evapco

WDC

INDUSTRIAL REFRIGERATION

WET/DRY AMMONIA CONDENSERS

The Optimum Solution for Energy & Water Conservation

Mr. GoodTower®
evapco

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WDC Wet/Dry Condenser

The two primary heat rejection methods for conventional, industrial refrigeration systems are evaporative and air cooled condensers. A summary of the operating characteristics for both of these methods is shown below.

Conventional Operating Characteristics

Evaporative Condensers

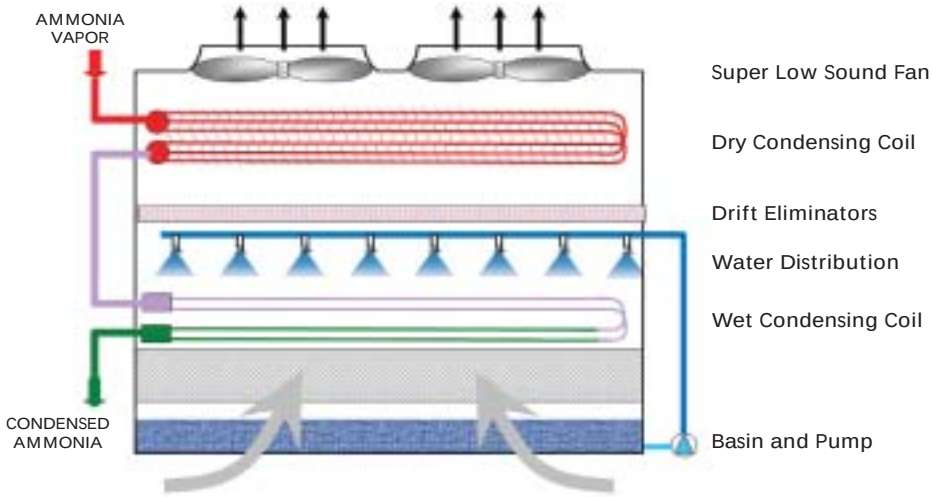
- Low condensing temperature
- Most efficient method for heat rejection
- Low axial fan kW
- Reduces installed compressor kW
- Requires make-up water and water quality management

Air Cooled Condensers

- Eliminates water and chemical treatment
- Eliminates effluent charges
- No visible plume
- Eliminates scale and biological fouling
- Higher installed compressor kW

The **WDC** **W**et/**D**ry **C**ondenser with the Super Low Sound Fan combines the most desirable characteristics of both evaporative and air cooled technologies into one industrial condenser. This new product innovation reflects EVAPCO's commitment to energy and water conservation via an environmentally friendly design.

WDC Principle of Operation



WDC Operating Characteristics

- Wet and dry condensing coils "in series" for optimum performance
- Low condensing temperature
- Water free operation 7 to 8 months of the year
- Low ammonia refrigerant pressure drop (less than 0.25 Bar)
- Significant energy, water and maintenance cost savings
- Low sound emissions

Wet Operation

The **WDC** is designed with the wet and dry condensing coils piped in series for maximum thermal performance. Therefore, the **WDC** operates wet (spray water pump on) when peak ambient temperatures exist, typically 22°C wet bulb and 30°C to 32°C dry bulb. Hot gas from the compressor discharge enters the dry condensing coil first before going into the wet (evaporative) condensing coil. Integrating a proven dry condensing coil (stainless steel tube construction with marine alloy, high density aluminum fins) with EVAPCO's patented Thermal-Pak® coil (hot dipped galvanized after fabrication) produces optimum operating characteristics. In addition, EVAPCO has strategically located both condensing coils in the **WDC** to eliminate the need to spray water over the dry, finned coil or to use an extended surface wet coil. In addition, each condensing coil is optimized for its dedicated, heat rejection duty.

Dry Operation

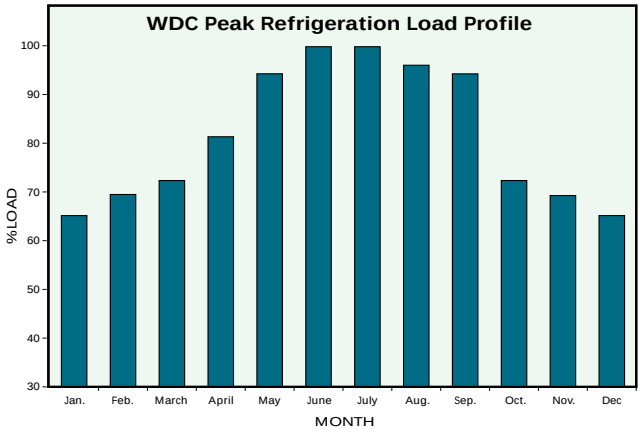
The **WDC** spray water pump can be switched off and the basin drained (dry mode) during extended periods of lower ambient dry bulb temperatures (typically 20°C and lower) or with reduced system loads. Operating the **WDC** in the dry mode eliminates water consumption, ensures the condensing temperature remains at or below the design temperature, while reducing total energy costs.

Operating Cost Savings and Benefits

To select the optimum **WDC** unit with low annual operating costs, EVAPCO has developed an exclusive wet / dry, industrial refrigeration ammonia condenser selection program. The **WDC** selection program clearly illustrates annual cost savings for both energy and water in comparison to a conventional evaporative condenser. The **WDC** is designed to significantly cut operating costs by reducing water consumption in areas where water, effluent and energy costs are high.

The benefits of selecting the **WDC** in lieu of a conventional evaporative condenser are numerous. Traditionally, evaporative industrial heat transfer equipment is sized to reject heat load requirements at peak ambient wet bulb temperatures. However, these design conditions represent only a fraction of the entire cooling season. In comparison, an air cooled condenser requires a significant increase in unit size and operating temperatures which in turn leads to lower system efficiencies. The new **WDC** combines the most desirable characteristics of both evaporative and air cooled technologies while allowing 100% of the heat load to be rejected through sensible cooling when ambient conditions are favorable.

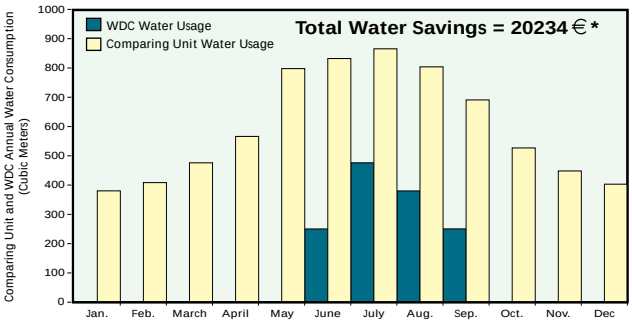
For example, an industrial refrigeration plant located north of Hanover, Germany, requires a condensing capacity of 850 kW (total heat rejection) using ammonia as the refrigerant. The design dry bulb temperature is determined to be 17°C to operate 100% dry at design capacity and will experience (on average) the following load fluctuations over the year (based on the maximum monthly ambient dry bulb temperature).



Water and energy cost savings comparisons between the new **WDC** and a centrifugal evaporative condenser are illustrated in the next column based upon both units meeting the design conditions specified above.

Water Savings

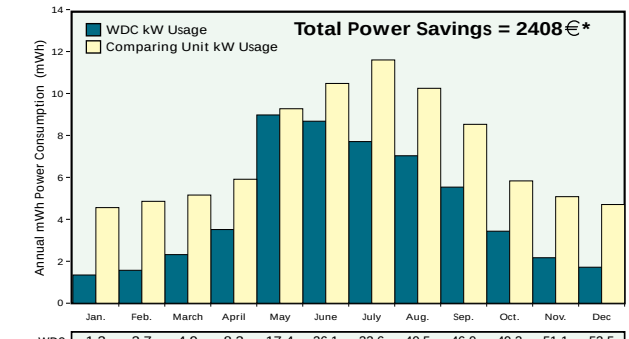
The **WDC** minimizes water usage, which in turn reduces water make-up, effluent and chemical treatment. In this example, the **WDC** demonstrates an 82% reduction in annual water consumption which yields a total savings of 20234 €. The following bar graph illustrates the **WDC**'s monthly water consumption in comparison to a centrifugal evaporative condenser, as well as, year to date totals.



WDC					0.2	0.7	1.1	1.3	1.3	1.3	1.3
	Year to Date Water Consumption (1000 m³)											
Comparing Unit	0.4	0.8	1.2	1.8	2.6	3.4	4.3	5.1	5.7	6.2	6.7	7.1

Power Savings

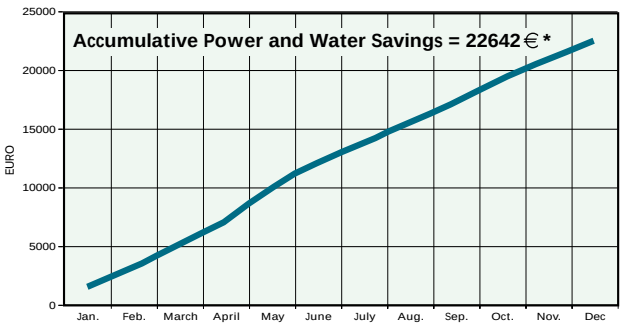
The **WDC** uses less energy and provides optimum cost savings over a one-year operating period in comparison to a centrifugal evaporative condenser especially during the eight months of dry operation (spray water pump off). In the example below, the **WDC** demonstrates a 40% reduction in total power consumption which yields a total power savings equivalent to 2408 €.



WDC	1.3	2.7	4.9	8.3	17.4	26.1	33.6	40.5	46.0	49.3	51.1	52.5
	Year to Date Fan and Pump Power Usage (mWh)											
Comparing Unit	4.6	9.5	14.8	20.7	30.1	40.8	52.7	63.1	71.6	77.3	82.3	86.9

Energy and Water Conservation

For the example presented the **WDC** demonstrates the accumulative savings of 22642 €, over a one-year operating period. The new **WDC** is the optimum solution for energy and water conservation.



* based on 0.07 € per kWh, 3.5 € per (1000m³) water and 3 cycles of concentration

WDC Wet/Dry Condenser

The **WDC** product line combines both evaporative and air cooled technology into one industrial condenser. The **WDC** reflects EVAPCO's commitment to environmentally friendly equipment design.

The **WDC** optimizes latent and sensible heat transfer to significantly reduce both energy and water consumption. This is accomplished by integrating the proven performance of a dry condensing section with the advanced technology of EVAPCO's induced draft evaporative condenser. In addition, every **WDC** comes standard with EVAPCO's exclusive Super Low Sound Fan!

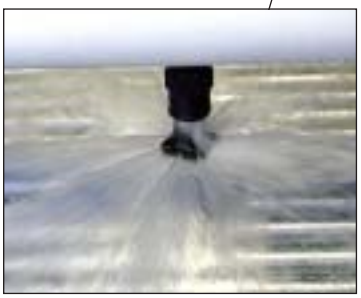
The **WDC** is the optimum solution for ammonia condenser applications requiring energy efficiency, water conservation and extremely quiet operation.

Large Inspection Plenums

- Location above and below dry condensing coil accessible through large hinged doors
- Internal aluminum platform (upper plenum)
- Lower plenum provides easy access to efficient drift eliminators, water distribution system and condensing coils

Efficient Drift Eliminators

- Advanced design removes mist from the evaporative cooling air stream
- Drift rate less than 0.001% of re-circulating water rate
- Constructed of inert polyvinyl chloride (PVC) for long life
- Modular sections for easy removal



ZM Spray Nozzle Water Distribution System

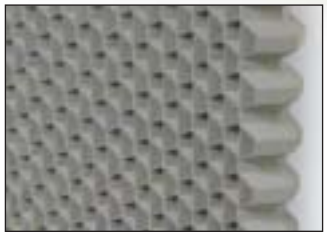
- Zero maintenance fixed position heavy duty nozzles
- Threaded nozzles with a large 33mm orifice to prevent clogging
- Eliminates aerosol formation
- Corrosion-free PVC water distribution pipes
- Removable distribution pipes with threaded end caps

Cold Water Basin / Stainless Steel Strainer

- Sloped / Step design minimizes operating water volume
- "Clean Pan" design allows complete water drainage
- The best strainer solution for durability and resistance to corrosion
- No sump heaters required

WST Air Inlet Louvers (Water and Sight Tight)

- Easy removal
- Keeps sunlight out of cold water basin minimizing biological growth
- Keeps water in the basin and debris out

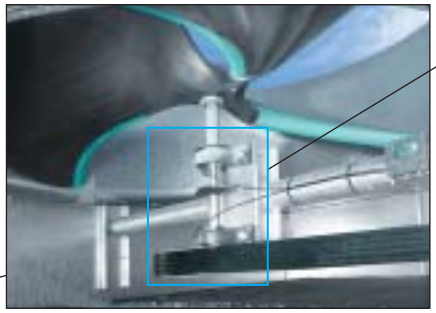


Patent Pending

for Energy & Water Conservation

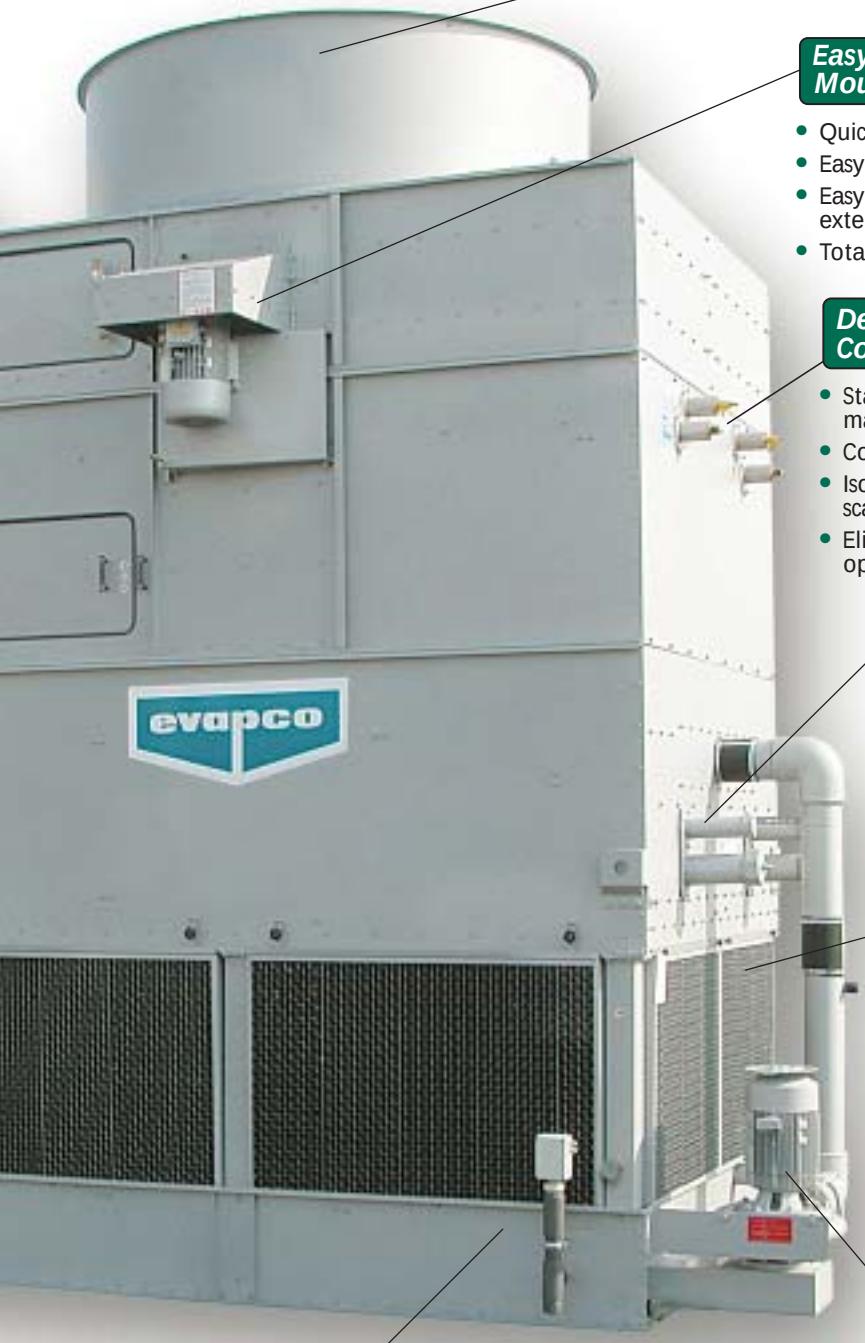
Super Low Sound Technology

- The ideal solution for sound sensitive installations
- Sound pressure level reductions from 9 dB(A) to 15 dB(A)
- Extremely wide chord, forward swept fan blades
- One-piece molded, heavy duty fiberglass reinforced polyester hub and blade construction



Unique Fan Drive System

- Power-Band belts for better lateral rigidity
- Non-corroding cast aluminum pulley
- Heavy duty fan shaft bearings with L-10 life of 75,000 – 135,000 hrs



Easy to Service Motor Mount Design

- Quick, outside the unit maintenance
- Easy belt adjustment
- Easy fan bearing lubrication via extended lube lines
- Totally enclosed fan motor(s)

Dedicated Dry Condensing Coil

- Stainless steel tube construction with marine alloy aluminum fin
- Condensing via sensible heat transfer.
- Isolated from spray water to eliminate scale and biological material fouling
- Eliminates plume during dry operation

Patented Thermal-Pak® Coil

- Assures maximum condensing capacity via advanced technology and latent heat transfer
- Allows for greater surface area per plan area
- Minimizes resistance to airflow

European Patent #0272766

Most Accessible Basin

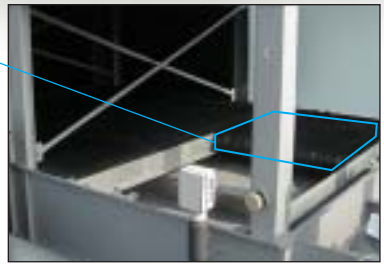
- Access from all four sides
- Large open area simplifies maintenance
- Basin may be inspected/cleaned during unit operation

Totally Enclosed Pump Motors

- Ensures long, trouble-free operation
- Greased for life

Water Silencers

- Removable, modular PVC sections
- Sound pressure level reductions from 4 dB(A) to 12 dB(A)



Z-725 Heavy Mill-Dip Galvanized Steel Construction

(Affordable stainless steel construction options available)

WDC Wet/Dry Condenser

Selection Strategy

The **WDC** unit selection will depend on the following criteria:

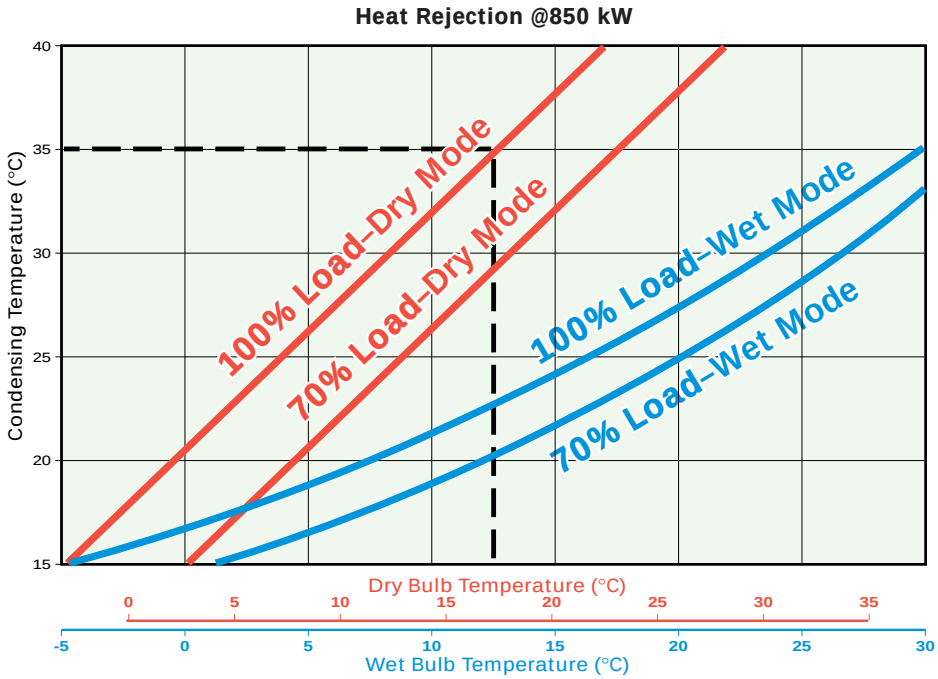
- Design dry bulb temperature required for 100% load–dry operation
- Estimated annual heat rejection load profile
- Local water and energy costs
- Maximum operating wet bulb temperature

EVAPCO's **WDC** selection program enables the design engineer to optimize the above criteria as well as select water or total system energy savings to meet site-specific requirements.

Typical Performance Example

The graph below illustrates the resultant operating condensing temperature for the **WDC** (at 850 kW total heat rejection for ammonia) as a function of the entering air dry bulb (color coded red) or wet bulb (color coded blue) temperature.

For example, selecting an 850 kW **WDC**, with a design entering air dry bulb temperature of 17°C, yields an operating condensing temperature of approximately 35°C during 100% dry operation. However, operating the **WDC** in the "wet mode" lowers the condensing temperature approximately 12°C, from 35°C to 23°C (assuming 17°C dry bulb and 12.5°C wet bulb temperature) which in turn provides significant compressor energy savings. The **WDC** selection software offers unique flexibility to enable the design engineer to optimize both water consumption and energy usage. Customizing the **WDC** selection using site-specific requirements and an estimated load profile provides the design engineer with many possible "switch points" between wet and dry operation. Matching the operation time for wet and dry performance to each specific application in the selection process will lead to the optimum solution for energy and water conservation.



Environmental Friendly Design

The new **WDC** is specifically designed to meet industrial refrigeration ammonia condensing requirements while being environmentally friendly. EVAPCO has combined its patented evaporative condensing technology with a proven air cooled condensing coil to provide the following environmentally friendly operating characteristics.

- Significant reduction in water usage, effluent and chemical treatment
- Lowest sound emissions in the industry
- Reduced energy consumption lowers power plant emissions
- Minimized legionella formation and emissions
- Reduced refrigerant charge, 20% on average
- Eliminates plume during dry operation

Clean Water Design

The **WDC**'s ability to operate in the wet mode for only three to four months per year minimizes the chance of Legionella formation. In addition, the low water volume basin design is sloped for complete drainage and easy cleaning. Sump heaters are not required, thereby, eliminating warm stagnant water and the favorable conditions for biological growth.

The **WDC**'s standard features such as the WST air inlet louvers and ZM spray nozzles contribute towards minimizing Legionella formation by eliminating water splash-out and spray water mist, respectively. In addition, the WST louvers are conveniently located around the perimeter of the unit. Each louver section is easily removed for direct access to the unit basin for cleaning, sanitizing and disinfection. This service can be performed by maintenance personnel when the ambient temperature is still very mild.

All of the above coupled with utilizing clean, fresh water during spring start-up makes this new innovative **W**et/**D**ry **C**ondenser the optimum solution. The new **WDC** provides superior technology and an environmentally friendly design as standard.

WDC Optional Equipment

VFD and Two Speed Motors

Variable frequency drive controllers (VFD's) provide an alternate means to unit capacity control. This electronic device coupled to an inverter duty fan motor(s) enable the fan(s) to operate at many different speeds, typically lower, which in turn saves energy. This is accomplished through varying the electrical frequency supplied to the motor(s) via the VFD. Another means of unit capacity control is two speed motors, which in comparison to VFD's have a slightly lower cost and provide only two stages of capacity control.

During off peak loads or reduced wet bulb temperatures, both of the above methods can operate the fan(s) at less than full speed. Two speed motors, when operating at the low speed, will provide 60% of the high speed capacity, yet consume approximately 15% of the power in comparison to high speed. In addition, both energy and sound levels will be greatly reduced when operating the WDC at low speed.

Self Supporting External Service Platforms

The **WDC** is available with self-supporting, external service platforms that include ladders which are designed for easy field installation. This option offers significant savings in comparison to field constructed, externally supported catwalks. The Evapco service platform may be installed on either side or the end opposite the connections.

Stainless Steel Basin

WDC condensers have a modular design which allows specific areas to be enhanced for increased corrosion protection. The basin area is often subjected to high concentrations of impurities and silt. Evapco offers an optional, all stainless steel basin for superior corrosion protection. This option provides Type 304 or Type 316 stainless steel for the entire basin area including the vertical support columns and the louver frames. Obtaining the maximum corrosion protection for the basin section is important since it provides the structural support for the entire unit.

Electric Water Level Control

The **WDC** may be ordered with an electric water level control in lieu of the standard mechanical float and make-up assembly. This option provides accurate control of water levels and does not require field adjustment.

Stainless Steel Fan Shaft

For particularly corrosive environments, the **WDC** can be constructed with an optional stainless steel fan shaft. This option provides superior corrosion resistance over other materials of construction.

Vibration Switch

The **WDC** can be furnished with a vibration switch. This option will provide an enhanced level of protection against upset conditions due to excess vibration.

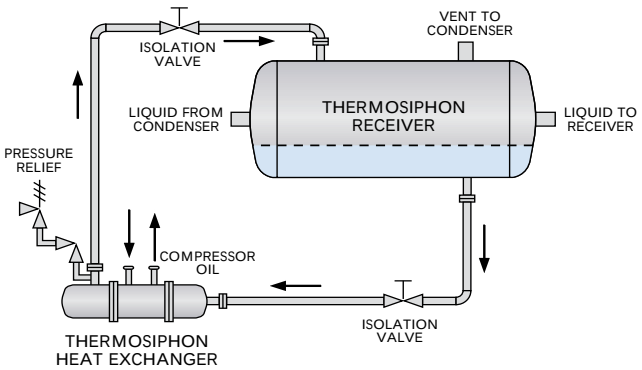
Thermosiphon Oil Cooling

Application

EVAPCO does not recommend operating the **WDC** wet/dry condenser with a "split coil arrangement" to provide secondary cooling for oil, water or glycol. For oil cooling only, EVAPCO recommends utilizing a properly designed thermosiphon oil cooling arrangement.

There are two primary types of oil cooling, direct and indirect. The manufacturer of the refrigerant compressor will normally recommend the appropriate thermosiphon arrangement depending upon the application. The schematic to the right illustrates a typical indirect thermosiphon oil cooling loop.

Every industrial refrigeration system is unique and will have site-specific requirements to be considered. To ensure a properly designed thermosiphon oil cooling loop, including liquid and return line sizes, please refer to the compressor manufacturer's installation recommendations. For additional information consult your local industrial refrigeration system designer and/or installer.



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