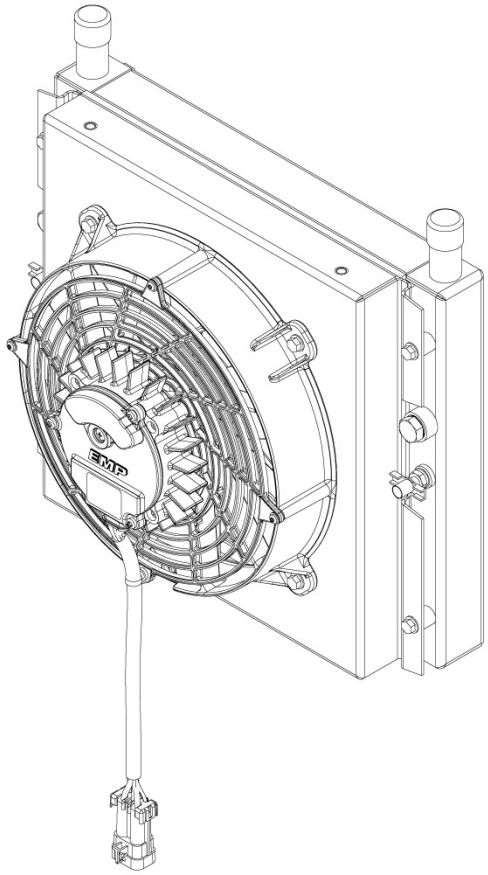
Installation and Service Manual
TK1 Thermal Systems with FIC11 or FIL11 Fans



This installation manual is effective for aftermarket installations of the following part numbers:

Part Number	
2020023067	2020023076
2020023071	2020023077
2020023074	2020023078
2020023075	2020023079

Rev	Rev By	Date	Description of Change	Approved By
B	ME	4/29/21	Revisions	ECN7265
C	ME	5/19/22	Revisions	ECN7627

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service@emp-corp.com

Product Overview

The EMP TK1 thermal system is designed to provide auxiliary cooling for water-glycol cooled systems.

The EMP TK1 thermal system can also be applied to any water, glycol, or other fluid system with similar hydraulic properties for the purpose of cooling the auxiliary system.

The fan type, voltage and airflow direction are shown on the fan product label.

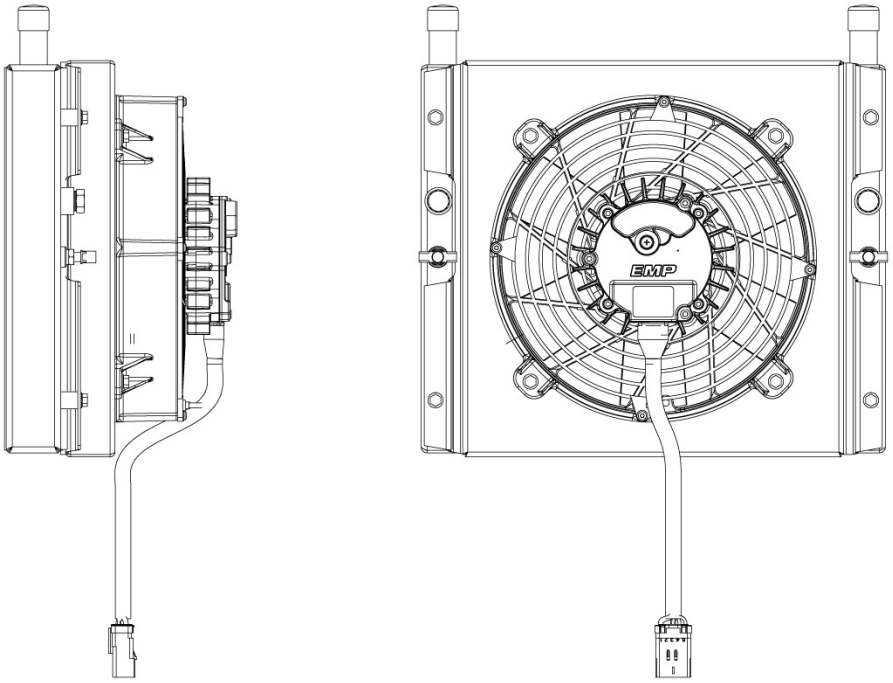


Table of Contents

Introduction

Purpose

The purpose of the Service Manual is to present information and procedures required to properly service and maintain your cooling system.

Service Technician Responsibilities

Ensure that all safety messages and information messages are read and understood before installation, maintenance, or repairs are performed. It is important to use caution when service work is performed. Knowledge of impacted systems and their operation are important before the removal or disassembly of any component.

Liability Disclaimer

EMP cannot anticipate every possible circumstance that might involve a potential hazard. The safety messages in this document, in related manuals, and on the product are therefore not all inclusive. If a tool, procedure, work method, or operating technique that is not specifically recommended by EMP is used, you must satisfy yourself that it is safe for you and for others. You should ensure that the product will not be damaged or be made unsafe by the operation, maintenance, or repair procedures that you choose.

More Information

Documents and software referenced in this manual are available for download from the support section of the EMP website, https://www.emp-corp.com/support/.

Routine Maintenance

Routine maintenance schedule and procedures are outlined in service bulletin 9910039031.

Technical Help

Contact EMP Technical Service for technical help at +1 (906) 789-7497 or service@emp-corp.com.

Warranty

Mail, Fax, or Email the completed warranty registration form at the end of the document to:

EMP Advanced Development, LLC
2701 North 30th Street
Escanaba, MI, USA 49829
FAX# +1 (906) 789-7825
warranty@emp-corp.com

About This Document

Warnings, Cautions and Notes

Two headings are used in this document to stress your safety and safe operation of the system. They are styled with a graphic bullet and bold, uppercase text: **WARNING** and **CAUTION**. Warnings highlight risks to personnel — hazards, unsafe conditions and practices that can result in personal injury or death. Cautions indicate conditions or practices that can cause damage to components, systems, or other equipment.

A third heading, styled as **NOTE**, calls attention to additional information about components and procedures discussed in the document.

Definition of Terms

CAN ..... Controller area network.
CAN Control.....Fan motor speed controlled by CAN messages.
EMP-Link Control .....Fan motor speed controlled by EMP-Link messages (for use with EMP system controllers).
FIC11 ..... 11” fan with CAN communication.
FIL11..... 11” fan with EMP-Link communication.
On/Off Control.....Fan runs when ignition enable signal is present.
PWM Control.....Fan motor speed controlled by PWM signal input.
Temperature Input Control.....Fan controller monitors thermistor input and controls fan motor to a corresponding calibrated speed.

Product Safety Warnings

⚠ **WARNING:** EMP cannot anticipate every possible circumstance that might involve a potential hazard. The safety messages in this document, in related manuals, and on the product are therefore not all inclusive. If a tool, procedure, work method, or operating technique that is not specifically recommended by EMP is used, you must satisfy yourself that it is safe for you and for others. You should ensure that the product will not be damaged or be made unsafe by the operation, maintenance, or repair procedures that you choose.

⚠ **WARNING:** Ensure that all safety messages and information messages are read and understood before installation, maintenance, or repairs are performed. It is important to use caution when service work is performed. Knowledge of impacted systems and their operation are important before the removal or disassembly of any component.

⚠ **WARNING:** Make sure the equipment cannot move before doing any work or diagnostic procedures on the EMP component, system, or vehicle.

⚠ **WARNING:** When working near electric components, ensure they cannot activate unexpectedly. Remove power or utilize lock out switches.

⚠ **WARNING:** Use extreme caution when working on systems under pressure (i.e. coolant, hydraulic fluids, air, fire suppression, etc.).

⚠ **WARNING:** Make sure the work area is ventilated and well lit.

⚠ **WARNING:** Make sure charged fire extinguishers are in the work area.

⚠ **WARNING:** Reinstall all safety guards, shields and covers.

⚠ **WARNING:** Make sure all tools, parts and service equipment are removed from the work area.

⚠ **WARNING:** Ensure that all system power and ground connection points are torqued to EMP and/or OEM specifications to prevent system damage. Failure to follow specified torque requirements can result in loose connections which can damage electronic components and will void EMP warranty.

Theory of Operation

NOTE: For exact controller parameters, Contact EMP Technical Service with the serial number of the component.

Operation

FIC11 systems support on/off, CAN and temperature input control.

FIL11 systems support on/off, PWM and EMP-Link control.

For more information about interfacing with the fan, refer to *Service and Installation Manual 11 Inch Axial Fan Assembly*, EMP document 9980036021.

Power

1. Ignition enable signal required
   - For 12V system, 9–16 volts.
   - For 24V system, 18–32 volts.
   - Maximum 5 amps.
   - 5-amp fuse should be installed on ignition enable line.
2. System (fan) power must be fused at 30 amps.

Heat Rejection

NOTE: Heat rejection curves are for systems with EMP fans.

Inlet Temperature Differential (ITD) = (fluid temperature into cooler - air temperature into cooler)

The performance of the system can vary ±10%.

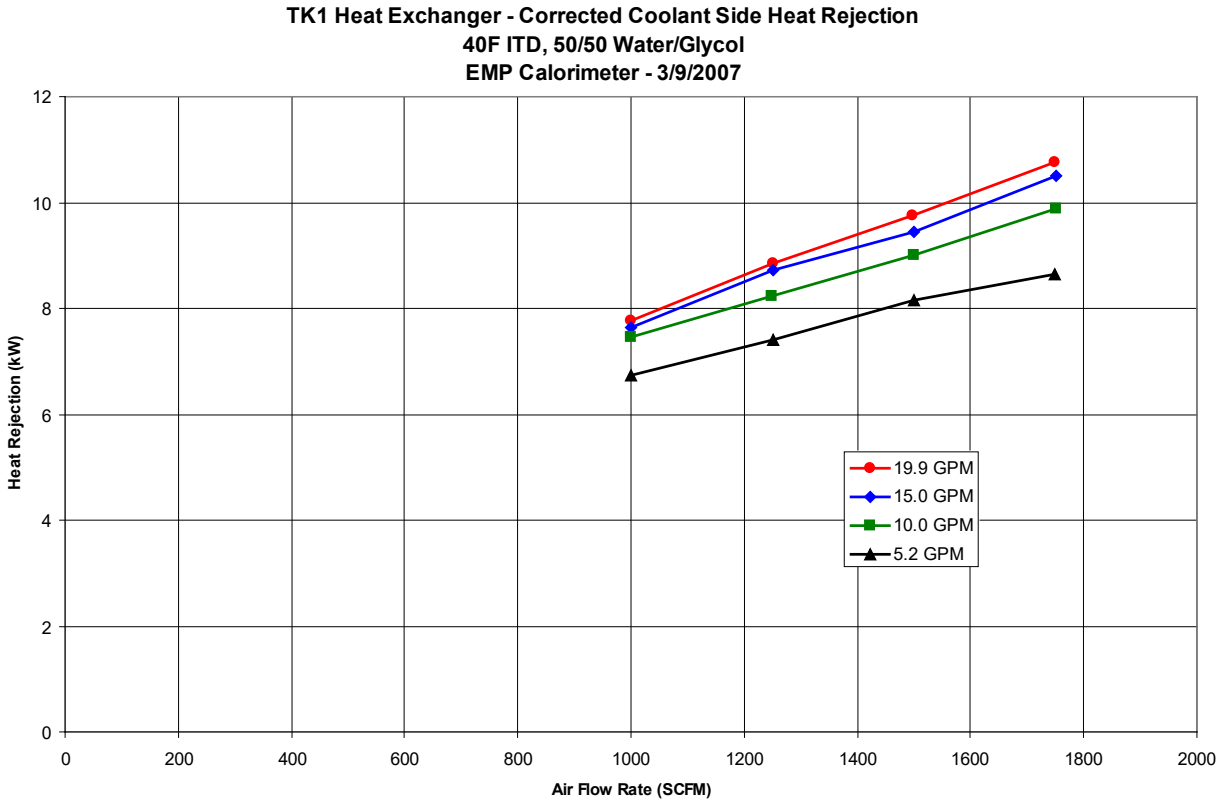
No external system restriction or airflow recirculation represented in test data. The system must be validated in the application to determine the affect additional system restriction and airflow recirculation have on performance.

4000 rpm is the maximum speed setting on 12V TK1.

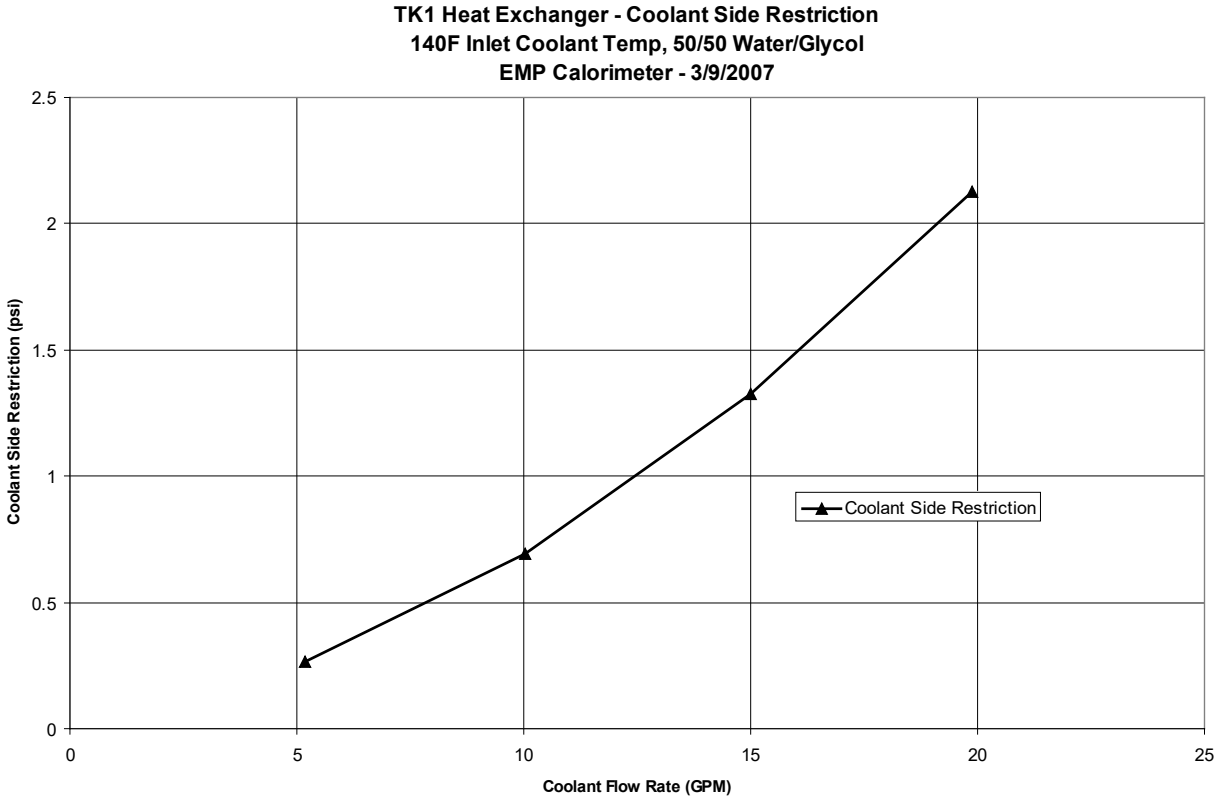
4600 rpm is the maximum speed setting on 24V TK1.

Depending on ambient conditions and duty cycles, cooler performance exceeding 4600 rpm can be achieved with 24V systems. Contact EMP to discuss these special cases.

The test results are for fans in puller configuration. Contact EMP for pusher configuration data.



11” Fan Speed	Air Flow Rate (SCFM)
4000	1000
4500	1250
5000	1500
5500	1750

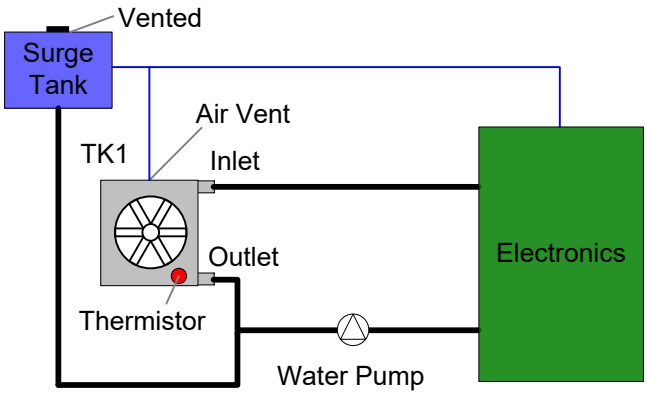

TK1 Heat Exchanger - Coolant Side Restriction
140F Inlet Coolant Temp, 50/50 Water/Glycol
EMP Calorimeter - 3/9/2007
Coolant Side Restriction (psi)
2.5
2
1.5
1
0.5
0
0
5
10
15
20
25
Coolant Flow Rate (GPM)
Coolant Side Restriction

Plumbing Schematics

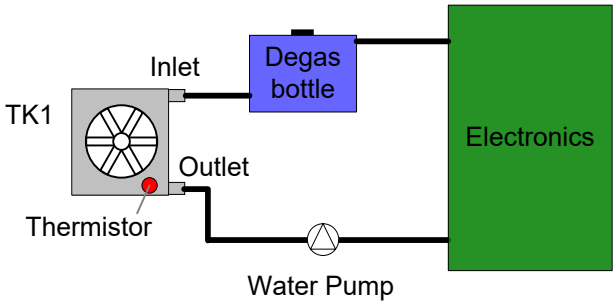
Electronics Cooling – Low Temperature Applications

NOTE: Thermistor for low temperature applications is to be located on the outlet side of the TK1.

NOTE: A vented surge tank suitable for use in electronics cooling circuits is available from EMP, part number 1370023082.



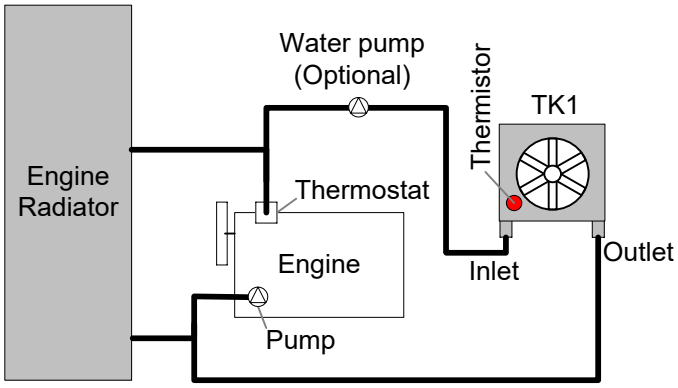
Vented Auxiliary System Schematic



Non-Vented Auxiliary System Schematic

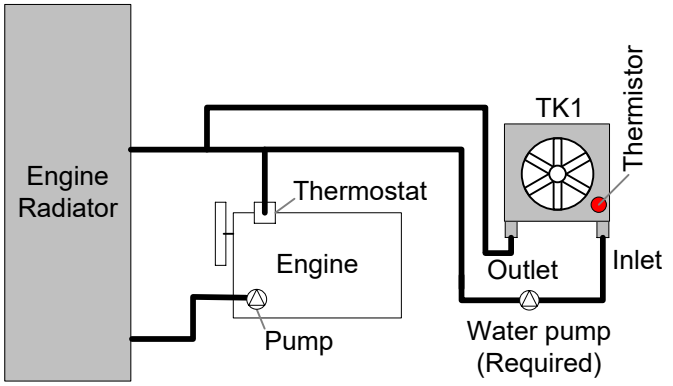
Auxiliary Engine Cooling – High Temperature Applications

NOTE: Thermistor for high temperature applications is to be located on the inlet side of the TK1.



Auxiliary Engine Cooling – High Displacement Engine Schematic

NOTE: Secondary cooling schematic shows system plumbed into the vehicle cooling system in parallel to the main cooling system for large displacement engines.



Auxiliary Engine Cooling – Low Displacement Engine Schematic

NOTE: Secondary cooling schematic shows system plumbed into the vehicle cooling system in parallel to the upper radiator hose for low displacement engines.

Electrical Schematics

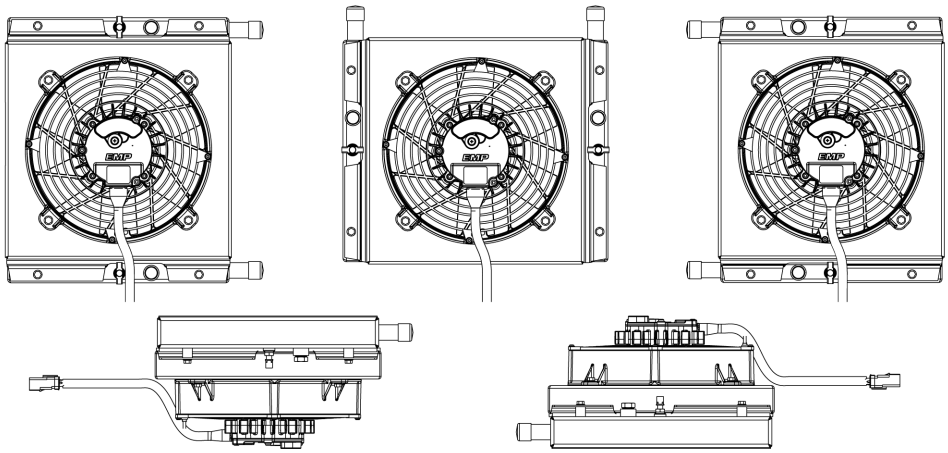
Refer to the application examples in *Service and Installation Manual 11 Inch Axial Fan Assembly* for electrical wiring schematics.

System Installation

Heat Exchanger and Fan Orientation

The hose barbs on the end of the tanks cannot be lower than the rest of the tank.

If the fan will be exposed to water spray, the grommet where the harness enters the motor cavity should be pointed down to avoid pooling of water at the grommet. If necessary, remove and reinstall fan oriented with the fan harness exiting the fan motor facing down as installed. Torque the four M6-1 x 16 fan mounting bolts to spec.



Proper Orientation

Improper Orientation

Harness Management

Harnesses should be supported every 12 to 18 inches.

Support connectors to avoid strain and side loads.

Use drip loops to reduce water contact with connectors.

Auxiliary Engine Cooling Installation

NOTE: Additional fittings, pipes, and/or hoses will be required to complete the installation of the cooling system.

Location

- Choose a rigid spot on the vehicle frame rail or body that is exposed to ambient air (cleaner/cooler is better) and as close as possible to the radiator pipes to minimize the length of the coolant hoses.
- Consider the routing of the hoses and power cables when selecting the location.

⚠ **CAUTION:** Any hosing, tubing, battery cable, wiring or electrical harness must not rub on a sharp edge.

⚠ **CAUTION:** Any hosing, tubing, battery cable, wiring or electrical harness must not rub or make contact with a hot surface. There should be 5” minimum clearance from the exhaust.

NOTE: Any hosing, tubing, battery cable, wiring or electrical harness should be supported at least every 18" to 20".

Installation for larger displacement engines with high coolant flow from engine water pump

NOTE: Do not allow the port and hose routing to be the highest point in the cooling system. The upper radiator pipe is usually close to the highest point in the engine cooling system. A high placement of the port can allow air to enter the auxiliary system if the cooling system level is not full.

Route supply plumbing from the upper radiator pipe, between the thermostat and main radiator to the TK1 cooler. Route return plumbing from the TK1 cooler to the lower radiator pipe, between the main radiator and main engine water pump.

Keep the following in mind when selecting port locations for the upper and lower radiator pipe:

- Account for routing of 1” heater hose covered with convoluted tubing running to the ports.
- Orient the new ports so that the hose routings will be out of the way of other components on the engine.

Installation for smaller displacement engines with lower coolant flow from engine water pump

NOTE: Do not allow the port and hose routing to be the highest point in the cooling system. The upper radiator pipe is usually close to the highest point in the engine cooling system. A high placement of the port can allow air to enter the auxiliary system if the cooling system level is not full.

Route supply and return plumbing between the upper radiator pipe and the TK1 cooler. The supply plumbing should connect to the upper radiator pipe after it exits the thermostat on the engine and before it goes into the main radiator. The return plumbing should connect to the upper radiator pipe between the supply connection and the main radiator.

- The upper radiator hose must be cut to allow installation of the supply and return lines.

Auxiliary Electronics Cooling Installation

NOTE: Additional fittings, pipes, and/or hoses will be required to complete the installation of the cooling system.

Location

- Choose a rigid spot on the vehicle frame rail or body that is exposed to ambient air (cleaner/cooler is better) and as close as possible to the electronics reservoir to minimize the length of the coolant hoses.
- Consider the routing of the hoses and power cables when selecting the location.

Installation

⚠ **CAUTION:** Any hosing, tubing, battery cable, wiring or electrical harness must not rub on a sharp edge.

⚠ **CAUTION:** Any hosing, tubing, battery cable, wiring or electrical harness must not rub or make contact with a hot surface. There should be 5” minimum clearance from the exhaust.

NOTE: Any hosing, tubing, battery cable, wiring or electrical harness should be supported at least every 18" to 20".

Route (2) 1” heater hose lengths wrapped in 1¼ split conduit from the TK1 to the ports on the electronics reservoir.

NOTE: When utilizing a water pump, it must be installed on the TK1 outlet side.

Service Parts Replacement

NOTE: Reference the service drawings for important notes, specifications, component locations, orientations, and torque specifications. Service drawings for this manual can be obtained at https://www.emp-corp.com/support/documents/ by searching for the system part number.

Connector Greasing

NOTE: See *Service Bulletin Approved Grease*, document 9910039075, for a list of dielectric grease products that have been approved for use in maintenance and service.

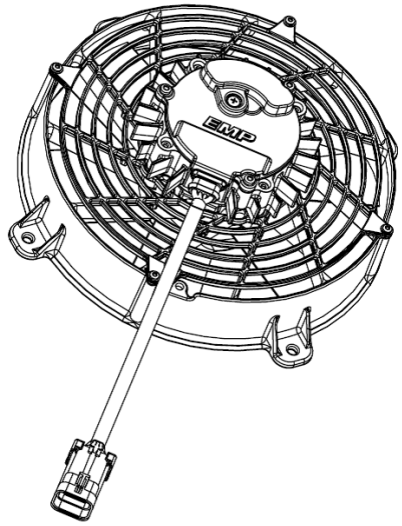
NOTE: Only use clean dielectric grease.

1. Apply dielectric grease to each harness side electrical connector. See the table below for specified grease amounts.
2. Remove any excess grease after proper connections have been made, if needed.

Reference Quantities

Grease	Description
1.25 g	7-pin Fan Connectors
None	10-pin Fan Connectors

FIC11/FIL11 Fan



WARNING: To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components. When working on or near the electrical fans, ensure battery power is off or lockout vehicle ignition so the system cannot activate unexpectedly.

NOTE: Take note of any harness fastener locations and orientations that are attached to the fan, prior to removal (edge clip mount zip ties, fir tree mount zip ties, p-clips, j-clips, connector mounting clips, etc.).

Removal

1. Cut/remove any zip ties that are securing the fan.
2. Disconnect the fan connector from vehicle connector.

NOTE: To avoid damaging the wires and/or pin connections, do not pull back using the wire harness to disconnect the connection. Wiggling the connector body will help in freeing the connection.

NOTE: Ensure the harness connector electrical sockets remain free of dirt to ensure a solid electrical connection when reconnecting to the components.

3. Remove the fan mounting bolts (4 places).

NOTE: The fan mounting bolts will be reused when installing the replacement fan.

Installation

CAUTION: To avoid potential damage to the wiring, route all wires away from any sharp edges, moving objects, and heat sources.

CAUTION: All wires should be secured every 12–18 inches. All zip ties must be placed over wire loom/convoluted tubing and not over bare wires.

NOTE: Reference the service drawings for component part numbers, important notes, specifications, component locations, orientations, and torque specifications.

1. Place the replacement fan onto fan shroud and orient per the installation notes or service drawing.

NOTE: Pre-coat the first few threads of the mounting bolts with Loctite 242 prior to reinstalling.

2. Install any harness fasteners (p-clips or j-clips), if applicable, onto the fan mounting holes that were removed during the removal process, along with the (4) mounting bolts. (Reference the service drawing for fasteners and locations).
3. Torque the fan bolts to specification using a crisscross pattern for torque sequence.

NOTE: Ensure the fan and all hardware have been replaced per the service drawing.

4. Clean any dust and debris from the harness connectors.
5. Connect the fan to the vehicle connector.

NOTE: Ensure that the locking tabs are fully engaged.

Shroud

⚠ **WARNING:** To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components.

⚠ **CAUTION:** The system is mounted to the vehicle via the shroud. You may choose to drain and remove the entire system or support the filled heat exchanger (radiator) when replacing the shroud.

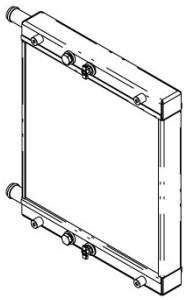
NOTE: Replace the foam seal when replacing the shroud.

1. If applicable, disconnect the fluid thermistor from the harness. This is done by lifting the locking tab on the harness and pulling the connector away from the mating connector.
2. (Optional) Allow the system is cool and fully drained the coolant. Disconnect the hoses and hose clamps and then remove the cooler from the vehicle.
3. Disconnect the fan from the controller.

NOTE: A fan that has been rotated to account for water spray should be reinstalled in the modified orientation.

4. Remove the fan from the shroud by turning the four mounting fasteners counterclockwise.
5. Detach the heat exchanger from the shroud by turning the 4 fasteners counterclockwise. If leaving the heat exchanger connected to the cooling system, ensure it is well supported before removing the fasteners.
6. Remove the used foam seal from the shroud and heat exchanger.
7. Attach new foam seal to the replacement shroud and trim to fit.
8. Assemble the fan to the replacement shroud using the M6 x 16 mm flange head fasteners. Ensure the orientation of the fan matches the initial installation. Coat the last 3–4 threads with a medium strength thread locker similar to Loctite 242 and torque to spec.
9. Assemble the shroud with fan onto the heat exchanger using the M6 x 16 flange head fasteners. Coat the last 3–4 threads with a medium strength thread locker similar to Loctite 242 and torque to spec.
10. If applicable, reinstall the fan/shroud/heat exchanger assembly on the vehicle.
11. Connect the fan controller to the fan.
12. If applicable, connect the fluid thermistor to the harness prior to providing power, ground and ignition enable to the system. Make sure the connectors are fully seated.

Heat Exchanger



TK1 Heat Exchanger Assembly

⚠ **WARNING:** Contents under pressure — Do not replace the heat exchanger while the system is hot.

NOTE: Replace the foam seal when replacing the heat exchanger.

1. Ensure the system is cool and fully drained prior to removing heat exchanger.
2. Remove the hose clamps from the inlet and outlet and then remove the hoses.
3. If the fluid thermistor is mounted in either tank of the heat exchanger, the thermistor must be removed. Disconnect the fluid thermistor from the system harness by lifting the locking tab on the connector of the system harness and pulling the connector away from the thermistor. Remove the thermistor by turning in a counterclockwise rotation.
4. (Optional) Disconnect the fan from the controller and remove the fan/shroud/heat exchanger assembly from the vehicle.
5. Remove the heat exchanger from the shroud. There are four M6 x 16mm fasteners that attach the heat exchanger to the shroud. Remove these fasteners by turning them counterclockwise.
6. Remove the used foam seal from the shroud and heat exchanger.
7. Place the fan shroud in a location where it will not be damaged until it is assembled on to the new heat exchanger.
8. If the thermistor was located in the top or bottom tank on the original heat exchanger, re-assemble the thermistor into the same location on the new heat exchanger. Assemble the thermistor per the instructions in this document.
9. Attach new foam seal to the shroud and trim to fit.
10. Assemble the new heat exchanger to the shroud/fan/harness assembly using the fasteners. Use a medium strength thread locker (Loctite 242 or equivalent) to prevent the fasteners from loosening over time. Torque to spec.
11. (If applicable) Install the assembled unit on the vehicle.
12. Attach the inlet and outlet hoses to the heat exchanger, securing with hose clamps.
13. Refill the system and ensure there are no leaks.

Troubleshooting

See the appropriate Diagnostic Outputs section in the appendices to *Service and Installation Manual 11 Inch Axial Fan Assembly* for information about communicating with a fan.

Additional troubleshooting information is available and varies by fan type:

FIL11 9980036083 – *Troubleshooting Manual CP02*
FIC11 9980039116 – *Troubleshooting Manual CP14*

Symptom	Check
Fan will not start	• Ensure the fan connector is properly seated. • Verify the fan is receiving battery voltage. • Verify the ignition enable line is seeing battery voltage. • With power disconnected verify the fan spins freely. • Verify the control signal (CAN/PWM) is working properly (if used).
Airflow direction is wrong	• Ensure the fan rotor has the correct airflow direction. • Ensure the fan rotor is spinning the correct direction as indicated by the arrow on the rotor. • Ensure the fan has the correct airflow direction on the label. • Verify the controller parameters with EMP.
Fan is reversing at the incorrect intervals or not reversing	• Verify the controller parameters with EMP. • Verify the control signal (CAN/PWM) is working properly (if used).
Fan is making rattling noises when running	• Verify the finger guard is firmly attached. • Verify the fan blade is firmly attached. • Verify the mounting bolts are torqued properly.
Fan is running intermittently	• Verify ignition enable signal is not intermittent. • Verify the control signal (CAN/PWM) is working properly (if used).
Fan speed is incorrect	• Verify the controller parameters with EMP. • Verify the control signal (CAN/PWM) is working properly (if used).
Fan amperage draw is high	• Verify the fan spins freely and there is nothing rubbing when the fan is spun.
Fan amperage draw is low	• Verify the fan rotation and airflow direction are correct.
CAN not operating properly	• Verify that CAN messages are being transmitted in the proper formats (see online Technical Guide or contact EMP Technical Support for CAN message details). • Verify that the proper component CAN address is being used.

Final Items

1. Install any removed guards and panels. Ensure fluids are topped off.
2. Verify switching of ignition enable signal is independent of power and that the signal properly activates and deactivates the system.
3. Where equipped, ensure battery cut off (knife switch) controls power to the system. Check that voltage at power and ground studs goes to zero when the switch is off.
4. If an EMP water pump is used, a low level sensor must be installed and activate when level is low.
5. If an EMP water pump is integrated in system, a low level indication should generate an operator warning and or deactivate the pump.
6. Where applicable, ensure system turns off upon fire suppression activation.
7. Activate the cooling system and place the vehicle or other system into normal operation.
8. Check the system for leaks at all pipe joints.

NOTE: Refer to the Installation Check List Document (9890039139) throughout the install process to ensure all install standards are met.

Product Warranty Registration Form

A standalone PDF of this registration form suitable for electronic submission is available in the Product Documentation section of the EMP website. Search for document number 9960039049.

Product Registration

Customer Information

Customer/Business Name	
Customer Contact Name	
Customer Contact E-mail	
Customer Contact Phone	
Address	
City	
State/Province	
Country	
Postal Code	

Product Information

Product Type (Complete one form per product type. For complete thermal system assemblies you do not need to register each assembled fan, controller, and pump)

- ◯ **Electric Water Pump**
- ◯ **Individual Fan**
- ◯ **Controller**
- ◯ **EMP Alternator**
- ◯ **Oil Pump**
- ◯ **OilMate System**
- ◯ **Other**
- ◯ **Electric Fan Cooling System**
  - **# of Fans**

Model Purchased	
Part Number	
Serial Number	
Installation Date	

Model, Serial Number, and Part Number are located on the EMP product label.

Vehicle Information

Fleet ID #	
Vehicle Make/Model	
Vehicle Model Year	
Vehicle Identification Number (VIN)	
Vehicle Miles/Hours at Installation	
If New System, Alternator Serial Number	
Notes	

Contact EMP

Mail/Fax/E-Mail completed registration forms to:

EMP Advanced Development, LLC
2701 North 30th Street
Escanaba, MI, USA 49829

FAX: +1 (906) 789-7825

E-Mail: warranty@emp-corp.com