# FOFA Transformer Oil Cooler Specification with Oil Pump & Valve Specification

## TECHNICAL SPECIFICATIONS for TRANSFORMER OIL-TO-AIR COOLER

**01.0 Scope of Work:**

For the supply of forced oil / forced air transformer oil cooler satisfying the attached Technical and Mechanical Specifications.

**02.0 Technical Specifications:**

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|---|---|---|---|
| **2.1** | Ambient Air Temperature | ($^{O}$C) | per IEEE/ANSI standards |
| **2.1.1** | Minimum Temperature | ($^{O}$C) | per IEEE/ANSI standards |
| **2.1.2** | Maximum Temperature | ($^{O}$C) | per IEEE/ANSI standards |
| **2.2** | Cooling Capacity | (kW) | per IEEE/ANSI standards |
| **2.3** | Top Oil Rise | ($^{O}$K) | per IEEE/ANSI standards |
| **2.4** | Oil flow Rate | (USGPM) | per IEEE/ANSI standards |
| **2.5** | Sound Pressure Level | (dBA) | per IEEE/ANSI standards |
| **2.6** | Power Supply: | | |
| **2.6.1** | Voltage | (V) | **480 – 3W Delta** |
| **2.6.2** | Phase | (Ph) | **3** |
| **2.6.3** | Cycle | (Hz) | **60** |
| **2.6.4** | DC available | (V) | **125V DC** |

**2.8 Number of coolers per transformer the transformer must be able to reach full nameplate rating with one cooler out of service**

## 1.0 GENERAL

1.1 Transformer oil coolers shall meet or exceed the requirements of this specification. Any variations from or exceptions to these requirements must be detailed in vendors quotation.

1.2 The transformer coolers must incorporate designs with a minimum of 10 years proven reliability in the transformer industry.

## 2.0 COOLING CAPACITY

**2.1** KW heat dissipation must meet or exceed the OEM design criteria.

**2.2** The cooler must be designed such that oil flow rate through the transformer meets the OEM design criteria.

**2.3** The transformer Top Oil Temperature rise shall be less than or equal to the required temperature as specified by the OEM.

## 3.0 HARDWARE

3.1 All hardware supplied on the cooler shall be Stainless Steel

## 4.0 COOLER CORE REQUIREMENTS:

4.1 The cooler must either be a single oil pass design or if multi-pass there must be vent & drain provision in each pass.

4.2 All tube to tubesheet joints shall be expanded using the roller expanding. A steel ferrule must be used inside aluminum tube joints.

4.3 The extended cooling surface shall be constructed of either:
4.3.a**. Unifin Integral Extruded Aluminum Fins** with a minimum mean fin thickness of 0.012" and a minimum fin tip thickness of .008". The extended surface shall have a maximum of 11 Fins Per Inch.

4.4 Acceptable tubing shall be mono-metal extruded aluminum fintube or copper tube. Spring type inserted oil turbulators are acceptable only for copper tube applications. When used, both ends of the turbulator must be permanently affixed at the top and bottom headers and sufficiently taut so that the spring does not move within the tube during cooler operation.

4.5 The core shall be designed such that the headers accommodate differential thermal expansion between the tube bundle and core side casings. The top core header connection shall be capable of supporting the weight of the complete cooler in a vertical orientation with the bottom end of the cooling core unsupported. However, except for replacement of an existing cooler, the transformer cooler shall be supported from the side casings for installation and operation purposes.

4.6 The header box shall be constructed of 1/4" (minimum) thick steel, A36 or better. The tubesheets shall be (minimum) 5/8" thick steel A36 or better. **Tubesheets shall be 316 stainless steel.** The header box shall be welded to the tubesheet using an ASME Section IX or equivalent certified procedures and welders, in order to minimize the number of oil leak paths. The oil connections shall be sized, located and oriented to match the original connections.

4.7 Each header (Top & Bottom) shall include a 3/4" NPT connection complete with a brass plug, for venting, draining and instrumentation.

4.8 The cores shall be designed to withstand 15 PSIG positive pressure or full vacuum and shall be tested, cleaned and prepared for shipment as per 6.0.

4.9 Cores shall be cleanable in the field using high pressure water or air providing that the cleaning jet is directed perpendicular to the tubes and parallel to the fins.

## 5.0 FAN/ PLENUM REQUIREMENTS

5.1 All fan motors shall have a maximum speed of 1200 rpm

**5.2** Air flow from the fans shall be horizontal, in a direction away from the transformer tank

**5.3** The fan cabinet or panels shall be hot-dipped galvanized after cutting, drilling, etc., and before assembly onto the cooler core

**5.4** All fans shall be balanced statically, and subjected to a run test in the final assembled position to ensure no rubbing, excess vibration exists or amperage overload.

**5.5** All fan motors shall have a type TEAO or TEFC cast iron frame and a minimum 1.15 SF. The motors shall be designed with a minimum of a Class F insulation and Class B Rise (max rise <60C) : Ambient operating temp 65C . Sealed bearings with grease suitable to –30C. The motors shall be built for outdoor weatherproof duty (Standard IP55) with condensate drain holes in the appropriate locations. Each motor shall be given a high potential voltage test for shorts prior to commissioning.

**5.6** All fans shall be protected with an OSHA approved hot dip galvanized fan guard. The fan guards shall be bolted to the cooler in such a way as to ensure easy removal.

**5.7** The motor power cables shall terminate in an NEMA 3X enclosure at the bottom of the cabinet and each power lead shall have an individual terminal connection.

**5.8** The fan plenum shall be constructed such that no water can be trapped on the interior or between the cabinet and core.

**5.9** Fan mounting panels shall be sized for each individual fan. Panels shall be hinged on one side to allow and capable of being opened for easy access to the front of the cooler core and/or the motor for cleaning and maintenance. Hinges shall be stainless steel.

## 6.0 COOLER TESTING, CLEANING AND PREPARATION FOR SHIPMENT:

**6.1** All cooling cores shall be pressure tested at a minimum of 35 PSIG for 15 minutes minimum, using appropriate leak detection methods.

**6.2** The cores shall be filled with clean, water free Transformer mineral oil and flushed in both directions using a minimum tube velocity of 6 ft/s. The final particle count for the flushing shall meet an ISO Cleanliness level of 12-10-7 Results must be kept on record at the Vendor’s factory and made available to the

User if required. A cleanliness certificate stating that this procedure has been completed shall be included with each shipment.

**6.3** The cores shall be purged of ambient air, filled with dry air or nitrogen (-60°C dew point) and pressurized to a minimum 5 PSIG for shipment. Airtight covers shall be provided on the oil connections. A tire valve shall be supplied on the core to allow verification of the level of pressurization with a standard tire pressure gage.

## 7.0 EXTERIOR FINISH:

**7.1** Unless otherwise specified, all carbon steel cabinets, fan bell mouths, fan guards and motor mounting components shall be hot-dip galvanized after drilling punching, bending, etc.
Headers and core casings shall finished with be finished with paint suited to the specified operating environment.

## 8.0 DOCUMENTATION:

**8.1** A certified Outline drawing of the cooler shall be supplied a maximum of 6 weeks after the receipt of an order. E-mail transmittal of drawings is preferred.

**8.2** Test certificates shall be provided for all above-mentioned procedures.

**8.3** A certificate of cooler cleanliness shall be provided upon shipment.

## 9.0 MOUNTING

9.1 These mounting specifications pertain to standard vertical tube mounted coolers. These coolers shall be mounted to the transformer tank wall using braces extending from the tank wall to slotted holes on the back of the cooler side casings. Two braces per side shall be used.

9.2 Anti-sway bars connected to the bottom of the cooler shall not bear any cooler weight, so that the cooler core can freely expand and contract with thermal variations.

9.3 These coolers shall be mounted with a minimum of 3ft (1 meter) clearance for air flow between the cooler and the transformer tank wall.

# Transformer Cooling Oil Pump & Valve Specifications

1.0 General

1.1 All transformer oil pumps shall be manufactured by Cardinal Pumps and Exchangers, a subsidiary of Unifin International LP, **no exceptions allowed**.

1.2 All pumps shall have sleeve type bearings manufactured by Cardinal or Harley. (Quote prices for Harley Pump with TecSonic Bearing Monitor System)
1.3 All pumps must be mounted beneath their respective OFAF coolers, with an oil flow gage with alarm contacts installed in the piping between the cooler and pump.

2.0 Oil Flow Rate

2.1 Oil flow rates shall not exceed 600 USGPM to prevent the possibility of initiating streaming electrification in the windings.

3.0 Electrical

3.1 Pumps shall have a Cardinal 370, 3 pin. male power connector located at the 12:00 o'clock position on the motor
3.2 Temperature rise of the motor shall not be in excess of 10°C above the temperature of the cooling oil passing through the pump.

4.0 Mechanical

4.1 Pump housing shall be made of cast iron of sufficient thickness to withstand the pressures and vibration of operation on an EHV transformer.
4.2 Pump design shall be coordinated with the OFAF cooler design to accomplish the oil flow rates and top oil temperature rise specified by the transformer OEM.
4.3 The lower connection between the OFAF cooler and the inlet piping can be bolted ANSI 150# flanges or a flexible coupling to allow for oil pipe thermal variations.
4.4 Pump piping shall have no bends or elbows between the pump inlet or discharge unless the bend/elbow is more than 3 oil pipe diameters away from the pump.
4.5 Inlet and outlet cooling oil flanges on the transformer tank wall must have parallel faces and be square to the centerline of the piping. The piping system shall impose no bending moments on the pump housing and shall not require excess torque on mounting bolts to bring gaskets to metal-to-metal closure.
4.6 Rotating Shafts must be center ground and the complete rotor assembly, including impeller, shall be dynamically balanced prior to assembly of the pump.

**5.0 Cooling Loop Isolation Valves**

5.1 Each cooler/pump combination shall have a set of two, bolt-in, removable isolation valves, one each at the top and bottom transformer tank cooling oil outlet and inlet flanges.

**5.2 Valves shall be new Cardinal Pumps. Valves shall use Viton as the seal packing and flange gasket material for maximum performance and durability.**

5.3 Thickness of the valve body shall not exceed 2.25”.

5.4 The valves shall be guaranteed and tested for 15 PSI pressure and full vacuum and shall seal off the piping for either case throughout its life.