Menu 2: This screen is accessed by pressing the DOWN key from MAIN MENU 1. It shows the outside temperature, return temperature and the current mode of operation (Heating or Cooling mode) and VFD status.
- There are many functions available on the controller panel. These include, adjusting the set points, manual control, communications and others. It is recommended that before reviewing or modifying these parameters that you obtain a Carel manual with the specific set points and programming for your controller. This manual is only available from Thermotech.

18. If a Rotation Sensor is part of the project, run the wheel for a minimum of 5 minutes at maximum and minimum RPM and verify that the controller is reading the correct RPM (main menu screen 1), and that the system does not go into alarm. It should be noted that an alarm condition will exist if the wheel stopped for more than 5 minutes or if any of the temperature sensors are disconnected or not properly connected.

Sequence of Operation

The controller receives temperature inputs from four air streams:
OA = Outside air entering the heat exchanger
SA = Supply air, conditioned outside air leaving the heat exchanger
RA = Return air from the conditioned space entering the heat exchanger
EA = Exhaust air temperature leaving the heat exchanger

OA & RA air streams use a single temperature sensor each. SA & EA air streams normally use a single temperature sensor each. Multiple sensors are used when a single controller controls multiple wheels in a common plenum.

The controller operates as follows:
Cool Mode activates when OA-RA>= x (x is a constant with default value, -3 settable from -5 to +5). The control outputs 10VDC to the VFD, resulting in a 20 RPM or 12 RPM rotation (wheel dependent). A 1˚F dead band is used between modes.

Heat Mode activates when OA-RA< x. PID control is used to maintain the SA set point. The control outputs 0 to 6VDC to the VFD. An EA set point is used in colder climates to protect the wheel from condensation and or frost. The controller will ensure the EA air stream does not go below the set point. The EA set point overrides the SA set point.

Sleep Mode stops wheel rotation. It is triggered when SA>=SA set point (in Heat Mode only). **The wheel cyclically turns on for a short period to test air temperatures.** The wheel awakes if a) SA<SA set point when the wheel stops turning or b) at any time if SA<SA set point and the OA drops below the OA measured when Sleep is initiated. Also, the wheel awakes if the mode changes from Heat to Cool or the wheel is Disabled.

Disable – The owner may enable/disable the controls using a dry contact input. This stops wheel rotation completely. The wheel will not cycle on and off.

When a **rotation sensor** is incorporated, the controller indicates wheel speed. The sensor pulses once for each revolution and the controller counts these pulses. Update time is dependent on wheel speed.

Alarms are auto resetting. An alarm cannot be reset manually but resets when its trigger is fixed.
The alarms' statuses are available on the controller screen for:
Temperature probes – the controller checks the temperatures are within range.
Rotation alarm – if the wheel does not rotate for 5 minutes, this alarm triggers.
A dry contact switching output is provided to indicate when any alarms are triggered.

How the alarm functions for different modes:

	Cool and Heat	Sleep	Disabled
Temp. Probes	Active	Active	Active
Rotation Sensor	Active	Inactive	Inactive

Post Start-Up Checks

Post Start-Up Check List:

The following procedures will verify that the controller is modulating the wheel speed and that summer winter change over is functioning.

If controller is in the cooling mode, the controller can be forced into the heating mode by raising the return air temperature sensor above the outside air temperature sensors reading. This will put the controller in the heating mode and slow the wheel to 12 RPM or less.

If the controller is in the heating mode, raise the outside air temperature sensor above the return air temperature sensors reading. This will put the controller in the cooling mode and the wheel speed should increase to 20 RPM

A visual inspection of all 4 quadrants of the heat wheel is a good last step. Check that all tools and other equipment are removed.

At this point the Thermowheel ® should be functioning smoothly.

Seal Adjustment Procedure

Seal Adjustment Guide:

The seals are set at the factory and should not require adjustment. If the seals are rubbing on the media face, due to installation or other factors, the seals will need to be adjusted.

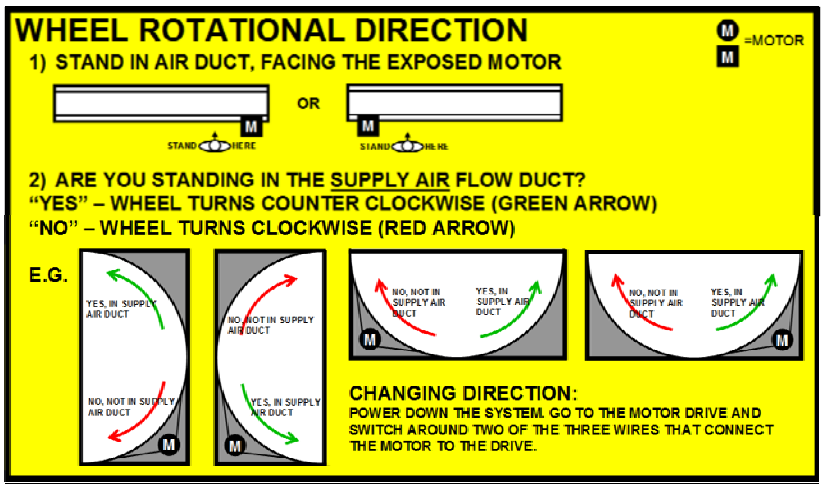
First, rotate the wheel one full revolution and determine where the wheel media face is rubbing on the seal. Working on one seal quadrant at a time, loosen the seal Tek screws. Then, move the seal away from the wheel surface until no more rubbing is noticed.

Loosening of Tek screws prior to seal adjustment.

A typical large diameter wheel will have a flatness variation of 1/16” from the high to the low point of the wheel surface. If the seals are adjusted correctly, the seal gap will vary that much as the wheel turns, but it should never be touching the wheel surface.

Wheel Rotation Check:

Use the directions to the right to determine the correct direction of wheel rotation. If the direction is incorrect, follow the instructions to change the motor wiring



Purge Adjustment Procedure

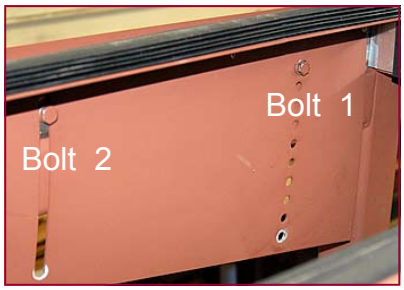
Refer to specific project data to determine if the purge angle is preset or needs to be adjusted after install. Contact Thermotech if you need to determine the proper purge angle.

Note: The wheel motor and systems fans should be off while performing this procedure. Care should be taken while working around the media so no damage is done to the media face.

Purge Adjustment For TF Series Wheels:

The purge angle can be adjusted with each purge setting hole equal to one degree. The bolts that position the purge angle are located on the backside of the purge and are not visible. First loosen bolt 2 and 3. Then remove the bolt 1. The whole purge section is then movable to a new location. Re-install bolt 1 in the new hole location and re-tighten all the bolts.

Purge angle detail showing bolt locations on front side of purge.



Purge angle detail showing bolt locations on back side of purge with no media or rotor installed.

Maintenance and Cleaning

MAINTENANCE PROCEDURES:

Rotor Bearings:

The main rotor bearings have been sized for an L-10 life of a minimum of 25 years; operating 24 hours per day, 7 days a week. The main reason for a main bearing to fail would be a lack of lubrication or hardening of existing grease in the bearing due to evaporation or by penetration of moisture causing corrosion. The bearings are filled with grease at our factory or at the time of start-up to eliminate a future failure. A small amount of grease should be added every 6 months in order to maintain fresh grease inside the bearing. Any excess purged grease needs to be wiped off to avoid it getting blown on to the wheel surface.

All our bearings are greased with a Dow Corning Molycote BR2 Plus Grease which is available through most bearing distributors or from McMaster-Carr Supply Co.

Drive System:

The direct drive is grease lubricated at the factory and requires no maintenance.

Cleaning:

The wheel media does not require any cleaning under normal operating conditions and proper maintenance of the drive systems and main bearings. The key is to make sure the wheel is always turning in order to utilize the counter flow airstreams and the purge sector to keep the media clean. Over the years there might be some accumulation of dirt on the face of the media but the inside will remain clean.

The best method to clean is to brush the surface on the air discharge side with the airflow on or by using a vacuum cleaner. A 2,300 psi pressure washer can be used in situations where the media is severely clogged. Care should be taken to not damage the media face by the full force of the spray. It is recommended that you test the pressure cleaning method on a small area of the media.

Troubleshooting

All Thermotech products are tested at the factory and should function normally upon start-up. In the unlikely event of a problem here are some basic troubleshooting steps.

Do not hesitate to contact TE for assistance with any of these issues.

Symptom	Solution
Wheel Does Not Turn	If a Carel controller is provided, depending on the software version, the wheel may be in sleep mode. Access main menu 2 as detailed on page 6 and note if readout states VFD sleep. This is a normal condition for sleep mode. If a remote enable / disable is provided check that it is enabled. If not provided check that a jumper is installed per the wiring diagram. Access main menu 2 as detailed on page 6 and note if readout states VFD off. Check circuit breaker. Visual inspection to confirm no seal rub. Restore power. Verify proper power to VFD. Verify proper power to motor. and connections. If motor is energized and not turning, contact TE.
Wheel Rotation Direction Incorrect.	Reverse power connections to motor.
Noise	Some minor noise should be expected as the wheel spokes pass the lateral or vertical seals. If there is a constant scraping or intermittent scraping, this could be seals rubbing on the rotor. Refer to page 3 to check free rotation of the rotor. If there are other loud or unexpected sounds or vibrations, contact TE.
Wheel RPM Incorrect	For variable speed wheels. An enthalpy wheel should operate in a range from 20 to 1/3 RPM in Summer and 12 to 1/3 RPM in Winter. A sensible wheel should operate in a range from 12 rpm to 1/5 RPM. Refer to page 7 and verify that the sequence of operation is correct. Check sensor wiring, controller and VFD connections. If wheel is still at incorrect RPM, contact TE.
Wheel RPM Readout Incorrect	On units with a rotation sensor; if the sensor is not reporting accurate RPM. First determine actual wheel RPM with a stopwatch. Compare this to the readout. The rotation sensor should be within 1/8” of the target to accurately report RPM. If read out is still incorrect, contact TE. The rotation sensor can have a lag time of up to 5 minutes in reporting correct RPM.
Incorrect Temperature Readings	Verify sensor wiring. Typical sensor resistance is a nominal 10K Ω at 72°. Verify sensor location. The supply and exhaust sensor location are critical for accurate readings. Refer to the installation manual for correct sensor location.
High air loss.	Check seals, refer to page 8 for seal adjustment procedure. Other causes for high air loss may be due to problems in the AHU.
High pressure drop.	Check wheel face for obstruction and fouling. If the wheel face is clogged, it may be cleaned by brushing the surface with the airflow on or by using a vacuum cleaner. A 2,300 psi pressure washer can be used in situations where the media is severely clogged. Care should be taken to not damage the media face by the full force of the spray. It is recommended that you test the pressure cleaning method on a small area of the media.

APPENDIX A

- Warranty Statement

THERMOTECH ENTERPRISES
5110 W. Clifton Street Tampa, FL 33634 Tel (813) 865-4701 www.thermotech-usa.com

TF and TR Series 10 YEAR PARTS & LABOR WARRANTY

TC Series 3 YEAR PARTS & LABOR WARRANTY

This warranty covers the items listed in this manual and starts on the date listed on the cover of this manual.

Warranty Statement:

This warranty includes all* equipment as stated herein, materials, and workmanship associated with the energy recovery wheels and accessories provided and installed by Thermotech. All material is warranted to be free from defects in material and workmanship when used in a proper and normal manner. Should any failure to conform to the above appear within the warranty period, Thermotech Enterprises shall upon prompt notification and confirmation that the product has been stored, installed, started, operated, and maintained properly, and in accordance with the THERMOWHEEL® OWNERS MANUAL and STARTUP CHECKLIST, correct the non-conformity at Thermotech's option, either by repairing any defective part or by providing a repaired or replacement part. Installation labor where applicable, will be provided at no additional cost to the owner.

The completed startup checklist must be returned to Thermotech Enterprises within 30 days of unit on site operation to activate warranty.

* This warranty applies to drive and control components when purchased and assembled by Thermotech. If control components and/or variable frequency drive are provided by others, Thermotech will provide motor manufacturer standard warranty only.

THERMOTECH ENTERPRISES

DC-EG-006

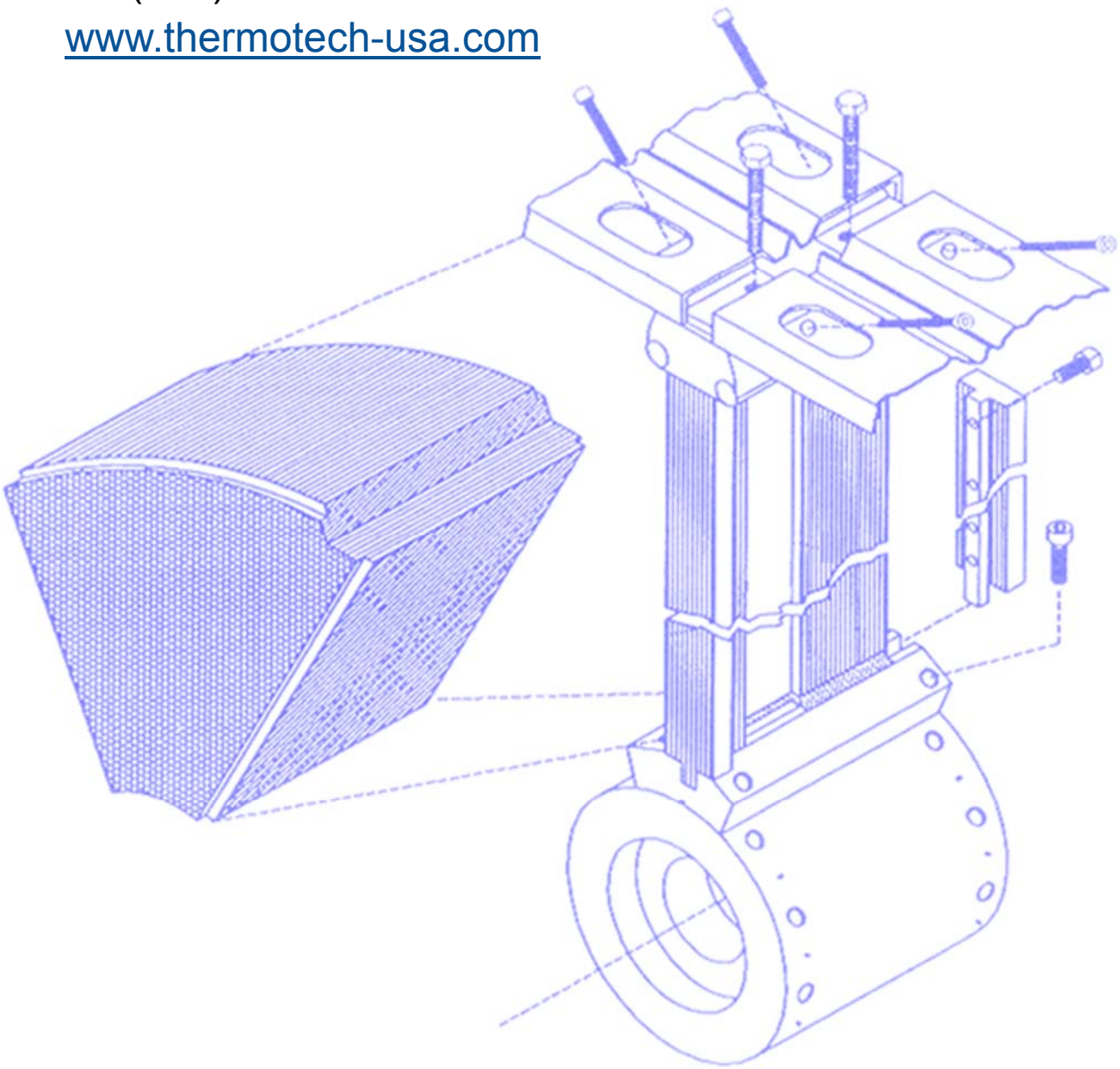
Rev. 4/16/14

THERMOWHEEL

THERMOWHEEL FIELD STARTUP CHECK LIST FOR T SERIES-Units

PROJECT NAME:	**DATE:**	
CITY & STATE:	**A.H.U. #:**	
TEI MODEL #:	**SER #:**	
REFER TO THE OM FOR THE FOLLOWING STEPS, SPECIFIC SETTINGS ARE IN THE APPENDIX (PAGE #17 OM)		
VFD VOLTAGE : PHASE:		
DESCRIPTION OF STARTUP STEP	**COMPLETED BY:**	**COMMENTS OR TORQUE VALUE USED**
VERIFY MOUNTING ARRANGEMENT AND CORRECT INSTALLATION		
WHEEL ROTATION BY HAND TEST (PAGE #3 OM)		
SEAL CHECKED FOR RUBBING (PAGE #3 OM)		
WAS RE-ADJUSTMENT OF SEALS REQUIRED (PAGE #8 OM)		
SIDE SEAL CHECK (PAGE #3 OM)		
SEALS SET TO WITHIN 0.06" TO HIGH POINT OF WHEEL (PAGE #8 OM)		
PURGE ANGLE CHECK (PAGE #9 OM)		
WAS RE-ADJUSTMENT OF BEARINGS REQUIRED (PAGE #3 OM) NOTE: BEARING BOLT SIZE AND TORQUE VALUE USED		
CHECK PILLOW BLOCK BEARING SET SCREWS ARE TIGHTENED		
TOP OFF BEARINGS WITH BR2+ LITHIUM BASED GREASE		
VERIFY GREASE PURGES FROM BEARING AND REMOVE EXCESS		
SECONDARY SPOKES INSTALLED / TIGHT AGAINST PRIMARY SPOKES		MAX TORQUE LIMIT 40 FT.LBS.
RIMS PULLED TIGHT AND RIM BOLTS TORQUED TO 60-70 FT.LBS.		
OVERALL ROTOR & MEDIA ROTATION FLATNESS OF +/- 1/32 "		
VERIFY MOTOR WIRED FOR CORRECT VOLTAGE (PAGE #4 OM)		
MOTOR INSTALLED WITH TORQUE ARM INSTALLED PER(PAGE # 4 OM)		
PULL INSPECTION COVER ON DRIVE AND VERIFY KEY IS INSTALLED		
VERIFY ALL SENSORS ARE CORRECTLY WIRED		
ROTATION SENSOR MOUNTED AND CHECKED OUT		
START WHEEL IN LOCAL MODE		
VERIFY WHEEL ROTATION DIRECTION (PAGE #8 OM)		
RECORD RPM @ MIN @ MAX (PAGE #8 OM)		CHECK WITH STOP WATCH
FOLLOWING TESTS WITH FANS @ MAX RATED AIRFLOW		TURN ON FANS
RECORD AMPS @ MIN @ MAX (PAGE #5 OM)		
ROTATION SENSOR READING @ MIN @ MAX		FOR UNITS WITH ROTATION SENSOR ONLY
RUN UNIT FOR 5 MIN. @ MIN VERIFY NO ROTATION ALARM		FOR UNITS WITH ROTATION SENSOR ONLY
SET VFD TO REMOTE OPERATION		
VERIFY ALL TEMP READINGS		FOR UNITS WITH CONTROLER ONLY
OA= RA= SA= EA= (PAGE #6 OM)		FOR UNITS WITH CONTROLER ONLY
NOTE MODE OF OPERATION COOL OR HEAT		FOR UNITS WITH CONTROLER ONLY
VERIFY UNIT IS MODULATING WHEEL SPEED TO ATTAIN SA SET POINT		IN COOLING MODE MAX SPEED ONLY WILL NOT ATTAIN SET PT.
PLEASE RETURN CHECKLIST TO Thermotech ATTN: STARTUP		jshields@thermotech-usa.com
NOTE ANY PROBLEMS:		
	TECHNICAN:	
STARTUP COMPLETE	**CUSTOMER:**	

Thermotech Enterprises
5110 W. Clifton Street
Tampa, FL 33634
Tel (813) 865-4701
www.thermotech-usa.com



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