



OUTDOOR CONDENSERS & DRY COOLERS

Operations & Maintenance Manual

DOCUMENT: SVW14-DRYCLOMM-20190131

UPDATED: MARCH 2019

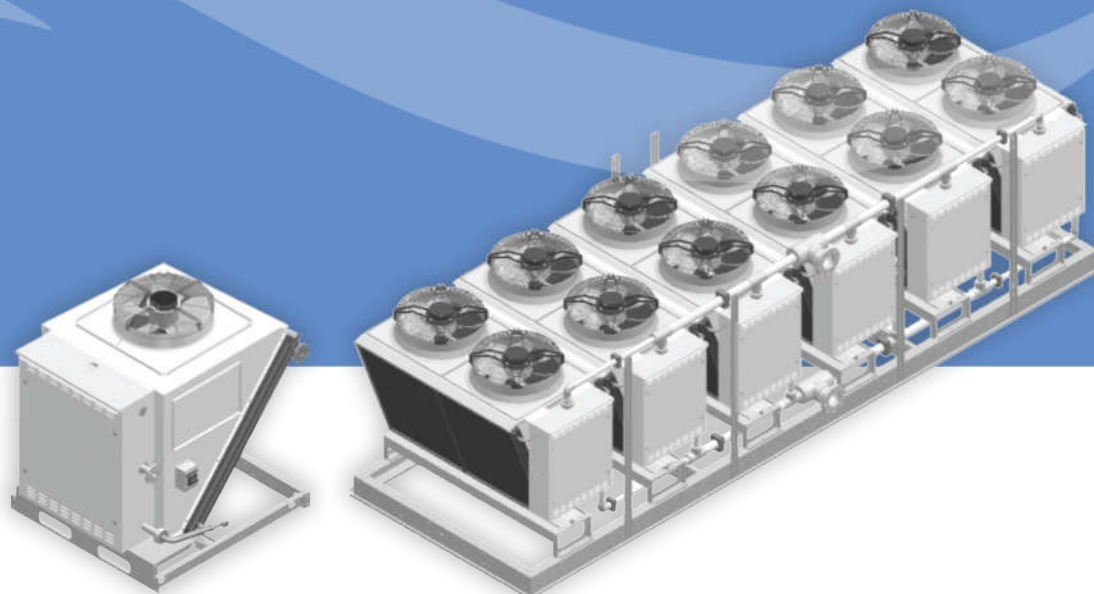


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GENERAL INFORMATION

This manual provides basic information about the applicable equipment and its operation.

Important information regarding installation, maintenance, and start up as well as additional and auxiliary systems and devices (as applicable) is normally provided with the equipment and can also be obtained from the manufacturer (see Contact Us below).

Operating Safety (Warnings, Cautions, and Notes)

FOR YOUR SAFETY: READ BEFORE PERFORMING ANY OPERATIONS, MAINTENANCE OR SERVICE TASKS!



Only qualified technicians should install, operate, maintain or service mechanical equipment including current one.

Make sure to read this manual before performing any tasks to familiarize yourself with the equipment as well as with any potential hazards. Always exercise caution!



Beware of electrical power and high electrical voltage!

- Follow proper safety procedures – lockout, tagout, and other respective procedures
- Failure to follow safety procedures can result in serious injury or death



Beware of moving parts and hot surfaces!

- Make sure to stop all moving parts (fans etc.) before accessing the equipment and performing respective tasks (maintenance, repair etc.)
- Be aware of potentially hot surfaces and sharp metal edges!



Beware of pressures and chemicals!

- Operating equipment may contain glycol-based cooling media mixture under the pressure!

The following warnings, cautions, and notes appear throughout this manual and referenced documentation whenever special care must be taken to avoid potential hazards that could result in equipment malfunction or damage, personal injury, or death.

⚠ WARNING

Indicates a potentially hazardous situation which could result in serious injury or death if handled improperly.

⚠ CAUTION

Indicates a potentially hazardous situation which could result in moderate injury or equipment damage if handled improperly.

NOTE

Indicates a situation that could result in equipment damage or improper/ineffective operation if handled improperly.

Reference and Additional Information

For safe, efficient and problem-free operation, it is critical to handle the equipment (as well as related systems and components) properly at each step — from receiving and storage to installation and start up. Relevant information can be found in the respective documents, like **Installation Manual**.

ATTENTION: INSTALLATION AND SERVICE CONTRACTORS

⚠ WARNING! Any work (installation, start up, service, maintenance, repair, etc.) on any mechanical equipment must be performed in accordance with respective manufacturer’s recommendations as well as submittal documentation, local Codes and Regulations, and appropriate field practices. Failure to do so could result in personal injury, equipment damage or malfunction, and will void equipment warranty. Only qualified and properly trained individuals should perform tasks on this equipment.

ATTENTION: MAINTENANCE TEAM

⚠ CAUTION. To ensure equipment longevity and proper and efficient operation, the dehumidifier and its auxiliary systems and devices (outdoor condenser, dry cooler, boiler package, etc.) should be maintained properly and regularly. Failure to do so could negatively affect premise comfort levels and people’s health. It could also lead to equipment damage, malfunction, premature tear and ware and may void equipment warranty.

ATTENTION: WARRANTY CONDITIONS AND COVERAGE

NOTE. The equipment is provided with comprehensive conditional warranty coverage. Any warranty work sought to be reimbursed must be approved by the manufacturer **Customer Support Team** prior to work commencing. Installation, start up, maintenance etc. are not within warranty scope.

Refer to the manufacturer standard warranty statement for more details on warranty conditions, scope and coverage.

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Basic Information

View and Options

The views of standard NG series dry coolers' product line are shown in Figure 1 and 2.

Dry Cooler Options

- **Capacity.** Table 1 references dry cooler type and their respective capacity. For more details on dry coolers composition and layout – see **Layout and Components** Chapter

Table 1 - Dry Cooler Options

Capacity, BTU/H*	Dry cooler Type	Picture
30000 - 45000	NG-Z-11	Figure 1-A
62000 - 88000	NG-V-01**	Figure 1-B
90000 - 104000	NG-V-02**	Figure 1-B
113000 - 170000	NG-V-11	Figure 1-C
280000 - 385000	NG-V-31	Figure 2-A
180000 – 290000	NG-V-12	Figure 2-B

* Capacities shown above are *APPROXIMATE* (depending on various factors, including cooling media properties, GPM, temperatures etc.); for specific cooler capacity, refer to submittal documentation!

**NG-V-01 and NG-V-02 type dry cooler would have different fan (and, therefore, different capacity).

- **Coils & Fans** - single and multi fan & coil combo.

- ▶ Figure 1 shows single fan dry coolers: NG-Z, NG-V-01 and -02 are “single fan – single coil” type, NG-V-11 is “single fan – two coil” cooler.
- ▶ Except for NG-V-31 (Figure 2-A), all the multi-fan coolers (see Figure 2) are comprised of number (up to six) of NG-V-12 (Figure 2-B) coolers (mounted on the same frame, piped, wired and operating as one single unit).
- ▶ Cooler capacity and number of fans are reflected in its type/ nomenclature: Figure 2-C shows NG-V-62 cooler, comprised of six “two fans — two coils” NG-V-12 sections.

- **Fan Type** Normally, single fan dry cooler would have EC-commutated fan (varying its speed via 0-10VDC signal), while multi-fan dry cooler would normally be equipped with two-speed fans; for more details – refer to specific equipment submittal and wiring diagram.
- **Cooling Media** Typically, water-glycol (rust inhibitor-infused food-grade propylene glycol is used) mixture is used as cooling media, however pure water could be used also. Refer to dry cooler main label for details on glycol type, ratio etc.

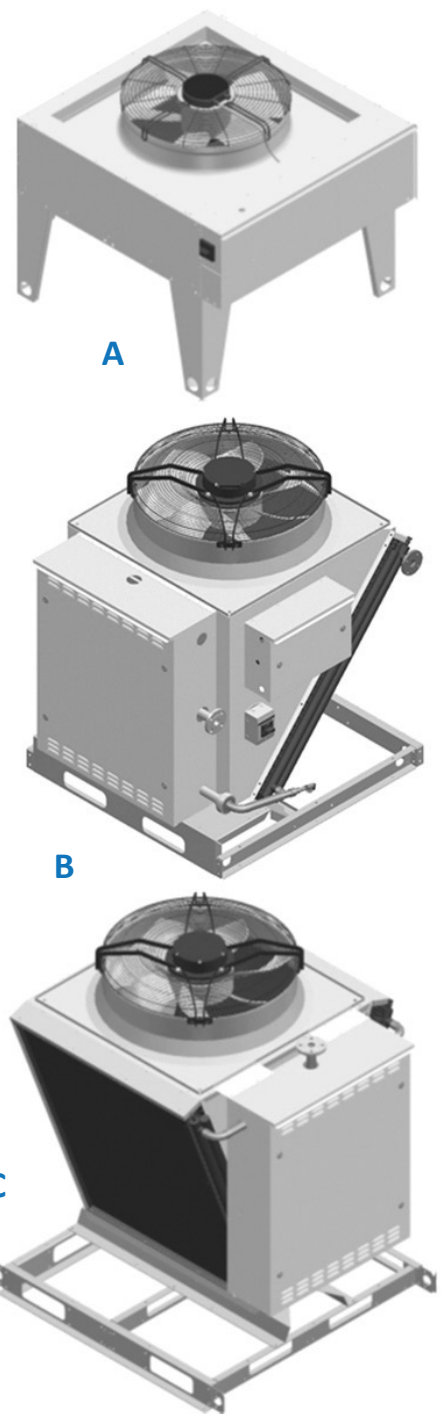


Figure 1. Single Fan Dry Cooler Units

- **Pump Package** (optional). As needed, dry cooler could be equipped with pump package — to establish cooling media flow (or to serve as additional/booster pump).

- ▶ *For multi-fans coolers:* If pump package is required, each “two-fan” section, normally, would get its own package (Figure 2-C shows NG-V-62 type cooler, equipped with six pump packages – one per section).

- **Discharge Airflow** – Dry cooler Installation. Except for NG-Z type, all dry coolers are designed for vertical air discharge (horizontally mounted cooler). NG-Z type, however, could be provided for both, vertical and horizontal discharge airflow (for more details – refer to **Installation Manual**):

- ▶ Vertical air discharge (default) – cooler is mounted on horizontal surface (roof, concrete pad etc.)
- ▶ Horizontal air discharge – cooler is mounted on vertical surface (wall, support structure etc.). This option requires special mounting legs’ set.

- **Optional Installed Disconnect.**

- **Other Equipment Integration.** Cooler could be directly integrated/attached into system/equipment it serves (mounted on the same frame and piped and wired at the factory). Alternatively, it could be provided as stand-alone piece of equipment, that has to be installed and connected to the equipment/system it serves on site.

- **Control** (for more details – see **Basic Operation** Chapter):

- ▶ *External control:* cooler is controlled by the equipment it serves.
- ▶ *Stand-alone (self-controlled):* cooler is equipped with it’s own control (normally, based on the cooling media entering temperature)

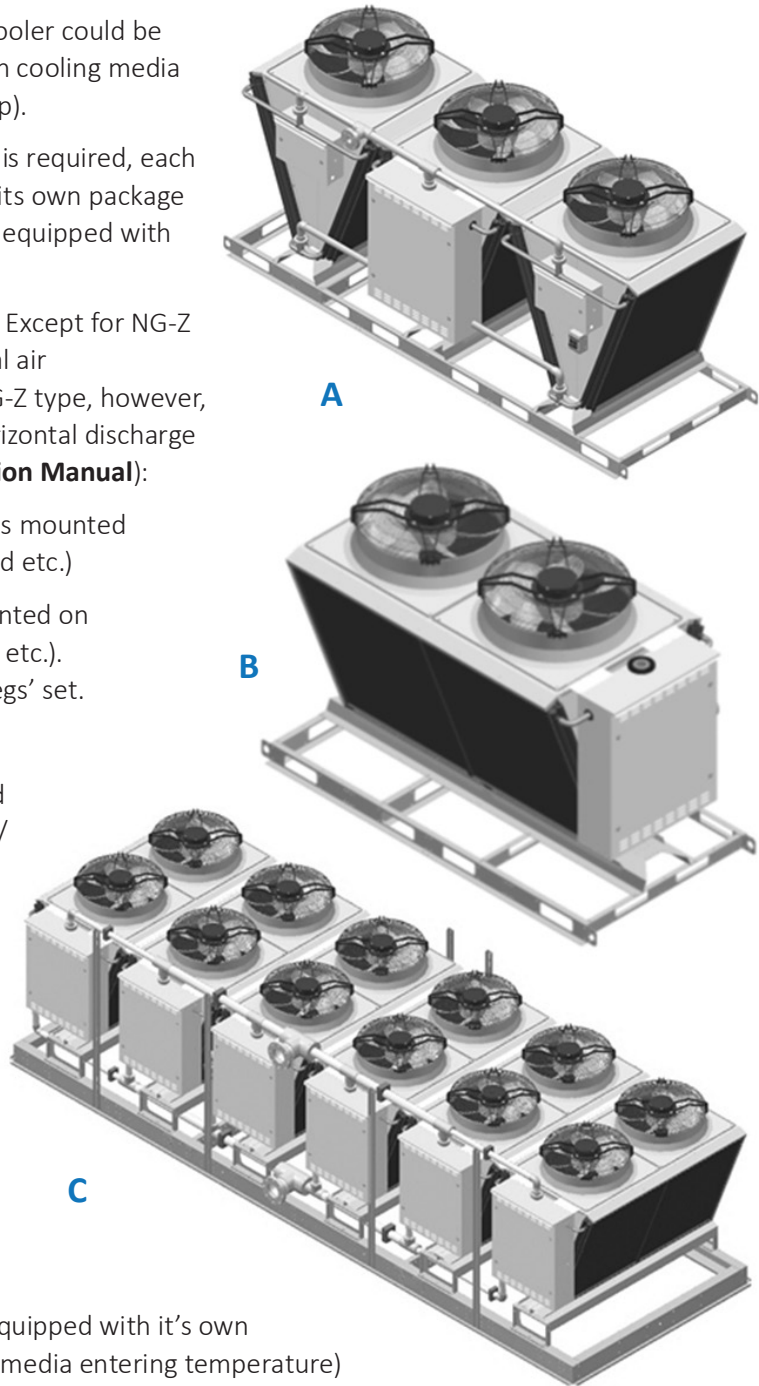


Figure 2. Multiple Fan Dry Cooler Units

ATTENTION: EQUIPMENT CLEARANCES

⚠ CAUTION. Proper clearances should be maintained for adequate airflow and heat rejection, as well as for maintenance and service of the equipment! Generally, up to 36” sides (all around) and 96” top clearances are required. For more information on clearances as well as equipment dimensions and other details, refer to the submittal documentation.

External Systems Connection

⚠ CAUTION

Current manual refers to/depicts general/default external systems connection location. For details regarding specific dry cooler's connections (location/elevation, piping sizes, flow direction, wiring terminals etc.), refer to the submittal documentation as well as dry cooler diagrams, labels and stickers.

Normally, the only systems need to be connected to the dry cooler are cooling media piping and electrical power (control wiring connection is required also, unless current dry cooler is self-controlled).

Cooling Media Piping Connection. Normally dry cooler is provided with two piping connections (one – inlet, another – outlet) for cooling media. Connections are normally identified/labeled in respect to cooling media flow direction (hot/warm media entering the dry cooler – **IN**, cool media leaving the dry cooler – **OUT**).

- If dry cooler is provided with pump package option, cooler connections might be located within pump package – refer to specific dry cooler labels and submittal documentation (drawings etc.).

Electric Power and Control Connection. Electric power is normally brought to the dry cooler disconnect (if cooler is equipped with one) or to power distribution block, located in cooler's electrical box. Control wiring is normally brought to the control terminals within electrical box.

- Dry coolers, equipped with multiple electrical boxes, normally required power and control connection only to one box (indicated as "main") – power and control wiring between boxes is normally done at the factory.
- Self-controlled dry coolers normally do not require external controls connected.

Equipment Specific Data

Specific information for individual dry cooler is provided in the following methods:

Main Label (Table 2): the manufacturer tag attached to the dry cooler, that includes its most critical data:

Table 2. Main Label Example

Dry cooler DATA				
	Serial Number	XXXXXXXXXA		
	Dry cooler Model:	NG-V-12-CUC-V		
	Electrical Data:	Voltage	MCA	MOP
	Unit:	208/3/60	21.0	35.0
	Quantity:	HP	FLA	RPM
Fan Motor:	2	3.4	8.1	980
Pump Motor:	1	0.75	3.6	
	Connection Size:	2	NPT Flange	
	Maximum Fluid Flow:	80	GPM	
	Pressure Drop:	18.0	ft-H2O	
	Internal Volume:	17.6	U.S. Gal.	

- General data including *Serial Number* and *Dry cooler Model* (nomenclature)
 - ▶ Serial Number is usually composed of 8 digits. Additional letter “A”, placed at the end of serial number, usually indicates that given dry cooler is provided together with another equipment it serves (dehumidifier etc.).
- Operational data:
 - ▶ Electrical (voltage, amp draw, HP etc.)
 - ▶ Cooling media (GPM, connection size etc.)

Labels and Stickers: attached normally to indicate dry cooler external systems connections (piping, electrical etc.), terminals designation, to display warning etc.

Wiring Diagrams: typically, attached to the interior side of the dry cooler main electrical panel, depicting control and power wiring.

Operation and Control

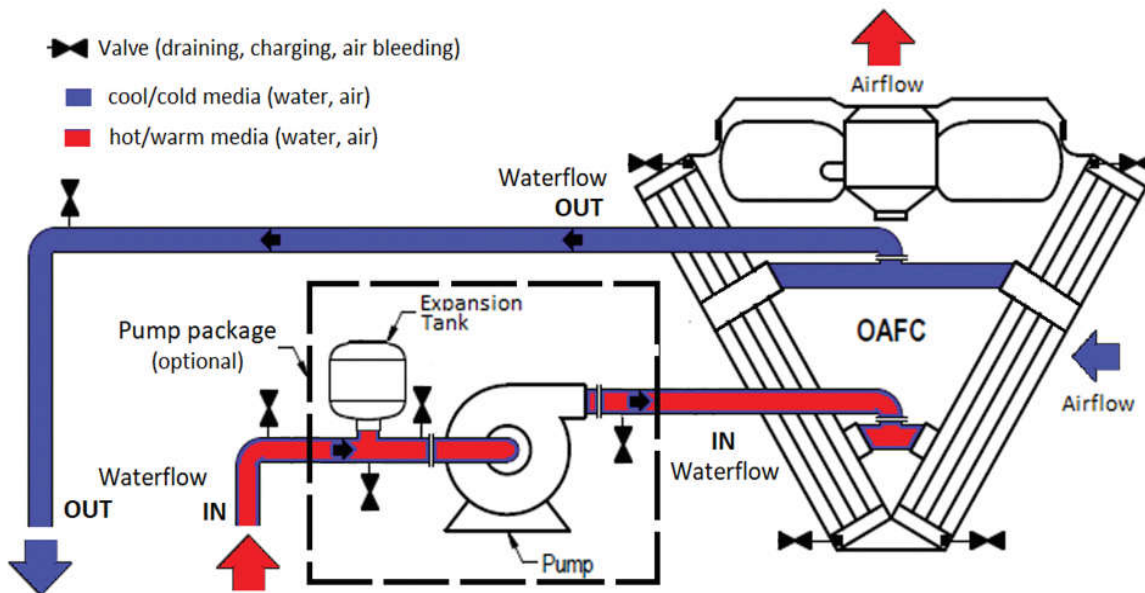
Dry cooler rejects the heat, absorbed by the cooling media (water etc.) from the external system(s) that dry cooler serves, to the outdoor air.

Operation and Media Flow

Dry cooler operation is quite simple:

- Upon the command (when heat rejection is needed) dry cooler engages its fan(s) to establish the airflow across the coil(s).
 - ▶ Depending on the type of fans (modulating EC-type or two-speed), control type and command received, cooler total airflow is adjusted by varying fan(s) speed and/or number of operating fans.

Figure 3. Multiple Fan Dry cooler Units



For more details on dry cooler piping connection refer to Installation Manual, submittal documentation etc. as well as local Codes and proper field practices.

- Cooling media flow must be established also – either by separately controlled pump (part of the external system) or by the built-in pump package pump. In latter case, pump would engage with the fan(s) and will stay engaged while the command exists (while at least one fan is running).
- Until call for heat rejection is satisfied and command to dry cooler is removed, fan(s) and pum will run; once command removed, all fans and the pump will stop.

Figure 3 shows schematic layout of dry cooler operation amd media (air and water/glycol) flow. For more details on dry cooler piping connection refer to Installation Manual, submittal documentation etc. as well as local codes and proper field practices.

Control

Couple different types of control schematic, based on type of fans and control sourse, could be used.

Fan Type:

- **Modulating** (EC-type) fans are capable of varying their speed (from 0 to 100%) based on 0-10VDC signal. These fans are typically used in smaller dry coolers (mostly – single fan ones).
- **Two-speed** fans are capable of running in two alternative speed (low or high); it’s normally done by switching between “star” and “delta” motor wiring (fans are pre-wired from the factory to switch from one to another, based on respective contactor – low or high speed – being engaged). These fans typically are used on mid- to large size multi-fans dry coolers.
 - ▶ **Staging.** Standard (and the most simplistic) staging uses just two stages – low speed and high speed – where all fans are running together (in low or high speed, as commanded).

Control Type (all control types referenced below are applicable to all fans type described above):

- **Externally Controlled** Dry cooler. Fan(s) speed signal (modulating or stage switch-over) is provided from external system (usually – the one that dry cooler serves, to satisfy said system operational requirement). This is typical for dry cooler serving single systems. Typical signal type for this control type are modulating (0-10VDC) or two-speed switch-over (however, other arrangements are available)
- **Self-controlled** (“stand-alone”) Dry cooler. Fan(s) speed signal (modulating or stage switch-over) is based on built-in control device. Most commonly used one is a thermostat, monitoring temperature of the cooling media (water/gklycol mixture), entering the dry cooler.
 - ▶ Typically, thermostat is pre-set to maintain entering cooling media temperature at certain level: the thermostat issues the signal to start the fan(s) and increase their speed as temperature increases (and, respectively, reduce fans’ speed when temperature reduces). Typically, this signal is 0-10VDC – it could be accepted by EC-type fans directly or translated into staging signal with additional device (this allows to set more than two stages to finetune dry cooler operation).

Dry cooler is normally provided with the wiring diagram, depicting its specific control schematic – refer to it as needed.

LAYOUT & COMPONENTS

General layout of the various NG-series dry coolers is shown in Figures 4 & 5. While layout and main components are similar for all applicable dry coolers, there are some deviations (number of fans and coils, composition, etc.). Refer to **Views and Options (Basic Information)** chapter for additional information:

Dry Cooler Main Components

- ▶ Figures 4-A & B and Figure 5-B show **NG-V** type dry coolers (two, six and single-fan models, respectively), while Figure 5-A shows **NG-Z** type dry cooler.
- ▶ Examples show all/most available options (like pump package etc.); some of shown options may not be present on your dry cooler – refer to submittal documentation as needed.
- Cooling air-side **coil(s)** (31) (where heat from glycol mixture is rejected to the ambient air) is mounted onto metal frame, upstream (before) the **fan(s)** (32), that pulls the air through the coils to absorb the heat.
 - ▶ Depending on the equipment type and required capacity, dry cooler may have one or multiple coils and fans – refer to **Views and Options (Basic Information)** chapter).
- Dry cooler **piping connections** (33) are identified in respect to cooling media flow direction (hot/warm media entering the dry cooler – IN, cool media leaving the dry cooler – OUT);

Figure 4. General Layout of NG-series Dry coolers

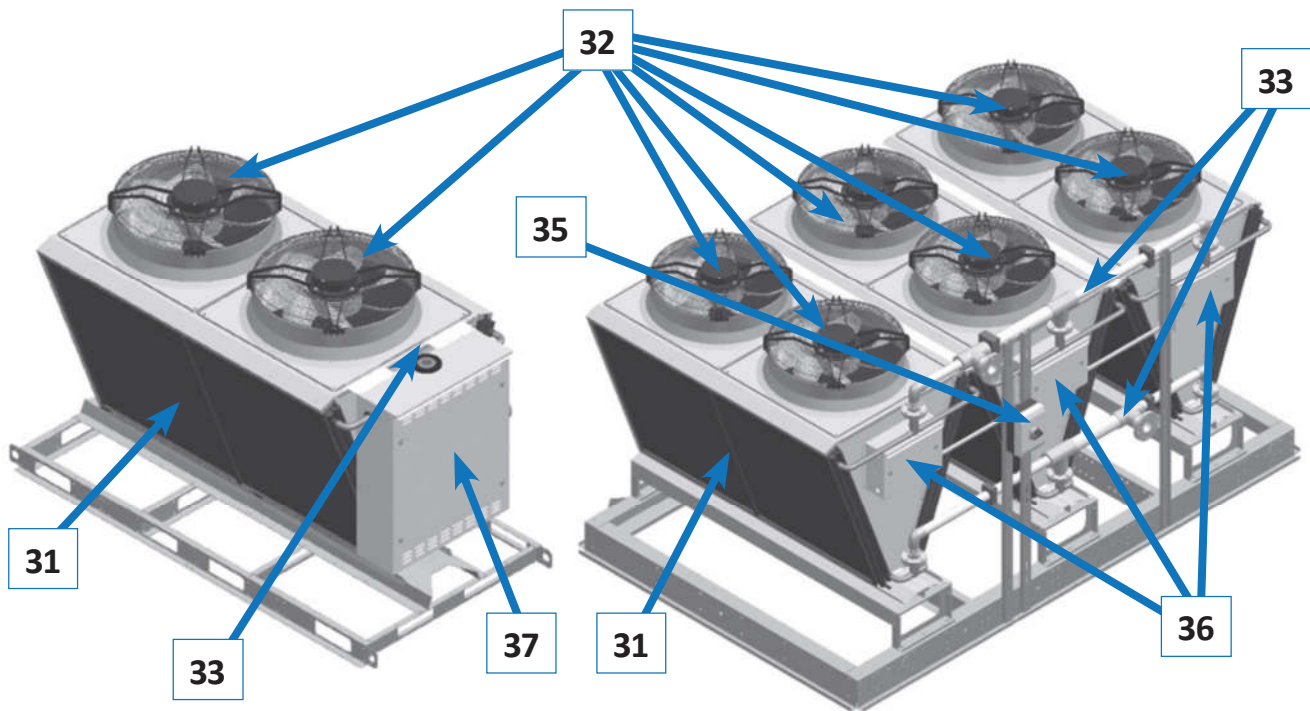


Figure 4-A. NG-V Unit

Figure 4-B. NG-V Unit

Figure 5. General Layout of NG-series Dry coolers

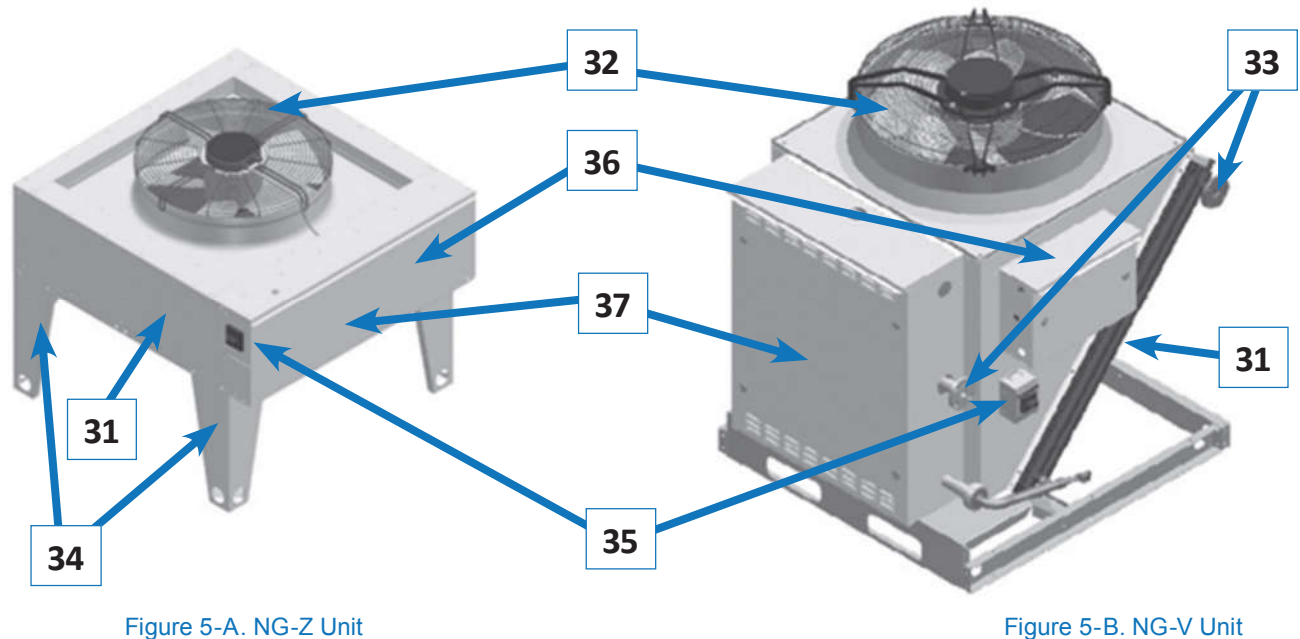


Figure 5-A. NG-Z Unit

Figure 5-B. NG-V Unit

- ▶ In some cases, dry cooler piping connection(s) may be located within **pump package** box (37), if dry cooler is provided with one.
- ▶ Piping connection location may vary – refer to particular cooler labels, stickers, submittal and other documentation.
- ▶ Dry cooler manifold/connection, normally, is not equipped with isolating valves, filters etc. (this also applies to pump package, if dry cooler is equipped with such option; see pump package layout below).
- **For NG-Z Type (Figure. 5-A) ONLY!** Said dry cooler allows for either vertical or horizontal installation and could be provided with different (respective to installation type) set of **legs/supports** (34), which are required assembly on-site (Fig. 3 shows the most common, horizontal installation and respective leg set). For more details on the installation refer to the **Installation Manual**.
- Electric power is normally to be brought to **disconnect** (35) (if cooler is equipped with such), which feeds it to the **electrical box** (36), that contains dry cooler power and control apparatuses.
 - ▶ Depending on dry cooler specifics, location of electrical box may slightly differ; in some cases, electrical box may be incorporated into **pump package** or located on the opposite side of the dry cooler.

Electrical Box – Power and Control

Dry cooler power and control wiring and apparatuses (transformer, contactor(s), fuses, wiring terminals etc., as applicable) are located in the electrical box, shown in Figure 6: typical box of dry cooler type NG-Z and Figure 7: type NG-V:

- In some cases dry cooler electrical box could be incorporated within pump package.
- NG-V type dry cooler with multiple fans would have multiple boxes (typically – one box per one pair of fans).
 - ▶ Multiple electrical boxes on one dry cooler are normally connected to each other at the factory, so external power and control wiring has to be brought only to one (main) electrical box.
- Depending on the specifics of the dry cooler (size, type of fans, control method etc.), electrical box layout and components may vary – refer to your dry cooler submittal, wiring diagram and other documentation.



Figure 6: Typical Box of Dry cooler Type NG-Z



Figure 7: Typical Box of Dry cooler Type NG-V

Pump Package

If equipped with such option, dry cooler would have a pump package box. Figure 8 shows general layout of pump packages, used for NG-V model dry coolers. Note, that the package could be mounted onto the dry cooler directly (standard) or provided separately.

Dry Coolers Pump Package

Dry coolers, if equipped with such option, would have a **pump package** box. Figures 8 & 9 show general layouts of pump packages, used for NG series: NG-Z and NG-V type, respectively. Note that the package used with NG-V coolers is normally mounted onto the cooler directly, however, it also could be provided separately.

- **Pump** (38) establishes glycol mixture circulation through the dry cooler and dehumidifier
- **Expansion tank** (39) compensates for temperature-based glycol/cooling fluid volume fluctuation
- The pump package **electrical sub-panel** (40) contains the pump package electrical power and control apparatuses
 - ▶ In some cases, pump package electrical sub-panel may contain power and control apparatuses for the entire dry cooler (fan(s) and pump package).
- The pump package manifolds are usually equipped with pressure gauges, automatic air venting and manual draining/charging valves.

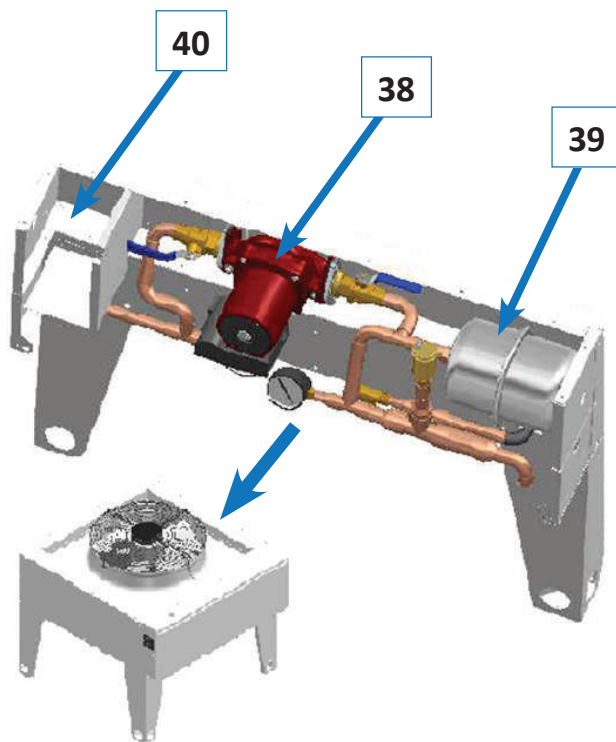


Figure 8: Pump Package Box NG-Z

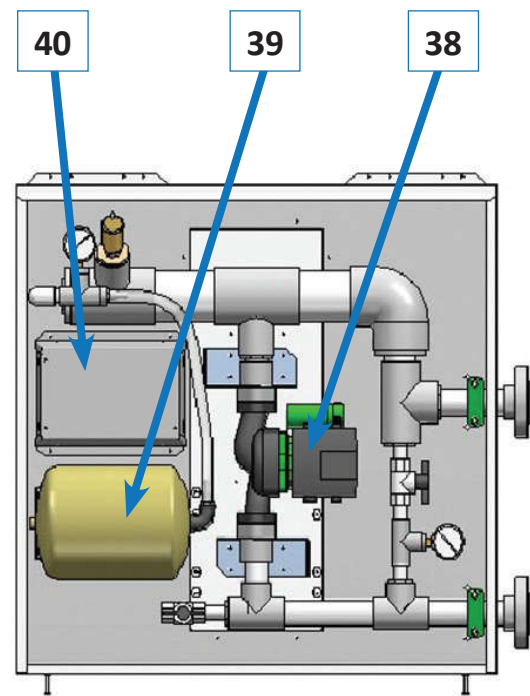


Figure 9: Pump Package Box NG-V

BASIC MAINTENANCE

Although dry cooler is built for minimal service downtime, periodic preventative maintenance is required to ensure maximum reliability, safety, and operating efficiency.

WARNING

To ensure equipment longevity and proper and efficient operation, it **must be maintained** properly. It is recommended to create a **facility-specific Routine Maintenance Program**. Failure to perform necessary maintenance task(s) properly and regularly could result in personal injury, equipment damage or malfunction and will void the equipment warranty.

Maintenance and Safety

Only qualified/properly trained personnel should attempt to perform respective maintenance tasks.

- **Live Electric Power!** When necessary, have a licensed electrician or other qualified professional to perform the required task.
- **Turn the power off.** Before performing any maintenance, disconnect all electrical power, including remote disconnect, and discharge all energy storing devices (VFDs, etc.) before servicing. Follow proper lockout procedures to ensure that power cannot be accidentally restored. Failure to follow provided safety warnings and labels could result in serious injury or death.
- **Be properly trained and equipped.** Some maintenance tasks may involve usage of power tools, chemicals, etc. Refer to such tools and materials data (manuals, MSDS, etc.). Personnel performing such maintenance tasks should be:
 - ▶ Properly trained to handle such tools and materials safely
 - ▶ Equipped with proper personal protective equipment
- **Be aware of potential hazards.** The equipment contains moving mechanical parts, components with water-glycol mixture under the pressure (refer to the equipment main label for the details as needed) and some hot/warm surfaces. Before performing any equipment maintenance work, make sure that all moving parts are stopped, and it is safe to perform required task.

Maintenance Key Points

Dry cooler is rather low-maintenance equipment, yet there are some basic/key maintenance considerations:

- Ensure that the **equipment is accessible** (minimum clearances are maintained): approaches are not restricted/limited (with materials, other equipment, manifolds, snow etc.).
- Maintain **clean air-side coils surfaces**: make sure to clean coils from cobweb, dust, leaves etc. regularly.

Routine Maintenance Program

Creating facility-specific routine maintenance program and following it is vital to equipment longevity and efficient operation.

Detailed maintenance recommendations for specific components, as/if needed, could be sourced from respective component manufacturer's manual or other documentation.

The suggested general maintenance tasks and their frequency/intervals, listed below, can be used to create mentioned maintenance program (be aware that list below is a suggestion only - frequency and tasks may vary per installation, based on various factors like ambient environment cleanliness, type of equipment etc.):

Monthly – Quartely	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Observe equipment general operation (for unusual vibration, noise etc.) <input checked="" type="checkbox"/> Verify control settings (applicable to “self-controlled” equipment) <input checked="" type="checkbox"/> Inspect the airside coils for dirt, cobweb build-up, etc.; clean as needed
Semi-Annually – Annually	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Check electrical connections (both, power and control), tighten as needed <input checked="" type="checkbox"/> Check the frame and fasteners for being structurally sound (loose fasteners, corroded/deteriorating components etc.) <input checked="" type="checkbox"/> Check glycol/water mixture ratio/percentage, adjust as needed.

Specific Components Maintenance and Special Tasks.

Air-Side Coil(s) Cleaning.

- Warning: Hazardous chemicals! Cleaning agents can be highly acidic or alkaline. Handle all chemicals carefully and use appropriate personal protective equipment (PPE). Refer to the cleaning agent manufacturer’s Materials Safety Data Sheet (MSDS) for safety and handling information. Failure to follow all safety instructions could result in serious injury or death.

To clean the coil:

- Disconnect all electrical power to the equipment
- Use a soft brush to remove loose debris from the coil
- Mix a high-quality coil cleaning detergent with water according to the manufacturer’s instructions
- Clean coil according to suggested instructions
- Thoroughly rinse both sides of the coil and the drain pan with, clean water
- Straighten any coil fins that have been bent during the cleaning process
- Replace all panels and parts and restore electrical power to the equipment

Dry Cooler Winterization.

Normally dry coolers are used in the systems, filled with glycol mixture to prevent the system and the dry cooler from freezing and, potentially, rupturing, when exposed to temperatures below freezing point.

When dry cooler is used with media that, when exposed to low temperatures, could freeze (water or lower-percentage glycol mixture), one way to protect the equipment is to drain it (also known as “winterization” of the equipment).

Though dry cooler itself is normally equipped with means to be drained properly/fully, it is recommended to have same means in place for entire system/equipment dry cooler serves:

- Have each local high point of the system equipped with means to bleed the air (air bleeding valve etc.)
- Have each local low point of the system equipped with means to drain the fluid.

⚠ CAUTION

Draining and re-filling the dry cooler must be performed by trained personnel, according to proper field practice and system layout. Improper draining or re-filling the system could lead to equipment damage, malfunction, premature tear and wear and may void equipment warranty.

Ensuring that the dry cooler and associated system(s) equipped with proper means of draining, creating draining and re-filling procedures as well as determining whether draining is warranted to protect the equipment is outside of manufacturer's scope and is a sole responsibility of installing contractor and local maintenance team.

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