



QLCI™ 
Designed by TROX®

Displacement Induction Ventilation

**QLCI INSTALLATION, OPERATION, & MAINTENANCE (IOM)
MANUAL**

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1.1 INTRODUCTION



Important!

You must read all instructions prior to the installation, operation, or maintenance of this product!

The QLCI displacement induction ventilation diffusers are designed to provide air quality and acoustical performance similar to conventional displacement systems but are designed specifically for the North American climate. Units are fitted with a series of air induction nozzles that allow the supply of conventional air (50° to 55°F) to the terminal. These nozzles induce room air through a cooling and/or reheat hydronic coil to pre-condition the air prior to mixing with the primary nozzles. The result is a constant volume (variable temperature) displacement type supply of air to the space.

The integral hydronic coil within the unit is sized to allow the QLCI terminal to condition the room while the central system air handler supplies air at (or near) the mandated space ventilation rate. Therefore, the central station air handler can supply 100% outside air while all of the return air from the space is exhausted.

The diffuser uses the primary air energy to induce air through the hydronic coil and does not contain any moving parts such as, fans, motors, or compressors to be maintained.

1.2 SAFETY

The customer must use qualified personnel and follow all applicable building codes and safety regulations when installing, commissioning and performing maintenance of this product. Eye protection and gloves should be worn at all times when handling the product.

Consult all local building, occupational safety and other codes applicable to the installation.

Please pay particular attention to the symbols used throughout the manual that indicate safety related issues, warnings and important notices or information; read the complete manual before installation and be familiar with the meaning of the safety symbols in the next section 1.3.

1.3 SYMBOLS USED IN THIS MANUAL

When reading this manual, particular attention must be given to the parts marked with the following symbols:

	<p>Warning! Indicates a potentially dangerous situation for the product and the environment</p>
	<p>Important! Designation of a danger that can cause personal injury or damage to property</p>
	<p>Note! Indicates important notices or information</p>



Fragile!

Handle with care. The diffuser should not be handled using the water pipes which may cause damage to the unit.

1.4 RECEIVING, INSPECTION AND STORAGE

All Carson Solutions products are inspected and tested prior to shipment to ensure the highest quality. Carson Solutions products are packed and labeled in individual cardboard cartons.

Upon receipt of the product shipment, conduct a thorough inspection of the outer packaging and pallets for possible damage. If damage has occurred during shipping, indicate the damaged items on the delivery papers immediately and inspect the product contained in those containers for damage.

If damage has occurred during shipping, immediately file a claim with the carrier.

Refer to the Manufacturer's Representations and Warranties on pages 14-15 of this manual for detailed handling instructions and damage reporting procedures.



Note!

Carson Solution products should not be removed from its individual carton for storage. Do not unpack units until they have been moved to the installation location and just before installation is to begin.

Carson Solutions products should be stored in a clean and dry location. If products remain packaged as delivered (strapped and wrapped on pallet), they can be stored as delivered (do not stack pallets). If the packaged products are removed from pallet, they should not be stacked more than four high.

Packaging is not suitable for outside storage



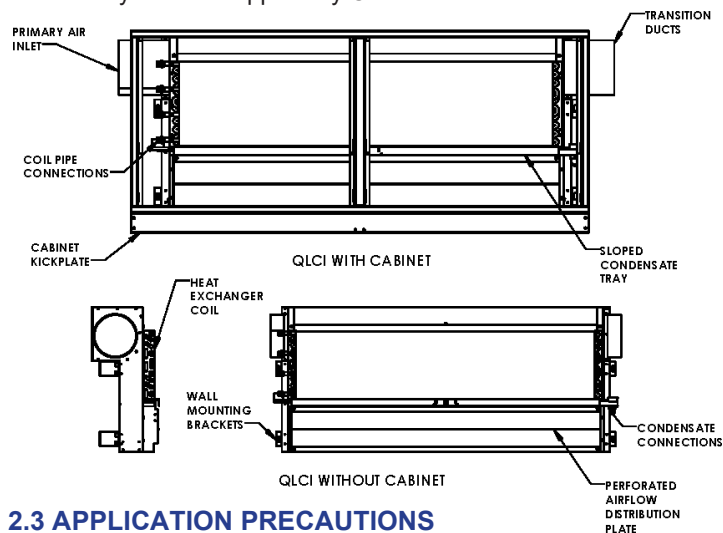
2.1 PRODUCT OVERVIEW

The QLCI displacement induction ventilation diffusers are designed specifically for classroom applications. Units can operate in cooling, heating, and or ventilation modes. In standard cooling or heating modes, primary air is delivered through a series of induction nozzles. As ventilation or primary air is fed to the round OA plenum, the air passes through a series of nozzles, producing both a relatively high velocity airstream and an area of low pressure thereby inducing room air through the assembly's return grill and across its integral hydronic coil. The air is reconditioned and then mixed with the primary air prior to being discharged back into the space via a grill mounted on the lower face of the QLCI unit. In certain circumstances designers have elected to apply optional rear fin tube heating elements for either primary or supplemental heating in the space. Please consult your local Representative or Carson Solutions directly to evaluate what heating approach is best suited for your application.

The QLCI displacement induction ventilation diffusers should be installed in the quantities, sizes and configurations shown on the project plans and performance schedules.

2.2 CONSTRUCTION DESCRIPTION

The assembly (figure 1) of the QLCI consists of a heat transfer coil (2- or 4-pipe), primary air inlet (top or side), induction nozzles, transition connecting duct and sloped condensate tray with connection. Cabinet structure is constructed of heavy gauge steel and powdercoated with a fingerprint proof texture paint. Optional accessories such as bookshelves, utility cabinets, and OA duct covers may also be supplied by Carson Solutions.



2.3 APPLICATION PRECAUTIONS

When in cooling mode, the entering water temperature to the QLCI displacement induction ventilation diffuser coil should be maintained warmer than the space dew point temperature in order to prevent condensation.

Extreme latent load applications may, however, require lower chilled water temperatures be used to condense moisture from the recirculated air during the reconditioning process. Please consult with a local Representative or Carson Solutions directly for review of design approaches.



Important!

Installation must be performed by properly trained and authorized personnel only! Read all instructions before beginning installation.

2.4 PREPARATION FOR INSTALLATION

The QLCI displacement induction ventilation diffuser is manufactured by Carson Solutions with the following details:

- Single or dual duct connections
- A series of induction nozzles
- Integral heat exchange coil
- Rear wall mounted fin tube elements
- Perforated discharge baffle plate
- Mounting brackets with a 3/8" x 1" slot
- Sloped condensate trays with capped 1/2" drain
- Architectural cabinets

2.4.1 ITEMS PROVIDED BY INSTALLER

Installer to provide (according to all applicable local building codes):

- Proper PPE should be used by the installer
- Level and measure equipment
- Tools such as wrenches, pliers, screw drivers, and drills
- A mounting system including 2x4's and all mounting hardware for installation
- Hydronic piping system with NPT fittings
- Water flow regulators and strainers if applicable
- Manual shut-off valve for each pipe run (recommended) supply and return water circuits (unless factory furnished flexible hoses are included with product order) or hard connections
- Air-side balancing and/or control devices as specified in the project plans and specifications
- Recommended hardware to attach each unit to each other is (4) 5/16-18 x 1" Phillips head truss screws and (4) 5/16" serrated nuts per QLCI. End wall units only require 2 of each per QLCI

2.4.2 UNIT WEIGHTS



Caution!

Machinery recommended for movement and installation of QLCI's. Refer to table below for unit weights and use caution when removing from packaging.


Add 7% for to values below for water weight

QLCI Unit Size	Weight without Cabinet	Weight with Cabinet
4ft	68 lbs	128 lbs
5ft	84 lbs	160 lbs
1500	95 lbs	180 lbs
6ft	101 lbs	192 lbs
2000	122 lbs	232 lbs
8ft	135 lbs	255 lbs

3.1 GENERAL PROCEDURE

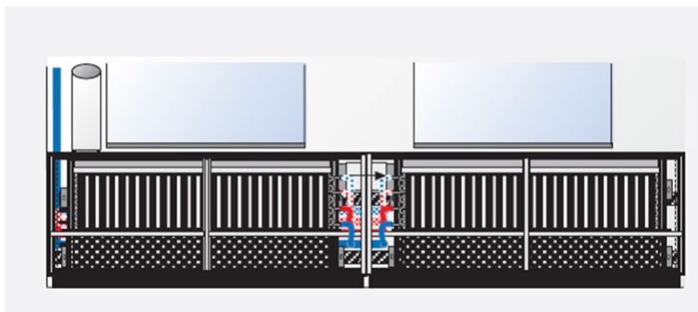
The QLCI displacement induction ventilation diffusers should be installed in quantities, sizes and configurations shown on the project plans, schedules, and submittals. Deviation from the designed plan should be avoided as the QLCI unit locations and configurations is critical to the comfort of the conditioned space. Units are designed for easy installation and access for maintenance.

3.2 INSTALLATION CONSIDERATIONS

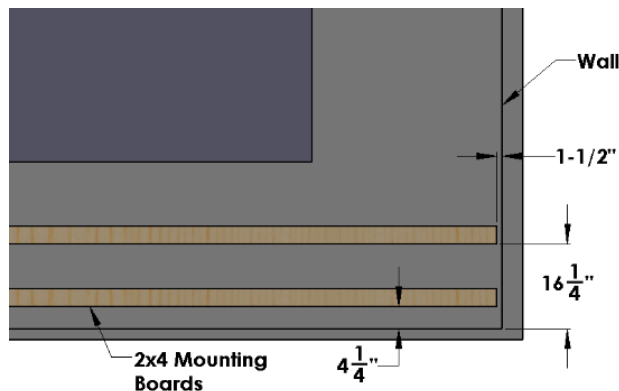


Note:
The locations of the 2x4's is very important to install in the locations provided in the dimensions in **Section 3.3**.

Most classrooms will require the QLCI units are installed along 75% to 80% of the exterior exposure to provide adequate space conditioning at noise levels that are compliant with ANSI S12.60. The supply air duct and vertical pipe runs can be housed in the class- room walls or may be covered using optional architectural duct covers and can be accessed through the utility cabinets provided by Carson Solutions.



- b.) The **2x4 Mounting Boards** should run the length of the QLCI installation (not individual units). The **2x4 Mounting Boards** should stop 1.5" from edge of wall to allow end unit side panel to set flush against the wall.



STEP 2: Example install QLCI hydronic water piping

- a.) Typically, a **BUC** is used where the water pipes are dropped from the ceiling along a wall perpendicular to the exposure and are secured to the wall between the mounting boards as shown below. If using a **BUC**, it will be necessary to install the **BUC** first before the main **Supply** and **Return** piping is ran and connected. **Additional valves, regulators, and strainer may be required. See project plans and specifications for more information.**



3.3 INSTALLING THE QLCI

STEP 1: INSTALL 2X4'S MOUNTING BOARDS

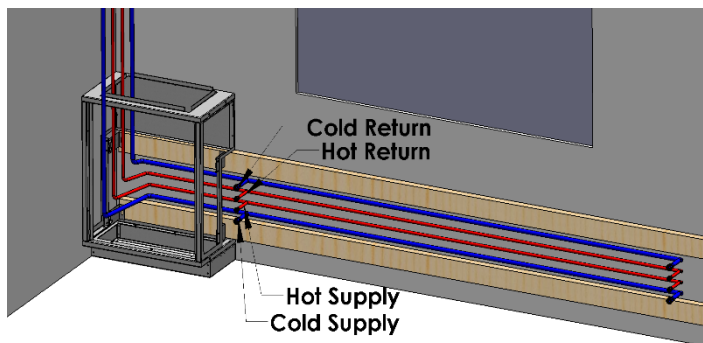
- a.) Secure two **2x4 Mounting Boards** to the perimeter wall making sure they are securely mounted to wall framework as shown below. (Fasteners supplied by others).



- b.) Install threaded 1/2" NPT connections (provided by others) on each pipe or solder straight end connections 2" to 3" from the point where the QLCI units connect to each other along the wall as shown below.



- c.) Once all the piping is connected, test for leaks and insulate piping. Refer to project plans for insulation specifications. Use standard plumbing practices and test for leaks once the piping is complete. See **Section 4.1** for pressure ratings.

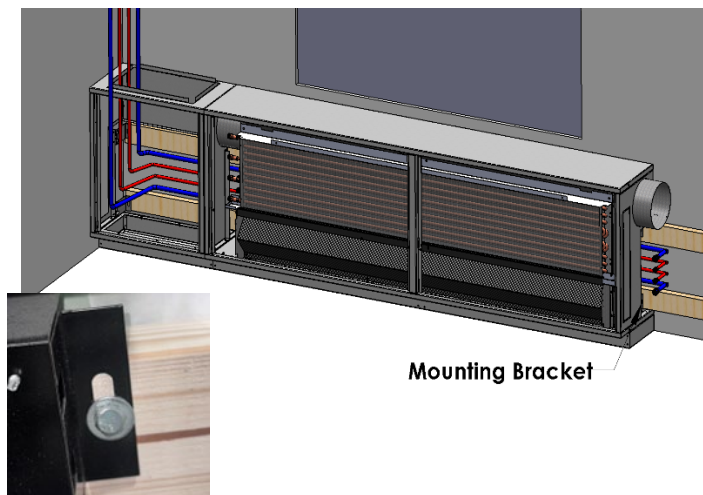


STEP 3: Attaching the QLCI units to the wall

- a.) Locate the (2) socket head screws on the face of each upper face panel. Loosen the locking screws using an **5/32"** Allen Wrench and remove the units upper face panels (as shown below). Do not use a power driver to loosen or tighten latches. Do not allow the upper face panels to fall as this could cause damage to the panel surface. Remove lower panel as needed by removing the (2) TEK screw.



- b.) Position the first QLCI unit (nearest the supply air duct) against the wall. Secure units to the **2x4 Mounting Boards** by driving **3/8"** lag bolts and **3/8"** flat washers through the unit's four (4) **Mounting Brackets** as shown below.



STEP 4: Positioning and connecting the remaining units

- a.) Repeat **Step 3** to mount the remaining units to the wall and to make water connections.



- b.) Connect the QLCI units together by sliding the connector sleeve from the adjacent QLCI unit onto the entry spigot and seal the connection as described below in **Section 3.5**.



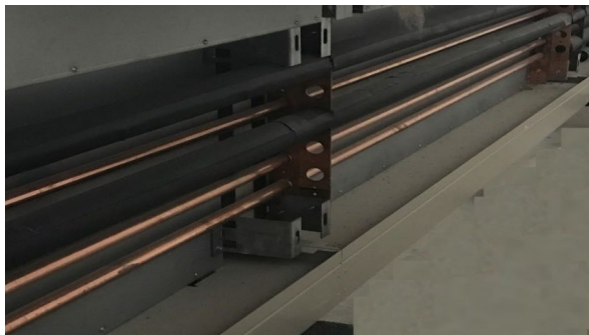
- c.) Attached each QLCI to another using (4) **5/16-18 x 1"** Phillips head truss screws and (4) **5/16"** Serrated nuts per QLCI. End wall units only require 2 of each per QLCI. Locate the upper and lower holes as shown. Insert hardware and tighten the units together.



It is recommended to use these holes on the QLCI top and bottom panels to attach each unit together.



- d.) **Alternative piping method 1:** Units can be placed on roller carts and connected to each other first. The pipework can be connected to the back of the QLCI's, and piping connections can be connected to each other before mounting the entire run of QLCI's to the wall mounted 2x4's as shown below.



- e.) **Alternative piping method 2:** QLCI units can allow the piping runs to be in the front of the units above the hydronic coil. This allows the QLCI to be mounted to the 2x4's first, then connect the ductwork before making the piping connections. The feeding pipework can be routed through the side wall knockouts. QLCI's and piping connections can be connected in the front as shown below.



- c.) Piping should be insulated and properly labeled in accordance with local building codes as shown below.



3.3.1 OPTIONAL REAR FIN-TUBE ELEMENTS

Optional rear fin-tube heating elements can be supplied for mounting between the rear of the QLCI and the attachment wall. Please refer to the **Optional Rear Fin-Tube Heater IOM (CS_QLCI_RFTH_IOM)** for installation and piping connections prior to installing the QLCI system onto the wall.

STEP 5: Connecting to water supply

- a.) Connect the unit's hydronic coil to the water piping using flexible braided stainless-steel hoses (1/2" female NPT's to connect to coil). In most applications, flexible braided stainless-steel hoses require 90° elbows. Hard copper piping may also be used. Proper sealing techniques should be applied. Refer to Division 23 Section 23 21 13 "Hydronic Piping", connect coils to supply with shutoff valve, strainer, control valve, and union or flange, and to return with balancing valve and union or flange.
- b.) The vertical chilled/hot water pipes are connected via flexible hoses run through a pipe work knockout on the top or side of the unit.



3.4 WATER CONNECTIONS

The QLCI unit is fitted with four water pipes which terminate in 1/2" NPT threaded male connections. Each coil is factory tested for leakage and provided clean and capped. Caps shall not be removed until piping installation is in process.

Note:
When installing a two-pipe design, connect only the outside pipes if four-pipe coil was supplied.

STEP 1:

Identify the warm and/or chilled water supply connections on the QLCI unit. See Section 3.4.1.



STEP 2:

Remove the plastic caps before making the final water connections.

STEP 3:

Make the water connections to the hydronic coil piping using flexible braided stainless-steel hoses (1/2" female NPT's to connect to coil). Hard copper piping may also be used. Proper sealing techniques should be applied. Refer to Division 23 Section 23 21 13 "Hydronic Piping", connect coils to supply with shutoff valve, strainer, control valve, and union or flange, and to return with balancing valve and union or flange.

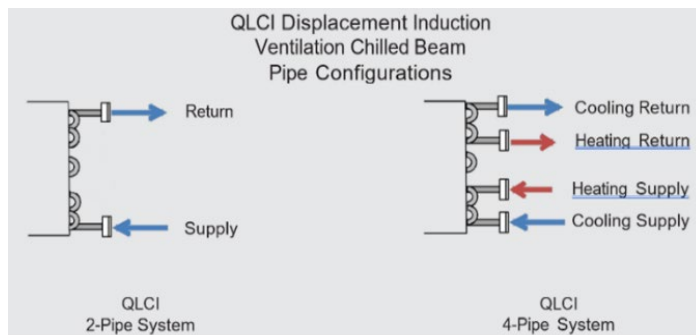
Extreme Caution!
Do NOT over-tighten NPT fittings. Applying excessive force on the water pipes may damage the hydronic coil and is not covered under warranty.

Carson Solutions optional Stainless Steel Flexible Hoses (contact your factory rep to purchase).



3.4.1 WATER CONNECTIONS IDENTIFICATION

Piping connections for standard 2-pipe and 4-pipe QLCI displacement induction ventilation chilled beam diffusers to be operated and connected as shown below.



3.5 CONDENSATE DRAIN CONNECTION

The QLCI unit is fitted with a sloped condensate drain tray with an anti-clogging 1/2" plastic drainpipe fitting (1/2" OD). Each drainpipe is located on the right side of the QLCI when looking at the unit from the front. The drainpipe fitting should be connected to a condensate line or pumping system as specified in project documents. Each drain comes capped from the factory. Remove cap prior to pumping each drainpipe fitting.



3.6 AIR CONNECTION

STEP 1:



Note:

QLCI displacement induction ventilation diffusers operate at higher terminal pressures than diffusers in standard VAV systems therefore the ductwork and connections feeding the diffuser must be thoroughly sealed to prevent excessive leakage.

The air connections should include a minimum of three duct diameter lengths of straight ductwork upstream of the QLCI connection to ensure laminar flow and prevent noise generation. Straight ductwork connections will yield a reliable pressure port measurement.

Air connections can be made with either hard-pipe (most common) or with flexible duct. If using flexible duct, limit duct length to a maximum of 5ft.

Using the supplied transition collar to connect each QLCI together. Properly seal ductwork with either foil HVAC aluminum tape or with duct sealant mastic. The inner duct connection must be fully sealed to prevent leakage and loss of performance.



Ensure there is an airtight connection between the supply duct and each QLCI duct interconnections. Duct connections should meet SMACNA class B standard up to 2 in. W.G. Refer to Division 23 – Heating, Ventilation and Air Conditioning (HVAC) Section 23 31 13.01 “Metal Ducts” and or Section 23 07 13 “Duct Insulation” for additional information.

3.7 FLUSHING THE WATER PIPING SYSTEM

Before flushing the water system, close all valves that isolate the QLCI units and flush the main piping system first. Refer to Division 23 Section 23 25 00 “Pipe Cleaning, Flushing, and Chemical Treatment”.

3.8 FILLING AND VENTING THE WATER SYSTEM

To ensure easy venting, the main pipes should be installed at a higher level than the QLCI units. The horizontal pipes should be installed rising slightly towards the venting points.



Note:

There should be no high points to create air pockets within the system.

Before filling, all shut-off and control valves must be in the fully open position. The pumps should not be running during the filling processes (static filling). Continuous venting is necessary during this process. The installation of both manual and automatic venting systems is recommended. The pump should only be started when filling is complete. To remove all air from the system, the majority (>75%) of the system should be closed so that the water can circulate at a sufficient rate. When each section is full, it should be closed, and the procedure repeated throughout the system.



Note:

Use ONLY non-chilled water when filling up the system! Cold water can cause immediate condensation on the pipes. Warm water contains less oxygen which can limit venting to some extent.

4.1 WATERSIDE COMMISSIONING



Important:
Commissioning is to be performed by properly trained and authorized personnel only!

- Fully purge the complete hydronic system of air prior to commissioning.
- Carefully inspect the system for leaks, paying particular attention to the connections.
- Carefully inspect flexible hose for leaks, if applicable.
- For the face coils normal operating pressure is rated at 250 psig max up to 300°F. The maximum working pressure should not exceed 360 psi.
- If equipped, the fin-tube elements the minimum flow rate of 1GPM ranging from 110°F to 220°F at a pressure drop of 47 Millinches per foot. Maximum flowrate at 4GPM at the same operation temperature ranges at a pressure drop of 525 Millinches per foot. The maximum working pressure is 200 psig.



Note:
The QLCI unit is not provided with any water flow control or measuring devices, therefore the pipe work system should be fitted with sufficient balancing aids to enable adjustment of the flow rate.

4.2 AIRSIDE COMMISSIONING



Note:
Do not attempt to read the total discharge airflow rate using a hood or any other device that adds downstream pressure to the unit, as it will reduce the amount of induction and give false readings. The total supply air flow (primary + induced) cannot be measured.

NOTE: Using a traverse duct calculation of the supply duct before the QLCI will not guarantee that the diffuser is properly balanced because performance is based on internal plenum pressure.

4.2.1 AIRSIDE COMMISSIONING AND K-FACTOR TABLE



Note:
The constraints detailed in the tables below are for standard QLCI. For QLCI's with non-standard nozzle configurations, contact Carson Solutions directly.

STEP 1

Locate the (2) socket head screws on the top of the upper left face panel. Loosen the locking screws using an **5/32"** Allen Wrench and remove the units upper face panels (as shown below). Do not use a power driver to loosen or tighten latches. Do not allow the upper face panels to fall as this could cause damage to the panel surface.



STEP 2

Use the commissioning tube to measure the internal pressure of the plenum.



STEP 3

The primary air volume in CFM can be calculated with this formula and the K-Factor value in the charts below: Data on the charts below are given at Standard Atmosphere at sea level.

The primary air volume in CFM can be calculated with this formula:

$$CFM = K \times \sqrt{\Delta P}$$

CFM = primary airflow (CFM)

K = constant - read from Table below

ΔP = static pressure measured in primary air chamber (in. W.G.)

K-Factor Chart 8" Inlet		Steps
DIU Size	Nozzle Size 2R (U)	
4'	143	<ol style="list-style-type: none"> 1. Measure nozzle pressure using the pressure tap port located behind the front left upper panel. 2. Use a 1/4" hose to attached to the low pressure side of the Manometer. 3. Measure and record the nozzle pressure P_{TAP} in. W.G. 4. Calculate the primary airflow rate by inserting the constant K for the DIU size and the presure measurement P_{TAP} into the equation below:
5'	190	
1500mm	221	
6'	236	
2000mm	298	
8'	333	

CARSON SOLUTIONS $CFM = K \times \sqrt{P_{TAP}}$ www.carsonsolutions.com

Volume Flow Controller (optional) general information:

If a volume flow rate control is required, a volume flow controller (supplied by others) may be installed in a constant volume system. See manufactures information specifications for further details.

Carson Solutions offers a range of volume flow rate controllers. Please contact Carson Solutions for more information.



Example: Size 1500mm QLCI, 2R-nozzle

measured static pressure of 0.295 in. W.G.

K = 221 (from Table 2)

$$CFM = 213 \times \sqrt{0.295}$$

$$= 120.0 \text{ CFM}$$

STEP 4

Make necessary adjustments to the balancing damper for the desired scheduled static pressure to the measured result. Adjusting the balancing damper should be used for trimming only.

Re-installed front face panels.

Refer to Division 23 Section 23 05 93 "Testing, Adjusting, and Balancing" for additional procedures for displacement unit, adjusting and balancing.

5.1 CLEANING INSTRUCTIONS

QLCI units contain no moving or consumable parts, therefore the maintenance requirements are limited to periodic inspection for leakage and occasional cleaning of the hydronic coil, front face panel and the condensate tray.

The accumulation of dust on the hydronic coil will eventually restrict the airflow through the coil, reducing cooling and heating performance.

The inspection frequency is subject to the environmental conditions and occupancy levels. It is recommended that the QLCI units be inspected on an annual basis until a scheduled maintenance pattern is established.



Important!

Maintenance is to be performed by properly trained and authorized personnel only!

Properly maintain water conditions which prevent corrosion of copper tubing. If included in the system design, check the condensate sensors or humidity sensors according to sensor manufacturer's methods and schedule.



Important!

Wear eye protection and gloves.
Product includes sharp edges and burrs.

To clean the hydronic coil:

STEP 1

Locate the (2) socket head screws on the top of each upper face panel. Loosen the locking screws using an **5/32"** Allen Wrench and remove the units upper face panels (as shown below). Do not use a power driver to loosen or tighten latches. Do not allow the upper face panels to fall as this could cause damage to the panel surface.



STEP 2

Using a soft nozzle brush attachment, gently vacuum in the direction of the coil fin to remove any accumulated dust. Be careful not to bend or damage any fins. A fin comb can be used to straighten any bent fins.



STEP 3

After cleaning the coils, replace the unit face panels by tightening locking screws with **5/32"** Allen Wrench.

To clean the QLCI unit:

When necessary, the cabinet can be cleaned using a mild detergent diluted with warm water. Apply with a soft cloth, rinse, and wipe dry.



Note!

Strong or abrasive chemical detergents should not be used as they may cause damage to the paint finish.

To clean the condensate tray:

If necessary, the condensate drip tray can be cleaned using a small amount of disinfectant applied with a soft cloth. Wipe dry.

5.2 REPLACEMENT PARTS

The QLCI displacement induction ventilation diffuser contains no serviceable or consumable parts. Contact Carson Solutions for more information.

6.1 SYMPTOMS & SOLUTIONS

SYMPTOM	PROBABLE CAUSE	SOLUTION
<p>LOSS OF AIRFLOW</p>	<p>Obstruction on front face panel or hydronic coil</p>	<p>Remove front face panel and inspect/clean grill and hydronic coil as necessary</p>
	<p>Air connection detached from diffuser</p>	<p>Inspect attachment hardware and reconnect ductwork</p>
	<p>Obstruction in primary air plenum</p>	<p>Remove primary air connection and check for debris</p>
	<p>Air dampers incorrectly set</p>	<p>Inspect and adjust air damper as necessary</p>
	<p>Faulty or incorrectly set air handling unit</p>	<p>Inspect and re-commission air handling unit (by certified contractor)</p>
<p>REDUCED COOLING OR HEATING</p>	<p>Reduced cooling or heating performance</p>	<p>Confirm primary airflow is at designed CFM or above</p>
	<p>Obstruction on front face panel or hydronic coil</p>	<p>Remove front face panel and inspect/clean grill and hydronic coil as necessary</p>
	<p>Loss of water circulation through hydronic coil</p>	<p>Inspect control valves and check flow using system test points</p>
<p>CONDENSATION ON PIPE-WORK OR HYDRONIC COIL</p>	<p>Chilled water temperature too low</p>	<p>Measure chilled water temperature and reset to design value</p>
	<p>Incorrect primary air temperature or condition</p>	<p>Measure room humidity level. If humidity is higher than design condition, the primary air is failing to control room humidity. The air handling unit must be set so the primary air is dry enough to offset the latent gains.</p>
	<p>Primary air volume too low</p>	<p>Measure primary air volume using procedure described in section 4.2.1 Increase air volume design figure.</p>

7.1 MANUFACTURER'S REPRESENTATIONS & WARRANTIES

CARSON DESIGN MANUFACTURING (CDM), INC. DBA (CARSON SOLUTIONS) TERMS & CONDITIONS OF SALE Version 01-01-22 ALL SALES ARE SUBJECT TO THESE TERMS AND CONDITIONS OF SALES ("TERMS") AND AS CONTAINED IN CDM'S INVOICE AND ARE ALSO SUBJECT TO CDM'S CREDIT AND OTHER POLICIES AND PROCEDURES, WHICH ARE HEREBY INCORPORATED BY REFERENCE AND SUBJECT TO CHANGE.

1. TERMS TO GOVERN: These Terms shall be binding upon CDM Inc, and its subsidiaries and affiliates ("Seller") and the buyer ("Buyer"). No modification, amendment or change, whether in Buyer's purchase order, shipping release forms or otherwise shall obligate Seller, unless authorized in writing by Seller. Any different or inconsistent terms and conditions contained in Buyer's forms whether issued before or after Seller's quotation are hereby expressly superseded by these Terms.

2. ACCEPTANCE & PRICES: Any proposal offered by Seller to Buyer is valid for sixty (60) days from Seller's issuance. Upon the expiration of sixty (60) days or sooner if revoked by Seller, the proposal shall expire. Pricing shall remain valid for Seller's products shipped within 90 days from the date of Seller's acceptance. Thereafter, prices are subject to change. Prices include transportation charges predicated on a single shipment and any partial shipments may result in additional cost to Buyer. Seller reserves the right, at any time, to withdraw a bid, quote or a price that contains an error.

3. PAYMENT & TAXES: Upon credit approval, payment terms for Products shipped hereunder or labor performed will be thirty (30) days net with no retainages unless contrary terms appear on the face hereof or otherwise expressly agreed to in writing by Seller. Should Buyer default in the timely payment to Seller of sums due on an order, Seller is entitled to any remedies provided in these Terms or by law. If Buyer fails to pay any amounts when due, Buyer shall pay Seller interest thereon at a periodic rate of the lesser of one and one-half percent (1.5%) per month or the maximum allowable legal interest rate, along with all costs and expenses (including without limitation mechanics lien or bond, collection expenses, reasonable attorneys' fees, filing and service fees and disbursements and Court costs) incurred by Seller. Buyer is responsible for all sales, customs, or use tax imposed by any governmental agency, including, but not limited to, Federal, State, Local or international authorities, payable on the transaction under any applicable statute, except those taxes due as a result of Seller's gross profits. If Seller is not timely paid or Buyer is otherwise in default, Seller reserves the right to pause or terminate any work or services in process and/or reschedule any delivery at any time.

4. PERFORMANCE: Seller shall be obligated to furnish only the Products or labor described in the applicable purchase order or acknowledgement and agreed to in writing. The duty to perform under any order on the part of Seller and the price thereof is subject to the approval of its Credit Department, and is contingent upon the absence of strikes, accidents, floods, act(s) of terrorism, war, fires, fuel shortages, the inability to procure materials from the usual sources of supply, the requirements of the US Government (through the use of priorities or preference or any other manner) that Seller divert either the material or the furnished Product to the direct or indirect benefit of the US Government, or upon any like or unlike cause beyond the reasonable control of Seller. Upon disapproval of the Credit Department or upon the occurrence of any such event, Seller may delay performance or, at its option, renegotiate prices and terms and conditions of sale with Buyer. If Seller elects to renegotiate and Seller and Buyer are unable to agree on revised prices or terms, Seller may cancel without any liability.

5. SHIPMENT & RISK OF LOSS: Shipment dates are estimates only, FOB factory. Title and risk of loss shall pass to Buyer upon Seller's delivery to carrier. Customers may only make their own shipping arrangements with Seller's agreement. Seller shall advise when the Products have been completed and send an invoice at that time. All Product must be picked up by Buyer within 30 days of Seller's completion of manufacture. Seller specifically rejects any order containing a time is of the essence clause or liquidated damage penalties for late shipments. Seller is not responsible for loss of goods from shortages, damages or transit delays. Any claims for damage in shipment, mis-delivery, loss of the Products or other damage shall be the responsibility of and filed by Buyer.

6. CHANGES, CANCELLATION & RETURNS: Changes requested by Buyer following Seller's acceptance of order must be approved by Seller in writing and may result in an increase in price by Seller to recover all labor and material costs, including normal overhead and profit. If any portion of a Seller accepted order is cancelled by Buyer without default on the part of Seller or without Seller's written consent, Buyer shall be liable to Seller for cancellation charges including, but not limited to, Seller's incurred costs and the profit Seller would have realized from the transaction had the agreement not been breached by Buyer. Products shall not be returned except by written permission of Seller pursuant to Seller's return policy.

7. AUTHORITY OF AGENTS: No agent, employee or representative of Seller has the authority to bind Seller to any affirmation, representation or warranty concerning the Product or labor sold, except for Seller's authorized agents, employees or representatives.

8. INDEMNITY: Seller shall protect and indemnify Buyer from and against all claims, damages, judgments and loss solely arising from Seller's infringement or alleged infringement of any United States patent by any of the articles or material delivered hereunder, provided that in the event of suit or threat of suit for patent infringement, Seller shall promptly be notified and given full opportunity to negotiate a settlement. Seller does not warrant against infringement by reason of Buyer's design of the articles or the use thereof in combination with other materials, or in the operation of any process. In the event of litigation, Buyer agrees reasonably to cooperate with Seller. All parties concerned shall be entitled, in connection with any proceeding under the provisions of this Article, to be represented by counsel at their own expense. Buyer shall defend, indemnify and hold Seller harmless from any personal injury, wrongful death or property damage caused in whole or in part by Buyer's breach, negligent or intentional act(s).

9. LIMITED WARRANTY: Seller warrants that at the time of delivery and for a period of twelve (12) months from the initial startup ("Start-Up"), or eighteen (18) months from date of shipment, whichever is less, Products will be free from defects in material and manufacture provided that Products have been installed with proper Start-Up, maintained and operated under normal conditions for service in accordance with the instructions of Seller, and that Products have the capacities and ratings set forth in Seller's design specifications. No warranty is made against corrosion, erosion or deterioration. At Seller's option, Seller's obligations and liabilities under this warranty are limited to repair of Products or replacement of components for Products not conforming to this warranty. This Limited warranty does not cover labor for component repair or replacement. Once Seller's service department has been notified and approved any warranty related service work, Seller will repair or replace components as needed and ship FOB factory. Seller shall not be obligated to pay for the cost of lost refrigerant or Glycol. Consumable parts and Products that are consumable in nature are explicitly excluded from this warranty. Consumables include, but are not limited to, filters, glycol and refrigerant. No warranty or liability whatever shall attach to Seller until full payment has been received. No warranty herein extended shall apply to repair or correction of conditions arising from improper or incorrectly connected air duct, piping, wiring, power supply, blown fuses, freezing, improper Product control when programmed by non-Seller controls, or personnel, or by anyone other than Seller employee or its representative. Operation of Products for temporary conditioning of a building during construction without the written consent of an officer of the Seller immediately voids any warranty coverage. If the Product is replaced, the replacement may not be new, but will be in good working order and at least functionally equivalent to the item or Product replaced. The replacement assumes the warranty status of the replaced Product. The warranty period does not restart. **THIS LIMITED WARRANTY IS VOIDED BY MISUSE, NEGLIGENCE, FAILURE TO FOLLOW INSTRUCTIONS OR SELLER'S MANUALS OR TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER. THE WARRANTY AND LIABILITY SET FORTH HEREIN REPRESENT BUYER'S EXCLUSIVE REMEDY AND ARE IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES WHETHER IN CONTRACT, TORT, WARRANTY OR IN NEGLIGENCE, EXPRESSED OR IMPLIED, IN LAW OR IN FACT, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE. SELLER PROVIDES NO INDEPENDENT WARRANTY FOR THIRD PARTY PRODUCTS OR COMPONENTS SOLD TOGETHER OR INCORPORATED WITH SELLER'S PRODUCT(S).**

10. LIABILITY DISCLAIMER: TO THE MAXIMUM EXTENT PERMITTED BY LAW, SELLER'S TOTAL LIABILITY FOR CLAIMS, REGARDLESS

OF THE FORM OF ACTION OR THEORY OF LIABILITY (INCLUDING CONTRACT, TORT OR WARRANTY), SHALL BE LIMITED TO THE FEES PAID TO SELLER BY BUYER FOR THE PRODUCTS OR LABOR THAT WAS THE PROXIMATE CAUSE OF THE DAMAGE. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL, PUNITIVE, OR INDIRECT DAMAGES OF ANY KIND (INCLUDING, WITHOUT LIMITATION, LOST PROFITS, LOSS OF USE, OR CLAIMS OF THIRD PARTIES) THAT MIGHT OCCUR AS A RESULT OF THE PERFORMANCE OR BREACH OF THE AGREEMENT OR IN ANY WAY ARISING OUT OF OR IN CONNECTION WITH THE AGREEMENT WHETHER BY CONTRACT, TORT, WARRANTY OR OTHERWISE. SELLER SHALL NOT BE LIABLE OR RESPONSIBLE FOR ANY CRANE, RIGGING, LABOR OR OTHER CHARGES OR DAMAGES OF ANY KIND OR NATURE CAUSED IN WHOLE OR IN PART BY DELAYS IN SHIPMENT OR SELLER'S BREACH.

11. ASSIGNMENT: Buyer may not assign or transfer this agreement. Seller may assign its rights or obligations under this Agreement in the event of a merger or change of control of Seller.

12. GOVERNING LAW: This Agreement shall be governed and construed in accordance with the laws State of Minnesota. Buyer consents to jurisdiction in the Circuit Court of Hennepin County, Minnesota. Each party consents to that choice of law and jurisdiction and irrevocably waives any objection to same.

13. EXPORT CONTROLS: Buyer shall comply with the export laws and regulations of the United States. Buyer agrees it shall not export or enter into an agreement for the export any goods from Seller to any prohibited or embargoed country or to any denied, blocked or restricted person or entity.

14. MISCELLANEOUS: Seller's waiver or failure to enforce the terms of this Agreement shall not constitute a waiver of Seller's rights. The prevailing party may recover their reasonable attorney fees and reasonable out-of-pocket expenses.

