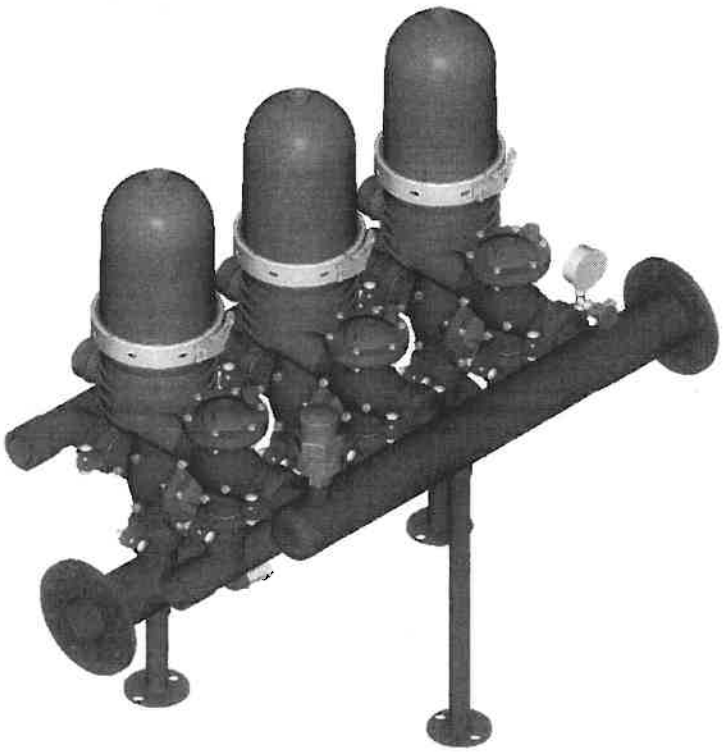
ARKAL SPIN KLIN

2" Spin Klin Battery External Source
Automatic Backwash

Operation, Service & Maintenance Manual



ARKAL FILTRATION SYSTEMS Bet Zera, Jordan Valley, 15135, ISRAEL Tel: 972-4-677-5140
www.arkal.com E-mail:filters@arkal.com Fax: 972-4-677-5476

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Table of Contents

1. Introduction

General

Arkal Filtration Systems congratulates you on purchasing the **2" Spin Klin Battery with External Source** . All Arkal's filters are easy to install, use and service and don't require special skills to operate them.

For operation and maintenance of the filter please follow the instructions in this manual.

2. Safety Instructions

1. Prior to installation or handling of the filter, read carefully the installation and operation instructions carefully.
2. Confirm filter draining prior to service.
3. Take precautions while lifting, transporting or installing the filter.
4. Installation of the filter should be performed so as to avoid direct water splashing on any of the filter parts and especially on the electronic control unit.
5. Confirm that filter weight, when full, meets the support construction requirements.
6. Prior to installation confirm that line pressure matches filter's operational pressure.
7. During installation, use standard flanges and connections only.
8. Check that all filter flange bolts are properly secured.
9. Please note, the filter enters a flushing mode automatically, without prior warning.
10. Use original parts only when servicing the filter.
11. Arkal cannot accept responsibility for any changes or modifications to the equipment.

SPECIAL NOTE

Before opening the filter lock, check that there is no pressure in the filter.

3. Description & Operation

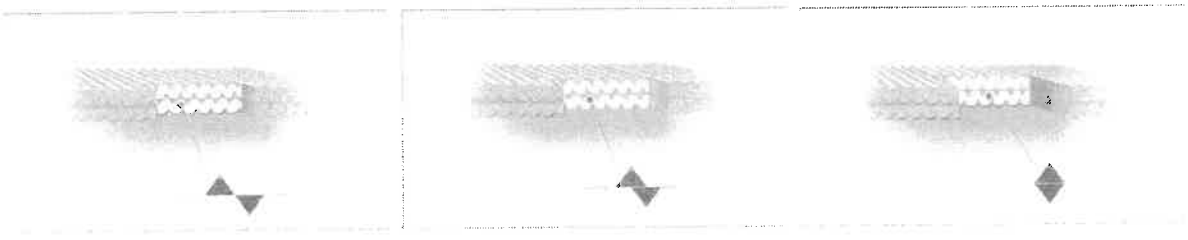
3.1 Disc Filtration Technology

Arkal Filtration Systems uses a specially designed disc filtration technology. Thin, color-coded polypropylene discs are diagonally grooved on both sides to a specific micron size. A series of these discs are then stacked and compressed on a specially designed spine. When stacked, the groove on top runs opposite to the groove below, creating a filtration element with a statistically significant series of valleys and traps for solids. The stack is enclosed in a corrosion and pressure resistant housing.

During the filtration process, the filtration discs are tightly compressed together by the spring's power and the differential pressure, thus providing high filtration efficiency. Filtration occurs while water is percolation from the outer diameter to the inner diameter of the element. Depending on the micron rating, there are from 18 (in 400 micron discs) to 32 (in 20 micron discs) stopping points in each track, thus creating the unique in-depth filtration.

Table of Filtration Grades of the Discs and Color Code

Color Code	Blue	Yellow	Red	Black	Green	Gray
Mesh	40	80	120	140		
Micron	400	200	130	100	55	20



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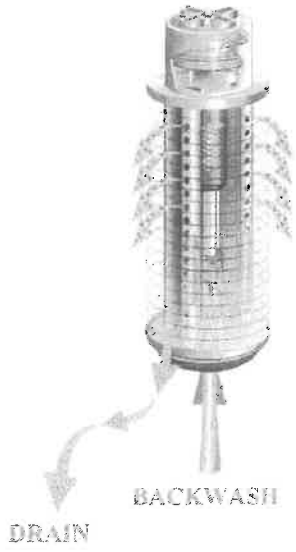
3.2 Spin Klin Technology – Spin Klin Spine Model II

Spin Klin Spine – The Core of the Spin Klin Filtration System

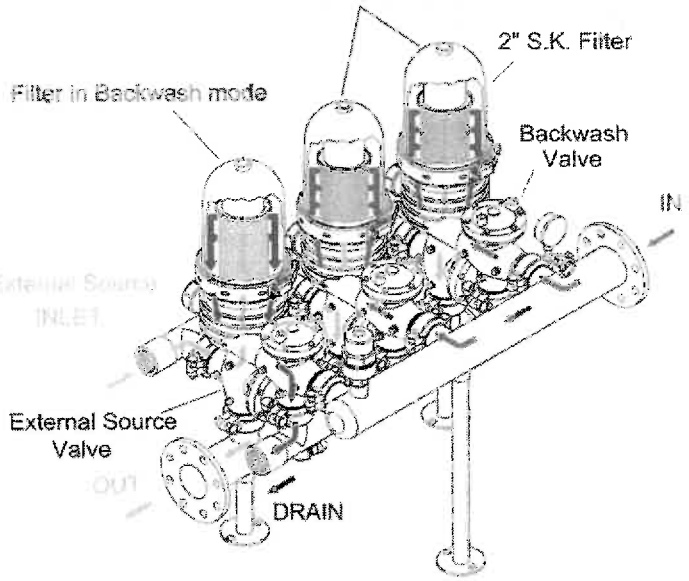
The Spin Klin® discs are stacked on the Spin Klin® spine. The discs are color-coded according to micron size, and are assembled to suit your water filtration requirements. The spine assembly has a spring compression unit and an internal piston, which operate during alternate filtration or backwash modes. The spine assembly is specially designed to compress the micron housing. Inside the housing a spring and the pressure difference compress the discs tightly during the filtration process, forcing the water to flow between the grooves and trap the solids.

Spin Klin Automatic Backwash Operation

Activated by a predefined command (differential pressure or time) alternate units of the Spin Klin® system go into backwash mode. The inlet valve is shut as the drain is automatically opened. During the backwash process, the compression spring is released and the pressure difference is eliminated. The spine piston rises up, releasing the pressure on the discs. Tangential jets of clean water are pumped at high pressure in the opposite direction through nozzles at the center of the spine. The discs spin free and clear, loosening the trapped solids. Solids are quickly and efficiently flushed out through the drain.



3.3 Mode of operation



Filtration Process

- During the filtration stage water flows through the **INLET MANIFOLD** distributing through the **INLET VALVES** to the 2" **SPIN KLIN FILTERS**
- The water passes through the **FILTER** and flows out clean through the **OUTLET VALVE** and **OUTLET MANIFOLD** to the customer.

Backwashing Process

The **CONTROLLER** transmits a pulse (as per pressure differential or time, whichever is first.
Pneumatic command from solenoid No. 1 sends a pressure pulse to two users simultaneously.

A. To the **INLET VALVE** converting it from filtration mode to backwash mode.
B. To the **OUTLET VALVE** converting it from filtration mode to backwash mode.

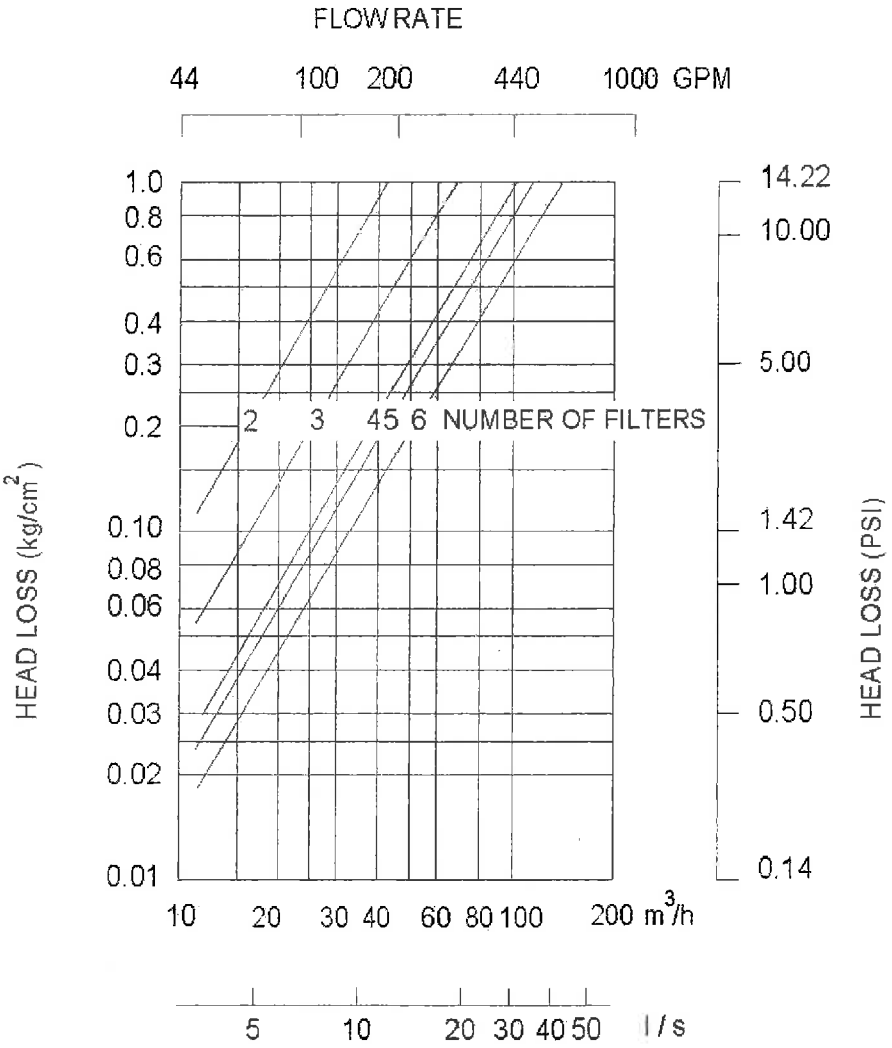
- The **ETERNAL SOURCE WATER** flow in to **FILTER NO. 1.**
- The piston of the **SPIN KLIN FILTER** rises, thus decompressing discs.
- **FILTER NO. 1.** is then flushing for 15 seconds.

When the time elapses the control unit stops the backwash signal to the solenoid.
The solenoid releases the water pressure signal allowing the **INLET VALVE** and the discs of the spines to return to filtration mode.
Once **FILTER NO.1** is in the filtration position again the control unit sends a signal to begin the backwash process in **FILTER NO.2**.

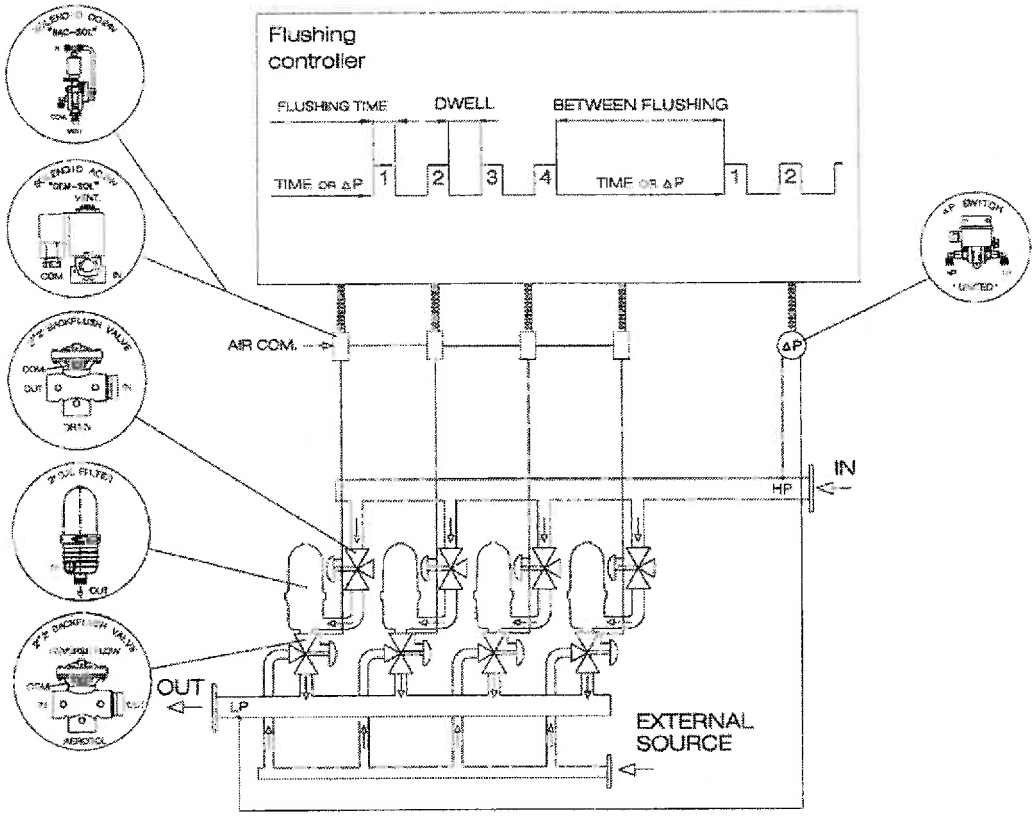
4. Technical Data

Parameters	METRIC	US
Maximum pressure	10 bar	145
Minimum pressure	2.8 bar	38 psi
Backwash Flow Rate per POD	10 m^3/hr	45 gpm
Maximum Temperature	70 °C	158 °F

5. Head loss chart



6. Control



- Refer to the manufacturer's handbook before installing the controller.
- Make sure that the voltage of both the solenoid unit and controller are correct.
- Set the manual operation button to automatic.
- Check that the ΔP hydraulic switch HIGH and LOW pressure lines are correctly connected to the appropriate ports.
- Set the starting backwash switch to ΔP 5-7 meters (6 - 8p.s.i.).
- Set the controller to a flush time of 15 seconds and a dwell time of 10 seconds. These settings may require adjustment to conform to local water conditions. Typically, a 1 to 3 hour interval between backwashes is recommended.

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7. Maintenance

Monthly Maintenance

Check inlet /outlet pressures -

If the pressure differential is above 5 m / 7 PSI activate the backwash of the Spin Klin filtration system.

In the event that the pressure differential remains high check for possible failures.

Check for leakages from the drain manifold -

If there is a leakage of water during the filtration stage, check for possible failure of the backwash valve seals.

Backwash controller performance -

Check that the controller timing parameters are correctly set and activate the backwash cycle. In the event of possible failure of the backwash controller, please refer to chapter 8, troubleshooting

Winterization

In order to prevent the filter battery from becoming damaged under freezing conditions - drain all the water from the filter battery and leave the drain valve open.

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Seasonal Maintenance - Cleaning the Discs

When manual cleaning of the discs is required, please follow the steps described below:

Make sure that system is not under pressure! Release the clamp and remove the cover. (Figure 1)
Unscrew the butterfly-nut on the filtration element. (Figure 2)
Remove the tightening cylinder. (Figure 3)

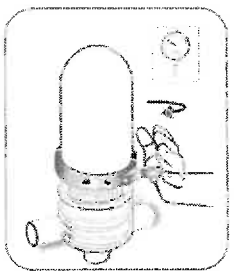
Figure 1


Figure 2


Figure 3

Remove the discs (for convenience we recommend using a plastic bag). (Figure 4, 5)
Tie each disc set on a string and place them in a cleaning solution (HCL, Chlorine, or other) refer to **"Cleaning Recommendations for Clogged Filtration Discs".**
Thoroughly wash the discs with fresh water and then reassemble the discs on the spines. (Figure 6)

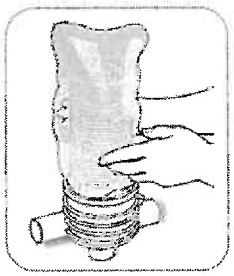
Figure 4


Figure 5

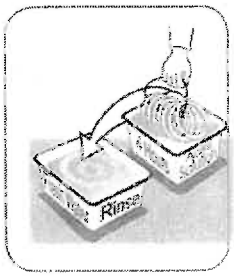

Figure 6

Check that the correct quantity of discs is assembled on the spine: when the discs are pressed with two hands, the top disc should be level with the imprinted circle on the outside of the spine. (Figure 7)
Replace on the tightening cylinder and tighten the butterfly-nut, (Figure 8,9)


Figure 7


Figure 8


Figure 9

Reassemble the filter cover and tighten the clamp. (Figure 10, 11)

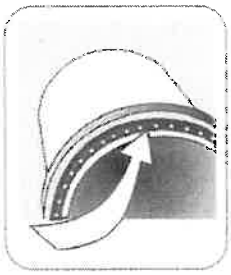
Figure 10

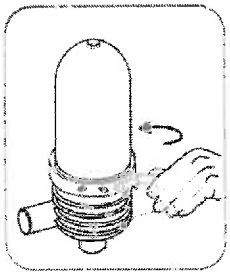
Figure 11

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Cleaning Recommendations for Clogged Filtration Discs

Water-formed deposits may cause clogging of the filter discs. The formation of these deposits depends on the quality of the filtered water and environmental conditions like temperature, pH, light, duration of filtration and more.

Common water-formed deposits are:

- Biological or organic deposits (mostly mucous or oily to the touch, beige, brown or green in color)
- Iron oxide (rust) or other metal oxides
- Carbonates (white or gray deposit)
- Combinations of the above

If these deposits cannot be eliminated by pretreatment of the water, we recommend the following cleaning procedure:

Material and Equipment

- A well ventilated working place.
- 2 small containers (1 liter), 2 large containers (15 liter) and a stirring stick, all resistant to chemicals, preferably of polypropylene.
- Plastic rope to tie up the disc.
- Sodium Hypochlorite NaOCl -
  Strong oxidizing liquid, commercial concentration: 10%.
  Oxidizes and removes organic and biological deposits.
- Hydrochloric Acid HCl -
  Very corrosive liquid, commercial concentration: 30%.
  Dissolves and removes carbonates, iron oxide, and other deposits.
- Safety equipment: safety glasses, gloves, long pants, long sleeved shirt and shoes.

Warning!

While working with chemicals protect yourself with the necessary safety equipment:

- Safety glasses, gloves, protective clothing.
- Work in a well ventilated area.
- Follow the manufacturer's instructions.

Cleaning Organic and Biological Deposits

- Open the filter and remove dirty discs.
  Warning – Never open the filter before the pressure has been released.
- Arrange the discs loosely on the plastic rope.
- Prepare a 5% Sodium Hypochlorite solution:
  1) Pour 5 liters of water into one of the large containers.
  2) Add 5 liters of Sodium Hypochlorite (10%) into the water.
- Soak the discs in the solution so that both sides are covered. To achieve maximum cleaning, agitate the discs several times with a stirring stick.
- Contact time with cleaning solution: up to 8 hours.
- Remove the discs carefully from the solution, put them in the second large container and rinse them very well with clean water before placing them back in the filter.
- We recommend flushing the cleaned discs again in the filter to ensure that all chemical residues are removed.

The cleaning solution can be used for several sets of discs. As the cleaning activity of the solution deteriorates, it may be necessary to soak the discs for a longer time.

Cleaning Carbonates and Iron Deposits

- Open the filter and remove the dirty discs.
- Arrange the discs loosely on the plastic rope.
- Prepare a 5% Solution of Hydrochloric Acid:
  1) Pour 10 liters of water into one of the large containers.
  2) Carefully add 2 liters of Hydrochloric Acid (30%) into the water.
  Soak the discs in the solution so that both sides will be covered.
  PLEASE NOTE: Carbonates react violently with hydrochloric acid (foaming, gas evolution).
  To achieve maximum cleaning, agitate the discs several times with a stirring stick.
- Contact time with cleaning solution: 1 - 8 hours.
- Remove the discs carefully from the solution and rinse them well with clean water before placing them back in the filter.
- We recommend flushing the cleaned discs again in the filter to ensure that all chemical residues are removed.

The cleaning solution can be used for several sets of discs. It may be necessary to soak the discs for a longer period of time as the cleaning activity of the solution deteriorates.

Cleaning Complex Deposits

If the composition of the deposit is not known, perform the following test:

- Take 5 discs for the test.
- Soak 2 discs in a 5% Sodium Hypochlorite Solution.
  Preparation of the solution:
  Pour 1 cup of water into a small container, then add 1 cup of Sodium Hypochlorite (10% NaOCl).
- Soak 2 discs in a 5% Hydrochloric Acid Solution.
  Preparation of the solution:
  Pour 2½ cups (= 500ml) of water into a small container, then add carefully ½ cup (= 100ml) of Hydrochloric Acid (30% HCl).
- Keep one disc as a control.
- Observe the cleaning process:
  If one of the solutions removes all of the deposit, clean the discs in that solution according to the instructions above.
  If neither solution removes the deposit completely, continue with the test procedure.
- Remove the discs from both solutions, rinse them well with water and soak them in the second solution: put the two discs, which have been in the Sodium Hypochlorite Solution, in the Hydrochloric Acid Solution, and the other way round.
- Check the cleaning process:
  If one of the treatments removes all of the deposit, clean all of the discs following the same two-step procedure in the exact same order. Rinse the discs well between the two cleaning processes.
  If the deposits haven't been completely removed, send a set of untreated discs to the laboratory for further examination.

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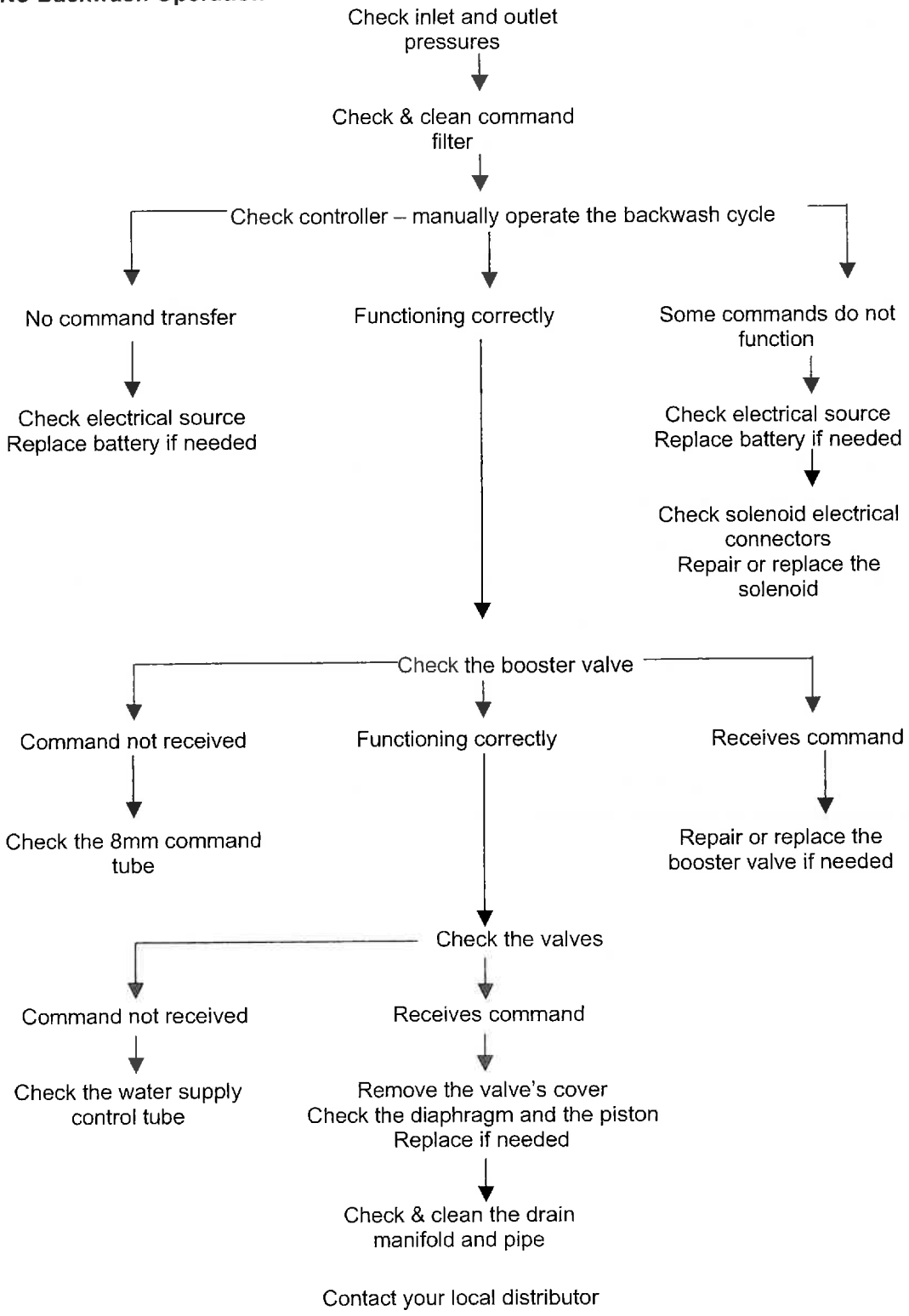
8. Troubleshooting

No Backwash Operation



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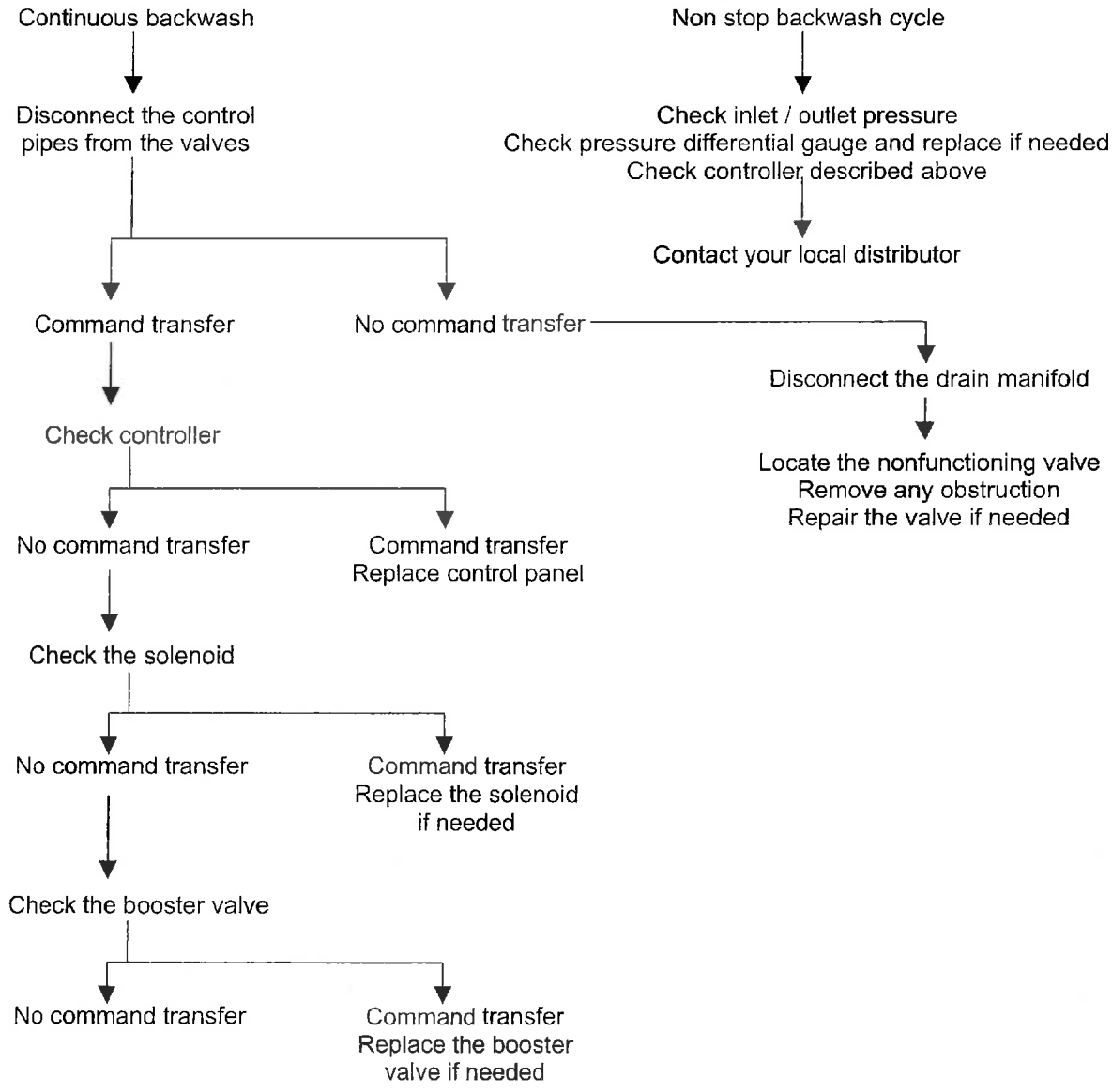
Identifying Malfunctions in the Galaxy system

Continuous or Non-stop Backwashing



Contact your local distributor

Warranty

ARKAL FILTRATION SYSTEMS STANDARD INTERNATIONAL WARRANTY

ARKAL FILTRATION SYSTEMS (hereinafter -"ARKAL FILTRATION SYSTEMS") guarantees to the customers who purchased ARKAL FILTRATION SYSTEMS products directly from Arkal or through its authorized distributors, that such products will be free from defect in material and/or workmanship for the term set forth below, when such products are properly installed, used and maintained in accordance with ARKAL FILTRATION SYSTEMS instructions, written or verbal.

Should such products prove defective within one year as of the day it left ARKAL FILTRATION SYSTEMS premises, and subject to receipt by ARKAL FILTRATION SYSTEMS or its authorized representative, of written notice thereof from the purchaser within 30 days of discovery of such defect or failure - ARKAL FILTRATION SYSTEMS will repair or replace or refund the purchase price, at its sole option, any item proven defective in workmanship or material.

ARKAL FILTRATION SYSTEMS will not be responsible, nor does this warranty extend to any consequential or incidental damages or expenses of any kind or nature, regardless of the nature thereof, including without limitation, injury to persons or property, loss of use of the products, loss of goodwill, loss of profits or any other contingent liabilities of any kind or character alleged to be the cause of loss or damage to the purchaser.

This warranty does not cover damage or failure caused by misuse, abuse or negligence, nor shall it apply to such products upon which repairs or alterations have been made by other than an authorized ARKAL FILTRATION SYSTEMS representative.

This warranty does not extend to components, parts or raw materials used by ARKAL FILTRATION SYSTEMS but manufactured by others, which shall be only to the extent warranted by the manufacturer's warranty.

No agents or representatives shall have the authority to alter the terms of this warranty nor to add any provisions to it not contained herein or to extend this warranty to anyone other than ARKAL FILTRATION SYSTEMS customers.

THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, EXCEPT THIS WARRANTY WHICH IS GIVEN IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

PEP Filters, Inc.
Limited Product Warranty

PEP Filters referred to hereinafter as "PEP" warrants to the original end-use purchaser that products manufactured by PEP are free from defects due to material or workmanship within 12 months after start-up or 18 months after shipment date from PEP's factory, whichever occurs sooner.

If PEP determines that a product manufactured by PEP has failed under normal use and service due to a defect in material or workmanship within the warranty period for such product, PEP will repair or replace the defective part or product at no charge to the original end-use purchaser. The determination to repair or replace shall be made by PEP in its sole discretion. The repaired or replacement product shall be shipped to the original end-user purchaser freight collect unless the original end-use purchaser makes other arrangements for shipment. The original end-use purchaser shall bear all risk of loss or damage during shipment. Repair or replacement does not extend the original warranty period for a product, and any warranty repair or replacement is warranted only for the balance of the original warranty period.

Exclusions:

- Any product that is not sold by PEP as new
- Any accessory or other product that is not specifically manufactured by PEP (In the case of such products, any warranty is limited to a pass through to the original end-use purchaser of any warranty received from the manufacturer to extent such pass through is permitted by the manufacturer)
- Any product that fails other than during normal use and service or that fails outside the warranty period for such product
- Normal wear and tear
- Any product that PEP determines (a) was tampered with, disassembled, repaired, modified or altered without the prior written authorization of PEP (b) damaged during or after shipment (c) used to pump material that the product was not designed to pump or otherwise used for a purpose or under conditions that differ from those for which it was designed (d) not properly maintained or operated or otherwise misused (e) subjected to abnormal use or service or (f) incorrect line voltages or fuses
- Pump seals – Initial poor water quality upon start-up may shorten the life of the original pump seal. Seal failure after initial start-up is not considered a defect in materials or workmanship. Pump seals are warranted against leakage at time of initial start-up only, provided there are no visual signs of seal damage caused by the pump running dry.
- Any party other than the original end-use purchaser
- Field repair, removal, reinstallation, labor, freight or other similar items
- Fire, flood, or other "acts of God" or other contingencies beyond the control of PEP

To be eligible for warranty repair or replacement, the original end-use purchaser must notify PEP Filters customer service (800.243.4583) of the product failure in writing within the warranty period for such product and, if requested by PEP, the product must be promptly returned within 21 days for inspection, freight prepaid, to either PEP's factory at 322 Rolling Hills Road, Mooresville, NC 28117 or to a PEP authorized service partner. The original end-use purchaser must also promptly provide PEP or its authorized service partner with all such information as either of them may request concerning the maintenance, operation, use and failure of any product that is claimed to have failed due to a defect in material or workmanship. Return of a product to PEP's factory requires a Returned Material Authorization (RMA) from PEP, which will include crating and shipping instructions. The RMA No. must be included with the returned product. The original end-use purchaser shall bear all risk of loss or damage during shipment.

THIS LIMITED WARRANTY IS PEP'S SOLE AND EXCLUSIVE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH OTHER WARRANTIES ARE EXPRESSLY EXCLUDED.

THE RIGHTS AND REMEDIES UNDER THIS LIMITED WARRANTY ARE THE SOLE AND EXCLUSIVE RIGHTS AND REMEDIES AGAINST PEP WITH RESPECT TO ALL PRODUCTS. EXCEPT FOR THE SPECIFIC LIABILITIES AND OBLIGATIONS PROVIDED UNDER THIS STANDARD LIMITED WARRANTY, PEP SHALL HAVE NO LIABILITY OR OBLIGATION WITH RESPECT TO ANY PRODUCT.

UNDER NO CIRCUMSTANCES SHALL PEP HAVE ANY LIABILITY FOR ANY CLAIM, LOSS, DAMAGE, INJURY, LIABILITY, OBLIGATION, COST OR EXPENSE THAT DIRECTLY OR INDIRECTLY RELATES TO OR ARISES OUT OF THE USE OR FAILURE OF ANY PRODUCT OR ANY LIABILITY FOR INDIRECT, SPECIAL, PUNITIVE OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOSS OF SALES, LOSS OF PROFITS, LOSS OF MATERIAL BEING PUMPED, DOWN TIME, LOSS OF PRODUCTION, LOSS OF CONTRACTS, OR DAMAGE TO REPUTATION OR GOOD WILL, WHETHER OR NOT PEP WAS AWARE OF OR ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

IN ANY EVENT, PEP'S LIABILITY IN CONNECTION WITH ANY INDIVIDUAL PRODUCT SHALL LIMITED TO THE ORIGINAL PRICE PAID TO PEP FOR SUCH PRODUCT.

No PEP authorized distributor or other person is authorized to modify this Limited Warranty or impose any liability or obligation on PEP other than expressly provided herein.

Doc No. PF.S.LPW--Rev0609

322 Rolling Hills Rd.
Mooresville, NC 28117
Tel: 800.243.4583
www.pepfilters.com

Final QC Documentation

amiad® WATER SYSTEMS

Order/Serial Number:	**10036241 SO 48318**
Customer:	**California Hydronics Corp**
Model:	**110101-000031**
Date:	**02/20/2015***

(N/A if not applicable)

Mechanical Checks:

System Hydro:	145	psig
Tank only Hydro:	145	psig
Pump Motor Nameplate Electrical:	460/3/60	Vac/Phase/Hz/ Amps
Pump Motor Running Amp:	6.3	Amps
Proper Pump Rotation	✓	Pass/Fail
Back Wash Operation: (Check linkage , valve and actuator operation including Limit switch setting)	Manual ✓	Pass/Fail
Separator Purge Operation:	N/A	Pass/Fail

Quality Procedures:

Clean and Shine System:	✓	QC Initials
Remove Excess Piping Tape/Sealant:	✓	QC Initials
Polish off Weld Discoloration :	✓	QC Initials
Application of Decals:	ACR	QC Initials
Removed Foreign Objects from Tank:	✓	QC Initials
Touch Up Paint:	✓	QC Initials

Electrical Checks:

Time Clock	N/A	Pass/Fail
Back Wash Timer		psig
Pressure Switch Diff Pressure set and checked	7	psig
Control Transformer	460/115/24	Primary Vac/ Secondary Vac
Control Transformer	0.100	Kva Rating
Overload Protection Set:	8.48	Amps
PLC operation:	Delta	Pass/Fail

Quality Procedures:

Verify secure wiring		QC Initials
Vacuum/Clean Interior Panel	✓	QC Initials
Polish off Weld Discoloration :	ACR	QC Initials
Verify fuses:	ACR	QC Initials
Attach wiring diagram	✓	QC Initials
Application of Decals, (PEP, voltage, warning)	✓	QC Initials

OTHER FUNCTIONS/ Notes or Comments

Spin Klin #

1.0 Leakage (45 to 90 psig)

Manifolds:	✓	QC Initials
Valves:	✓	QC Initials
Filters:	✓	QC Initials
Control Fittings:	✓	QC Initials
Air Vent:	✓	QC Initials

2.0 System performance in filtration

Valves:	✓	QC Initials
Filters:	✓	QC Initials
Water drainage from system:	✓	QC Initials

3.0 Visual testing:

4.0 Labels on system:

In, Out, Drain:	✓	QC Initials
High pressure, low pressure:	✓	QC Initials
Valve number:	✓	QC Initials

ACR

5.0 Labels on filter

Spin klin:	✓	QC Initials
Warning:	✓	QC Initials
Filtration grade:	✓	QC Initials
Suitable spare parts:	✓	QC Initials
Drawing & Operation Manual:	✓	QC Initials
Inlet/outlet flange cover:	✓	QC Initials
Identification label:	✓	QC Initials
Cleaning:	✓	QC Initials
Quality Control:	✓	QC Initials

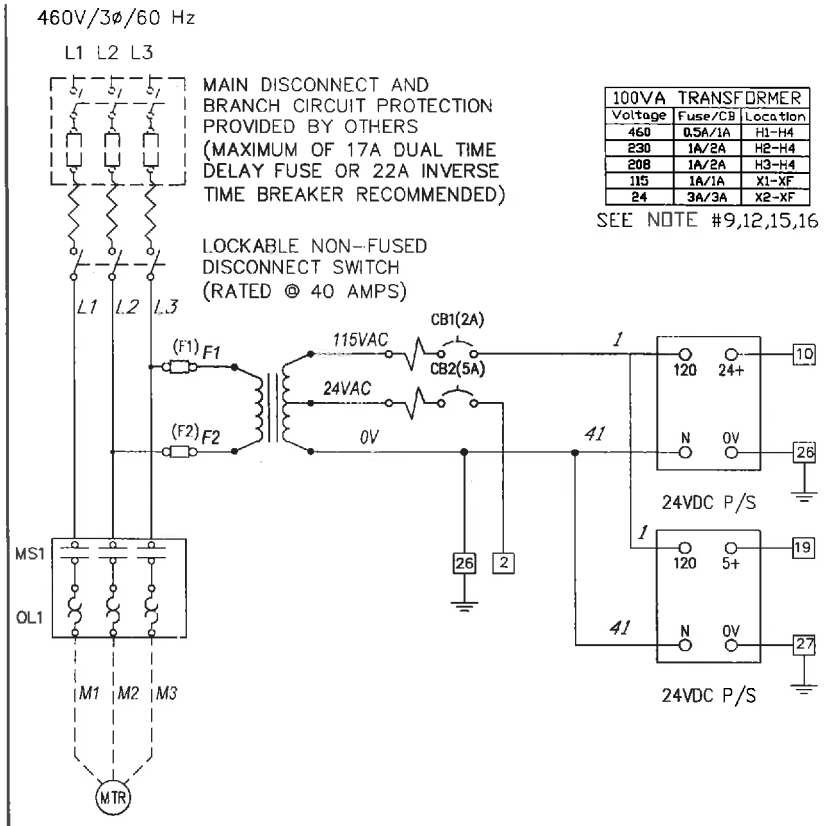
ACR

OTHER FUNCTIONS/ Notes or Comments

TEST BY ---------- Alvaro

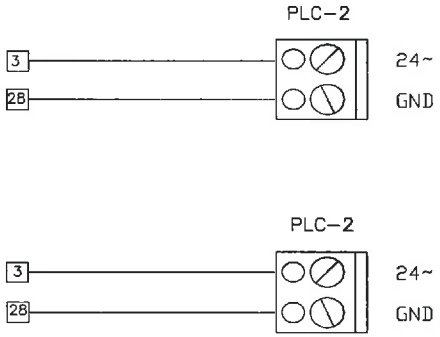
Assy by :---------- Jorge S Benedicto

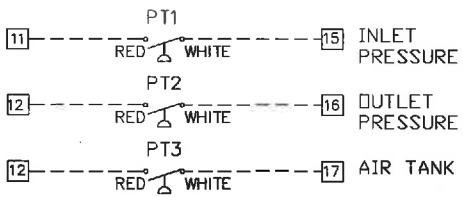
Electrical not tested

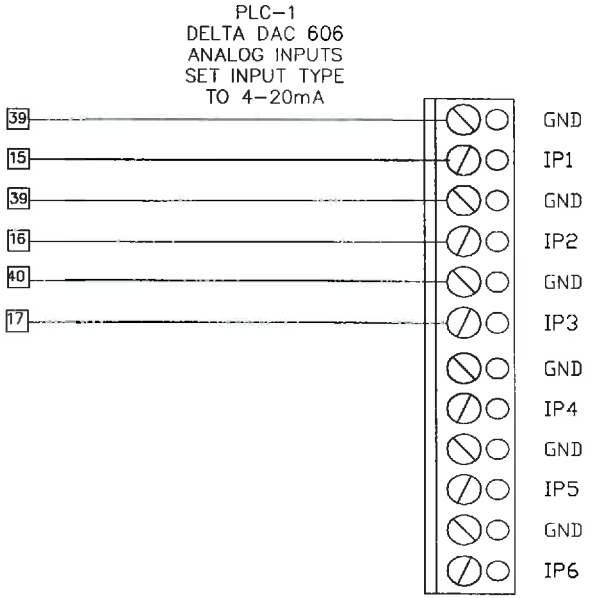


100VA TRANSFORMER		
Voltage	Fuse/CB	Location
460	0.5A/1A	H1-H4
230	1A/2A	H2-H4
208	1A/2A	H3-H4
115	1A/1A	X1-XF
24	3A/3A	X2-XF

SEE NOTE #9,12,15,16







GENERAL INFORMATION

	DESIGN CODE:	UL STANDARD 508A
POWER	VOLTAGE	460 VOLTS
	TOTAL FLA	8.69 AMPS
	# OF PHASES	3 ø
	FREQUENCY	60 HERTZ
	LARGEST MOTOR	7.5 HP
	SHORT CIRCUIT CURRENT	5 kA RMS SYMMETRICAL, 480 V MAX.
ENCLOSURE	SIZE	24"H x 24"W x 10"D
	UL RATING	TYPE 4X
	MATERIAL	FIBERGLASS

NOTES

1) GROUND PER 2011 NATIONAL ELECTRICAL CODE ARTICLE 250.
2) PANEL WIRING: ———— SHOP WIRING: – – – – – – – – CUSTOMER'S WIRING: ~~~~~~~~ FACTORY INSTALLED JUMPER: – – – – – – – –
3) USE COPPER WIRE RATED 60°C MINIMUM UNLESS OTHERWISE SPECIFIED.
4) DISCONNECT SWITCH TORQUE REQUIREMENTS: 35 LB IN. CONTACTOR/OVERLOAD TORQUE REQUIREMENTS: 7-10 LB IN.
5) SIZE THE MAIN DISCONNECT AND BRANCH CIRCUIT PROTECTION PER 2011 NATIONAL ELECTRIC CODE ARTICLE 430.
6) TERMINAL BLOCKS DENOTED BY .
7) CONDUIT HUBS AND FITTINGS MUST HAVE THE SAME UL ENVIRONMENTAL RATING AS THE CONTROL PANEL ENCLOSURE.
8) ALL WIRES ARE NOT TO EXTEND OUT OF TERMINATION POINT MORE THAN THE WIDTH OF THE WIRE.
9) CONTROL WIRING TO BE SIZED ACCORDING TO TRANSFORMER SIZE. IF 250VA OR LESS TRANSFORMER IS USED, CONTROL WIRING IS TO BE 18AWG. IF TRANSFORMER IS GREATER THAN 250VA AND LESS THAN OR EQUAL TO 1KVA, 16 AWG IS TO BE USED.
10) POWER WIRING SHOULD BE NO LESS THAN 14 AWG.
11) IF MOTOR IS LESS THAN 15.1-20 FLA, THEN 12 AWG IS TO BE USED. IF MOTOR IS 20.1-30 FLA, THEN 10 AWG IS TO BE USED. IF MOTOR IS 30.1-40 FLA, THEN 8 AWG IS TO BE USED.
12) INSIDE CABINET, ALL WIRE IS TO BE MTW, AND ALL WIRE OUTSIDE OF CABINET IS TO BE THHN UNLESS OTHERWISE SPECIFIED.
13) MOTOR OVERLOADS SET TO FLA OF THE PUMP MOTOR.
14) 75°C CU. WIRE MIN. ON MOTOR WIRES OUTSIDE OF CABINET.
15) ALL FUSING TO BE FERRAZ ATDR CL. CC OR EQUIVALENT
16) IF MORE THAN ONE SECONDARY IS TO BE USED, REPLACE XF WITH X3 IF A FUSE IS TO BE USED.
17) TB1= [5]

WARNING

Risk of Fire or Electric Shock

The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. All current-carrying parts and other components protected by this device should be examined and replaced if damaged. If burnout of a current element of an overload relay occurs, the complete overload relay must be replaced.

WIRE COLOR

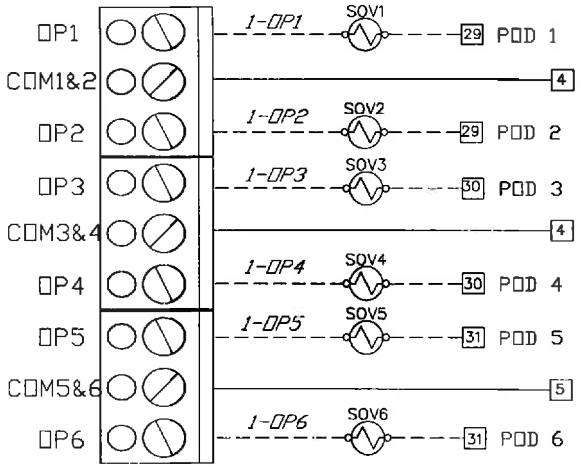
LINE	BLACK
AC	RED
GROUNDED NEUTRAL	WHITE
DC+	BLUE
DC-	WHITE/BLUE
GROUND	GREEN/YELLOW
EXTERNAL SOURCE	YELLOW

NO.	DATE	NOTES	BY
2	01/30/2015	ADD DELTA DAC-606 CONNECTIONS	RAM
1	04/08/2014	REMOVED PLC, ADDED CR, PTS	JTE

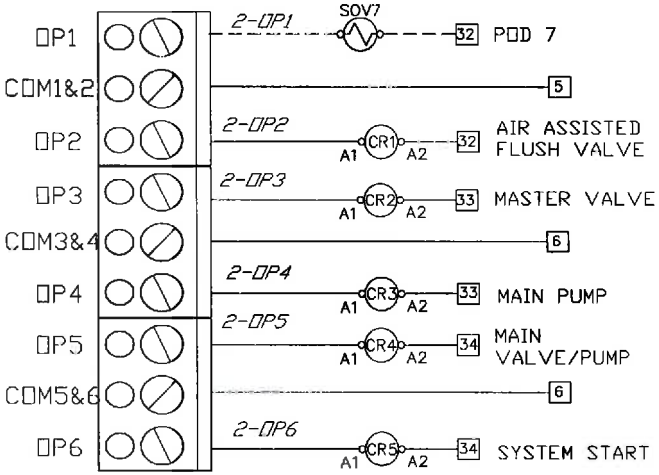
amiad WATER SYSTEMS
120-J TALBERT ROAD
MOORESVILLE, NC 28117 USA
(704) 662-3133 FAX (704) 662-3155

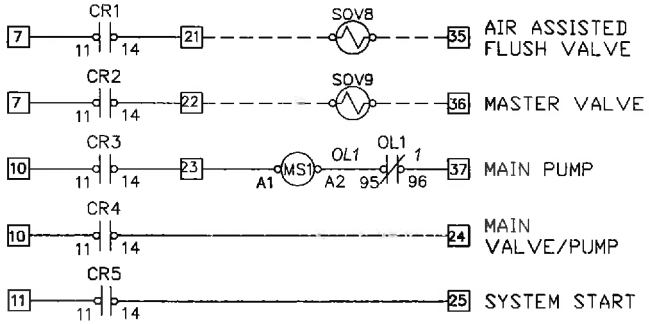
DRAWING DATE: 03/04/2014	DRAWING TITLE: 2X7X4, GRN, AIR AIDED FLUSH, HOR 460/3/60
SCALE: 1" = 1"	
SHT. 1 of 3	DRAWING NUMBER: 110101-000031-ELC
REV. NO. 2	
DRAWN BY: JTE	CATALOG NUMBER: 110101-000031
CHKD BY: ———	GENERAL TOLERANCES: ANGULAR ±1° FRACTIONAL ± 1/8"

PLC-1
DELTA DAC 606
BINARY OUTPUT
SET TO INTERNAL SOURCE



PLC-2
DELTA DAC 606
BINARY OUTPUT
SET TO INTERNAL SOURCE

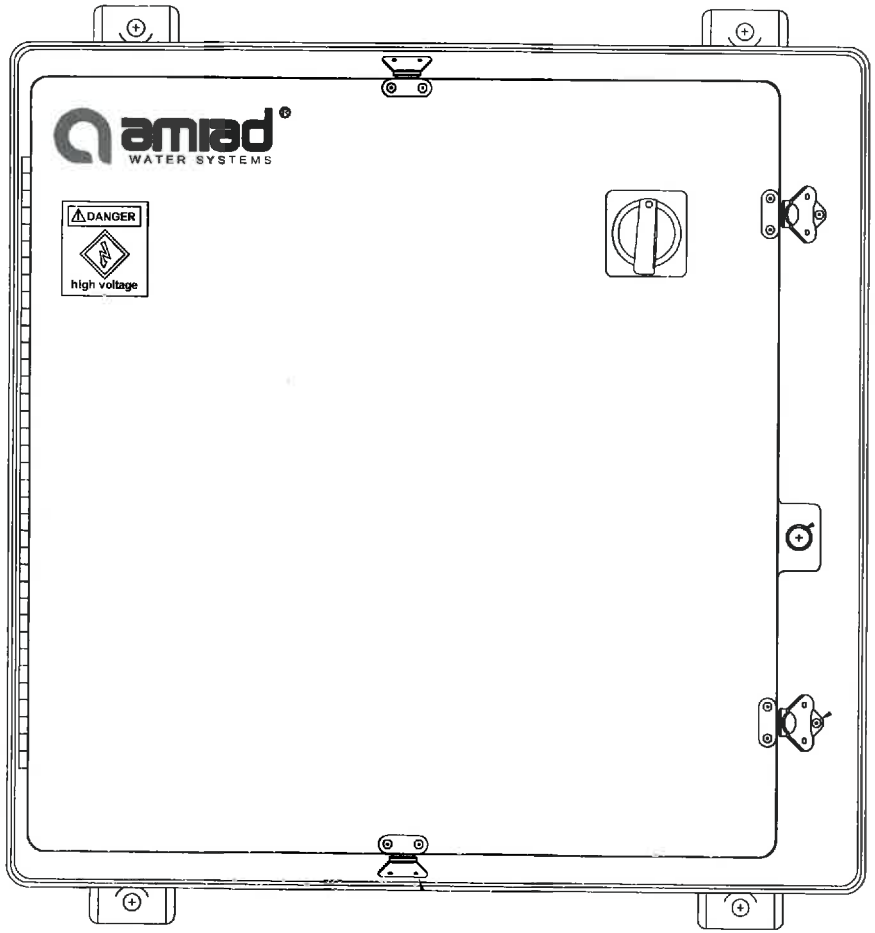


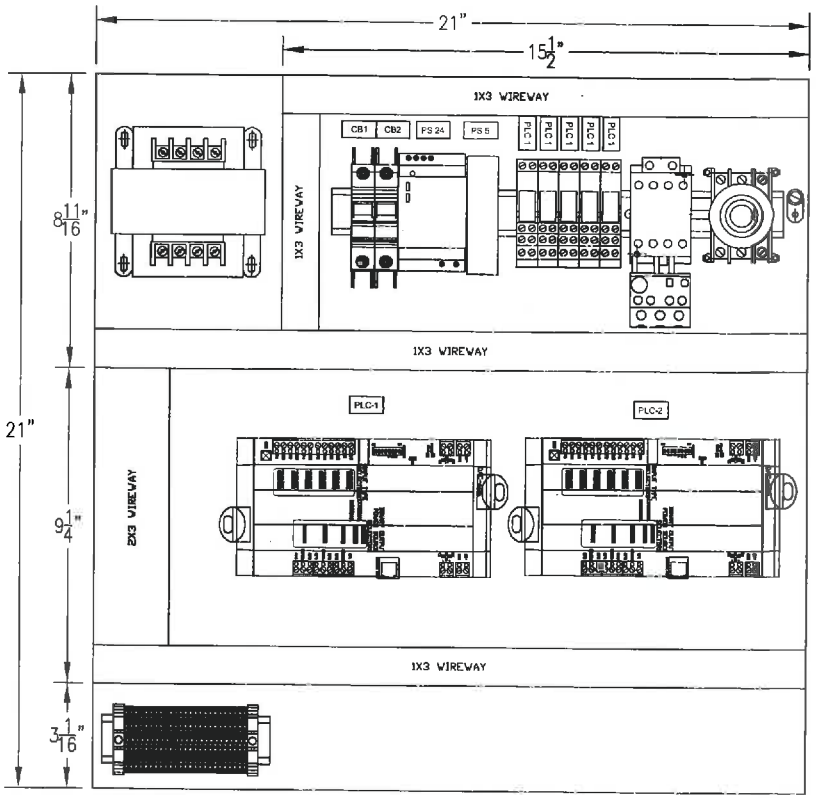


amiad WATER SYSTEMS
120-J TALBERT ROAD
MOORESVILLE, NC 28117 USA
(704) 662-3133 FAX (704) 662-3155

NO.	DATE	NOTES	BY
2	01/30/2015	ADD DELTA DAC-606 CONNECTIONS	RAM
1	04/08/2014	REMOVED PLC, ADDED CR, PTS	JTE

DRAWING DATE: 03/04/2014
DRAWING TITLE: 2X7X4, GRN, AIR AIDED FLUSH, HOR 460/3/60
SCALE: 1" = 1"
SHT. 2 of 3
DRAWN BY: JTE
CHKD BY: ----
DRAWING NUMBER: 110101-000031-ELC
REV. NO. 2
CATALOG NUMBER: 110101-000031
GENERAL TOLERANCES
ANGULAR ±1°
FRACTIONAL ± 1/8"





TB1

UPPER LEVEL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
LOWER LEVEL	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

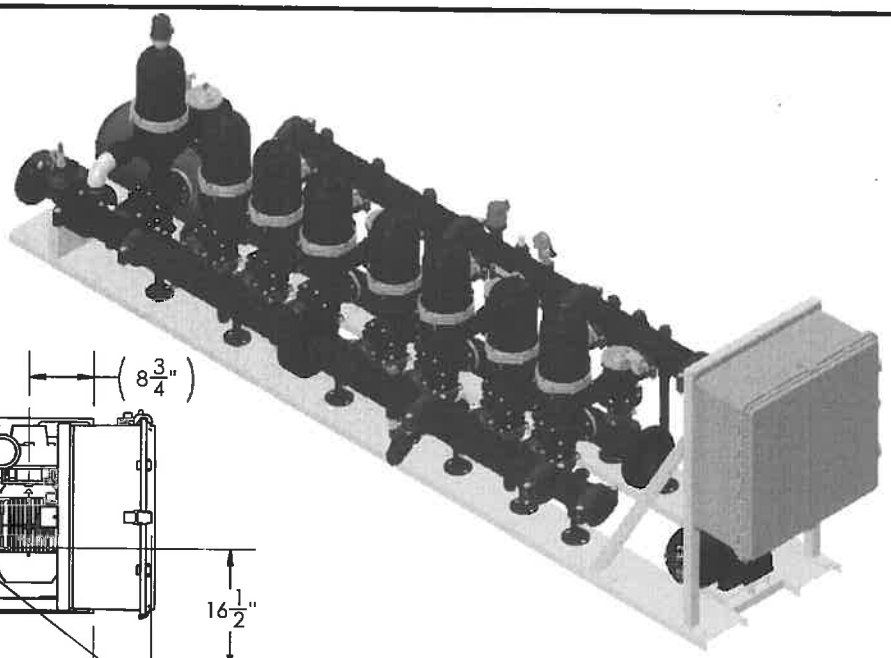
NOTE

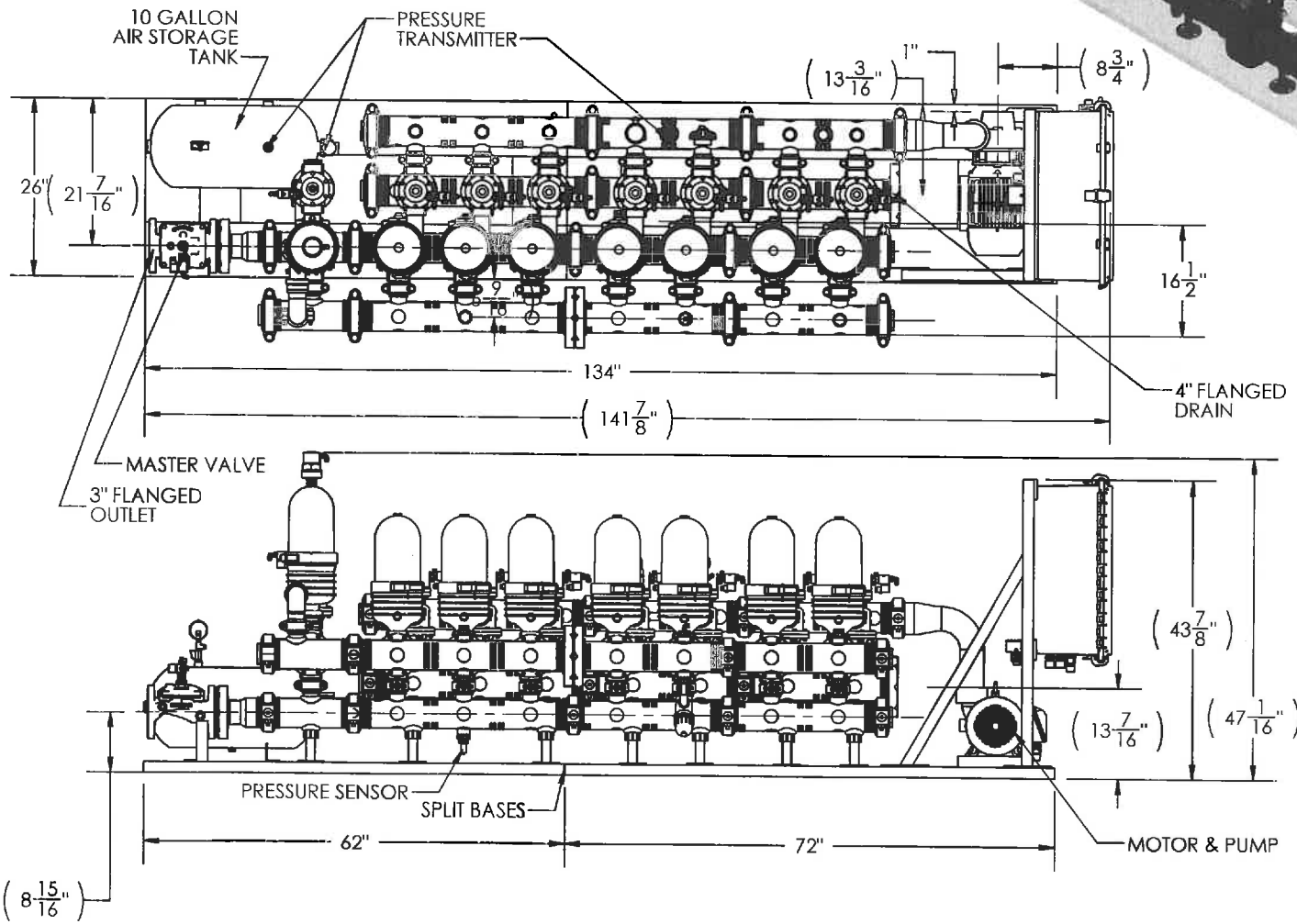
1. ALL HARDWARE WILL INCLUDE ONE MECHANICAL LOCK AND A FLAT WASHER.
2. THE ONLY EXCEPTION IS IF THE MECHANICAL SCREW IS A SELF-THREADING SCREW.
3. IF BOLT/SCREW NEEDS TO GO THROUGH A THROUGH-HOLE, THE BOLT/SCREW WILL NEED A FLAT WASHER ON BOTH SIDES OF THE MATERIAL AND MECHANICAL LOCK BEFORE THE NUT.
4. ALL HARDWARE HAS TO THREAD AT LEAST TWO COMPLETE TURNS THROUGH THE NUT/THREADED HOLE
5. IF VISIBLE, NO HARDWARE WILL EXTEND PAST THREE THREADS OUT OF THE NUT/THREADED HOLE.
6. BACKPLANE AND DEAD FRONT IF REQUIRED ARE TO BE GROUNDED ACCORDING NEC 70E.

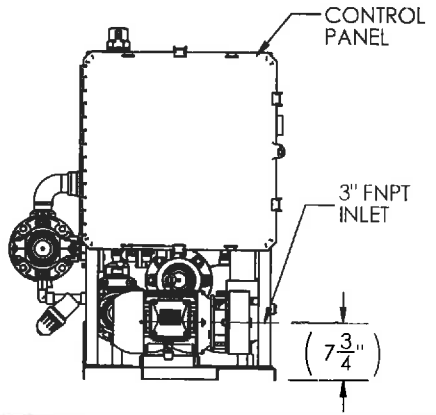
NO.	DATE	NOTES	BY
2	01/30/2015	ADD DELTA DAC-606 CONNECTIONS	
1			

amiad WATER SYSTEMS
120-J TALBERT ROAD
MOORESVILLE, NC 28117 USA
(704) 662-3133 FAX (704) 662-3155

DRAWING DATE: 03/04/2014	DRAWING TITLE: 2X7X4, GRN, AIR AIDED FLUSH, HOR 460/3/60
SCALE: 1" = 1"	DRAWING NUMBER: 110101-000031-ELC / REV. NO. 2
SHT. 3 of 3	
DRAWN BY: JTE	CATALOG NUMBER: 110101-000031
CHKD BY: ---	GENERAL TOLERANCES: ANGULAR ±1° FRACTIONAL ± 1/8"







NOTES

1) ALL DIMENSIONS GIVEN IN INCHES UNLESS OTHERWISE SPECIFIED.
2) MAXIMUM WORKING PRESSURE: 145 PSI
3) APPROXIMATE MASS: 1066 LBS

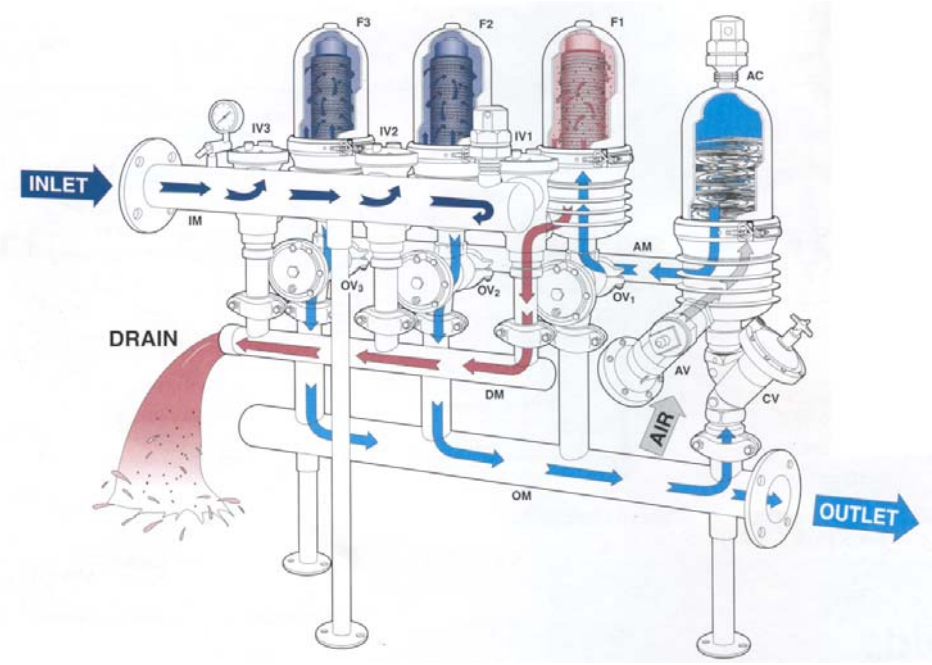
NO.	REVISION NOTES	DATE	BY
3	UPDATED FOR PRODUCTION RELEASE	1/30/2015	CEH
2	DIMS AND ADDITIONAL DWGS ADDED	1/15/2015	CEH
1	ADDED PRESSURE SENSORS, CENTER OF MASS, AND NEW CONTROL PANEL	11/6/2014	CEH

amiad® WATER SYSTEMS
120-J TALBERT ROAD
MOORESVILLE, NC 28117
PH: (704) 662-3133
FAX: (704) 662-3155

DRAWING DATE: 3/4/2014	DRAWING TITLE: 2x7x4ES Hor Assembly With Pump and Controls
SCALE: 1:26	DRAWING NUMBER: **110101-000031 ASY2x7x4ESH**
SHEET 1 OF 2	
DRAWN BY: MKB	CAT NUMBER: 110101-000031 REV. NO. 3
CHECKED BY: ___	GENERAL TOLERANCES (EXCEPT AS NOTED)
APPROVED. BY: ___	ANGULAR ± 1° FRACTIONAL ± 1/8" Dec: 2 Pl ± 0.05", 3 PL ± 0.010"

Air Aided Flushing Spin Klin® Battery – A. A. F.
Operation and Maintenance Manual

IM	Inlet Manifold
OM	Outlet Manifold
AM	Aerosol Manifold
DM	Drain Manifold
F	2” Spin Klin filter
IV	2”x2” Inlet Valve
OV	2”x2” Outlet Valve
AV	Air Inlet Valve
CV	Check Valve
AC	Accumulator



Filtration Process

- During the filtration stage water flows through the **INLET MANIFOLD** (IM), distributing through the **INLET VALVES** (IV) to the 2” **SPIN KLIN FILTERS** (F).
- The water passes through the **FILTER** (F) and flows out clean through the **OUTLET VALVE** (OV) and **OUTLET MANIFOLD** (OM) to the customer.
- At this stage the **ACCUMULATOR TANK** (AC) fills up with clean water from the **OUTLET MANIFOLD** (OM) through the **CHECK VALVE** (CV).

Backwashing Process

1. The **CONTROLLER** transmits a pulse (as per pressure differential or time, whichever is first.
2. Pneumatic command from solenoid No. 1 sends a pressure pulse to two users simultaneously.

   A. To the **INLET VALVE** (IV) converting it from filtration mode to backwash mode.

   B. To the **OUTLET VALVE** (OV1) converting it from filtration mode to backwash mode.
3. Air command from the solenoid of the **AIR VALVE** (AV):
   - Opens the **AIR VALVE** (AV).
   - The compressed air enters the **ACCUMULATOR** (AC).
   - The piston of the **SPIN KLIN FILTER** (F1) rises, thus decompressing discs.
   - The air is mixed with clean water and is carried to a **FILTER** (F1) which is then flushed.
   - The ratio between air and water will rise until there is hardly any water at termination (air alone does not spin the discs).

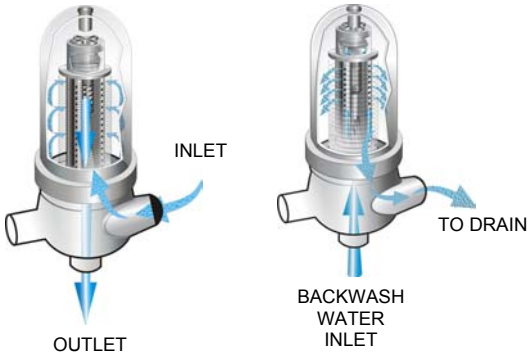
Spin Klin Technology- Spin Klin Spine Model 2

General:

The Spin Klin discs are stacked on the Spin Klin spine.

The discs are color-coded by micron **size,** and are assembled according to your water filtration requirements. The spine assembly has a spring compression unit and an internal piston, which are used to alternately compress and release the discs during filtration and backflush cycles.

Filtration Mode **Backwash Mode**



Filtration Mode:

During the filtration process the filter discs are tightly compressed together by the spring and the differential pressure, forcing the water to flow through the grooves and traps of the discs**.**

Backwash Mode:

During backflush the discs are released by releasing the inlet hydraulic pressure. Multi-jet nozzles provide tangential spray on the loosened discs, causing them to spin, and release the retained solids, which are flushed out to the drain.

2" x 2" Backwash Valve

Filtration Mode:

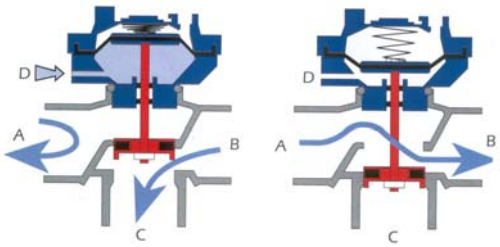
Water flows from port A (main supply) to port B (filter connection).

Port C (drain water outlet) is closed by the seal.

Backwash Mode:

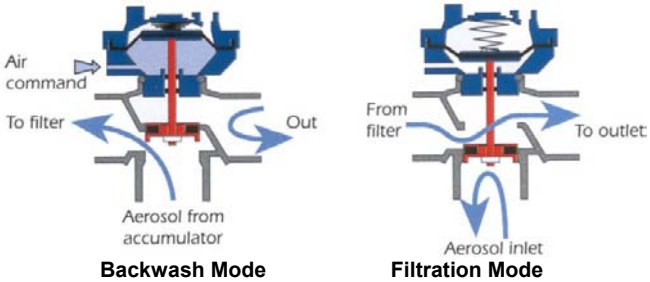
Command pressure is applied to the bottom side of the diaphragm through port D. The diaphragm moves up, pulling the sealed body by the shaft. Port A is closed by the seal, preventing flow to the filter. Port C is now open allowing flushing water to flow from port B (filter connection) to the drain.

Inlet Valve
Mode of Operation:



Backwash Mode **Filtration Mode**

Outlet Valve
Mode of Operation:



Backwash Mode **Filtration Mode**

Technical Data

Minimum water pressure:	0.8 bar (12 P. S. I.)
Maximum water pressure:	8.0 bar (115 P. S. I.)
pH:	4-11
Maximum Temperature:	70ºC (158ºF)
Water Flush volume:	12 – 22 liters (3.2-5.8 gallon) per single filter unit. The variance is according to the length of aerosol manifold
Air pressure control:	Equal or higher pressure used for backwashing Control source should be remote from flushing source
Recommended air compressor:	¾" H. P. + 80 liter (21 gallon) tank

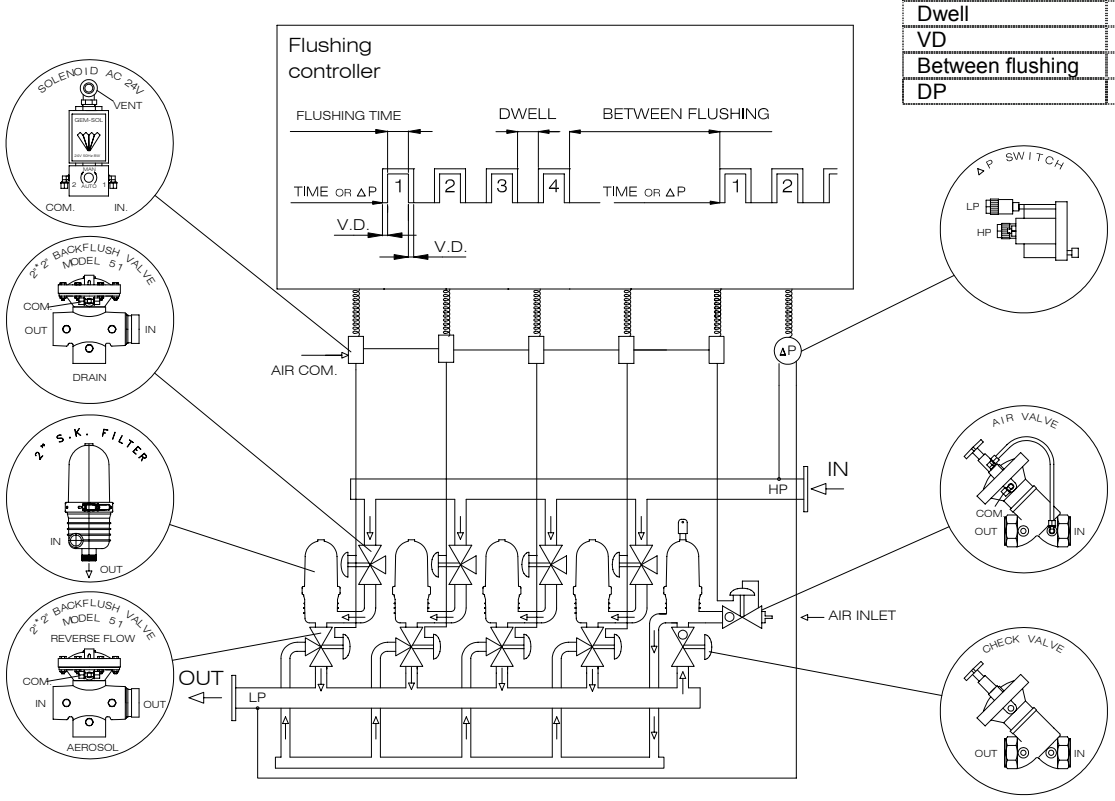
Air Volume and Flow Rate at Different Pressures

Air Pressure…6 Bar (65 P. S. I.)						
Water Pressure		Time	Air Flow Rate		Total Volume	
Bar	P. S. I.	Seconds	Ft^3/MIN	Liter/Minute	Liter	Ft^3
6	84	7.5	9.5	269	33.6	1.18
3.5	50	7.5	9.5	269	33.7	1.18
1.5	20	7.5	10	283.2	35.4	1.25

Air Pressure…4.5 Bar (85 P. S. I.)						
Water Pressure		Time	Air Flow Rate		Total Volume	
Bar	P. S. I.	Seconds	Ft^3/MIN	Liter/Minute	Liter	Ft^3
6	84	Air Pressure Always Needs to be Higher than Water Pressure				
3.5	50	8.5	9.5	269	38.1	1.3
1.5	20	8.8	11	311.5	45.7	1.6

Recommended Setup Time:

Flushing time	5 - 7 sec
Dwell	15-25 sec
VD	1 sec
Between flushing	1-2 hour
DP	(3-4.5)m, (4-6.5) psi



Spin Klin – System Maintenance

Monthly Maintenance

Check inlet /outlet pressures

In case the pressure differential is above 5 m / 7 PSI.

Activate automatic backwash of the Spin Klin filter battery.

In the event that the pressure differential remains high check for possible failures.

Check for leakages from the drain manifold

In case there is a leakage of water during the filtration stage, check for possible failure at the backwash valve seals.

Backwash controller performance

Check that the controller timing parameters are correctly adjusted and activate automatic backwash cycle. In the event of possible failure at the backwash controller.

Cleaning of the Command Filter

Close the command filter inlet valve, release the pressure trapped at the command filter, remove the cover. Thoroughly clean the filtration element and then reinstall the command filter element and cover, then open the inlet valve.

Winterization

In order to prevent the filter battery becoming damaged during water freezing - drain all the water from the filter battery and the command filter and leave the drain valve open.

Seasonal Maintenance – Cleaning the Discs

When manual cleaning of the discs is required, please follow the steps described below:

Make sure that system is not under pressure! Release the clamp and remove the cover. (Figure 1)
Unscrew the butterfly-nut on the filtration element. (Figure 2)
Remove the tightening cylinder. (Figure 3)

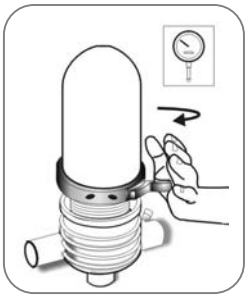


Figure 1

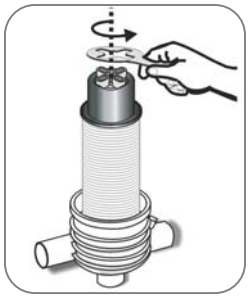


Figure 2

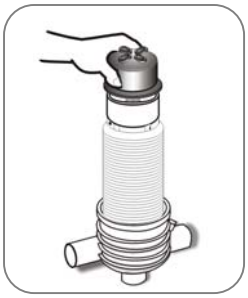


Figure 3

Remove the discs (for convenience we recommend using a plastic bag). (Figure 4, 5)
Tie each set on a string and place them in a cleaning solutions (HCL, Chlorine, or other) refer to **"Cleaning Recommendations Clogged Filtration Discs".**
Thoroughly wash the discs with fresh water and then reassemble the discs on the spines. (Figure 6)

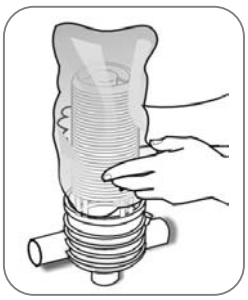


Figure 4


Figure 5

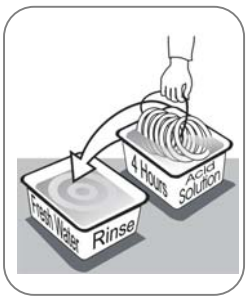


Figure 6

Check that the correct quantities of discs are assembled on the spine: when the discs are pressed with two hands, the top disc should be level with the imprinted circle on the outside of the spine. (Figure 7)
Put on the tightening cylinder and tighten the butterfly-nut, (Figure 8,9)

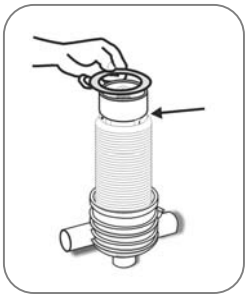


Figure 7

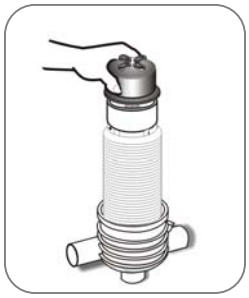


Figure 8

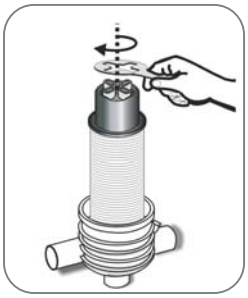


Figure 9

Reassemble the filter cover and tighten the clamp. (Figure 10, 11)

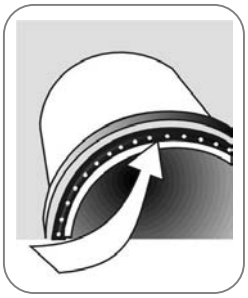


Figure 10

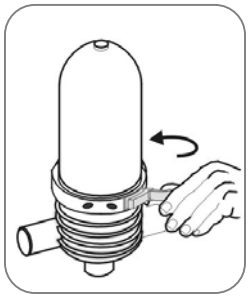


Figure 11

Cleaning Recommendations for Clogged Filtration Discs

Water-formed deposits may cause clogging of the filter discs. The formation of these deposits depends on the quality of the filtered water and environmental conditions like temperature, pH, light, duration of filtration and more.

Common water-formed deposits are:

- Biological or organic deposits (mostly mucous or oily to the touch, beige, brown or green in color)
- Iron oxide (rust) or other metal oxides
- Carbonates (white or gray deposit)
- Combinations of the above

If these deposits cannot be eliminated by pretreatment of the water, we recommend the following cleaning procedure:

Material and Equipment

- A well ventilated working place.
- 2 small containers (1 liter), 2 large containers (15 liter) and a stirring stick, all resistant to chemicals, preferably of polypropylene.
- Plastic rope to tie up the disc.
- Sodium Hypochlorite NaOCl -
  Strong oxidizing liquid, commercial concentration: 10%.
  Oxidizes and removes organic and biological deposits.
- Hydrochloric Acid HCl -
  Very corrosive liquid, commercial concentration: 30%.
  Dissolves and removes carbonates, iron oxide, and other deposits.
- Safety equipment: safety glasses, gloves, long pants, long sleeved shirt and shoes.

ATTENTION!

While working with chemicals protect yourself with the necessary safety equipment:

- Safety glasses, gloves, protective clothing
- Work in a well ventilated area
- Follow the manufacturer’s instructions

Cleaning Organic and Biological Deposits

- Open the filter and remove dirty discs.
  Attention – Never open the filter before the pressure has been released.
- Arrange the discs loosely on the plastic rope
- Prepare a 5% Sodium Hypochlorite solution:
  1) Pour 5 liters of water into one of the large containers.
  2) Add 5 liters of Sodium Hypochlorite (10%) into the water.
- Soak the discs in the solution so that both sides are covered. To achieve maximum cleaning, agitate the discs several times with a stirring stick.
- Contact time with cleaning solution: up to 8 hours
- Remove the discs carefully from the solution, put them in the second large container and rinse them very well with clean water before placing them back in the filter.
- We recommend flushing the cleaned discs again in the filter to ensure that all chemical residues are removed.

The cleaning solution can be used for several sets of discs. As the cleaning activity of the solution deteriorates, it may be necessary to soak the discs for a longer time.

Cleaning Carbonates and Iron Deposits

- Open the filter and remove the dirty discs.
- Arrange the discs loosely on the plastic rope.
- Prepare a 5% Solution of Hydrochloric Acid:
  1) Pour 10 liters of water into one of the large containers.
  2) Carefully add 2 liters of Hydrochloric Acid (30%) into the water.
  Soak the discs in the solution so that both sides will be covered.
  PLEASE NOTE: Carbonates react violently with hydrochloric acid (foaming, gas evolution).
  To achieve maximum cleaning, agitate the discs several times with a stirring stick.
- Contact time with cleaning solution: 1 - 8 hours.
- Remove the discs carefully from the solution and rinse them well with clean water before placing them back in the filter.
- We recommend flushing the cleaned discs again in the filter to ensure that all chemical residues are removed.

The cleaning solution can be used for several sets of discs. It may be necessary to soak the discs for a longer period of time as the cleaning activity of the solution deteriorates.

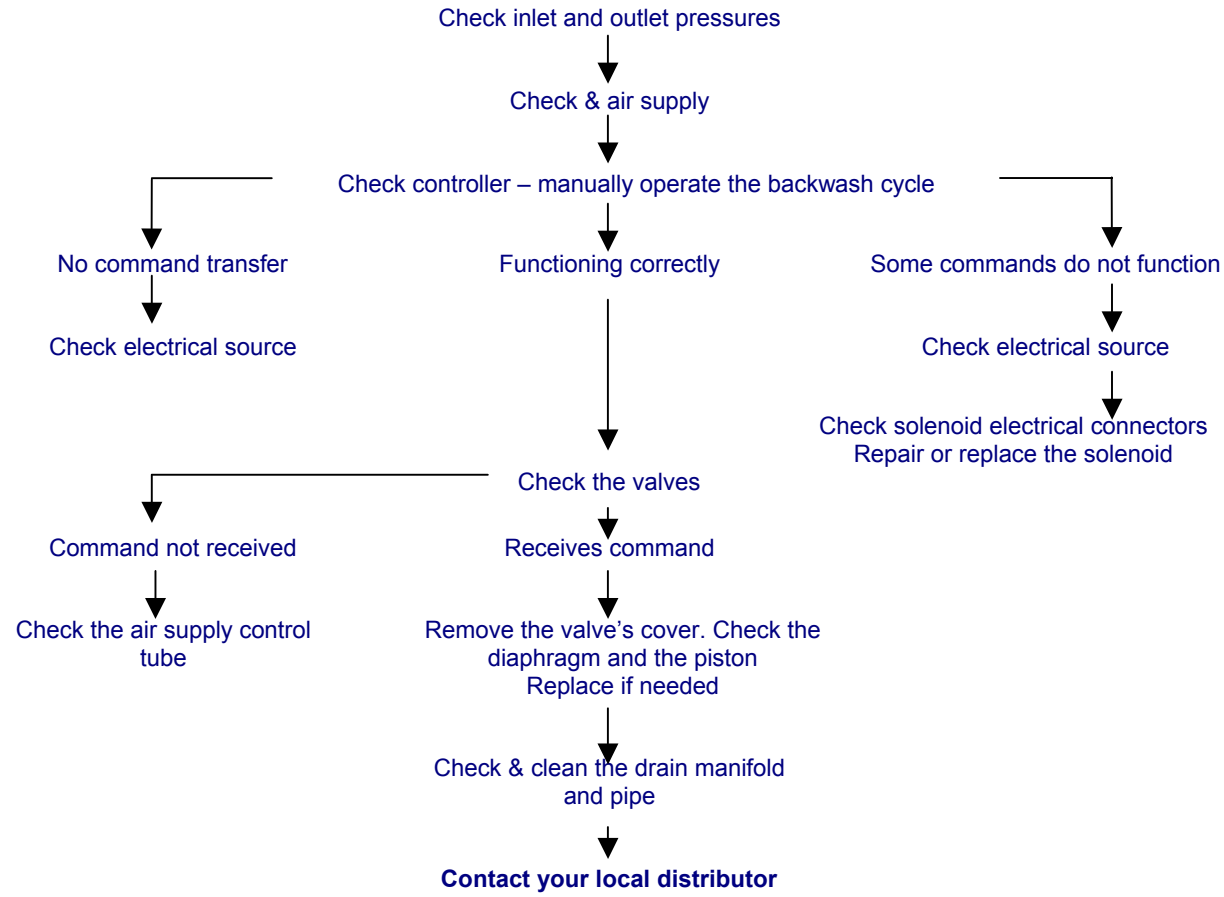
Cleaning Complex Deposits

If the composition of the deposit is not known, perform the following test:

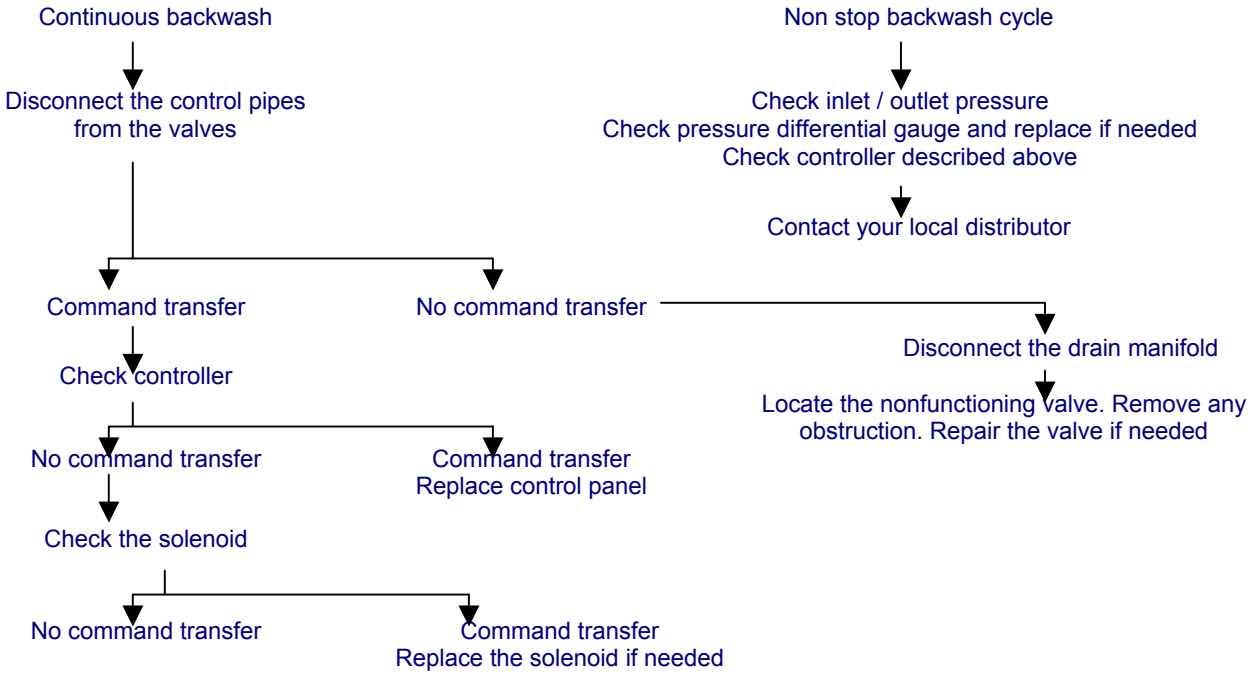
- Take 5 discs for the test.
- Soak 2 discs in a 5% Sodium Hypochlorite Solution.
  Preparation of the solution:
  Pour 1 cup of water into a small container, then add 1 cup of Sodium Hypochlorite (10% NaOCl).
- Soak 2 discs in a 5% Hydrochloric Acid Solution.
  Preparation of the solution:
  Pour 2½ cups (= 500ml) of water into a small container, then add carefully ½ cup (= 100ml) of Hydrochloric Acid (30% HCl).
- Keep one disc as a control.
- Observe the cleaning process:
  - If one of the solutions removes all of the deposit, clean the discs in that solution according to the instructions above.
  - If neither solution removes the deposit completely, continue with the test procedure.
- Remove the discs from both solutions, rinse them well with water and soak them in the second solution: put the two discs, which have been in the Sodium Hypochlorite Solution, in the Hydrochloric Acid Solution, and the other way round.
- Check the cleaning process:
  - If one of the treatments removes all of the deposit, clean all of the discs following the same two-step procedure in the exact same order. Rinse the discs well between the two cleaning processes.
  - If the deposit hasn't been completely removed, send a set of untreated discs to the laboratory for further examination.

Identifying Malfunctions in the 2” Spin Klin system

No Backwash Operation



Continuous or Non-stop Backwashing



Contact your local distributor

MODULAR COOLING TOWER

California Hydronics Corp

Tag: Santa Rita Jail R & R Cooling Tower

TWO UNITS MODEL NUMBER: TTXL-081930

Customer's Purchase Order No.: 192175
Tower Tech's Work Order No.: 2014006
As Built - February 28, 2014

DRAWING INDEX

TOWER TECH, Inc.
The Technology Company

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Oklahoma City, Oklahoma 73127

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OKLAHOMA CITY, OKLAHOMA 73127

Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 Cover Page
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team

REVISIONS		
NO.	DATE	REVISION

DATE

DATE:	24 JAN 14
DRAWING#:	14-006-C
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
COVER PAGE	C

General Notes:

1. These drawings are for technical information purposes only, and do not constitute an acceptance by Tower Tech of any customer order. Order acceptance, production release, and related tower delivery are subject to Tower Tech's approval of customer's purchase order.

2. In the event of a discrepancy between the "General Conditions of Sale" on the Buyer's Purchase Order and those outlined in Tower Tech's "General Conditions of Sale", Tower Tech's "General Conditions of Sale" shall have precedence. Tower Tech shall not be liable to Purchaser for any indirect or consequential damages. Tower Tech shall not be responsible for Purchaser's handling, modification, or end use of Tower Tech cooling Towers.

Installation Notes:

1. All tower modules are designed to provide maximum cooling within the smallest area possible. Errors in module placement can lead to recirculation of tower discharge air, with resultant loss of cooling capacity. Therefore, modules must be installed as shown on drawings. Modules must be placed next to each other at a distance of 2" between modules. Consult factory for recommended placement layouts.

2. Prevailing winds affect cooling tower performance. Never place modules next to existing structures, nor in any area where tower discharge air can be blown or drawn into adjacent HVAC systems. Consult factory for placement assistance.

3. Substructure height affects tower performance. The air inlet area must be as shown on factory drawings. Consult factory when restrictions (such as parapet walls, wind barriers, existing structures or vision barriers) are present.

Piping Notes:

1. NEITHER THE TOWER NOR THE INLET FLANGES ARE INTENDED TO SUPPORT ANY EXTERNAL PIPING WEIGHT. ALL EXTERNAL PIPING MUST BE "STAND ALONE" (SUPPORTED INDEPENDENTLY).

2. Upon tower shutdown, overhead piping can cause system surging and/or sump overflow. Automatic valve actuators on isolation valves will prevent most overflow problems. Consult factory if overhead piping is existing or required.

3. Tower Tech does not recommend the installation or use of orifice plates or bypass valves on its TTXL modules. Tower Tech's variable-flow nozzles are more efficient than those devices and help to prevent the pump head overloading and basin overflow that is possible in towers of conventional design. It is necessary to flow at least 200 GPM through each Rotary Spray Nozzle during cold water operations (when the ambient air temperature is below 32° F.) in order to maintain heat load inside the cooling tower module.

4. In low water-flow applications, sump connection sizes can be adjusted by obtaining written factory approval.

5. Tower Tech suggests the use of an appropriate flex flange connection (provided by customer) on each water inlet, to be field installed by customer, per manufacture's installation instructions.

Tower Storage:

1. Any ready-to-ship tower which is not approved by Customer for timely shipment (for any reason) will be charged demurrage after a one-month grace period. Tower Tech will assess a demurrage charge equal to a two percent (2.0%) of the total purchase price of the cooling tower for each month – or portion thereof – that the cooling tower is stored on Tower Tech property.

2. If Customer is unable to accept shipment of the cooling tower within a three-month period Tower Tech will arrange with the customer to invoice for applicable demurrage then move the cooling tower to an alternate storage site or use the cooling tower for another project.

Invoicing/Prepayment:

1. All ready to ship cooling towers will be invoiced by Tower Tech on the earlier of the original "Required Date" or the actual date of shipment. Payment terms will be as agreed to in writing by Tower Tech's Chief Financial Officer.

2. If the cooling tower invoice is paid in full prior to the "Required Date", all storage fees will be waived. However, the cooling tower unit must in any event be moved off Tower Tech's property within three months after the "Required Date".

APPROVAL: Approved As Is _____ Approved As Noted X

PRINTED NAME: Timothy M Wesig

SIGNATURE: _____

TITLE: Energy Project Manager

DATE: 02-07-2014

TOWER TECH, Inc.
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5400 NW 5th
OKLAHOMA CITY, OKLAHOMA 73127

Modular Fiberglass Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 General Notes
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

NO.	REVISION	DATE
	REVISIONS	

DATE:	24 JAN 14
DRAWING#:	14-006-1A
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
GENERAL NOTES	1A

DESIGN NOTES:

1) TOWER WEIGHTS - EACH CELL

MODEL NUMBER	TTXL-081930
DRY SHIPPING WEIGHT	15,412 LBS
OPERATING WEIGHT	25,695 LBS

2.) DISCHARGE (COLD WATER) SUMP FLANGE CONNECTION IS 14 INCH*.

* FACTORY CAN SUPPLY REDUCING BUSHING AT ADDITIONAL CHARGE, WHEN REQUIRED.

3) INLET CONNECTION IS 12 INCH.

4) WATER LEVELS:
FOR APPROPRIATE WATER LEVEL REFER TO STARTUP SECTION IN TOWER TECH'S DESIGN, INSTALLATION & OPERATION MANUAL.

LATERAL LOADS:

THE DESIGN LOADS ARE IN ACCORDANCE WITH THE IBC (INTERNATIONAL BUILDING CODE). WIND, SEISMIC AND GRAVITY LOADINGS ARE APPLIED. THE ILLUSTRATED TOWER SHELL AND SUBSTRUCTURE IS DESIGNED TO WITHSTAND A WIND PRESSURE OF 41 PSF (ASCE7-05 150 mph WIND, EXPOSURE C) AND A SEISMIC FORCE FACTOR: Cs - .4x WEIGHT, CATEGORY d (Ss = 200, S1 = 150, SOIL CLASS E).

MAKE-UP CONNECTION:

NOT PROVIDED - PLUGGED

FIELD WIRING:

FIELD WIRING BY OTHERS. ALL COMMUNICATION WIRE TO BE SHIELDED TWISTED PAIR CONDUCTOR - BELDEN OR EQUIVALENT.

MOTOR INFORMATION:

REFER TO TOWER TECH TECHNICAL REFERENCE GUIDE FOR MOTOR AMPS.

SFA/MMC REFERS TO SERVICE FACTOR AMPS/MAXIMUM MOTOR CURRENT. VFD MUST BE SIZED FOR FLA AT A MINIMUM. IF USE OF MOTOR SERVICE FACTOR IS DESIRED, VFD SHOULD BE SIZED FOR SFA/MMC.

STANDARD MOTORS ARE HIGH EFFICIENCY, TEAO SERVE DUTY, STANDARD DIRECT DRIVE WITH L 100,000hr. SEALED BEARINGS, 1/15 SERVICE FACTOR, INVERTER READY WITH QUANTUM SHIELD WIRING, CLASS "F" INSULATION (MINIMUM).

DIRECT-DRIVE FAN MOTORS ARE MANUFACTURED BY BALDOR (OR TOWER TECH APPROVED EQUIVALENT). MOTORS ARE TEAO (1.15 SERVICE FACTOR), INVERTER READY WITH CLASS "F" INSULATION.
SPECIFICATIONS FOR STANDARD MOTORS ARE AS FOLLOWS:

HORSE POWER:	3.0
NUMBER	8
VOLTS	230/460
AMPS	11.2/5.6
RPM	865
FRAME	215T
EFFICIENCY	84%
HZ	60
PHASE	3
POWER FACTOR	.61

WIRING:

SHIELDED 12-4 AWG OIL RESISTANT FLEXIBLE MOTOR SUPPLY CABLE.

CONTROL PANELS:

CONTROL PANELS ARE UL-RATED NEMA 4 AND ARE DESIGNED FOR SINGLE POINT CONNECTIONS. CABINETS HAVE INDIVIDUAL MOTOR POWER AND CONTROL CIRCUITS, AND ALL HOA SWITCHES ARE BACKLIT. CONSULT FACTORY FOR SPECIFIC CUSTOM DESIGN REQUIREMENTS OR INTERFACING DETAILS. AUXILIARY RELAYS ARE PROVIDED FOR REMOTE MONITORING OF THE MOTORS..

TEMPERATURE CONTROL NOTES:

1) THE OPTIONAL PLC IS MOUNTED IN A NEMA 4 FAN CONTROL CABINET. IT IS PROGRAMMED FOR BOTH FAN STAGING AND VARIABLE FREQUENCY DRIVE CONTROL WITH A SINGLE RESETABLE TEMPERATURE CONTROL. FAN CONTROL RESORTS TO FAN CYCLING IN THE ABSENCE OF A VFD EITHER FROM DRIVE FAILURE OR NON-INSTALLATION.
2) AN RTD SENSOR IS PROVIDED WITH A STAINLESS STEEL THERMOWELL (6" X 3/4" NPT). FIELD WIRING BETWEEN THE SENSOR AND THE CONTROL PANEL IS REQUIRED (BY OTHERS).
3) SENSOR IS TO BE LOCATED IN THE COLD WATER DISCHARGE PIPING IN A LOCATION THAT PROVIDES A TOTAL SUBMERSION OF THE SENSOR WELL AT ALL OPERATING CONDITIONS. A STRAIGHT HORIZONTAL RUN IS PREFERRED WITH THE SENSOR LOCATED IN THE SIDE OF THE PIPE.
4) A BACNET GATEWAY COMMUNICATIONS CARD IS PROVIDED TO INTERFACE THE CONTROL PANEL WITH A BUILDING AUTOMATION SYSTEM.

APPROVAL: Approved As Is _____ Approved As Noted X

PRINTED NAME: Timothy M Wesig

SIGNATURE: _____

TITLE: Energy Project Manager

DATE: 02-07-2014

TOWER TECH, Inc.
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5400 NW 5th
OKLAHOMA CITY, OKLAHOMA 73127

Modular Fiberglass Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 Auxiliary Notes
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS		
NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-1B
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
AUXILIARY NOTES	1B

TOWER TECH, INC.
Warranty Registration Information

End User Information:

Company Name: The County of Alameda
Company Main Phone Number: 510-208-9586
Contact Name: David Barba
Contact Phone Number: 510-208-9586
Installation Location: 3525 Broder Blvd. Dublin

Shipping Data Confirmation:

Proposed Shipping Date: ASAP
FOB Factory:
Required Delivery Date: ASAP
Shipping Contact Name: David Barba
Contact Phone Number: 510-208-9586
Freight Notification: n/a
Freight Terms: n/a

Signature: _____ Date: 02-07-14

Tower Tech, Inc.
Order Verification Sheet

Customer Information

CUSTOMER:	California Hydronics Corp
PROJECT:	Santa Rita Jail R&R Cooling Tower
PO Number:	192175

Cooling Tower Information

Product:	Two (2) - TTXL-081930
Substructure:	6'-0"
Prewire Options:	J-Box
Basin Inspection Port:	14
Warranty:	15 / 5 / 1
Fill Media:	CF 1900
DE'S:	CF80-MAX
Voltage:	460
Motor Manufacturer:	Baldor (or Equiv)
Motor:	3.0 HP
Motor Supports:	Stainless Steel
Sump Size:	14"
Makeup Size:	0"
Overflow Size:	6"

Performance Data

Gallons Per Minute:	2450 Each - 4900 Total
Hot Water Temp:	95°F
Cold Water Temp:	85°F
Wet Bulb Temp:	67°F

Special Equipment
Winter Drain Connections 2-per cell
NEMA 3R ABB VFD Panel w/Eclipse & dv/dt Filter
NEMA 4 T9900 Control Panel w/PLC
Split Style Fan Screens
Flowline Level Sensor w/Control Panel & Stilling Well

Tower Tech Contacts:

Sales:	405-290-7788
Shipping:	Randall Subieta 405-979-2125
Legal:	Sherry Shearer 405-979-2172 sshearer@towertechinc.com

Thank you for signing this description. Tower Tech accepts no liability for consequential, indirect or other special damages, or are we liable for any loss or damage resulting from delays in delivery caused by conditions beyond the control of Tower Tech, Inc. Also with the submittal is a copy of our general conditions of sale and warranty information.
I, as an authorized purchaser of this equipment, verify that all of the above information is correct. If a section has not been initialed, or noted for change, then I accept the original item as offered in this form and the Tower Tech Submittal Drawings. I also agree to the above items regarding required approval dates needed to meet the estimated ship date.

TOWER TECH, Inc.
THE TECHNOLOGY COMPANY
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E-MAIL: cad@towertechinc.com
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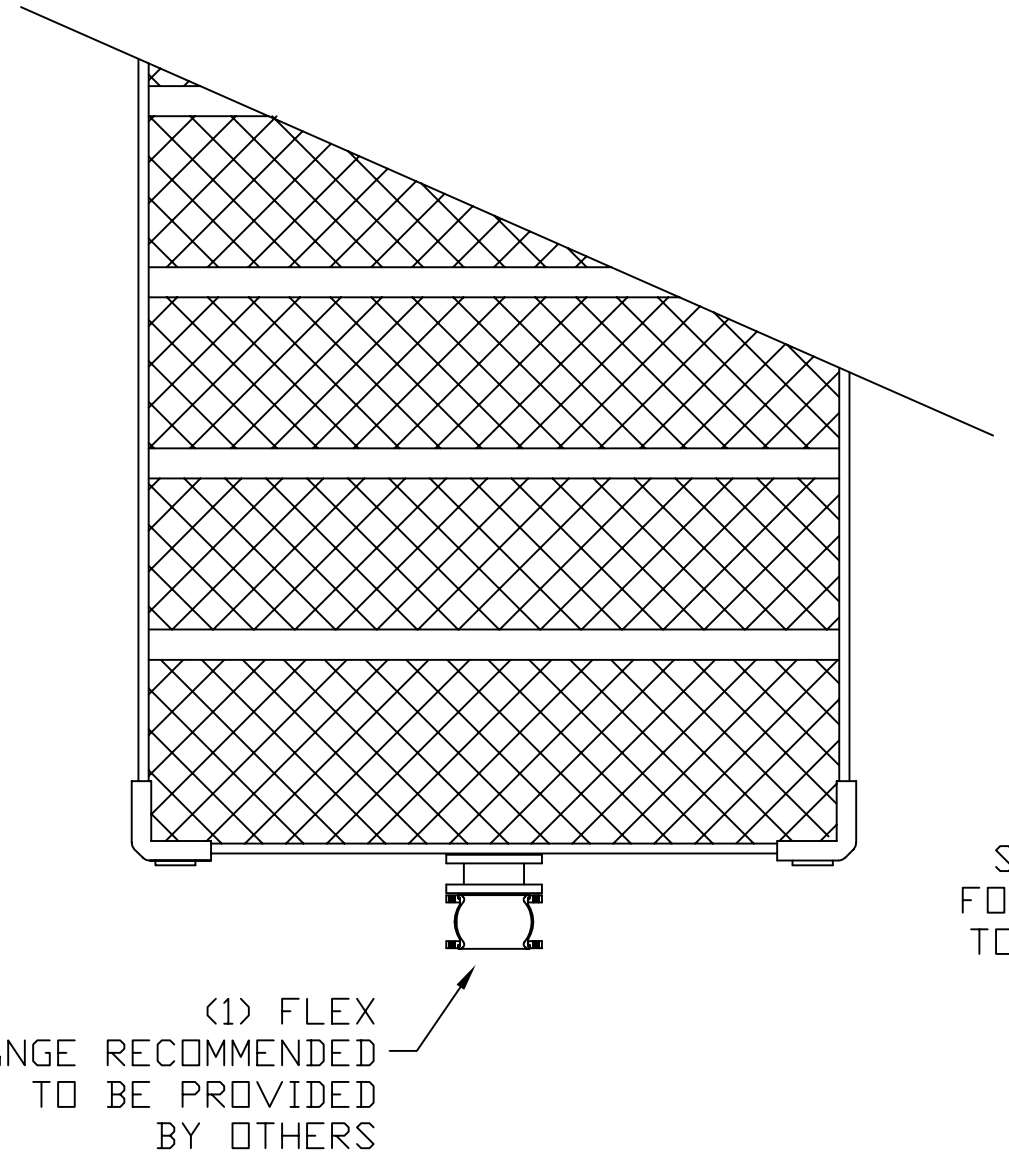
5400 NW 5th
OKLAHOMA CITY, OKLAHOMA 73127

California Hydronics Corp.
2-Unit Installation
Modular Fiberglass Cooling Tower
Model # TTXL-081930
TTXL-08 Warranty Registration & Order Verification
Tag: Santa Rita Jail R & R Cooling Tower

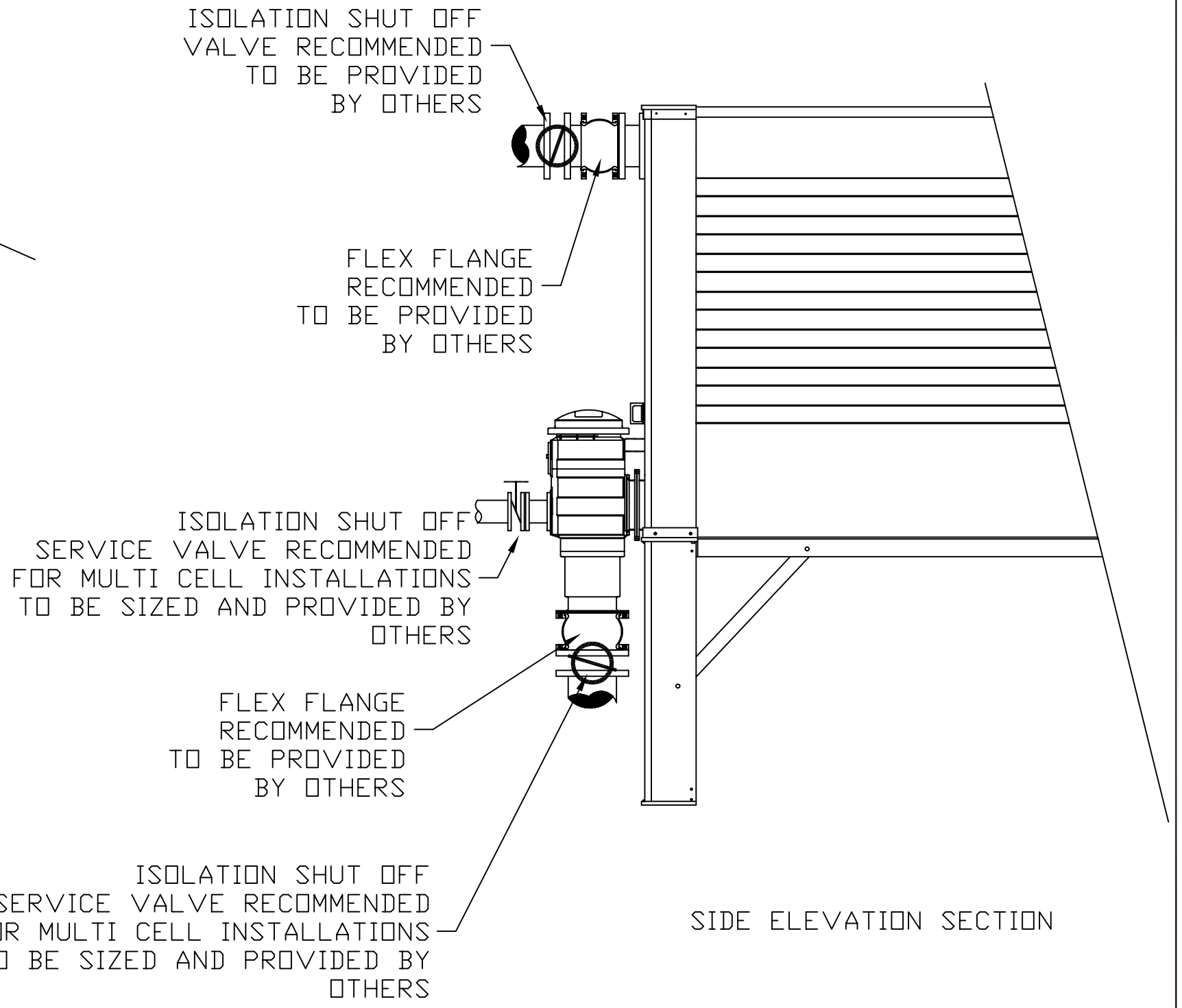
FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS		
NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-1C
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
WARRANTY REGISTRATION & ORDER VERIFICATION	1C



PLAN VIEW SECTION



SIDE ELEVATION SECTION

TOWER TECH, Inc.
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California Hydronics Corp.
2-Unit Installation

Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

TTXL-08 Connection Recommendations

Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

NO.	REVISION	DATE
	REVISIONS	

DATE:	24 JAN 14
DRAWING#:	14-006-1D
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
CONNECTION RECOMMENDATIONS	1D

TYPICAL CABLE LAYOUT

#1 - Factory wiring by Tower Tech. The tower motors are pre-wired to Factory Installed J-Box.

#2 - Field wiring by others. The wiring from the J-Box to the Control Panel to be installed in the field by others. There is a single point terminal connection for the load cable which should be shielded 4 conductor cable grounded on both ends.

TOWER TECH REQUIRES THAT VFD RATED CABLE BE USED WHEN THE TOWERS ARE USING A VFD.

SIDE AND TOP PENETRATIONS WILL VOID CUSTOMER WARRANTY.

#3 - Field wiring by others. Power Distribution Center should be wired to VFD if provided. Otherwise power cable provided by others can be wired to the designated terminals in the Control Panel.

#4 - Field wiring by others. Power feeds to the control panel are to land on the designated terminals.

a. Fan staging operation mode: One 230/460 Volt power feed is needed for the fan motor power supply when operating in the fan staging mode. A separate 120 volt, 20 AMP, power feed is required to power the control circuit.

b. VFD operation mode: One 460 Volt power feed and a separate 120 volt power feed are needed when operating the tower using VFD. The control circuit power cannot be pulled from the 460 volt circuit because the power feed is being altered by the VFD to control the speed of the fans. For that reason a separate 120 volt power feed must be provided to the 120 volt control circuit.

#5 - Field wiring by others. If the VFD or Control Panel is to be monitored or controlled by an outside source, the appropriate communication module must be ordered (the communication module will be installed at the factory) and the wiring to the outside source must be installed by others.

#6 - MOTOR STARTER PROTECTOR (MSP) IS EQUIPPED WITH AN AUXILIARY RELAY SHOULD THE MSP TRIP OR FAIL A DRY CONTACT SIGNAL CAN BE WIRED IN OR PARALLEL BACK TO A BUILDING MANAGEMENT SYSTEM.

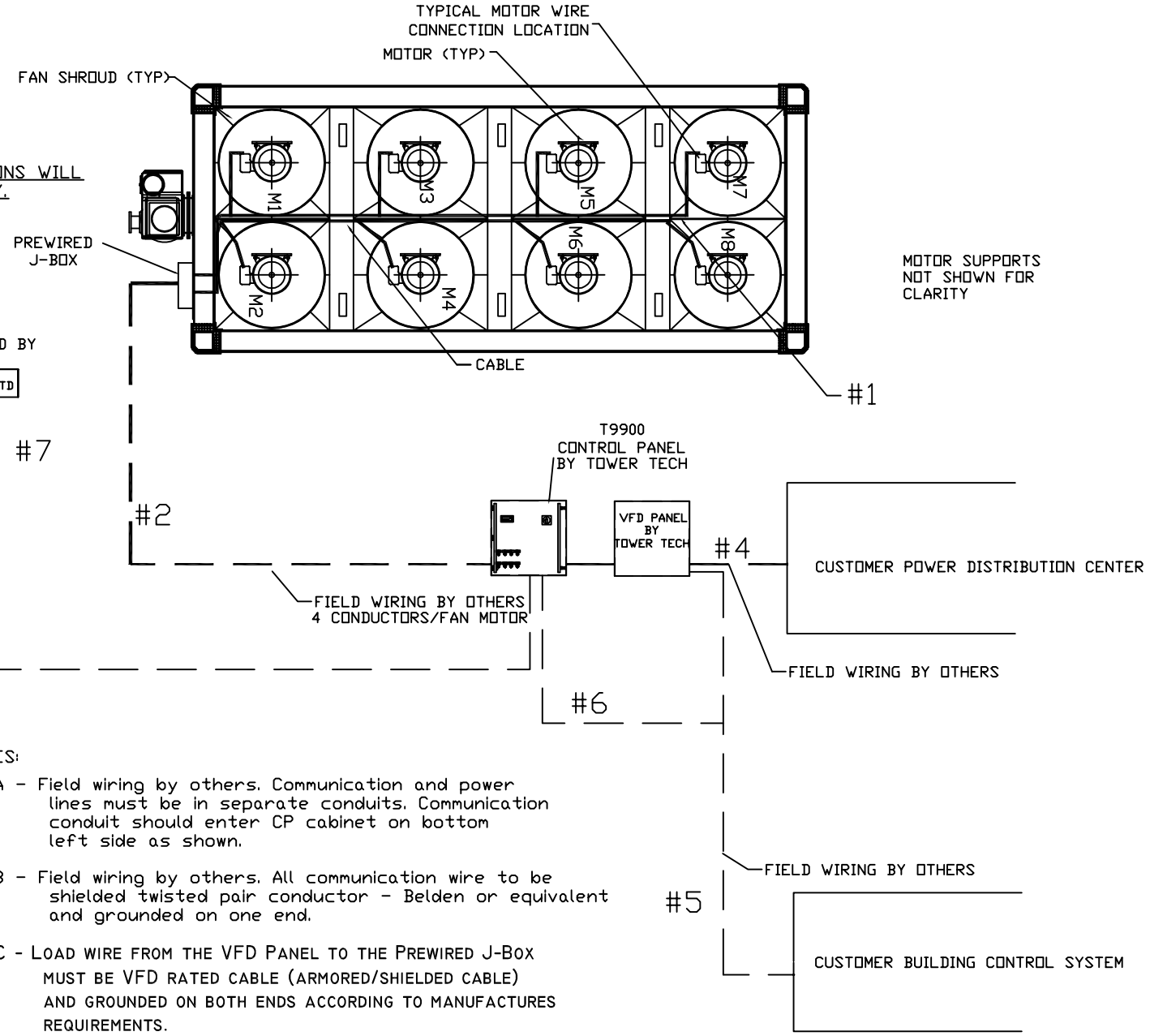
#7 - RTD provided with a Stainless Steel Thermo well (6" x ¾" NPT) to be installed within 15ft. of the cooling tower outlet flange. RTD should be installed in side centerline of pipe for total submersion. Field Wiring by others.

FIELD WIRING:

FIELD WIRING BY OTHERS. ALL COMMUNICATION WIRE TO BE SHIELDED TWISTED PAIR CONDUCTOR - BELDEN OR EQUIVALENT.

TOWER TECH REQUIRES VFD RATED CABLE BE USED WHEN OPERATING THE MOTORS USING A VFD.

TOWER TECH REQUIRES A DV/DT FILTER BE INSTALLED WITH ALL VFDs OR THE MOTOR WARRANTY IS VOIDED.



NOTES:

A - Field wiring by others. Communication and power lines must be in separate conduits. Communication conduit should enter CP cabinet on bottom left side as shown.

B - Field wiring by others. All communication wire to be shielded twisted pair conductor - Belden or equivalent and grounded on one end.

C - LOAD WIRE FROM THE VFD PANEL TO THE PREWIRED J-BOX MUST BE VFD RATED CABLE (ARMORED/SHIELDED CABLE) AND GROUNDED ON BOTH ENDS ACCORDING TO MANUFACTURES REQUIREMENTS.

D - Run output motor cables from multiple drive separately. Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately could result in death or serious injury.

E - Run input power, motor wiring and control wiring in three separate metallic conduits or raceways for high frequency noise isolation. Failure to isolate power, motor and control wiring could result in less than optimum drive and associated equipment performance.

NOTE: ALL CONTROL PANEL TERMINALS ARE TO BE FIELD CHECKED AND TIGHTENED BY FIELD ELECTRICIAN PRIOR TO INSTALLING POWER. ALL FIELD WIRING TO MEET LOCAL AND NEC WIRING CODES.

FIELD WIRING

TOWER TECH, Inc.
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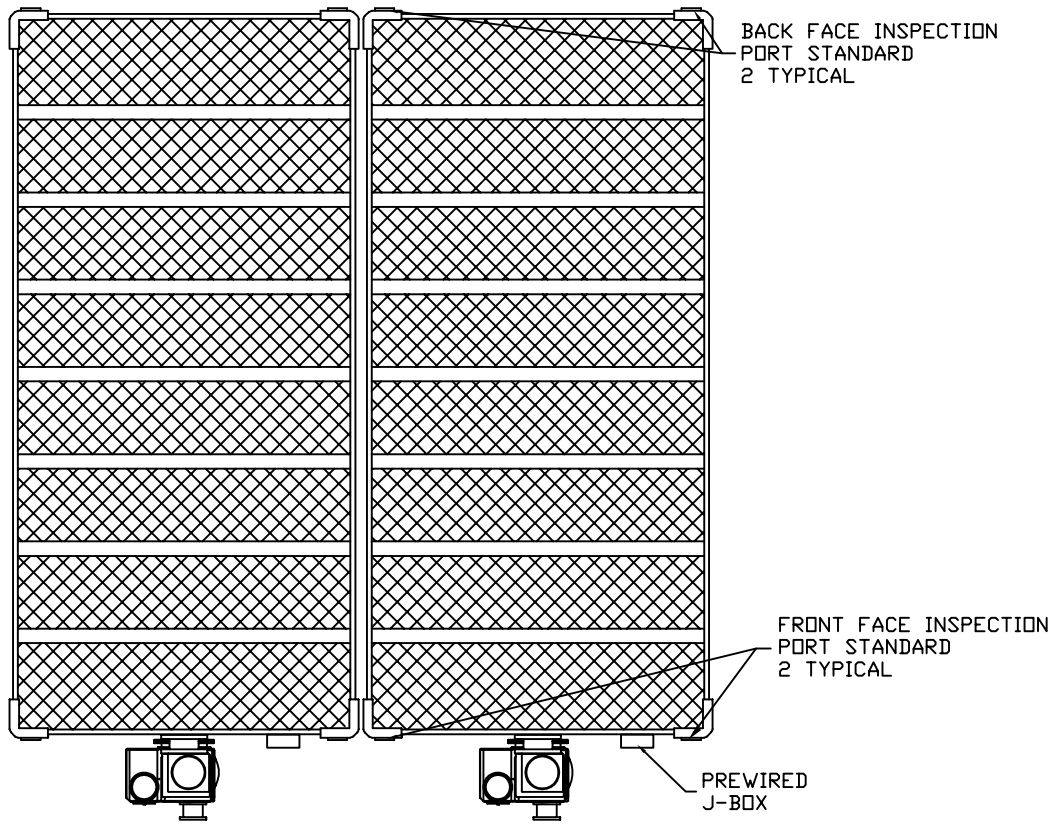
Modular Fiberglass Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 Wiring
Responsibility Chart
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

NO.	REVISIONS DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-1E
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
WIRING RESPONSIBILITY CHART	1E



GENERAL INFORMATION:

BASIC DATA (PER CELL):

ACTUAL DESIGN GPM	–	2450 Each – 4900 Total
HWT(°F)	–	95
CWT(°F)	–	85
WBT(°F)	–	67

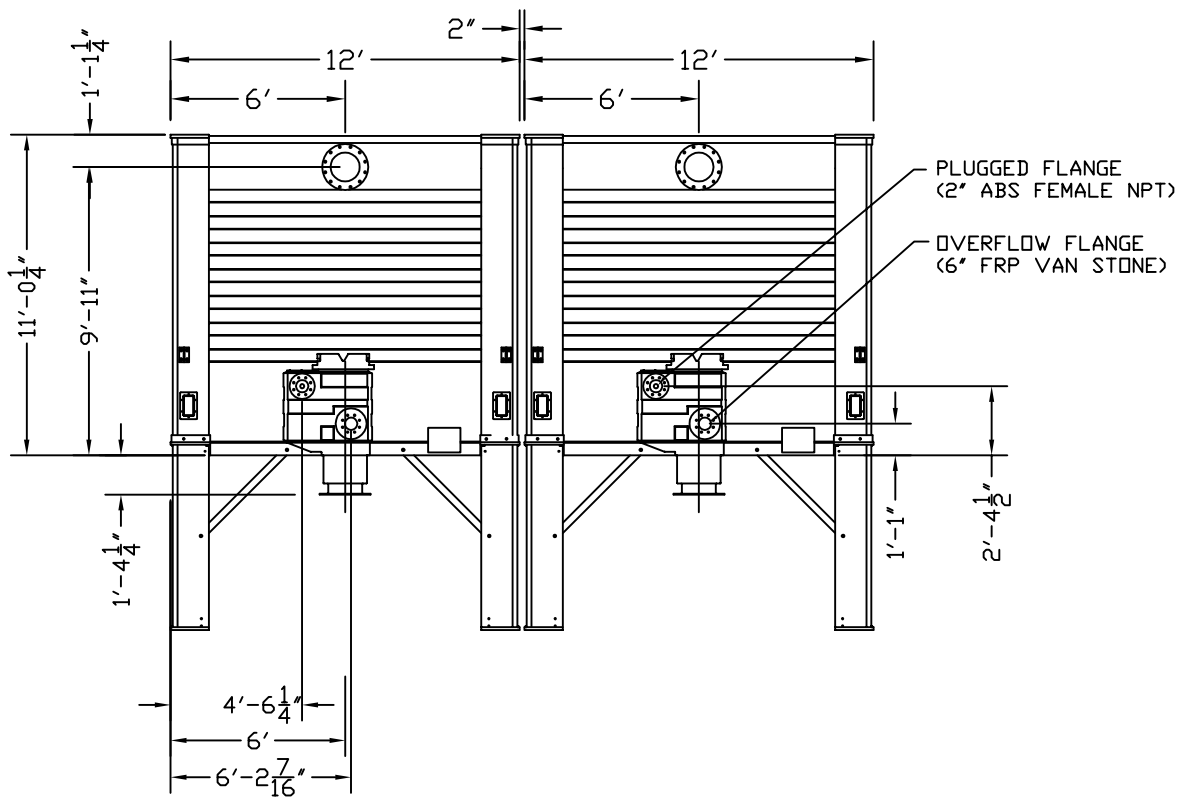
MOTOR DATA (PER CELL):

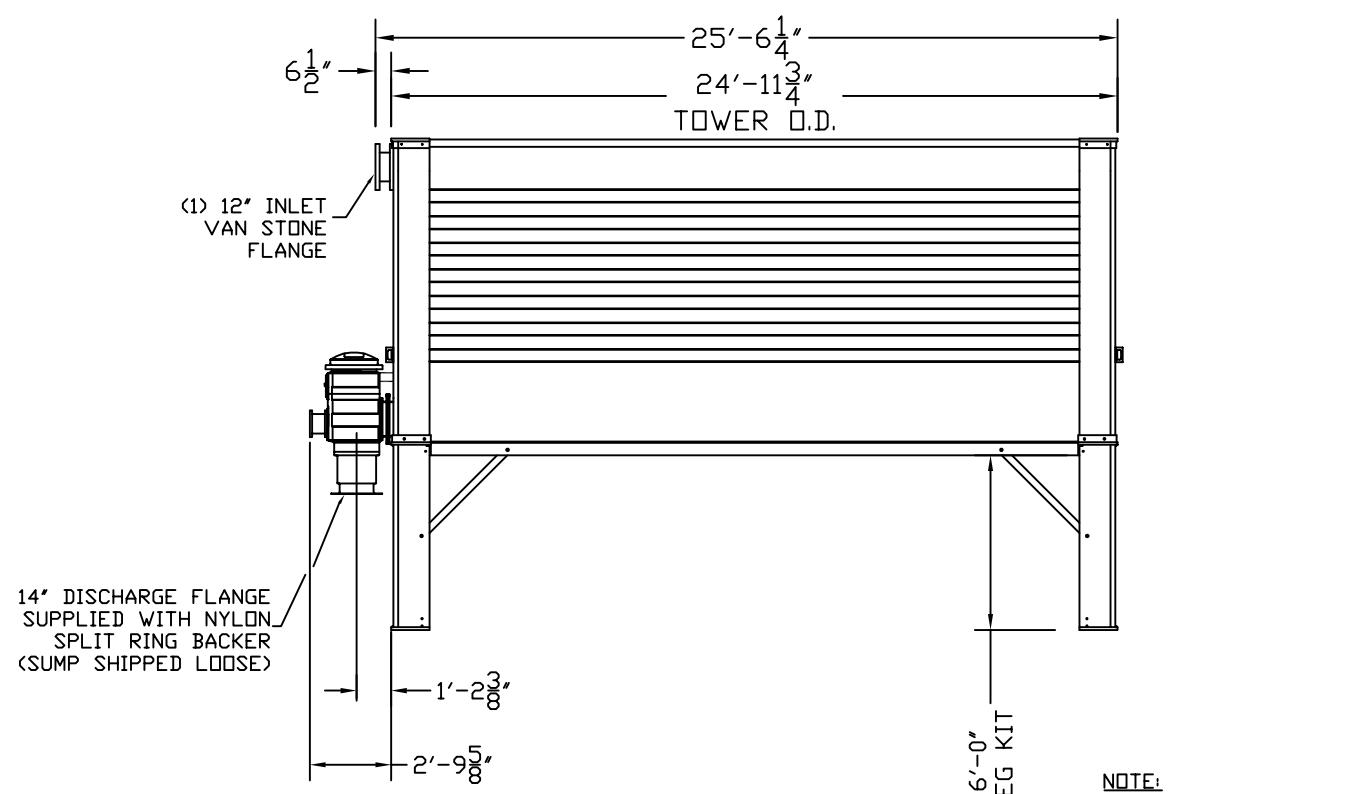
BRAND	–	BALDOR (OR EQUIV)
EFFICIENCY	–	HIGH
HP	–	3.0
VOLTAGE	–	460
HZ	–	60
PHASE	–	3
NUMBER	–	8
POWER FACTOR	–	.61

WEIGHTS (PER CELL):

DRY SHIPPING WEIGHT	–	15,412 lbs
OPERATING WEIGHT	–	25,695 lbs

1. ALL EXTERNAL PIPING PROVIDED BY CUSTOMER.
2. EXTERNAL PIPING TO BE "STAND ALONE" (INDEPENDENTLY SUPPORTED).
3. NO LOAD TO BE APPLIED TO TOWER TECH TOWER OR SUMP.
4. FOR APPROPRIATE WATER LEVEL REFER TO STARTUP SECTION IN TOWER TECH'S DESIGN, INSTALLATION & OPERATION MANUAL.
5. MAKE-UP CONNECTION/FLOAT VALVE CONNECTION FLANGE IS MADE FROM HIGH QUALITY PLASTIC TO ELIMINATE CORROSION.
6. THE MAXIMUM MAKE-UP WATER INLET PRESSURE IS 25 PSIG. WHEN USING THE MECHANICAL MAKE-UP FLOAT VALVE. FLOAT VALVE MAY NOT SHUT OFF TIGHT AGAINST HIGHER PRESSURES.





NOTE:
ALL GIVEN DIMENSIONS ARE WITHIN ±1/2″

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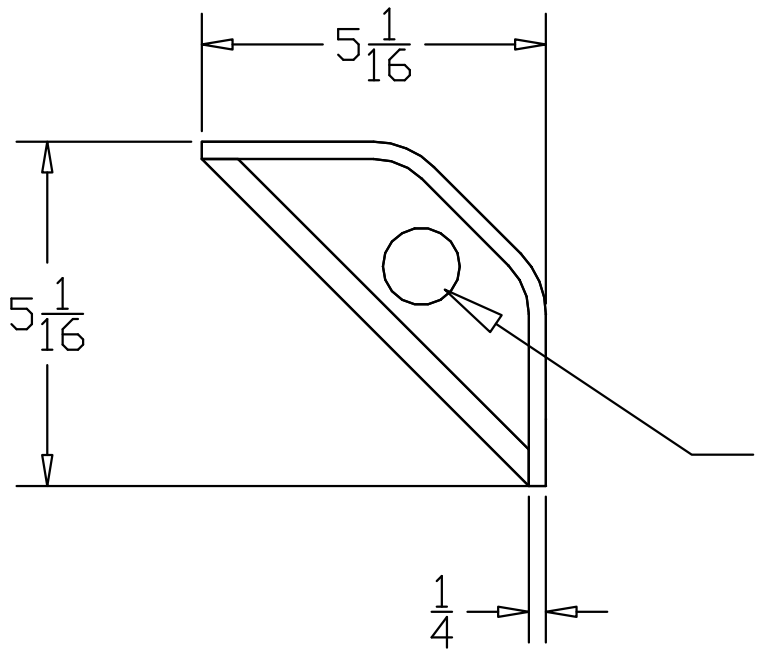
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 Plan & Elevation
Tag: Santa Rita Jail R & R Cooling Tower

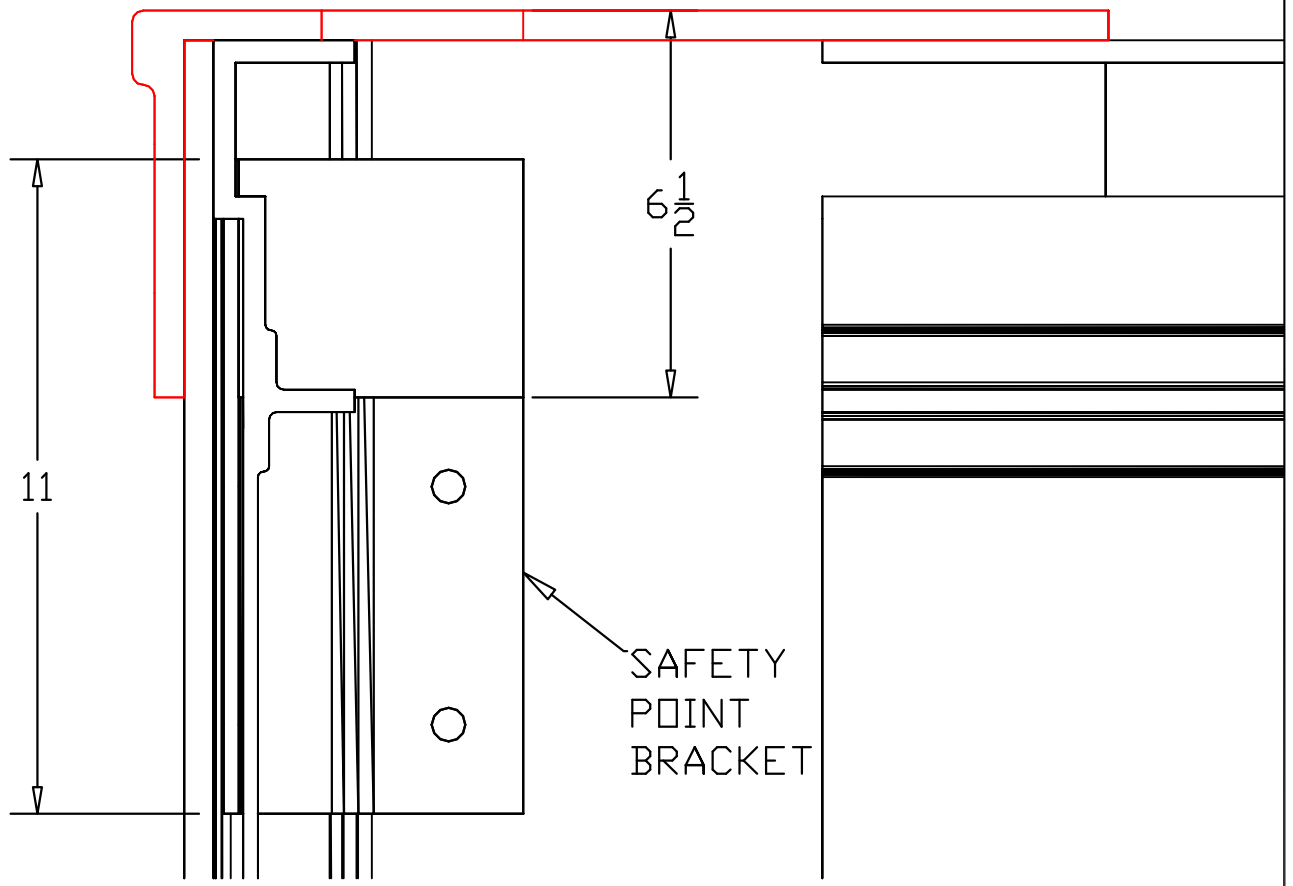
FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

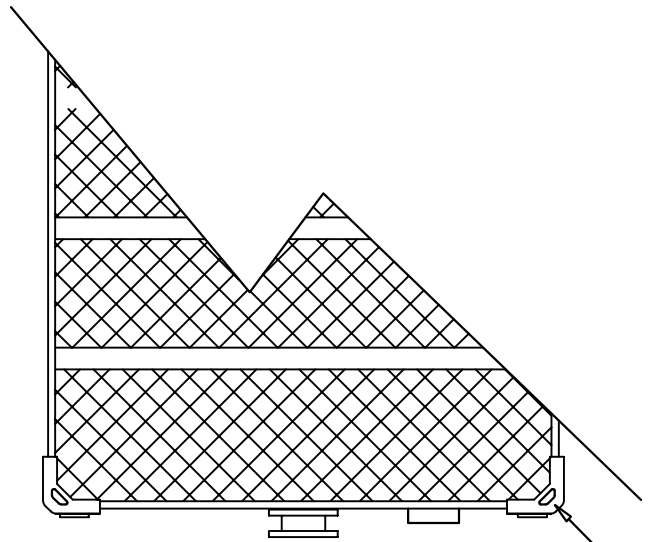
NO.	REVISION	DATE

DATE:	24 JAN 14
DRAWING#:	14-006-2A
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
PLAN & ELEVATION	2A



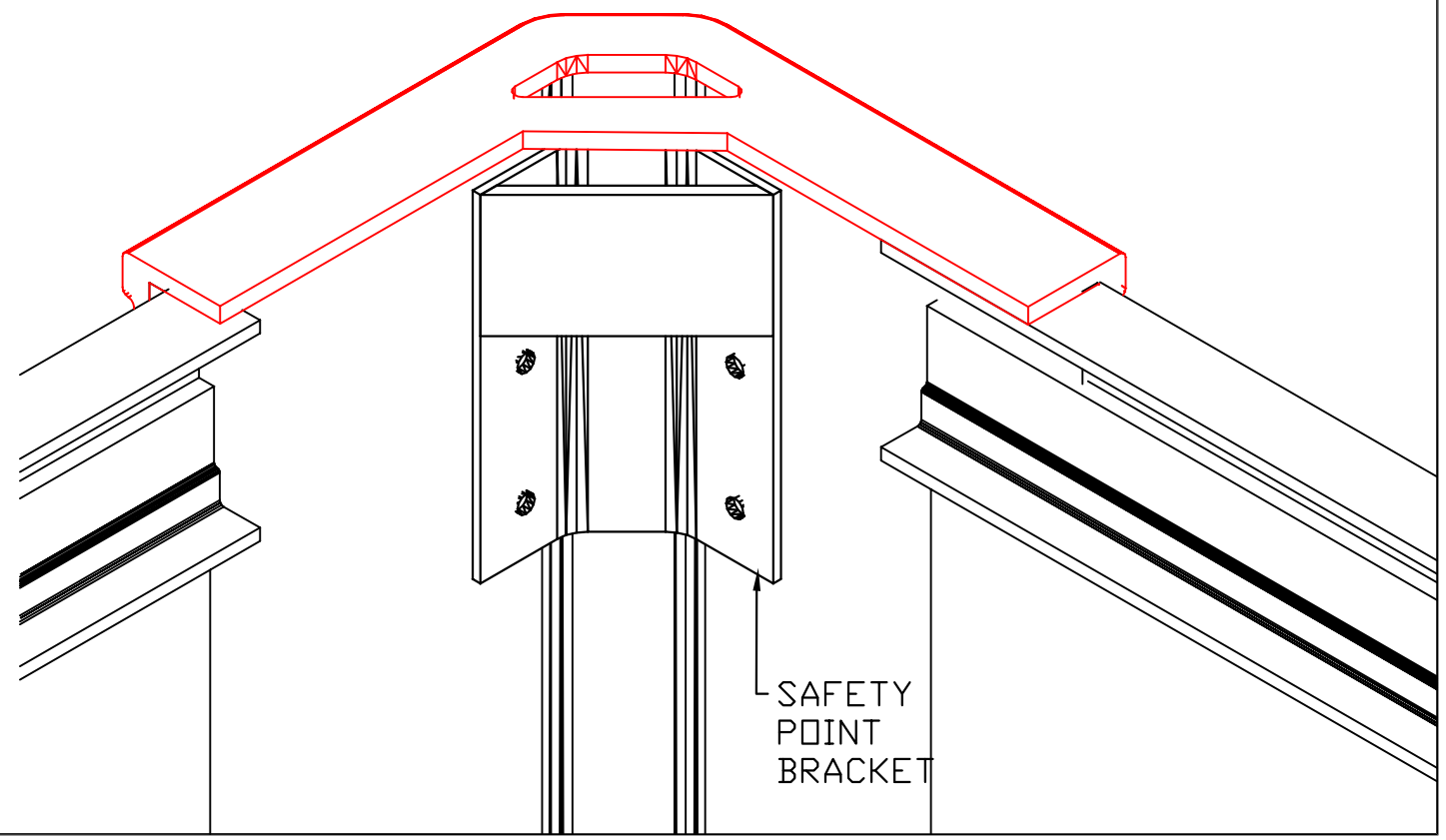
PLAN VIEW
SAFETY POINT BRACKET





SAFETY TIE-OFF
LOCATION TYP EACH
TOP CORNER.

Note: Each safety point has been certified for a maximum weight of 5,000 lbs for the sole purpose of an engineered fall protection system. Customer is responsible for the design and certified engineering of the actual fall protection system to meet local, state and federal OSHA requirements. Tower Tech is only providing a certified point to attach the fall protection system designed by others. The safety points are not certified for the purpose of lifting the cooling tower and any attempt to do so would void the warranty.



TOWER TECH, Inc.
THE TECHNOLOGY COMPANY
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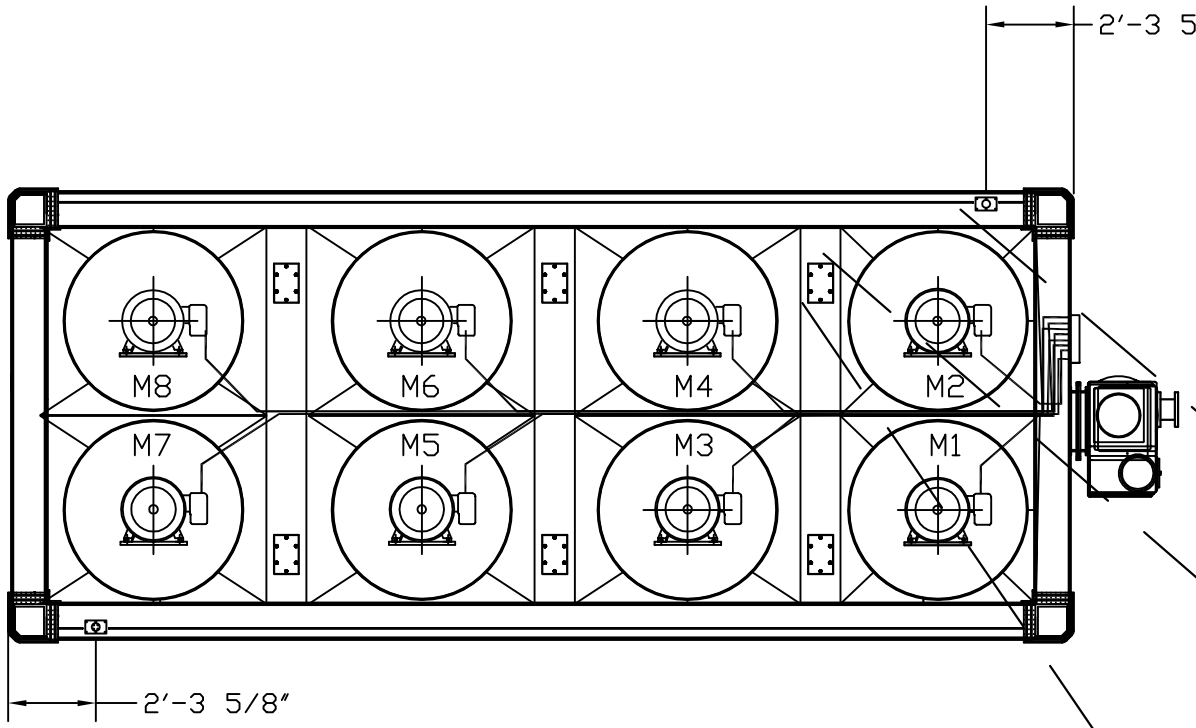
OKLAHOMA CITY, OKLAHOMA 73127

California Hydronics Corp.
2-Unit Installation
TTXL-08 Safety Tie Off Bracket
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930
Tag: Santa Rita Jail R & R Cooling Tower

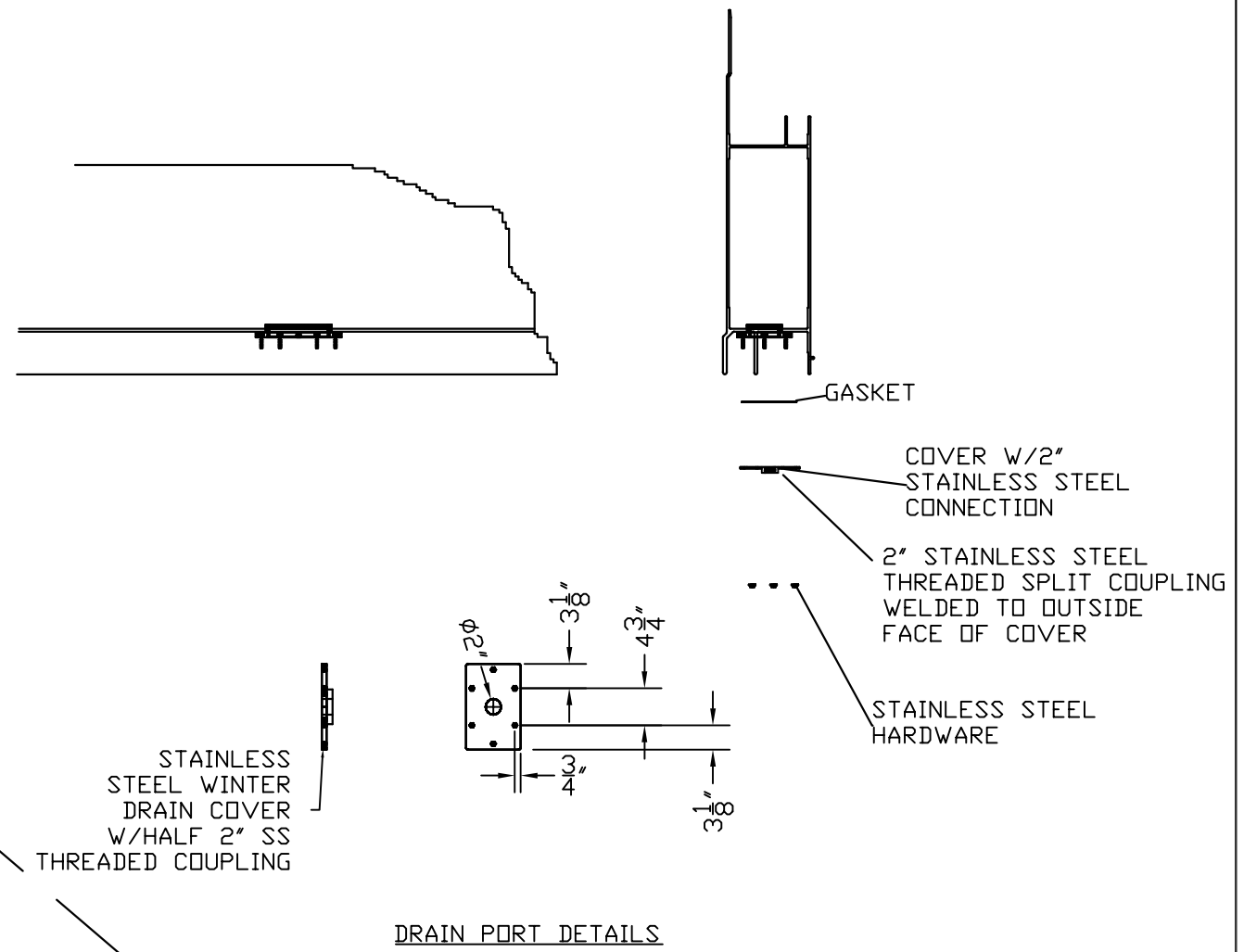
FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team

NO.	REVISION	DATE
	REVISIONS	

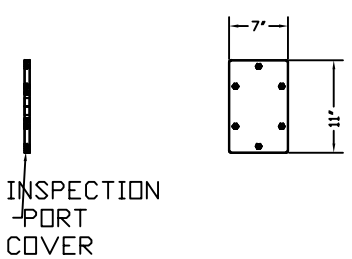
DATE:	24 JAN 14
DRAWING#:	14-006-2B
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
SAFETY TIE OFF BRACKET	2B



BOTTOM VIEW WINTER DRAIN LOCATIONS
TWO LOCATIONS ON EACH CELL



DRAIN PORT DETAILS



INSPECTION PORT COVER DETAIL

*MOTOR SUPPORTS NOT SHOWN FOR CLARITY

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California Hydronics Corp. 2-Unit Installation

Modular Fiberglass Cooling Tower

Model # TTXL-081930

TTXL-08 Winter Drain Detail

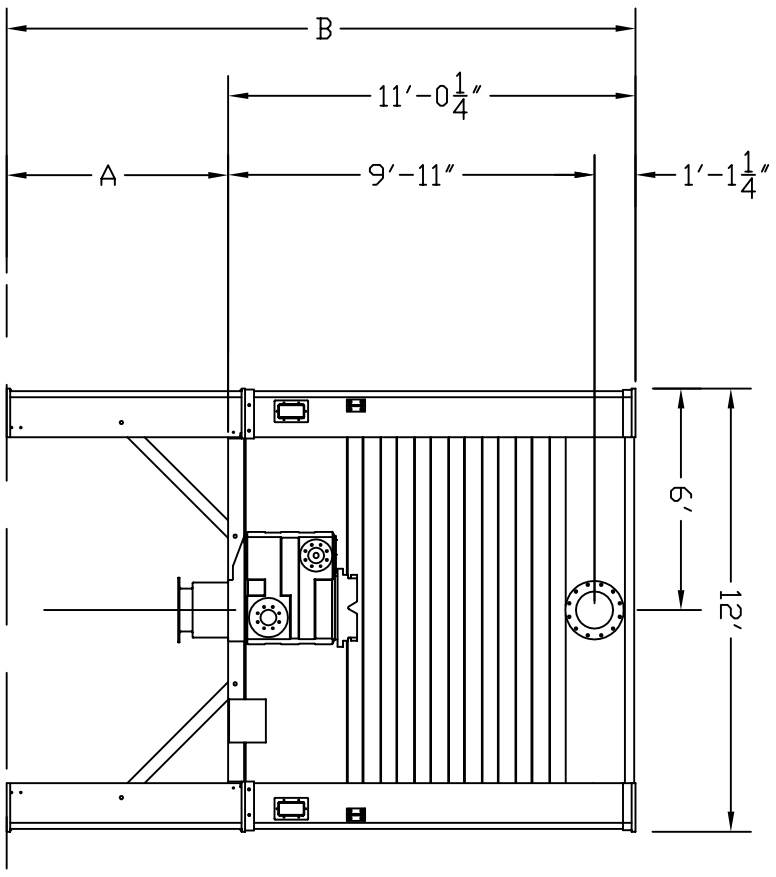
Tag: Santa Rita Jail R & R Cooling Tower

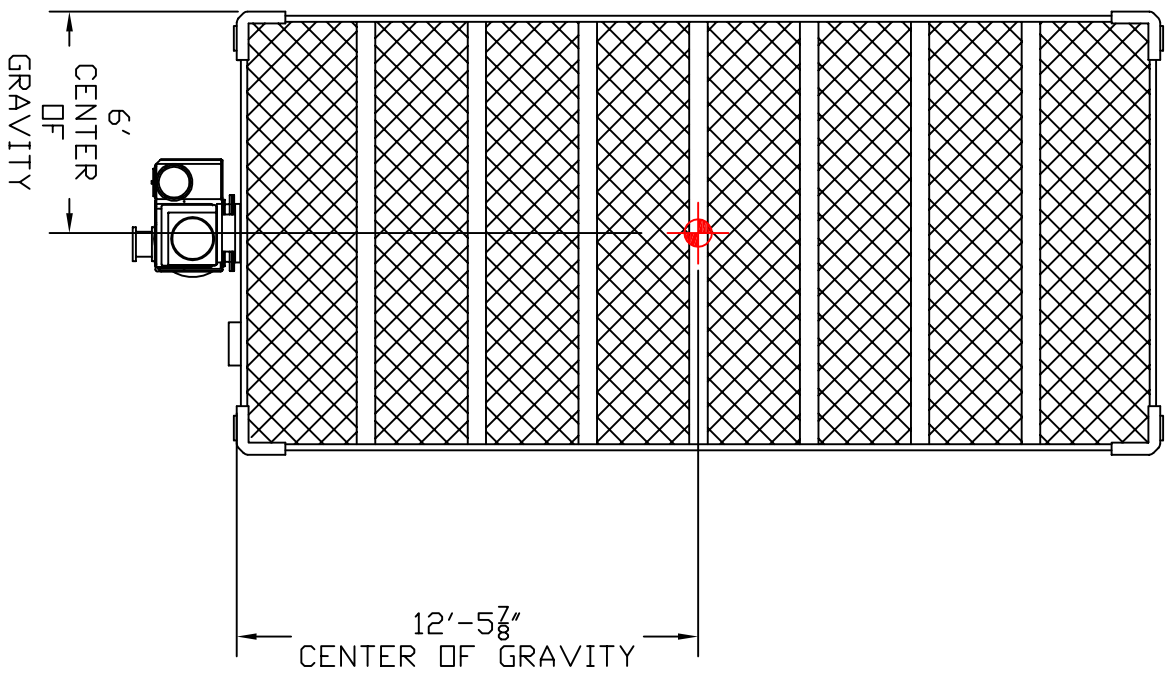
FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

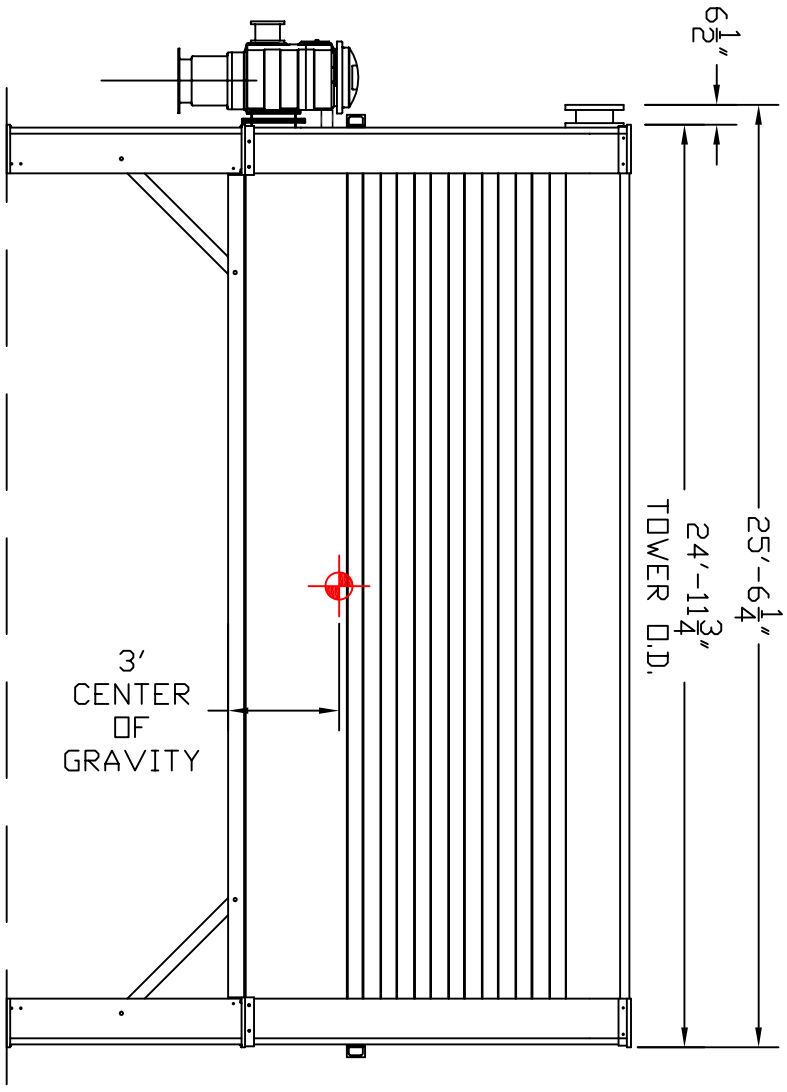
REVISIONS

NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-2C
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
WINTER DRAIN DETAIL	2C







GENERAL INFORMATION:

WEIGHTS (PER CELL):

DRY SHIPPING WEIGHT - 15,412lbs
OPERATING WEIGHT - 25,695 lbs

SUBSTRUCTURE CHART

SUBSTRUCTURE HEIGHT A	TOWER OVERALL HEIGHT B
1′-0″	12′-0 1/4″
4′-0″	15′-0 1/4″
6′-0″	17′-0 1/4″
8′-0″	19′-0 1/4″
10′-0″	21′-0 1/4″
12′-0″	23′-0 1/4″

DATE:	24 JAN 14
DRAWING#:	14-006-2D
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
CENTER OF GRAVITY	2D

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS

NO.	DATE	REVISION

California Hydronics Corp.
2-Unit Installation
TTXL-08 Center of Gravity
Tag: Santa Rita Jail R & R Cooling Tower

Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

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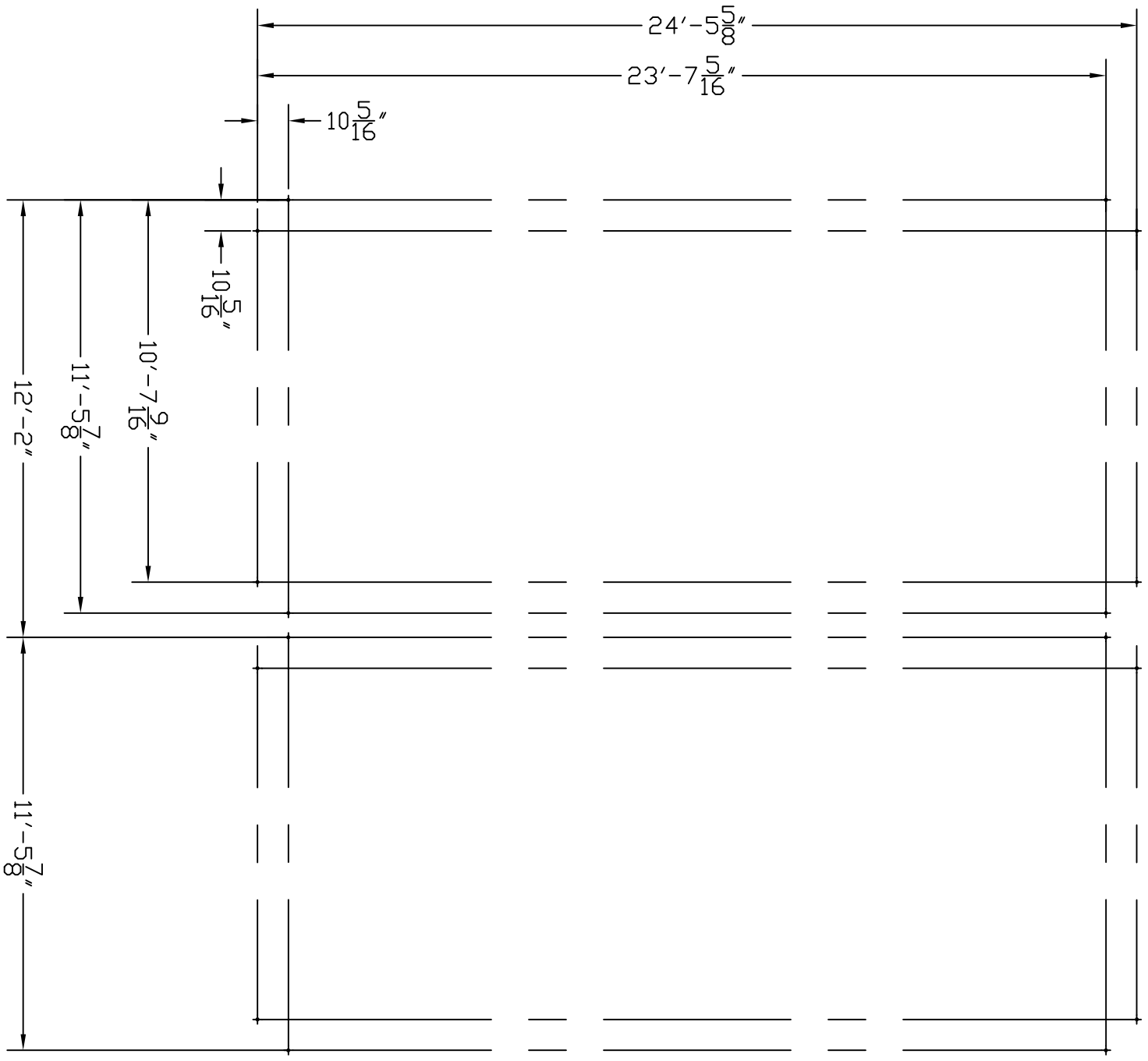

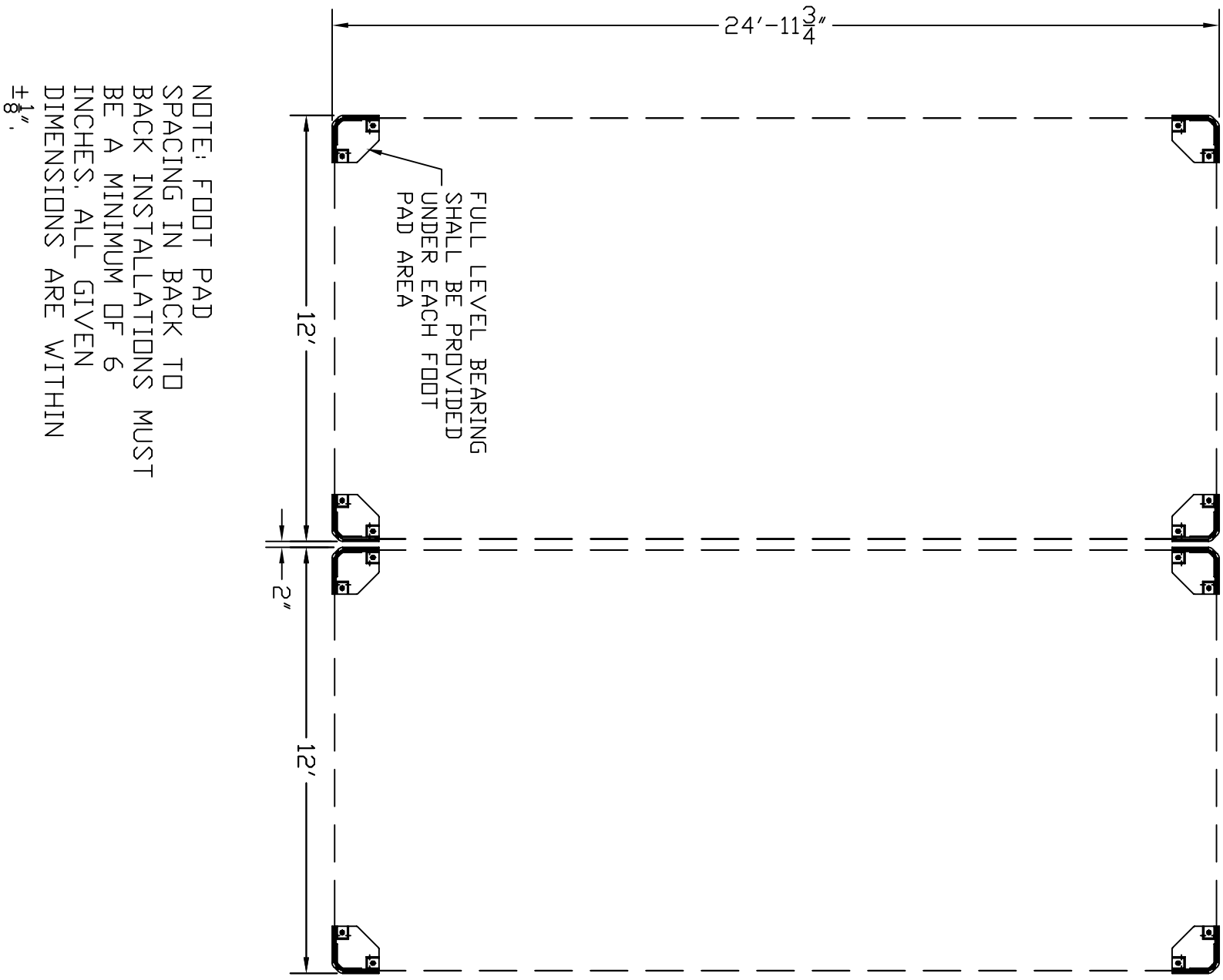

NOTE: FOOT PAD SPACING IN BACK TO BACK INSTALLATIONS MUST BE A MINIMUM OF 6 INCHES. ALL GIVEN DIMENSIONS ARE WITHIN ±1/8″.

DATE:	24 JAN 14
DRAWING#:	14-006-3
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
FOOTPRINT & ANCHOR PAD LAYOUT	3

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS

NO.	DATE	REVISION

California Hydronics Corp.
2-Unit Installation
TTXL-08 Anchor Pad Layout

Tag: Santa Rita Jail R & R Cooling Tower

Modular Fiberglass Cooling Tower
Model # TTXL-081930

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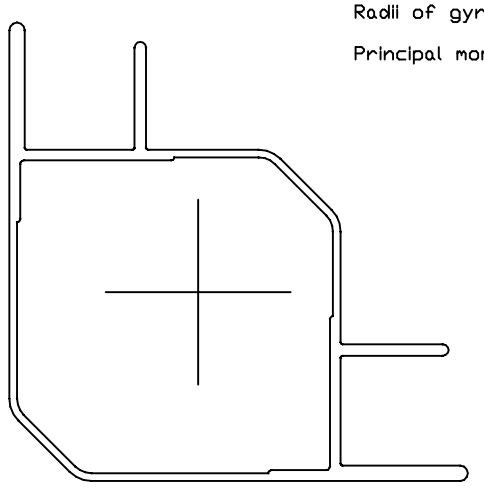
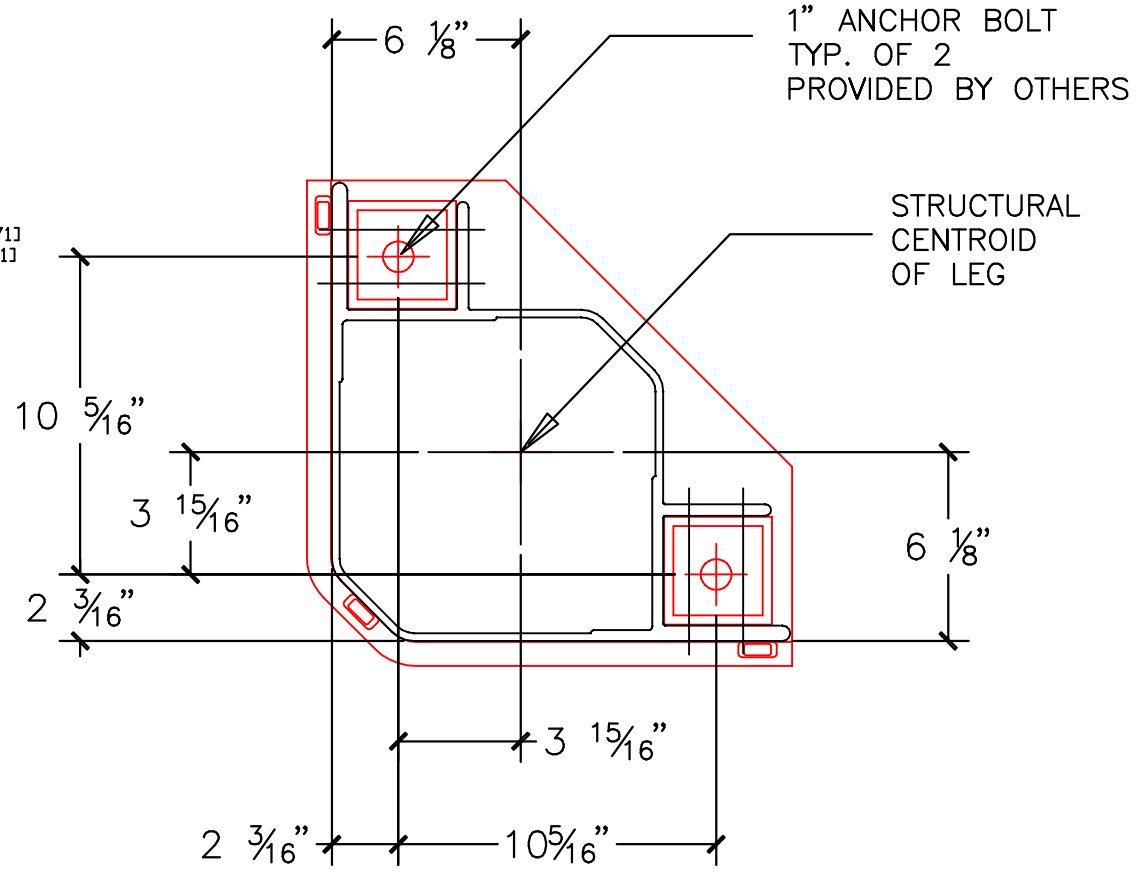
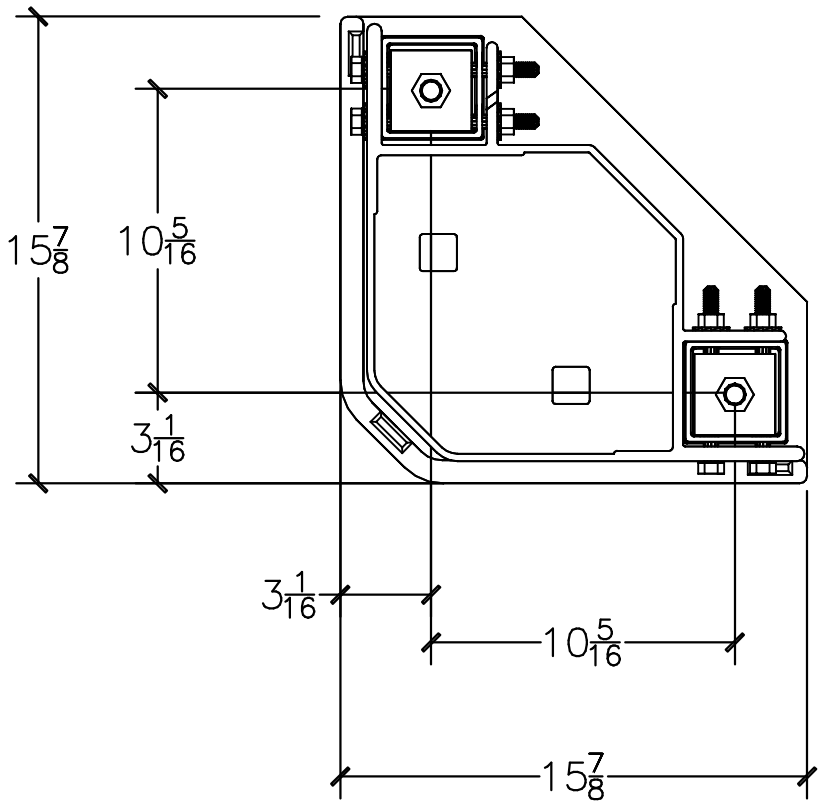
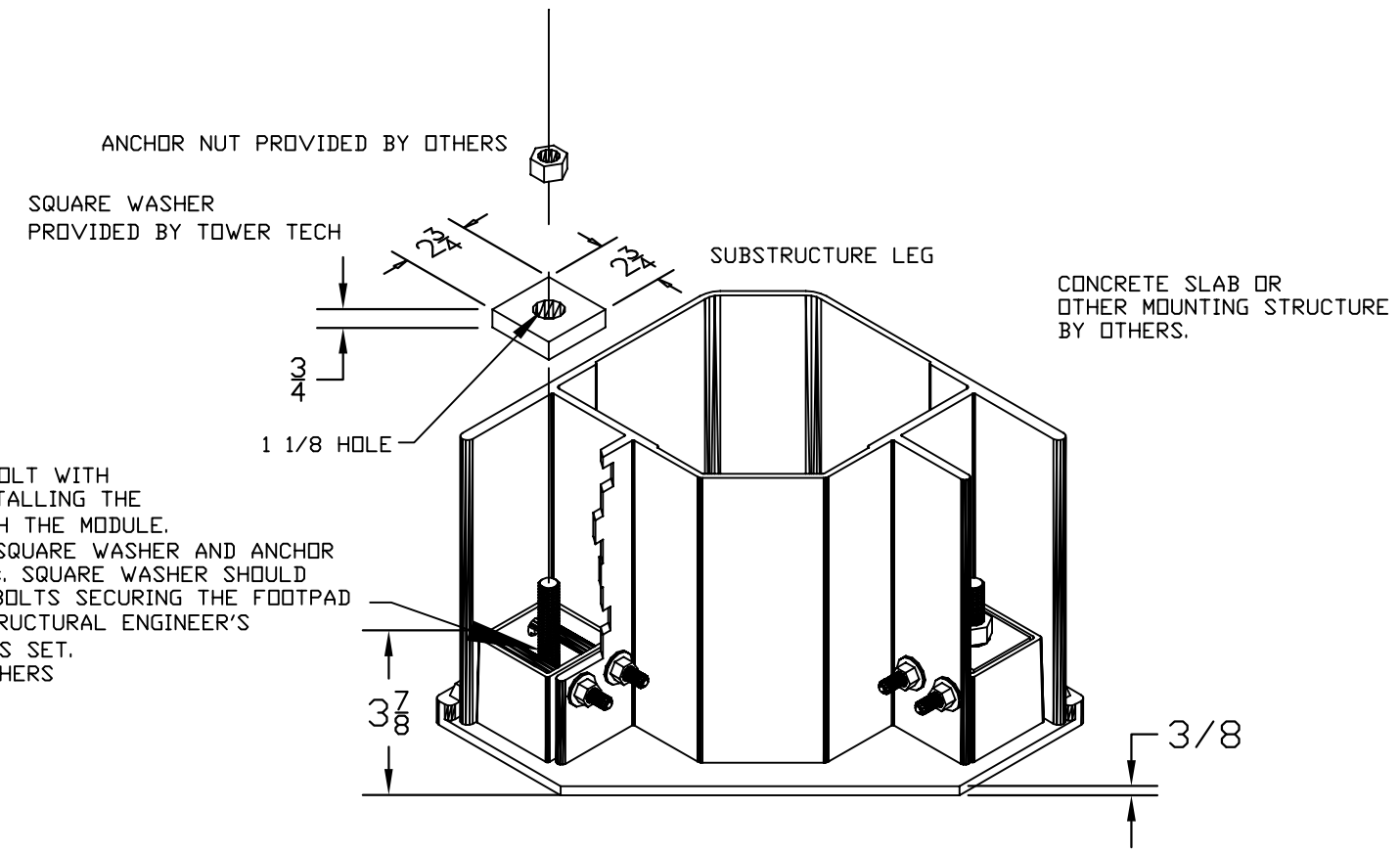
```
----------------    REGIONS    ----------------
Area:                    17.9141
Perimeter:               107.9072
Bounding box:          X: -6.1274  --  8.7476
                       Y: -6.1274  --  8.7476
Centroid:              X: 0.0000
                       Y: 0.0000
Moments of inertia:    X: 422.8851
                       Y: 422.8847
Product of inertia:    XY: -229.3880
Radii of gyration:     X: 4.8586
                       Y: 4.8586
Principal moments and X-Y directions about centroid:
                       I: 193.4969 along [0.7071 -0.7071]
                       J: 652.2729 along [0.7071 0.7071]
```







FILL POCKET AROUND ANCHOR BOLT WITH NON-SHRINK GROUT BEFORE INSTALLING THE SQUARE WASHER PROVIDED WITH THE MODULE. BEFORE GROUT SETS, INSTALL SQUARE WASHER AND ANCHOR NUT AND TORQUE TO 50 Ft-Lbs. SQUARE WASHER SHOULD ENGAGE THE TWO HORIZONTAL BOLTS SECURING THE FOOTPAD TO THE LEG. RE-TORQUE TO STRUCTURAL ENGINEER'S SPECIFICATION AFTER GROUT HAS SET.
ANCHOR BOLTS PROVIDED BY OTHERS



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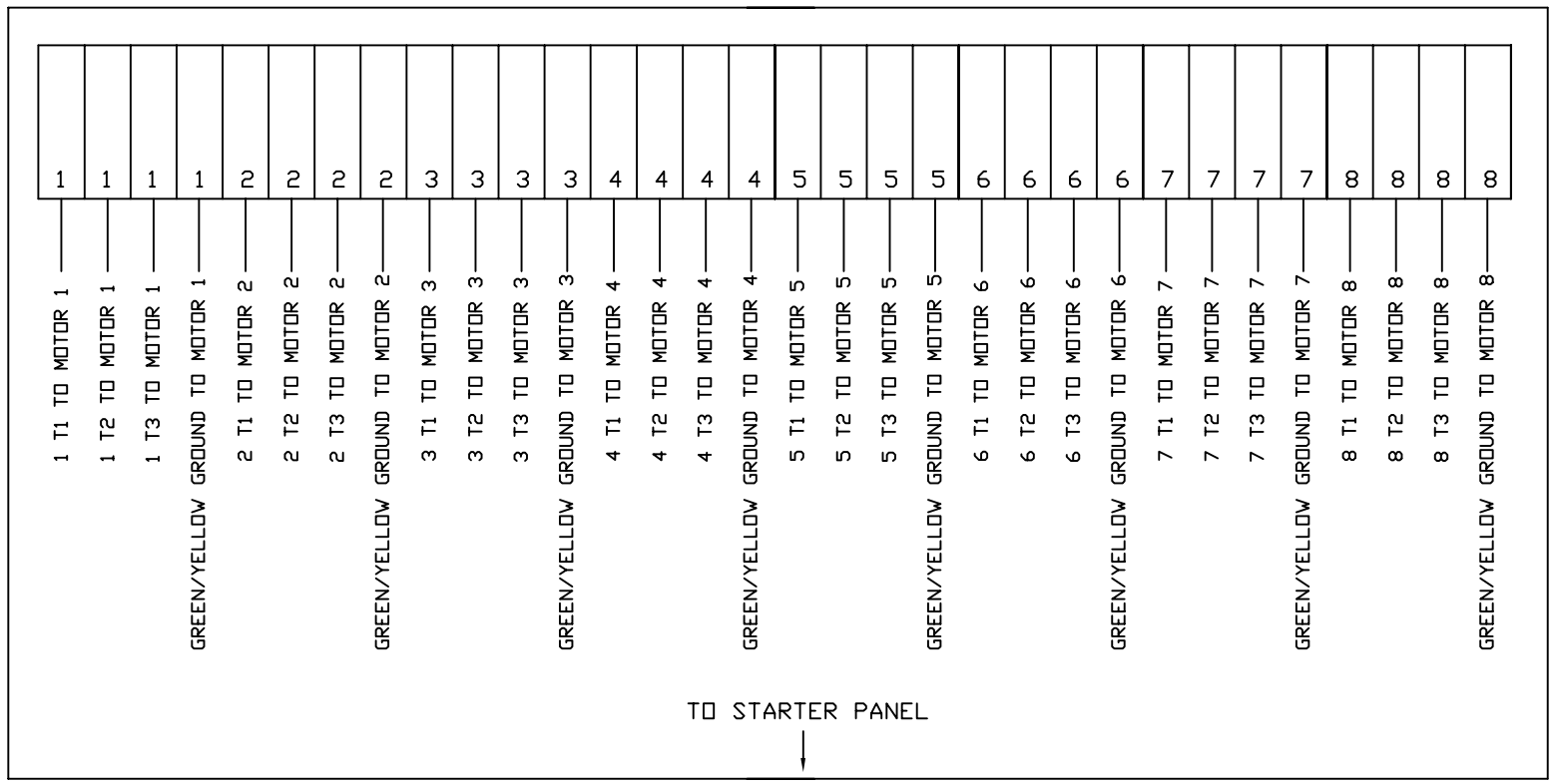
California Hydronics Corp.
2-Unit Installation
TTXL-08 Footpad Detail
Tag: Santa Rita Jail R & R Cooling Tower

Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

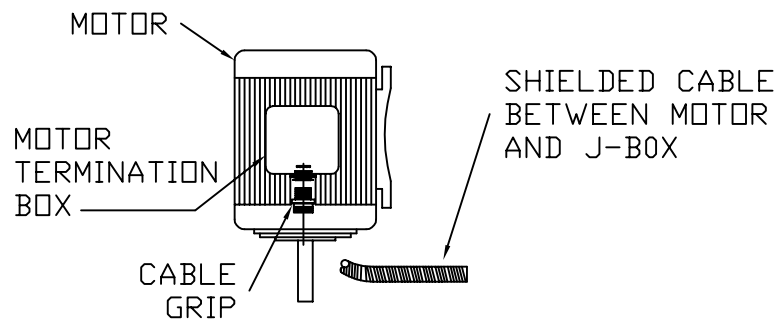
FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team

NO.	REVISIONS	DATE
	REVISION	DATE

DATE:	24 JAN 14
DRAWING#:	14-006-4
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
FOOTPAD DETAIL	4

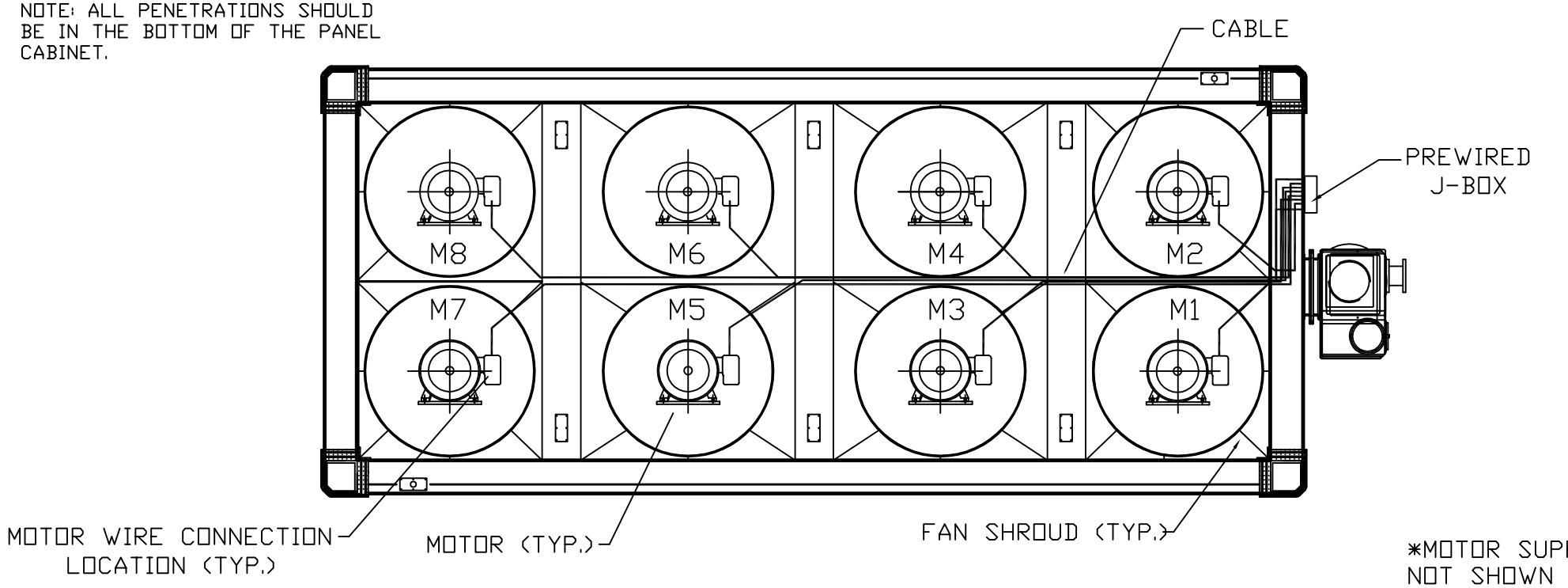


J-BOX LAYOUT



CONNECTION DETAIL

NOTE: ALL PENETRATIONS SHOULD BE IN THE BOTTOM OF THE PANEL CABINET.



TYPICAL CABLE LAYOUT

*MOTOR SUPPORTS NOT SHOWN FOR CLARITY

FIELD WIRING:

FIELD WIRING BY OTHERS. ALL COMMUNICATION WIRE TO BE SHIELDED TWISTED PAIR CONDUCTOR - BELDEN OR EQUIVALENT.

MOTOR PROTECTION:

INDIVIDUAL MOTOR PROTECTION FOR SHORT CIRCUIT AND THERMAL OVERLOAD MUST BE PROVIDED IN ACCORDANCE WITH THE CURRENT NATIONAL ELECTRIC CODE. THE CURRENT LIMIT FUNCTION OF A VARIABLE FREQUENCY DRIVE DOES NOT QUALIFY WHERE MORE THAN ONE MOTOR IS CONNECTED TO THE LOAD SIDE OF THE DRIVE. FAILURE TO PROVIDE THE INDIVIDUAL MOTOR PROTECTION WILL VOID THE MOTOR AND WIRING WARRANTIES.

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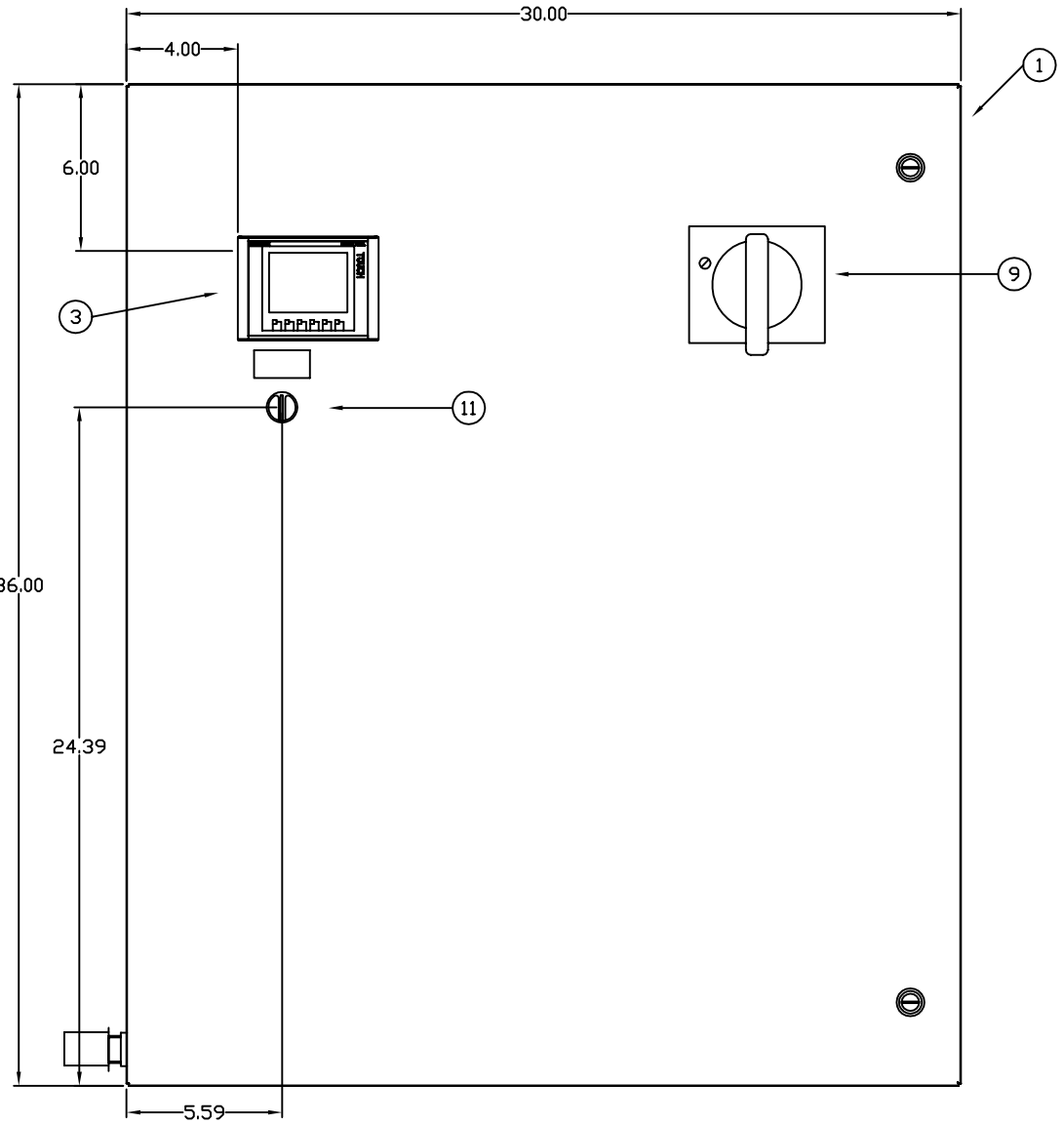
California Hydronics Corp.
2-Unit Installation
TTXL-08 Prewired J-Box
Tag: Santa Rita Jail R & R Cooling Tower

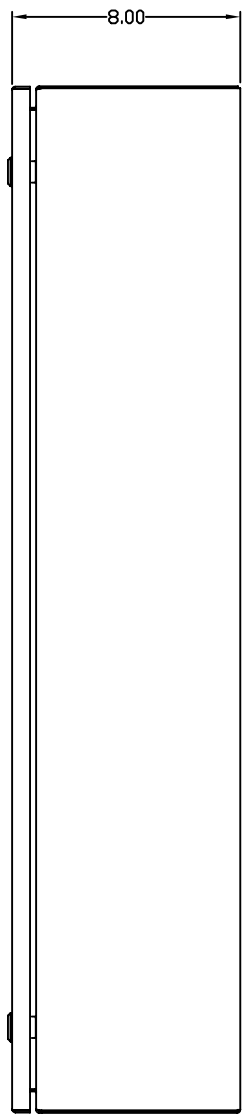
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

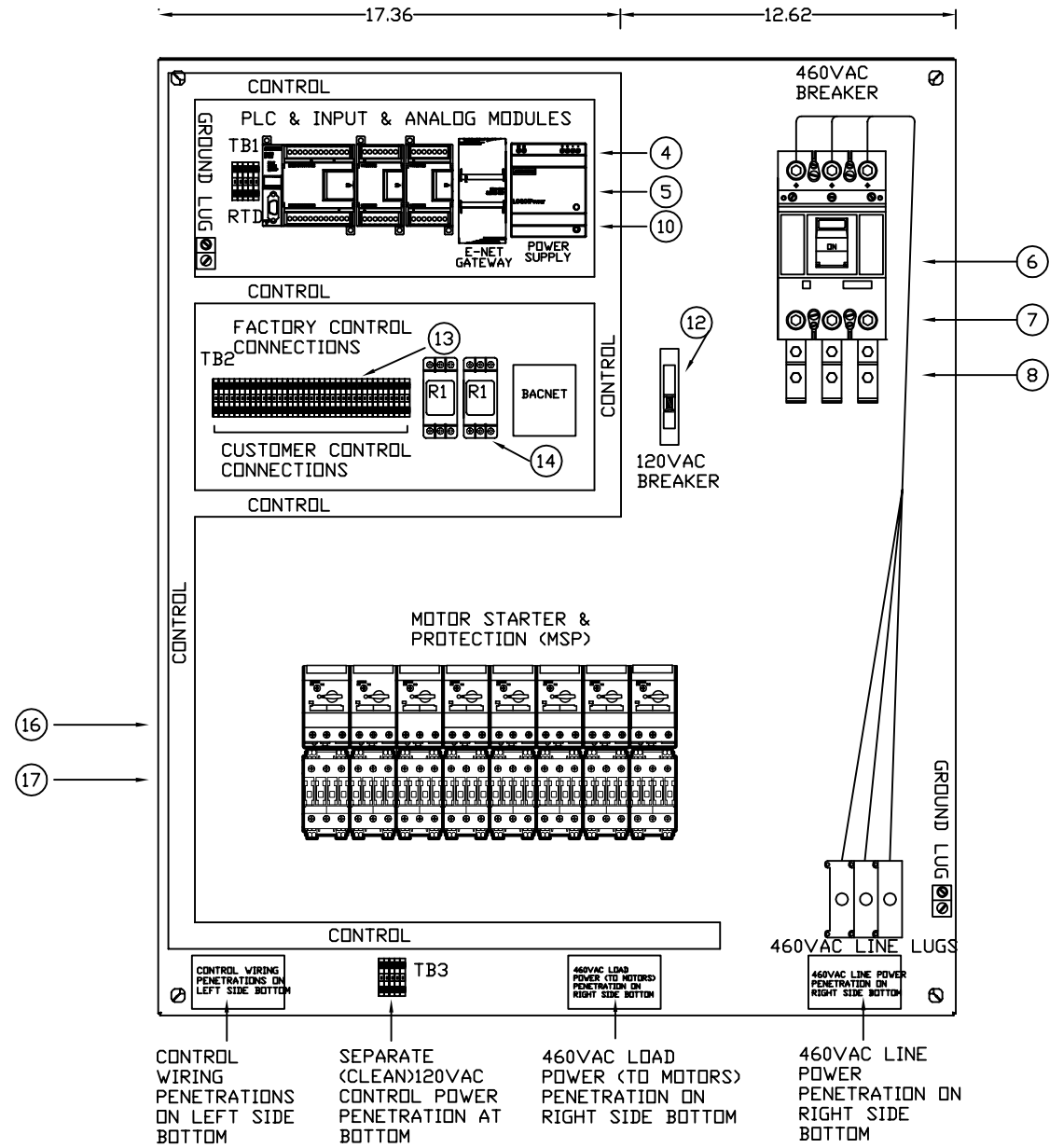
FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS		
NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-5
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
PREWIRED J=BOX	5







1	Enclosure
2	Enclosure mounting panel
3	KTP600 operator panel
4	CPU S7 1200 module
5	S7-1200 Analog Module
6	Circuit Breaker 3P/600Vac/ 250amp frame
7	Internal Auxiliary Contacts
8	-
9	Circuit breaker door mounted disconnect handle
10	S7-1200 8pt digital input module 24VDC
11	Black 2 position selector switch
12	Branch Circuit protector single pole
13	Terminal Strip
14	Control relay 3 pole 120VAC Magnacraft
15	-
16	Manual motor starter protector
17	Contactor

* NOTE: PANEL WILL SHIP LOSE
CUSTOMER TO INSTALL

#1 - Field wiring by others. No Penetrations in Cabinet/Enclosure other than from the bottom. Side and top penetrations will void customer warranty.

#2 - Field wiring by others. Communication and power lines must be in separate conduits. Communication conduit should enter CP cabinet on bottom left side.

#3 - Field wiring by others. 460/230 vac should enter CP cabinet on bottom right hand side as shown. Clean 120 vac should to enter CP cabinet in separate conduit at bottom middle as shown. Communication wires should penetrate CP cabinet at bottom left as shown.

#4 - Field wiring by others. All motor wiring is to exit in conduit from bottom of CP cabinet.

#5 - Field wiring by others. All communication wire to be shielded twisted pair.

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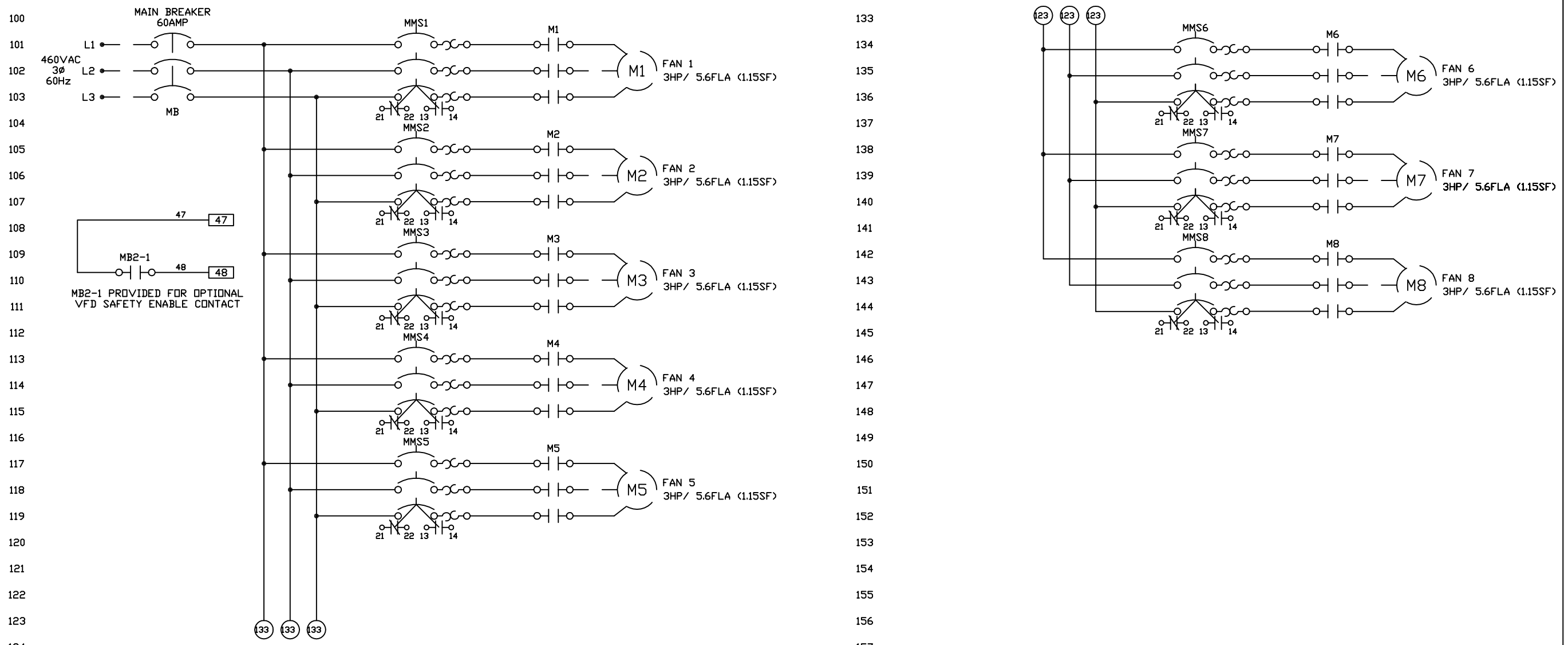
California Hydronics Corp.
2-Unit Installation
TTXL-08 Control Panel Cabinet
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team

NO.	REVISIONS	DATE
	REVISION	DATE

DATE:	24 JAN 14
DRAWING#:	14-006-6
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
CONTROL PANEL CABINET	6



NOTES:

1) ALL WIRING CONNECTED TO THIS CABINET MUST BE RATED AT LEAST 60° AND BE (LOW HYDROGEN PREFERRED) COPPER.

WIRE COLOR

BLACK - LINE VOLTAGE
RED - 120VAC
WHITE - NEUTRAL
GREEN - GROUND
BLUE - 24VDC +
BLUE W/WHITE - 24VDC -

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California Hydronics Corp.
2-Unit Installation
TTXL-08 Control Panel Wiring
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930
Tag: Santa Rita Jail R & R Cooling Tower

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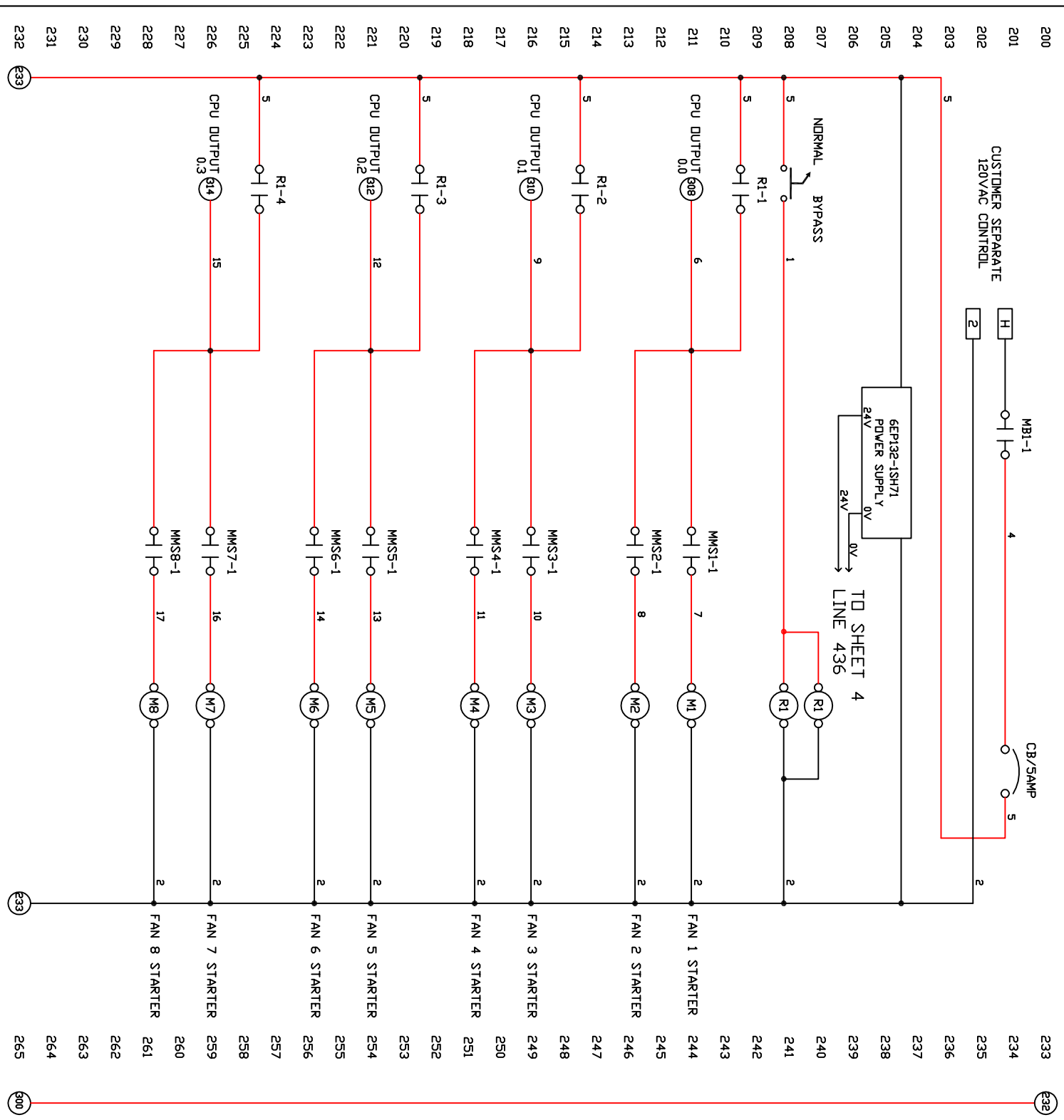
California Hydronics Corp.
Tower Tech Design Team

NO.	REVISIONS	DATE

DATE:	24 JAN 14
DRAWING#:	14-006-7A
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
CONTROL PANEL WIRING - 1	7A



WIRE COLOR

BLACK - LINE VOLTAGE
RED - 120VAC
WHITE - NEUTRAL
GREEN - GROUND
BLUE - 24VDC +
BLUE W/WHITE - 24VDC -

DATE:	24 JAN 14
DRAWING#:	14-006-7B
PROJECT#:	201406
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
CONTROL PANEL WIRING - 2	7B

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Tower Tech Design Team	

REVISIONS

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California Hydronics Corp.
2-Unit Installation
TTXL-08 Control Panel Wiring

Tag: Santa Rita Jail R & R Cooling Tower

Modular Fiberglass Cooling Tower
Model # TTXL-081930

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(J21 - J24) REPLACE JUMPER WITH WIRES TO VFD DRY CONTACT FOR VFD OPERATION. CONTACT STATE IS N.O. WHEN VFD IS OPERATIONAL. CONTACT STATE IS N.C. FOR VFD OFF, FAILED, OR BYPASS MODE. CLOSURE (N.C.) OF VFD DRY CONTACT PROVIDES TOWER REDUNDANT FAN STAGING CONTROL BY PLC FAN STAGING WHEN VFD IS NON-OPERATIONAL.

TOWER REMOTE ENABLE REMOVE TO DISABLE TOWER PLC TEMP STAGING (J22-25)

IN BYPASS

CPU 1212C AC-DC-RELAY

PLC INPUTS

PLC OUTPUTS

FAN 1 & 2 AUTO

FAN 3 & 4 AUTO

FAN 5 & 6 AUTO

FAN 7 & 8 AUTO

TO HMI (DOOR MOUNTED)

BLUE

BLUE W/WHITE

8PT DC INPUT

WIRE COLOR

BLACK - LINE VOLTAGE
RED - 120VAC
WHITE - NEUTRAL
GREEN - GROUND
BLUE - 24VDC +
BLUE W/WHITE - 24VDC -

DATE:	24 JAN 14
DRAWING#:	14-006-7C
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
CONTROL PANEL WIRING - 3	7C

FOR APPROVAL BY	DATE
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REVISIONS

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California Hydronics Corp.
2-Unit Installation
TTXL-08 Control Panel Wiring

Tag: Santa Rita Jail R & R Cooling Tower

Modular Fiberglass Cooling Tower
Model # TTXL-081930

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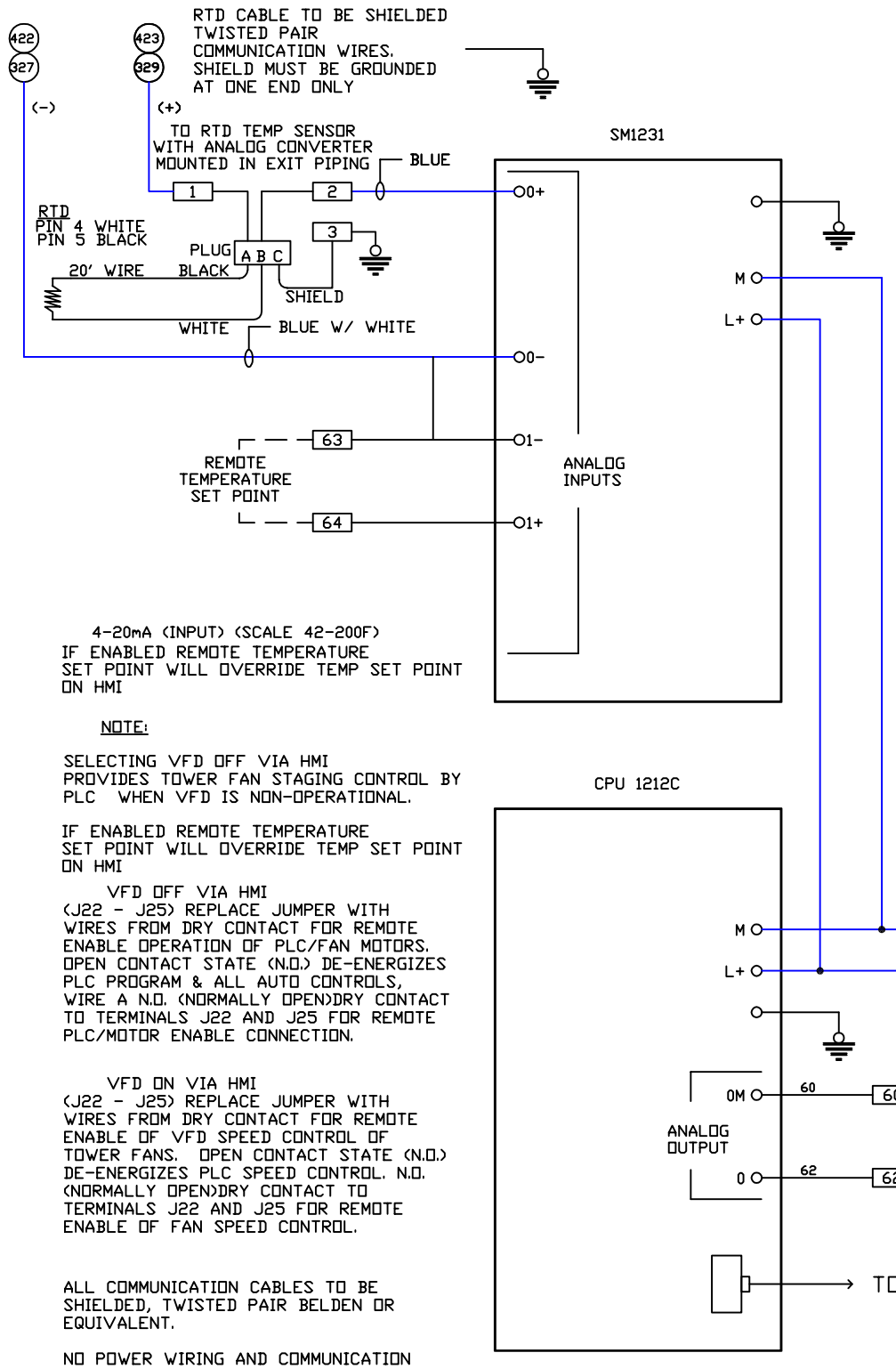

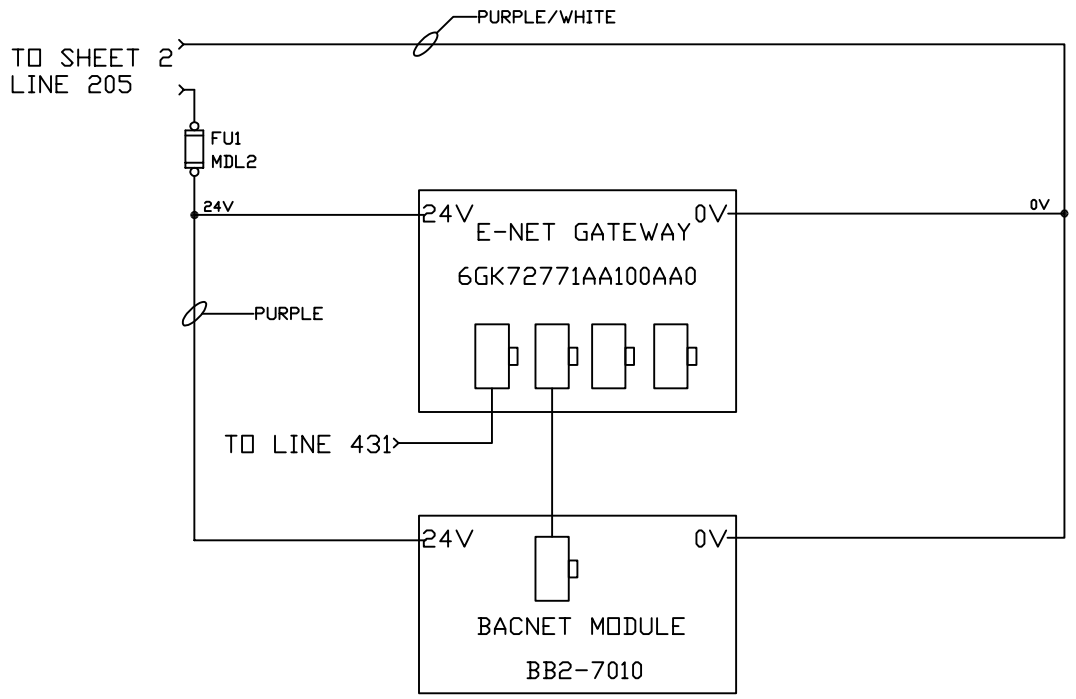

WIRE COLOR

BLACK - LINE VOLTAGE
RED - 120VAC
WHITE - NEUTRAL
GREEN - GROUND
BLUE - 24VDC +
BLUE W/WHITE - 24VDC -

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Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 Control Panel Wiring
Tag: Santa Rita Jail R & R Cooling Tower

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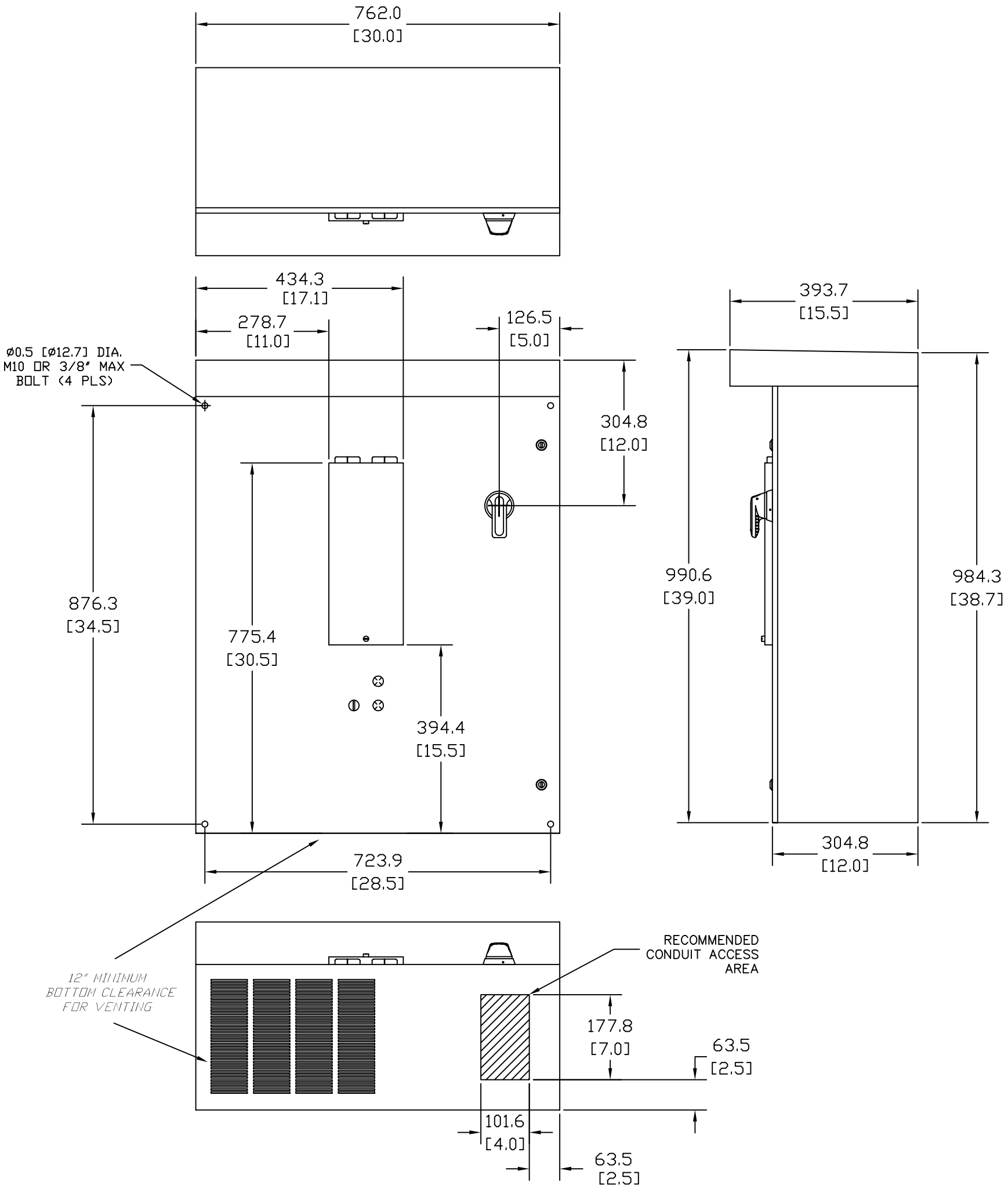
REVISIONS		
NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-7D
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
CONTROL PANEL WIRING - 4	7D



NOTES
1. DIMENSIONS SHOWN ARE IN MILLIMETERS [INCHES]
2. APPROXIMATE PRODUCT WEIGHT:
WITH BYPASS R4 - 96.8 Kg [213 lbs]
WITH OUT BYPASS R4 - 92.3 Kg [203 lbs]

F-3BUA000502-d, rev. 1, 6-1-00

ECO #		Rev. descr.				
Prep.	USINY/ MCS	D LACHANCE	5/19/09	Title DIMENSIONAL DRAWING AMC SIZE 2 UL TYPE 3R/NEMA 3R		Cont. sh. 4
Appr.	USINY/	J KELLY	5/19/09			
Resp. dept.	USINY/ 20500		5/19/09			
ABB Automation and Drives				Document number 3AUA0000060123	Lang. -	Rev. Ind. A / Sheet 3

DATE:	24 JAN 14
DRAWING#:	14-006-7F
PROJECT#:	201406
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
ABB VFD DRIVE PANEL	7F

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS

NO.	DATE	REVISION

California Hydronics Corp.
2-Unit Installation
TTXL-08 ABB VFD Drive Panel

Tag: Santa Rita Jail R & R Cooling Tower

Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

TOWER TECH, Inc.
THE TECHNOLOGY COMPANY
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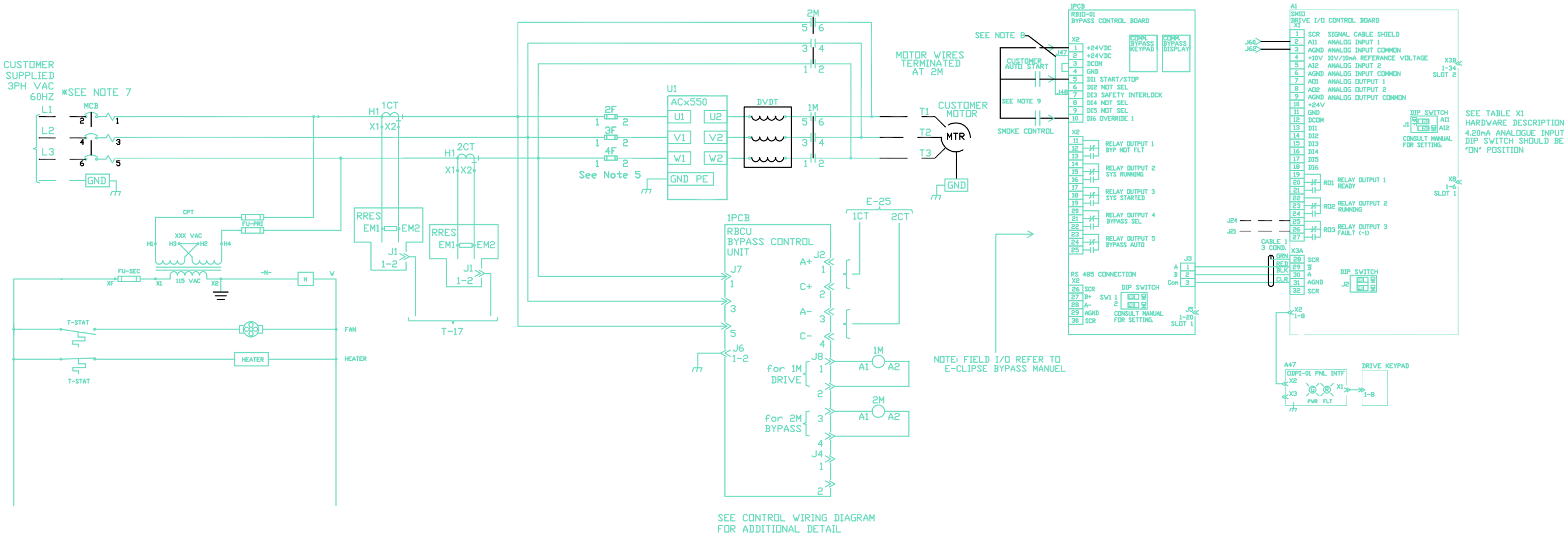
OKLAHOMA CITY, OKLAHOMA 73127



Hardware description

	X1		Hardware description
Analogue I/O	1	SCR	Terminal for signal cable shield (connected internally to chassis earth).
	2	AI1	Analogue input channel 1, programmable. Default[2] = frequency reference. Resolution 0.1%, accuracy ±1%.
			Two different DIP switch types can be used.
			J1: AI1 OFF: 0...10 V (R_i = 312 kohm)
			J1: AI1 ON: 0...20 mA (R_i = 100 ohm)
	3	AGND	Analogue input circuit common (connected internally to the chassis earth through 1 Mohm).
	4	+10 V	10 V/10 mA reference voltage output for analogue input potentiometer (1...10 kohm), accuracy ±2%.
	5	AI2	Analogue input channel 2, programmable. Default[2] = Actual signal 1 (PID1 feedback). Resolution 0.1%, accuracy ±1%.
			Two different DIP switch types can be used.
			J1: AI2 OFF: 0...10 V (R_i = 312 kohm)
			J1: AI2 ON: 0...20 mA (R_i = 100 ohm)
	6	AGND	Analogue input circuit common (connected internally to the chassis earth through 1 Mohm).
	7	AO1	Analogue output, programmable. Default[2] = frequency. 0...20 mA (load < 500 ohm). Accuracy ±3%.
	8	AO2	Analogue output, programmable. Default[2] = current. 0...20 mA (load < 500 ohm). Accuracy ±3%.
	9	AGND	Analogue output circuit common (connected internally to the chassis earth through 1 Mohm).

NOTES:
1. PROGRAMMING:
   DRIVE MACRO = MACRO = HVAC DEFAULT.
2. DASH LINES INDICATE CUSTOMER INSTALLED DEVICES AND WIRING
3. COPPER WIRE RATED FOR 75°C INSULATION MUST BE USED
4. REFER TO USER MANUAL FOR OPERATION, CONNECTIONS AND TIGHTENING TORQUE VALUES.
5. FUSE RATING LABEL IS ON DOOR
6. CUSTOMER REQUIRED TO PROVIDE BRANCH CIRCUIT PROTECTION AND DISCONNECT MEANS PER NEC AND LOCAL CODE.
7. SHORT CIRCUIT CURRENT RATING ON DOOR LABEL
8. REPLACE JUMPER WITH NORMALLY CLOSED SAFTY INTERLOCK CONTACT AS NEEDED
   X2 - TERMINAL 2 CONNECTS TO J-47 & TERMINAL 7 CONNECTS TO J-48
9. WHEN CONNECTING VFD TO TOWER TECH T9900 CONTROL PANEL WITH PLC
   INSTALL JUMPER BETWEEN X2-TERMAINAL 1 & 5 AND 5 & 10.

ABB Automation & Drives
800-752-0696

NOTE !
AFTER A CIRCUIT IS DEENERGIZED BY A CIRCUIT PROTECTIVE DEVICE, THE CIRCUIT MAY NOT BE REENERGIZED UNTIL IT HAS BEEN DETERMINED THAT THE EQUIPMENT AND CIRCUIT CAN BE SAFELY ENERGIZED. THE REPETITVE RECLOSING OF CIRCUIT BREAKERS OR REENERGIZING CIRCUITS THROUGH REPLACED FUSED IS PROHIBITED.

ABB ACH550
XXX HP XXX VAC
DRIVE WITH CIRCUIT BREAKER
BYPASS
NEMA 3R ENCLOSURE

ABB ACH550-BCRM+B058+
E205
UL TYPE 3R

DRAWN BY: DRP	SCALE: NONE	DRAWING NO
EDITED BY: DLL	DATE 3/6/09	ABB ACH550 BCRM+B058+ E205
	APP'D DLL	SHEET 1 OF 1

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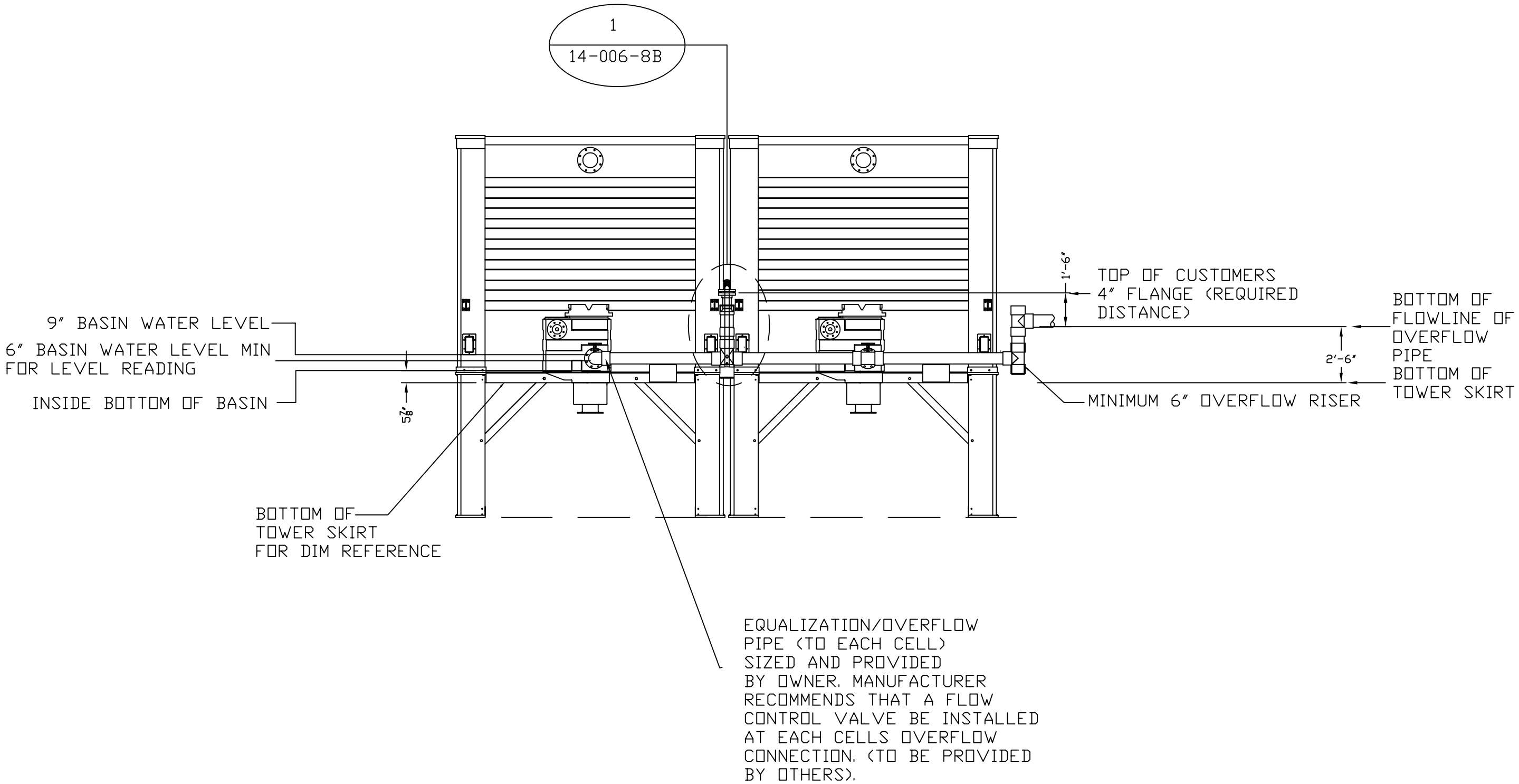
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 ABB VFD Drive
Panel Wiring
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS			NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-7G
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
ABB VFD DRIVE PANEL WIRING	7G



NOTES (TYPICAL ALL TOWER SIZES):

1) ALL EXTERNAL PIPING BY CUSTOMER.
2) ALL EXTERNAL PIPING TO BE INDEPENDENTLY SUPPORTED.
3) OPTIONAL OVERFLOW/EQUALIZATION LINE MUST NOT INTERFERE WITH ACCESS TO INSPECTION PORT OR OPTIONAL BASIN HEATER.

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Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 Overflow/Level Control
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team

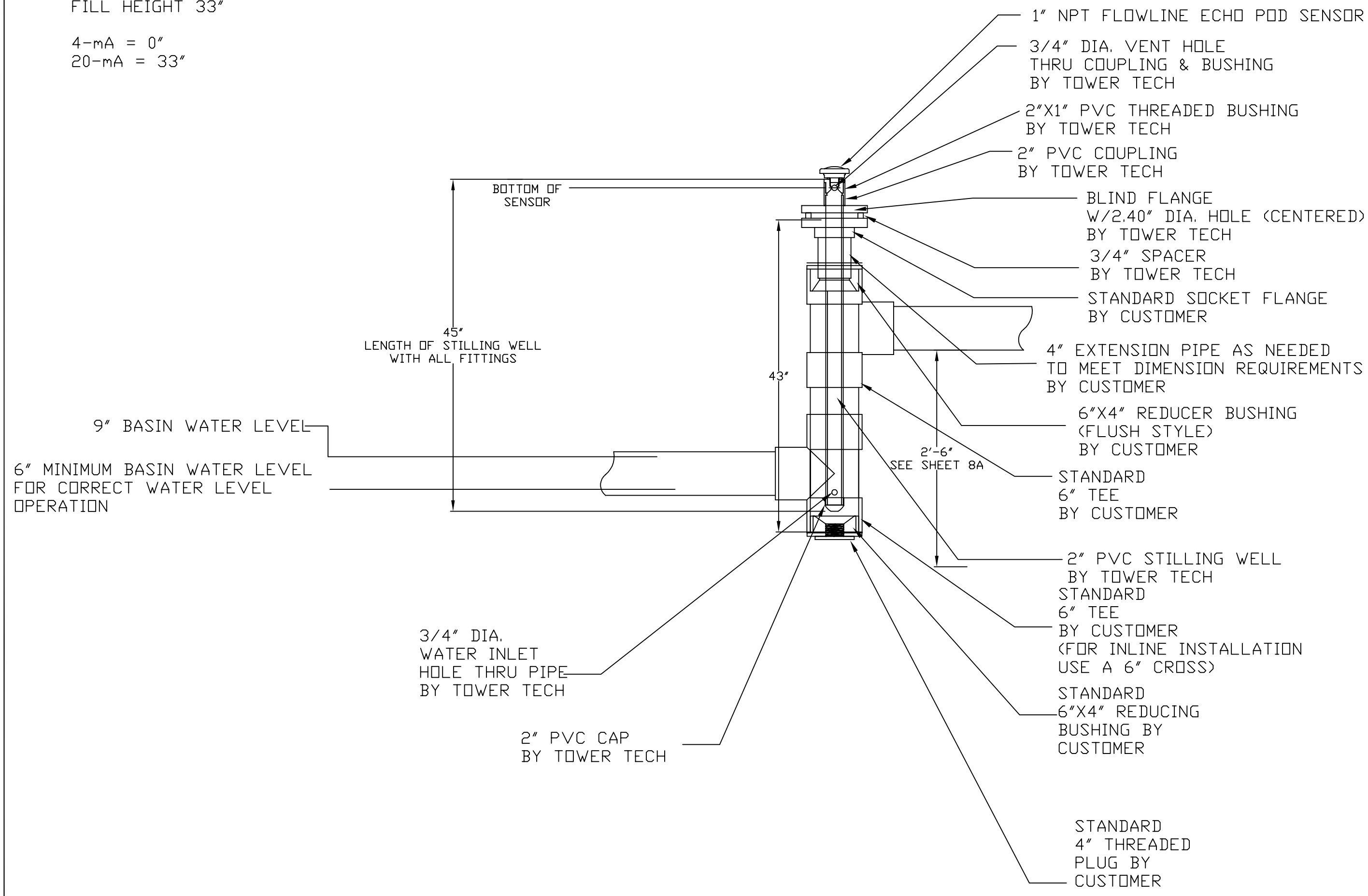
REVISIONS

NO.	DATE	REVISION	DATE

DATE:	24 JAN 14
DRAWING#:	14-006-8A
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
OVERFLOW/LEVEL CONTROL	8A

FLOW LINE SENSOR SETTING
BOTTOM OF SENSOR TO BOTTOM OF TANK 47″
FILL HEIGHT 33″

4-mA = 0″
20-mA = 33″



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California Hydronics Corp.
2-Unit Installation
TTXL-08 Stilling Well Detail

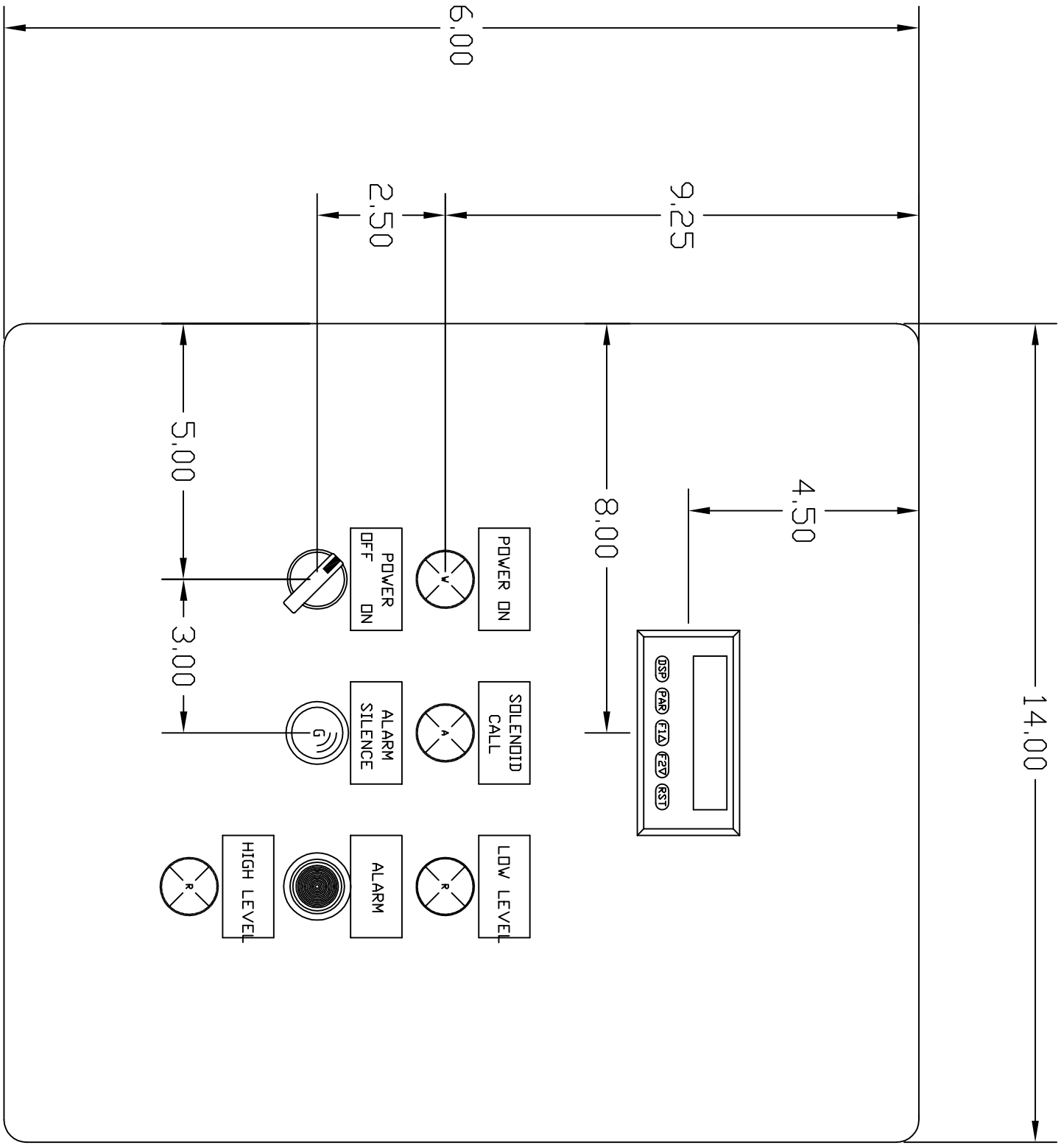
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

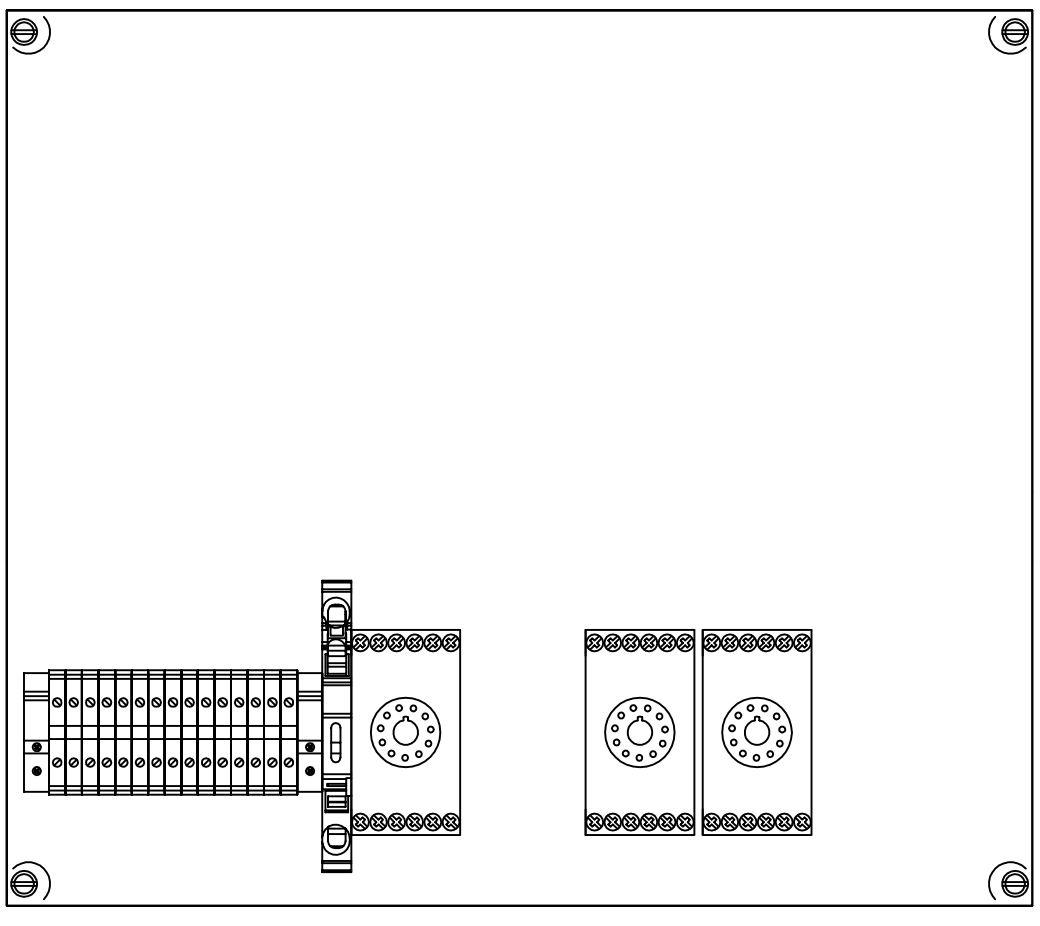
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS		
NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-8B
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
STILLING WELL DETAIL	8B





DATE:	24 JAN 14
DRAWING#:	14-006-8C
PROJECT#:	201406
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
LEVEL CONTROL PANEL CABINET	8C

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS

NO.	DATE	REVISION

California Hydronics Corp.
2-Unit Installation
TTXL-08 Level Control Panel Cabinet
Tag: Santa Rita Jail R & R Cooling Tower

Modular Fiberglass Cooling Tower
Model # TTXL-081930

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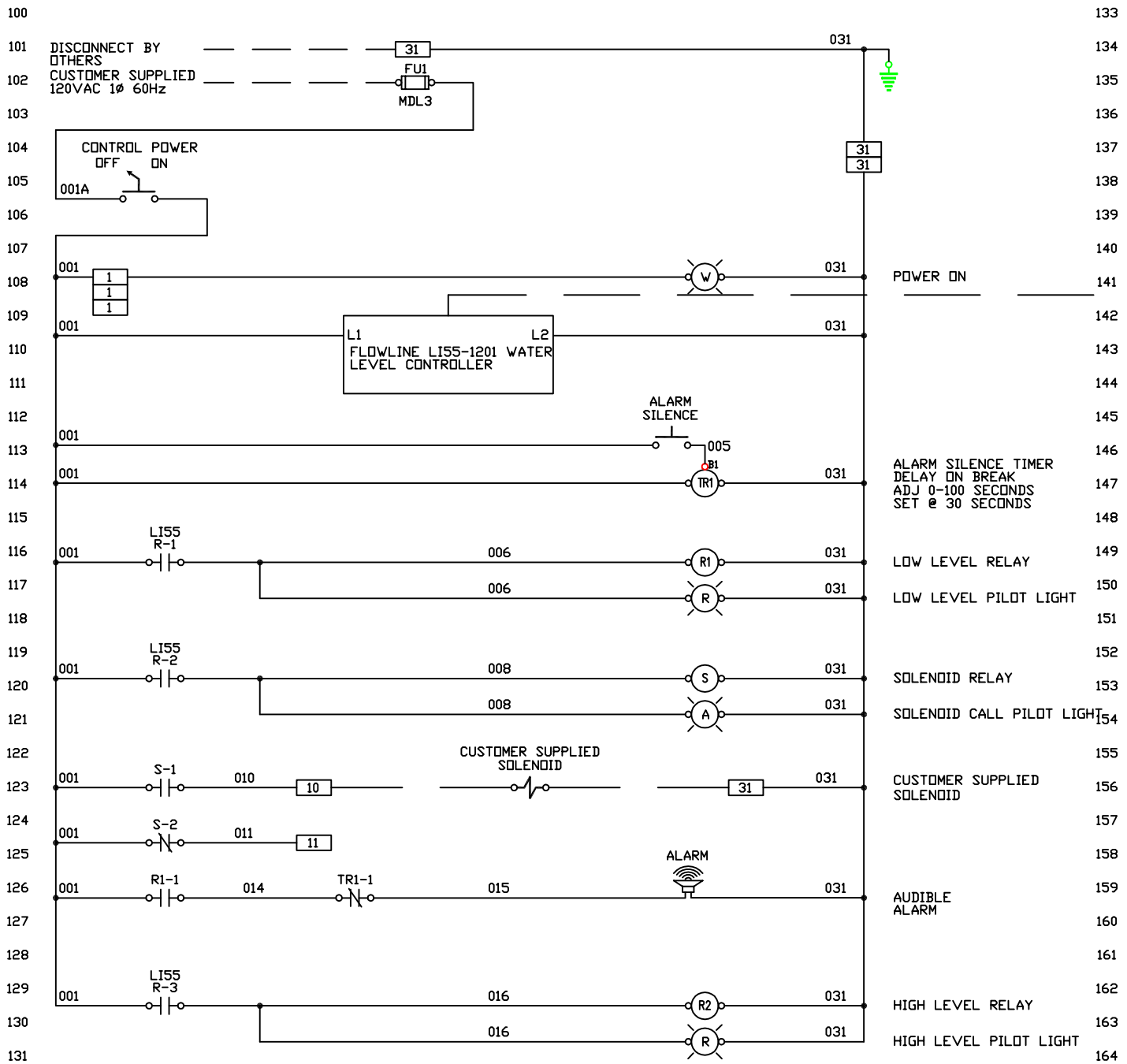
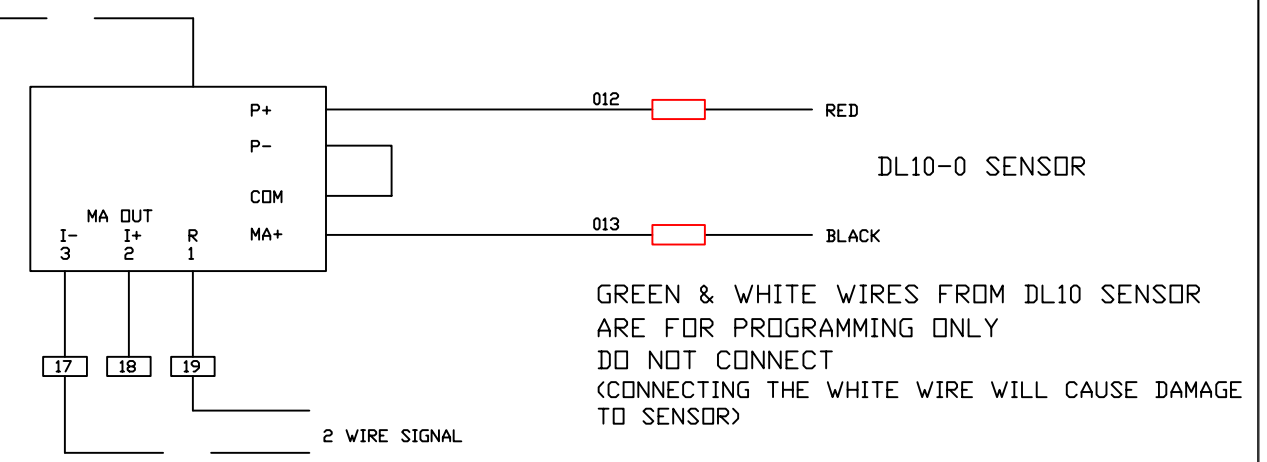
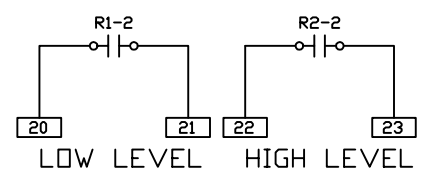




GREEN & WHITE WIRES FROM DL10 SENSOR
ARE FOR PROGRAMMING ONLY
DO NOT CONNECT
(CONNECTING THE WHITE WIRE WILL CAUSE DAMAGE TO SENSOR)

SIGNAL RETRANSMISSION
FROM CONTROLLER
MA OUTPUT INDICATES LEVEL
4mA = 0″
20mA = 33″

R2 - WATER SOLENOID ON @8″ OFF @ 10″
R1 - LOW LEVEL ALARM ON @ 5″ OFF @ 6″
SENSOR SET AT 44″ HEIGHT 33″ FILL
R3 - HIGH LEVEL ALARM ON @ 18.75″ OFF @ 18.74″



DRY CONTACTS FOR CUSTOMER USE

WIRE COLOR

BLACK - LINE VOLTAGE
RED - 120VAC
WHITE - NEUTRAL
GREEN - GROUND
BLUE - 24VDC +
BLUE W/WHITE - 24VDC -

NOTES:

1) ALL WIRING CONNECTED TO THIS CABINET MUST BE RATED AT LEAST 60° AND BE COPPER.

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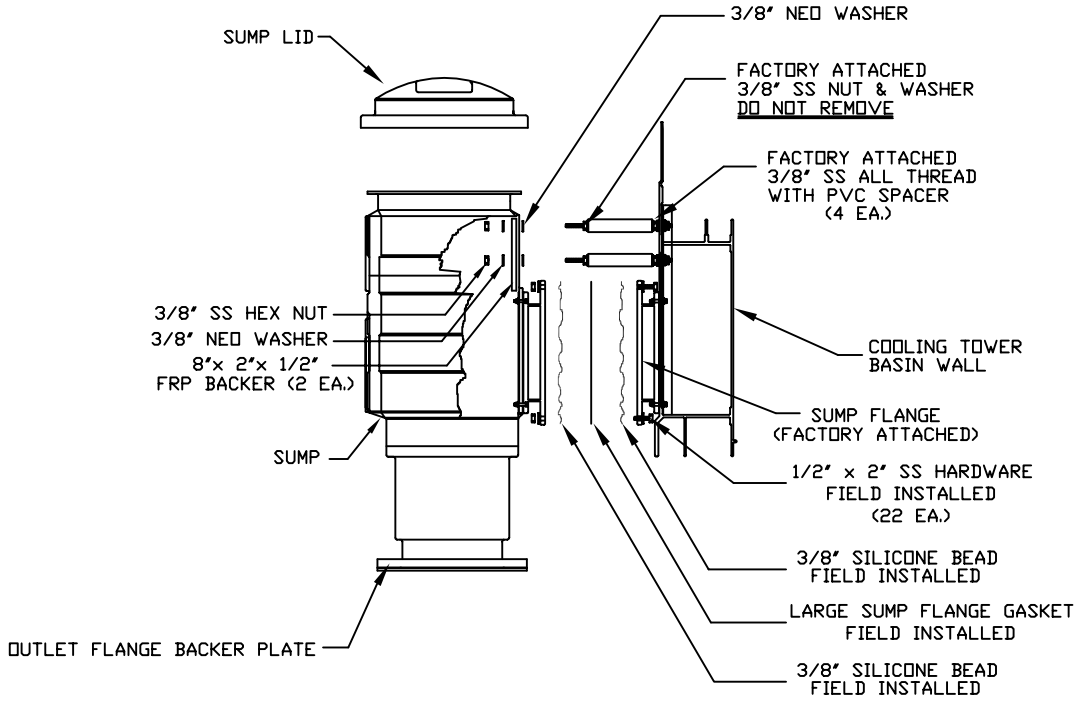
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 Level Control
Panel Wiring
Tag: Santa Rita Jail R & R Cooling Tower

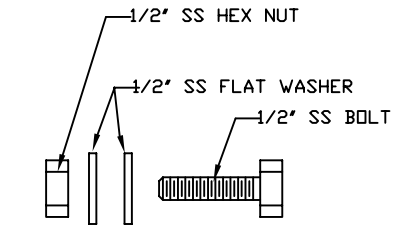
NO.	REVISIONS	DATE

FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team
DATE

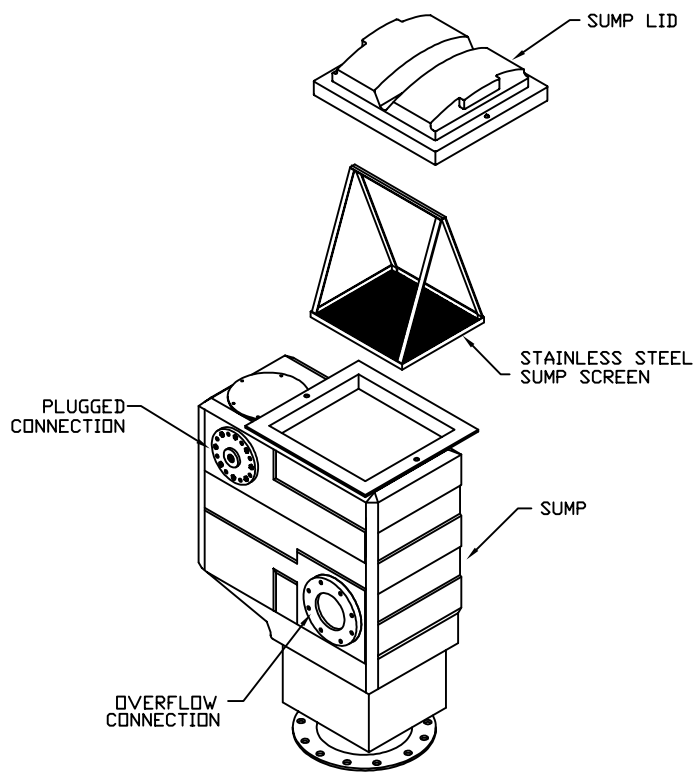
DATE:	24 JAN 14
DRAWING#:	14-006-8D
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
LEVE CONTROL PANEL WIRING	8D



SUMP ATTACHMENT DETAIL



1/2"X2" SS BOLT ASSEMBLY



SUMP SCREEN
INSTALLATION DETAIL

TO INSTALL EXTERNAL SUMP:

NOTE: ONLY ATTACH THE SUMP AFTER THE TOWER HAS BEEN UNLOADED FROM THE TRUCK.

1) REMOVE THE TWO WOODEN PLATES FROM THE SUMP FLANGES.

2) REMOVE SUMP LID THEN REMOVE CONTENTS PACKAGED INSIDE.

3) CHECK CONTENTS TO VERIFY THAT THEY ARE IN AGREEMENT WITH PACKING SLIP AND TO ENSURE THAT ALL NEEDED MATERIALS ARE PRESENT BEFORE PROCEEDING WITH INSTALLATION.

4) CLEAN OUTSIDE SURFACES OF BOTH SUMP FLANGES, THAT IS, THE FACTORY INSTALLED FLANGE (BOLTED TO THE TOWER WALL) AND THE FACTORY INSTALLED SUMP FLANGE.

5) APPLY A 3/8" BEAD OF SILICONE ALONG THE CENTER LINE OF BOLT HOLES AND AROUND EACH BOLT HOLE ON EACH FLANGE.

6) PLACE THE LARGE RECTANGULAR GASKET ON THE FLANGE ATTACHED TO THE TOWER WALL.

7) PLACE ONE 3/8" NEOPRENE WASHER ON EACH OF THE FOUR ALL-THREAD RODS ATTACHED TO THE COOLING TOWER WALL. ORIENT THE WASHER SO THAT THE NEOPRENE FACES TOWARDS THE SUMP BOX WALL.

8) PLACE TWO 1/2" X 2" BOLTS WITH WASHERS IN THE TWO OUTER HOLES OF THE FLANGE ATTACHED TO THE TOWER WALL. ORIENT THE BOLTS SO THAT THE HEAD OF THE BOLT FACES TOWARDS THE TOWER WALL.

9) LIFT THE SUMP INTO POSITION AND ALIGN THE FOUR ALL-THREAD RODS AND THE TWO 1/2" X 2" BOLTS INTO THEIR CORRESPONDING HOLES.

10) LOOSELY ATTACH AND HAND TIGHTEN EACH OF THE REMAINING TWENTY 1/2" X 2" BOLTS USING TWO WASHERS AND ONE NUT PER BOLT. ONCE ALL ARE LOOSELY ATTACHED BEGIN TO TIGHTEN THEM (TIGHTEN IN OPPOSITE PAIRS) FROM THE CENTER OF EACH SIDE TO THE CORNERS. PLEASE NOTE THAT USE OF A RATCHET WRENCH IS REQUIRED TO MAKE THESE CONNECTIONS.

NOTE: TWO FRP BACKER SUPPORTS ARE PROVIDED WITH ONE BACKER SUPPORT HAVING TWO HOLES ACCOMMODATING THE TWO LEFT FACING ALL-THREAD RODS AND THE SECOND BACKER SUPPORT ACCOMMODATING THE TWO RIGHT FACING ALL-THREAD RODS.

11) LOCATE THE TWO 8" x 2" x 1/2" FRP BACKER SUPPORTS. APPLY A BEAD OF SEALING SILICONE AROUND EACH BOLT HOLE (ON ONE SIDE ONLY).

12) THROUGH THE SUMP LID OPENING, INSERT ONTO EACH ALL-THREAD ROD ONE 8"x 2"x 1/2" FRP BACKER SUPPORT (SILICONE TOWARD SUMP WALL), ONE NEO WASHER AND ONE NUT. TIGHTEN NUTS.

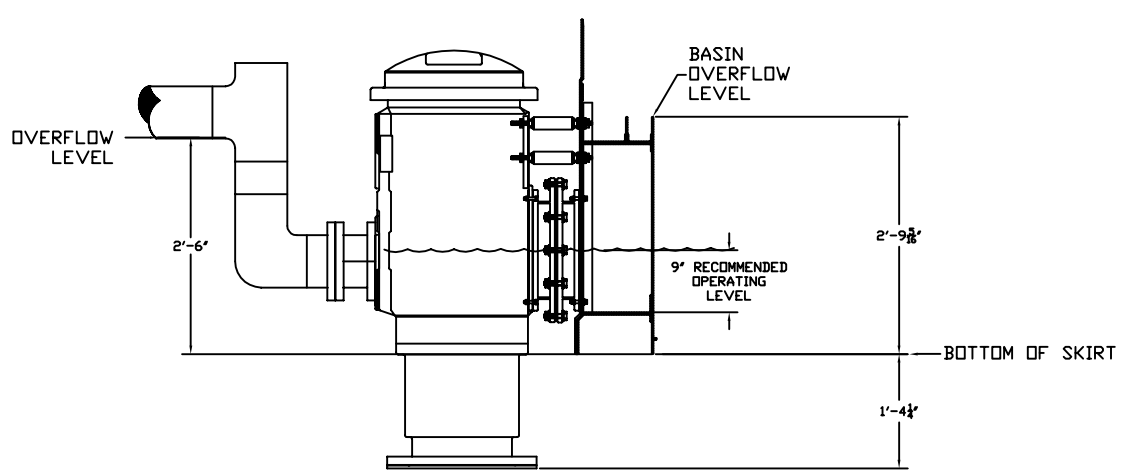
13) SET SUMP SCREEN AT THE BOTTOM OF THE SUMP.

14) N/A.

15) REPLACE SUMP LID.

NOTE THAT NEITHER THE TOWER NOR THE FLANGES ARE INTENDED TO SUPPORT ANY EXTERNAL PIPING WEIGHT. ALL EXTERNAL PIPING MUST BE "STAND ALONE" (SUPPORTED INDEPENDENTLY OF THE TOWER).

MAKE-UP CONNECTION/FLOAT VALVE CONNECTION FLANGE IS MADE FROM HIGH QUALITY PLASTIC TO ELIMINATE CORROSION.
THE MAXIMUM MAKE-UP WATER INLET PRESSURE IS 25 PSIG.
FLOAT VALVE MAY NOT SHUT OFF TIGHT AGAINST HIGHER PRESSURES.



FLOAT VALVE DETAIL

TOWER TECH, Inc.
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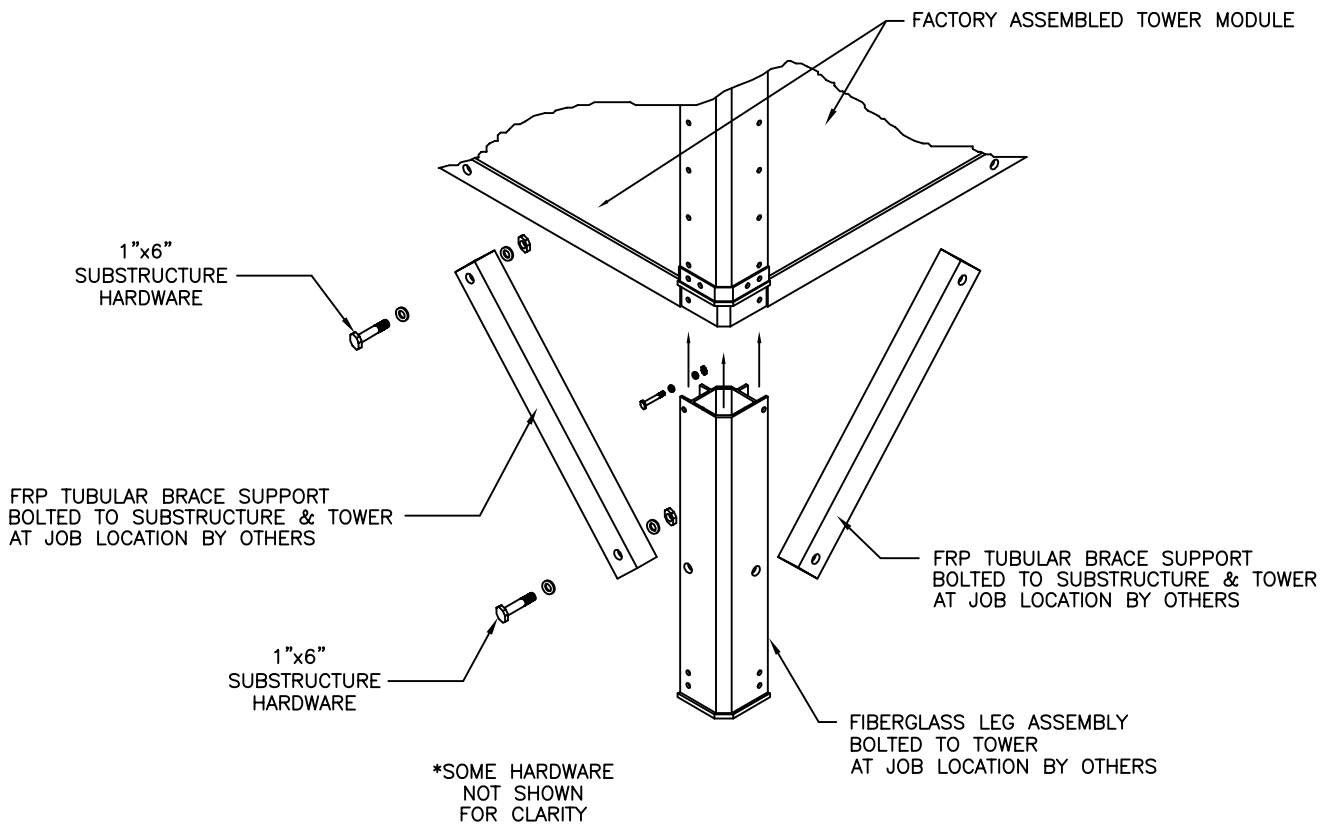
California Hydronics Corp.
2-Unit Installation
TTXL-08 Sump Detail
Modular
Fiberglass
Cooling Tower
Model # TTXL-081930
Tag: Santa Rita Jail R & R Cooling Tower

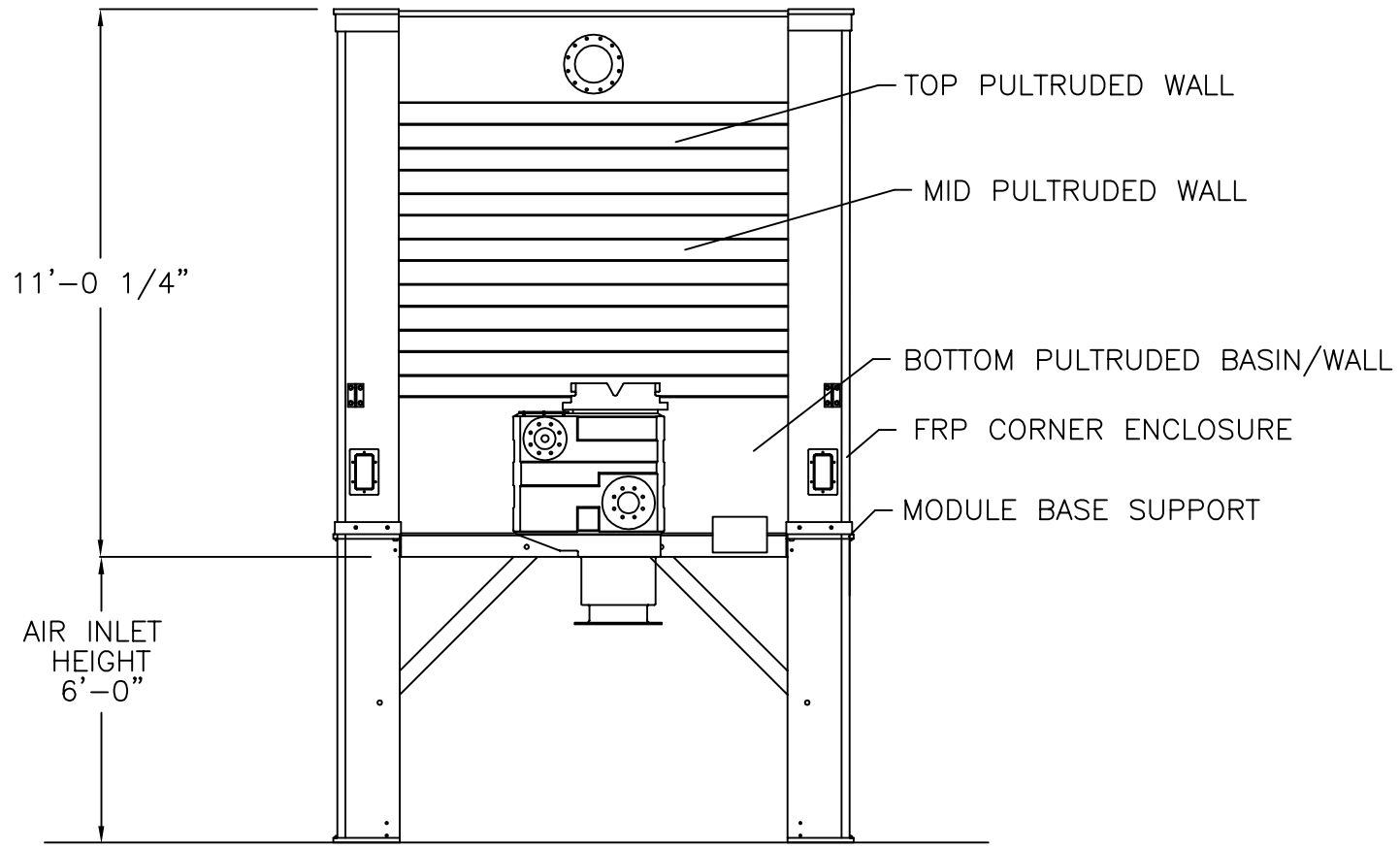
FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team

NO.	REVISIONS	DATE

DATE:	24 JAN 14
DRAWING#:	14-006-11
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
SUMP DETAIL	11

TYPICAL CORNER SUBSTRUCTURE DETAIL
6' LEG KIT





FRONT ELEVATION

STANDARD SUBSTRUCTURE INSTALLATION
WITH THE COOLING TOWER LIFTED SLIGHTLY ABOVE THE MAIN SUPPORT BEAM OR PAD DO THE FOLLOWING:

1. LOOSELY ATTACH THE PULTRUDED LEG (VERTICAL SUPPORT BEAM) TO THE TOWER CORNER ENCLOSURE USING TWO 1/2"X6" STAINLESS STEEL HEX BOLTS WITH WASHERS AND NUTS.
2. LOOSELY ATTACH THE TWO FRP TUBULAR BRACES TO THE COOLING TOWER APRON AND TO THE PULTRUDED LEG USING PROVIDED STAINLESS STEEL HEX BOLTS WITH WASHERS AND NUTS.
3. ONCE THE LEG AND BRACES ARE LOOSELY SECURED, THE COOLING TOWER CAN BE LOWERED ONTO ITS MAIN SUPPORT BEAM OR PAD. TIGHTEN ALL HARDWARE.
4. TIGHTEN ALL BOLTS TO 30 FT. LBS.

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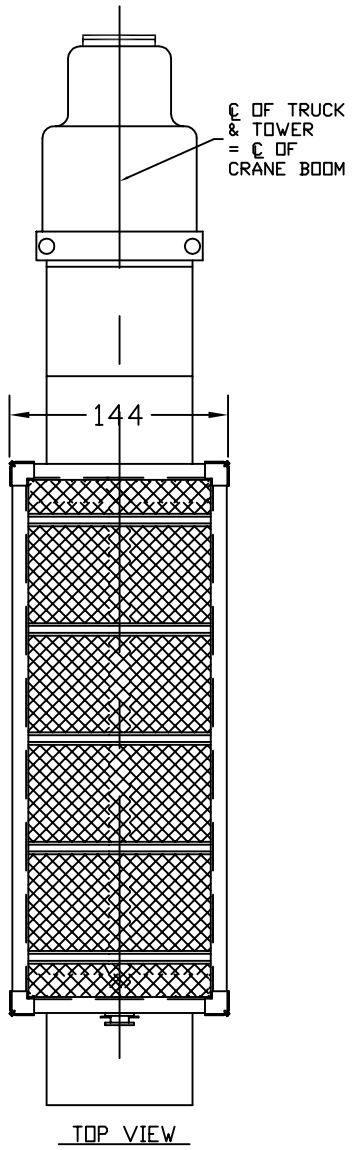
Modular Fiberglass Cooling Tower
Model # TTXL-081930

California Hydronics Corp.
2-Unit Installation
TTXL-08 Substructure Installation
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS		
NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-12
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
SUBSTRUCTURE INSTALLATION	12



TOP VIEW

TOWER LIFTING/INSTALLATION NOTES:

WARNING:
THE LIFTING POINTS ARE STRUCTURALLY LOCATED WITHIN THE TOWER'S ENVELOPE. ANY DAMAGE TO THE TOWER ENVELOPE CAUSED BY IMPROPER LIFTING MEANS/METHODS SHALL BE REPAIRED AND/OR REPLACED AS NEEDED, AT NO COST TO TOWER TECH, INC. AND MAY INVALIDATE TOWER WARRANTY.

PRIOR TO LIFTING TOWER, REMOVE ANY EXCESS WATER FROM BASIN. WATER IN BASIN CAN DRASTICALLY INCREASE TOWER WEIGHT, CAUSING FAILURE OF TOWER LIFTING MECHANISM.

1. Owner shall be responsible for lifting and placement of tower. Owner shall furnish all incidental materials required for location of tower in its final position. All work shall be in accordance with requirements of governing authorities and all OSHA safety guidelines.
The accompanying lifting diagrams are for general information purposes only, and owner shall have full responsibility for the work. Monitor weather conditions at all times, and suspend operation when inclement weather is expected.

2. Upon arrival of tower module (prior to any lifting operation), the tower shall be inspected on the truck by the owner's representative for general acceptance. Any items of concern related to lifting operations shall be documented and reported (in writing) to Tower Tech's representative. The owner's rep or his crane contractor shall inspect all corner lifting brackets and their bolting to the tower.

3. Prepare & position lifting items such as clevis, lifting cables, spreader beam, guide rope and any other incidental items that are needed for a complete and safe lifting operation. Carefully position crane and lifting assembly directly over the tower module, in order to eliminate any instability during the operation. All lifting connections and parts shall be checked prior to the final lifting operation. Reference table below for tower weights, recommended cable lengths, and/or I–beam lengths. A guide rope (provided by owner) shall be connected to the bottom of the module such that personnel are not positioned under the suspended tower at any time.

4. Should the tower need to be temporarily placed on the ground prior to its final positioning, the tower shall be stored on sound and level surface. Care shall be taken at all times not to distort or rack the tower module's envelope.

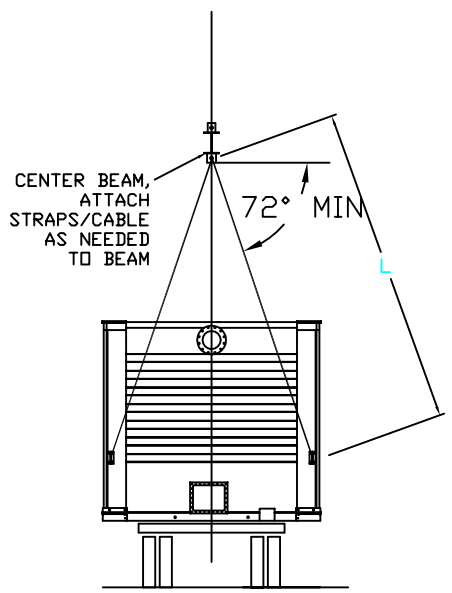
5. Prior to the tower lifting operation, check the pre–installed anchor bolts for alignment. Lift and position the tower near its final location and loosely attach the provided substructure kit and the brace angles. Lower tower into position on the pre–installed anchor bolts. Place proper oversized washer and nut over anchor bolts and tighten as needed. After all anchor nuts are installed, square and plumb tower, and tighten all leg bolts followed by the angle support bracket bolts. All substructure bolts/nuts shall be tightened with 85 ft–lb torque. After all bolts are securely fastened, check overall stability of tower, substructure panels, and tubular brace. Verify that tower is level and stability is adequate for operation. Disconnect crane from lifting brackets.

6. Upon the completion of lifting operation check for plumb and stability again. Attach sump box as shown on sump detail drawing and proceed with the tower start up as described in the Tower Tech Operation and Maintenance Manual.

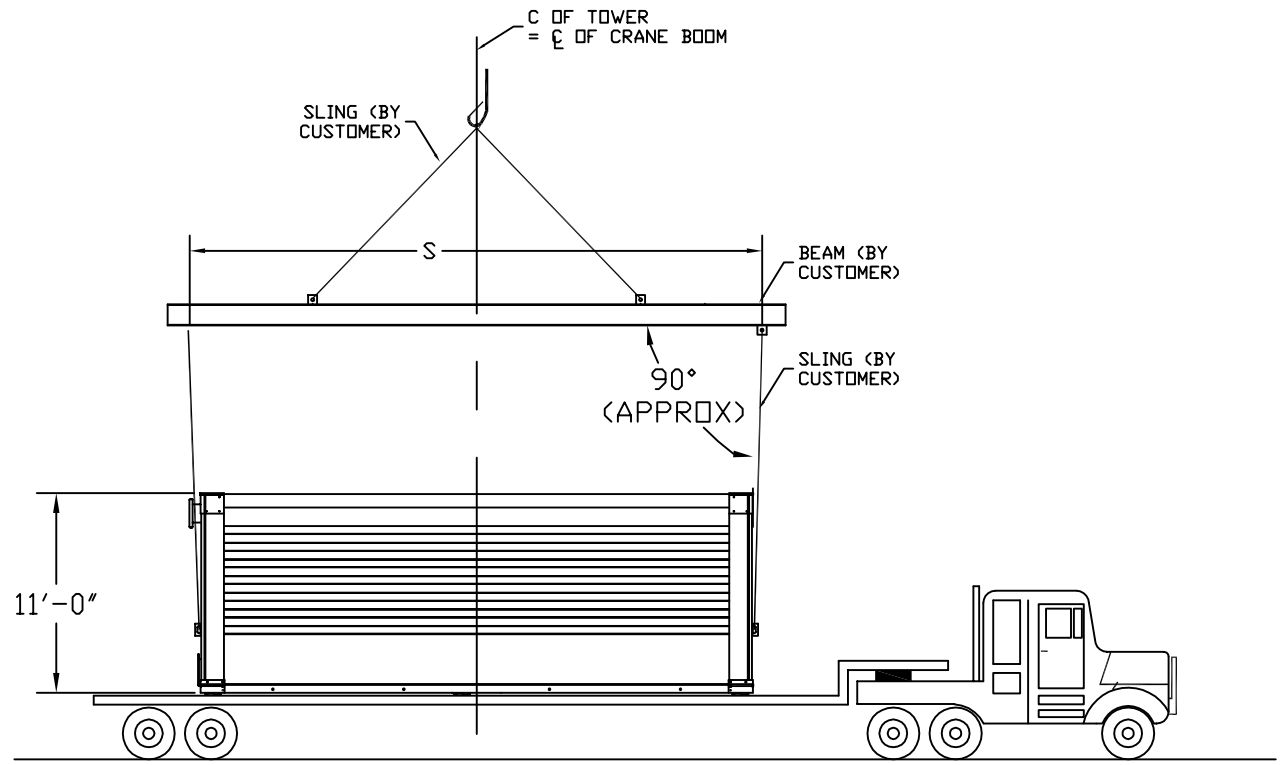
TOWER LIFTING DATA

SERIES #	WEIGHT *	L (ft)	S (min ft)
TTXL-12	5,245	20	14′-6″
TTXL-13	7,040	20	20′-3″
TTXL-04	7,912	20	14′-6″
TTXL-06	11,662	20	20′-3″
TTXL-08	15,412	20	26′-0″
TTXL-10	19,162	20	31′-9″

* Tower weights vary, based upon optional equipment, residual water, etc. Weights listed are guidelines only.



END ELEVATION



SIDE ELEVATION

TOWER TECH, Inc.
THE TECHNOLOGY COMPANY
TELEPHONE: (405) 290–7788
FAX: (405) 979–2131
E–MAIL: cad@towertechinc.com
WEBPAGE: http://www.towertechinc.com
5400 NW 5th
OKLAHOMA CITY, OKLAHOMA 73127

Modular
Fiberglass
Cooling Tower
Model # TTXL–081930

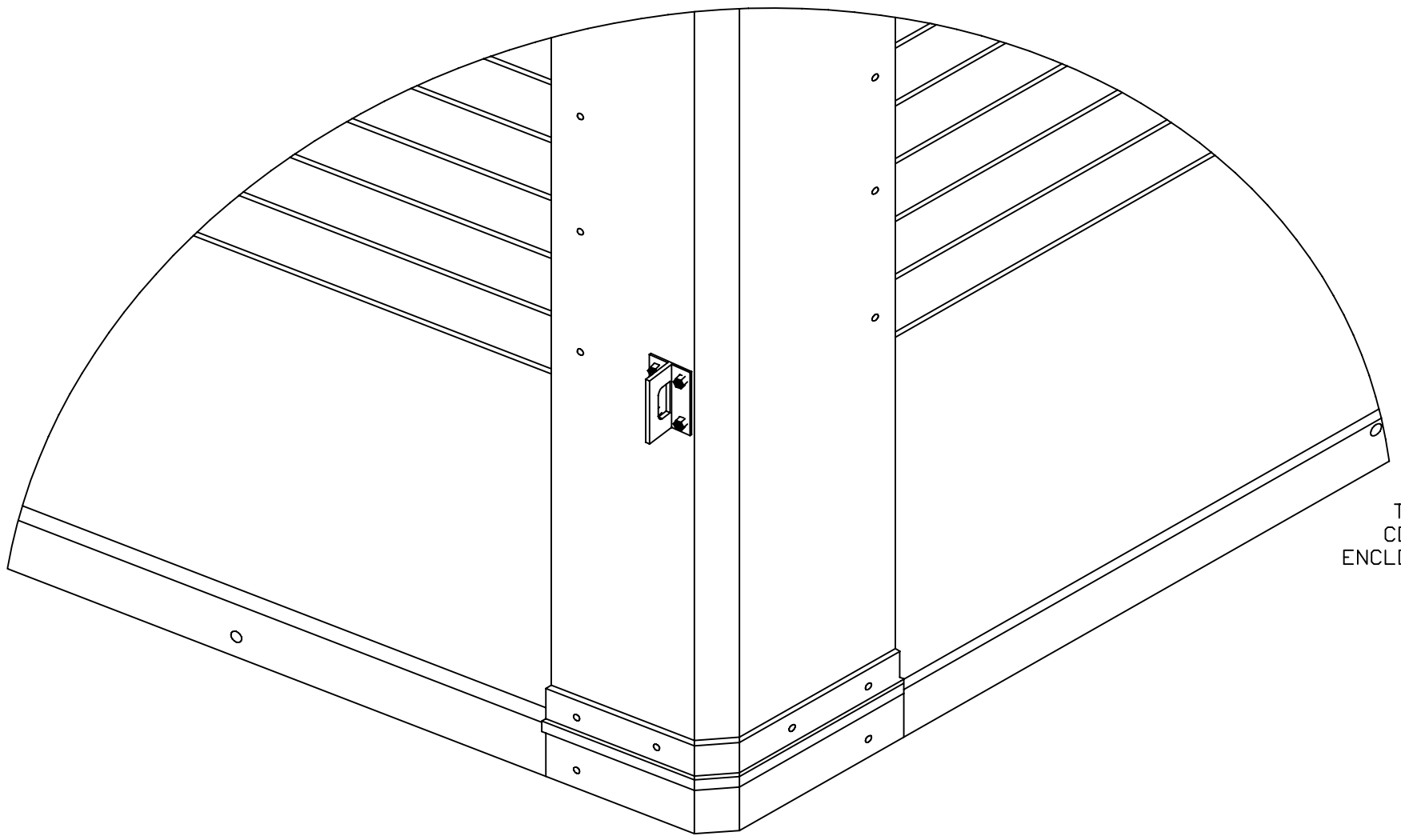
California Hydronics Corp.
2–Unit Installation
TTXL–08 Lift Rigging

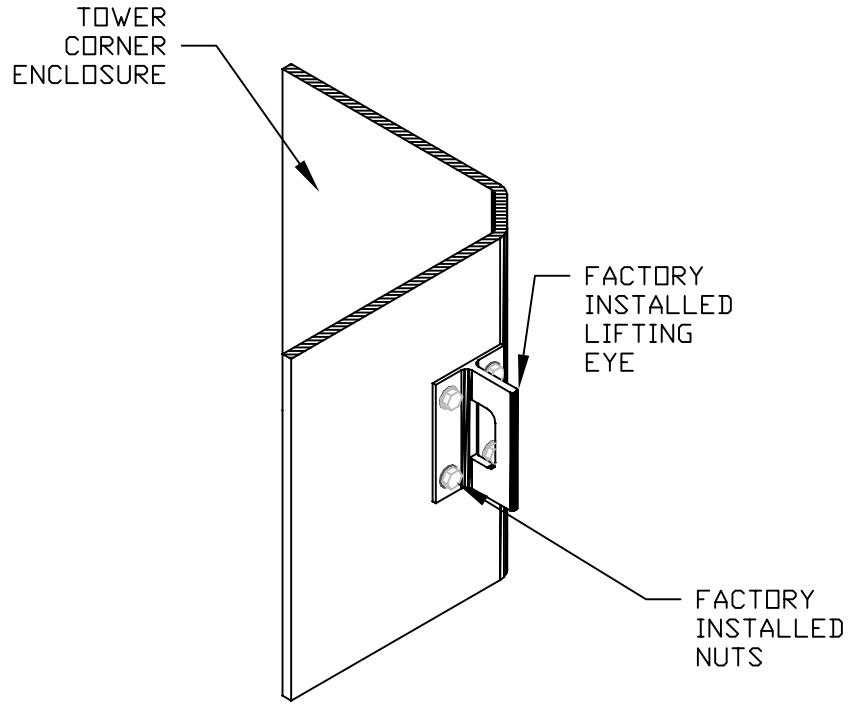
Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team

NO.	REVISION	DATE

DATE:	24 JAN 14
DRAWING#:	14–006–13A
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
LIFT RIGGING	13A





CAUTION: ENSURE THAT ALL HARDWARE SHOWN IS PRESENT, AS WELL AS, FULLY TIGHTENED PRIOR TO LIFTING.

TOWER TECH Inc.
THE TECHNOLOGY COMPANY
TELEPHONE: (405) 290-7788
FAX: (405) 979-2131
E-MAIL: cad@towertechinc.com
WEBPAGE: http://www.towertechinc.com
5400 NW 5th
OKLAHOMA CITY, OKLAHOMA 73127

California Hydronics Corp.
2-Unit Installation
TTXL-08 Lifting Bracket

Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

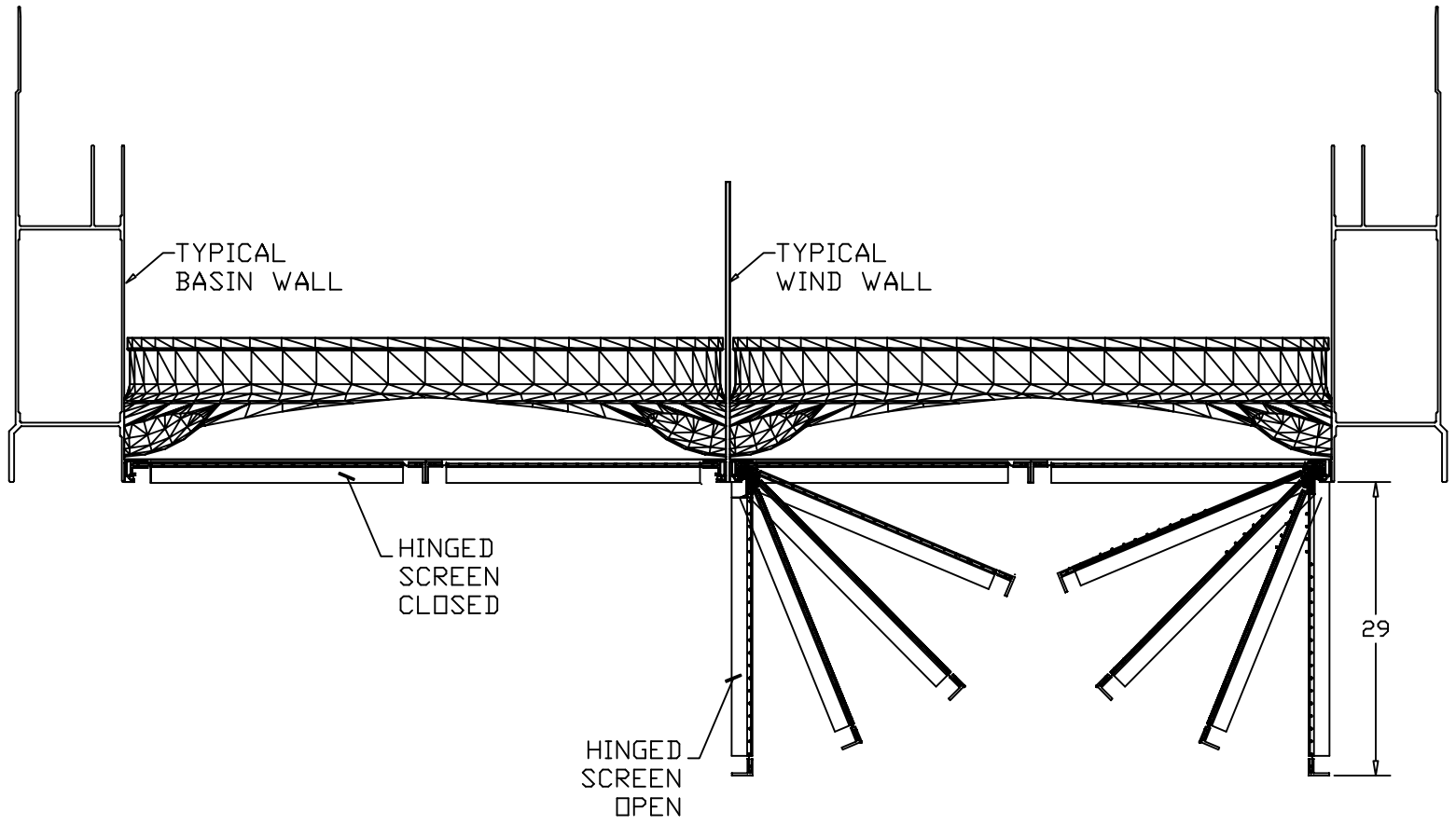
Cooling Tower

Tag: Santa Rita Jail R & R Cooling Tower

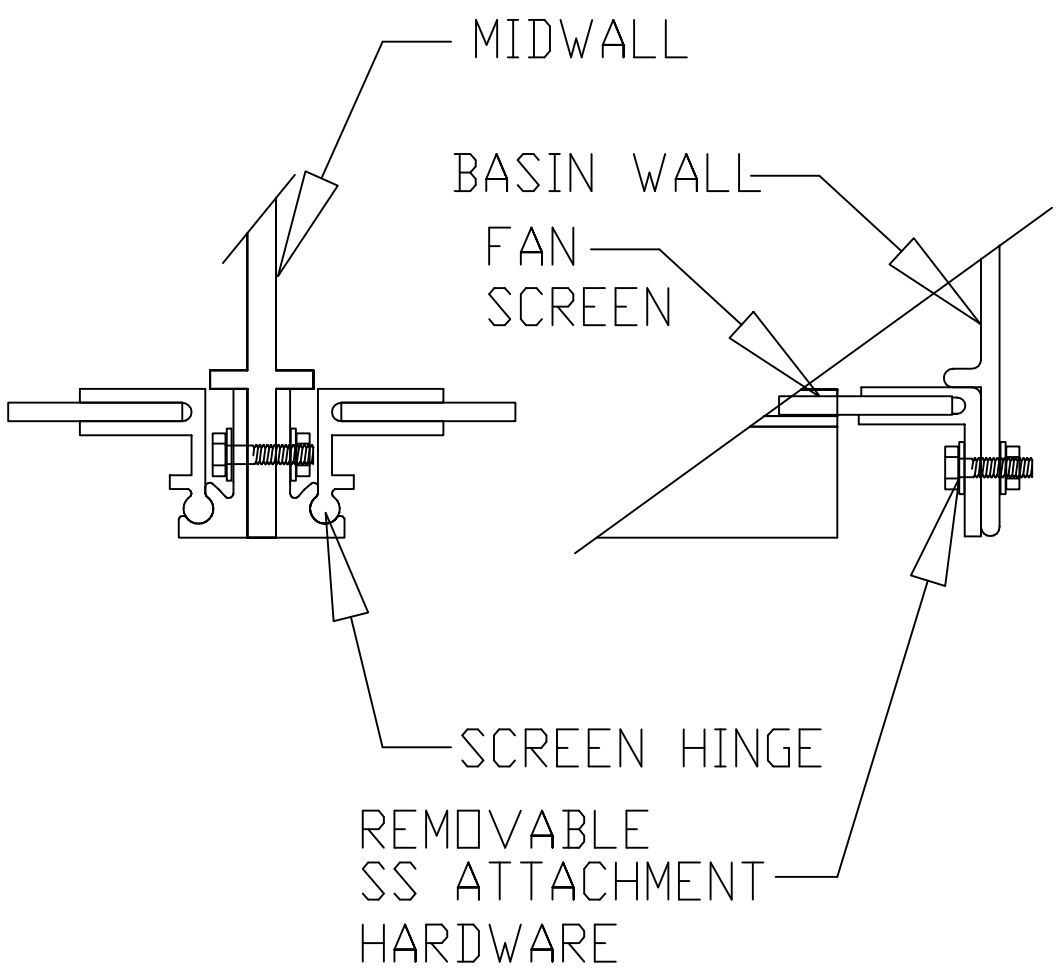
FOR APPROVAL BY
California Hydronics Corp.
Tower Tech Design Team

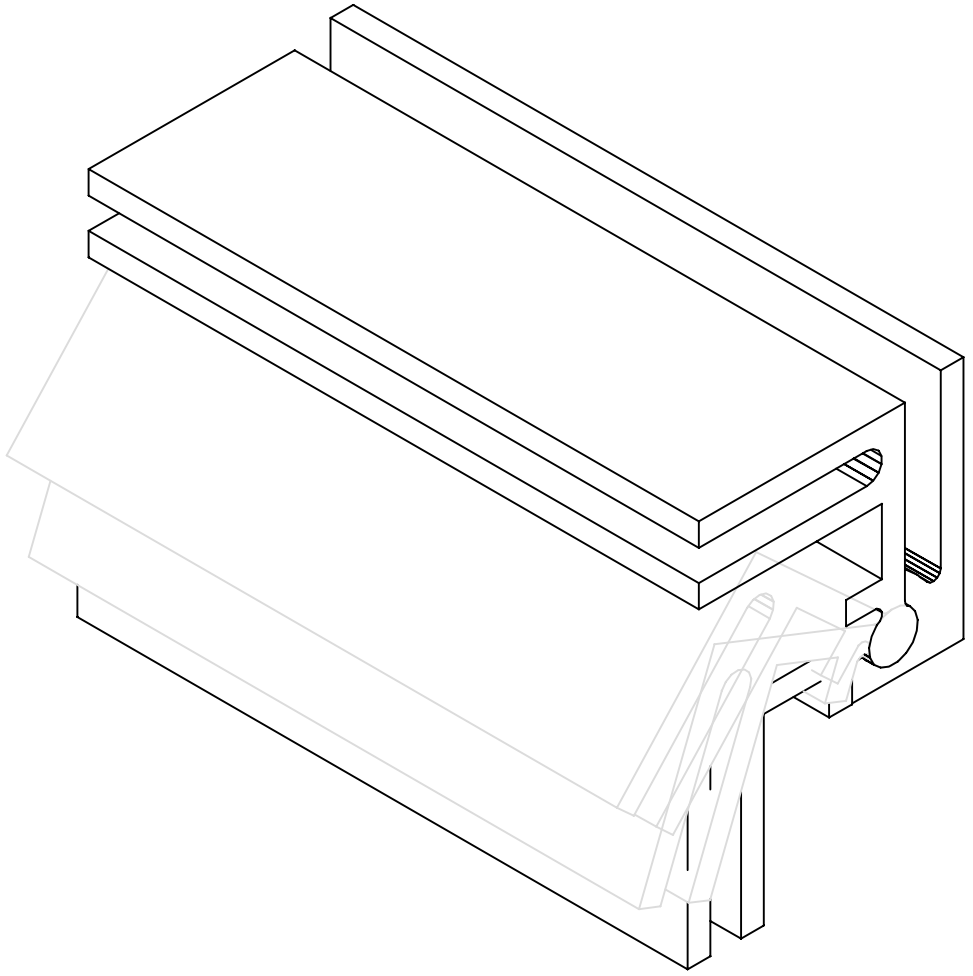
NO.	REVISIONS	DATE

DATE:	24 JAN 14
DRAWING#:	14-006-13B
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
LIFTING BRACKET	13B



NOTE: TO ALLOW FREE MOVEMENT OF HINGED FAN SCREEN ENSURE THAT THREE FOOT (3') TRAJECTORY IS CLEAR OR UNOBSTRUCTED.





TOWER TECH, Inc.
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5400 NW 5th
OKLAHOMA CITY, OKLAHOMA 73127

California Hydronics Corp.
2-Unit Installation
TTXL-08 Fan/Motor Access

Modular
Fiberglass
Cooling Tower
Model # TTXL-081930

Tag: Santa Rita Jail R & R Cooling Tower

FOR APPROVAL BY	DATE
California Hydronics Corp.	
Tower Tech Design Team	

REVISIONS		
NO.	DATE	REVISION

DATE:	24 JAN 14
DRAWING#:	14-006-14
PROJECT#:	2014006
CUST PO#:	192175
DRAWN BY:	RFB
CHECKED BY:	
FAN/MOTOR ACCESS	14

TOWER TECH
Outperform™

Installation, Operation and Maintenance Manual

TTXL Series
Modular Cooling Tower™

Ver. MK9000-11
Rev. 11-11-11

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www.TowerTechInc.com

Information herein applies only to Tower Tech TTXL Series Modular Cooling Towers manufactured from the date hereof until the date this publication is superseded.

TOWER TECH
Outperform™

Table of Contents

Chapter One: About This Manual

1.1 Scope

Information described herein pertains directly to the installation, operation and maintenance of the Tower Tech TTXL Series Modular Cooling Tower. The TTXL Series is a forced-draft, counter-flow design that allows modules to be arranged in a variety of configurations. The design also enables modules to be interconnected to accommodate virtually any cooling load. The design allows for the easy addition of new modules to a set of existing modules if the demand for cooling increases.

1.2 Use

Governing units of measurement in this publication are presented in English and Fahrenheit. An attempt has been made to present Metric and Celsius units of measurement, however, the accuracy of these measurements is not guaranteed. Dimensions of fastener hardware and flange connections are always presented in English units, only.

Pay particular attention to the following symbols when reading this manual:

NOTE	Notes are intended to clarify or make the installation easier.
⚠ CAUTION	Cautions are given to prevent equipment damage.
⚠ DANGER	**Danger warnings are given to alert installer and operators that personal injury and/or equipment damage may result if correct installation and operational procedures are not followed.**

Read all parts of this manual before installation or operating the tower. Contact our Customer Service Department at (405) 979-2123 if you have any questions.

⚠ CAUTION This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state, and national codes including, but not limited to building, electrical, and mechanical codes.

DANGER **Disconnect and lock out electrical power before attempting to inspect, repair, or perform maintenance on the module. Failure to follow installation instructions specified herein may create a condition whereby the operation of the product could cause personal injury, property damage, and/or death. Tower Tech assumes no liability for situations resulting from the failure to follow directions as specified in this manual.**

1.3 Reference

Forms referenced in this instruction can be ordered as follows:

Post Office Box:
Tower Tech, Inc.
ATTN: Publications Distribution Center
P. O. Box 891810
Oklahoma City, OK 73189 U.S.A.

Street Address:
Tower Tech, Inc.
ATTN: Publications Distribution Center
5400 N.W. 5th Street
Oklahoma City, OK 73127 U.S.A.

Electronic:
ATTN: Publications Distribution Center
TEL (405) 290-7788
FAX (405) 979-2131
Literature@TowerTechInc.com

1.4 Customer Service Support

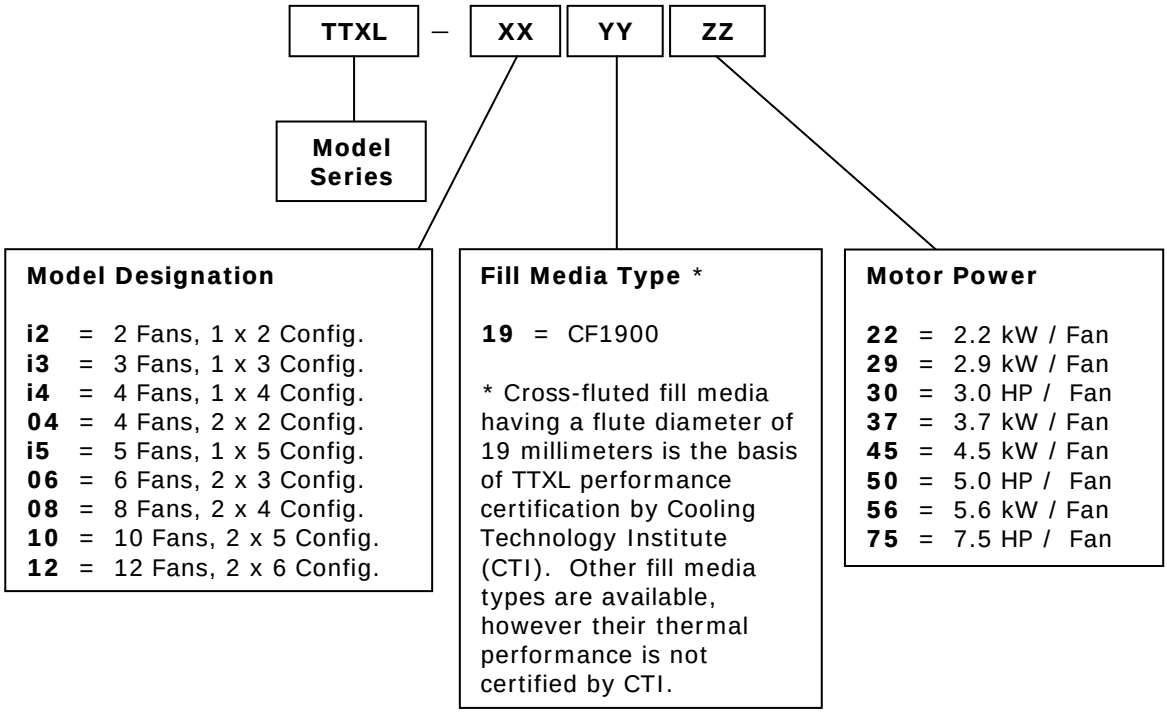
Your satisfaction is important to us. Please direct any questions you may have regarding installation, operation, or maintenance of your Tower Tech Modular Cooling Tower to our knowledgeable Customer Service Support staff.

E-Mail Us at Service@TowerTechInc.com

Call Us at (405) 979-2123 Monday through Friday, 8:00 a.m. to 5:00 p.m. Central Time.

Chapter Two: TTXL Series Features

2.1 Model Nomenclature



2.2 Modular Design

Cooling towers come in a variety of configurations. These configurations can vary according to the type of airflow encountered, the type of draft used, the tower erection site, and the materials of construction. These characteristics and myriad other design factors are what distinguish one cooling tower design from another.

The Tower Tech TTXL Series Modular Cooling Tower is characterized as a forced-draft, counter-flow cooling tower. A 3-D section view displaying the internal components of a TTXL Series tower is depicted in Figure 1.

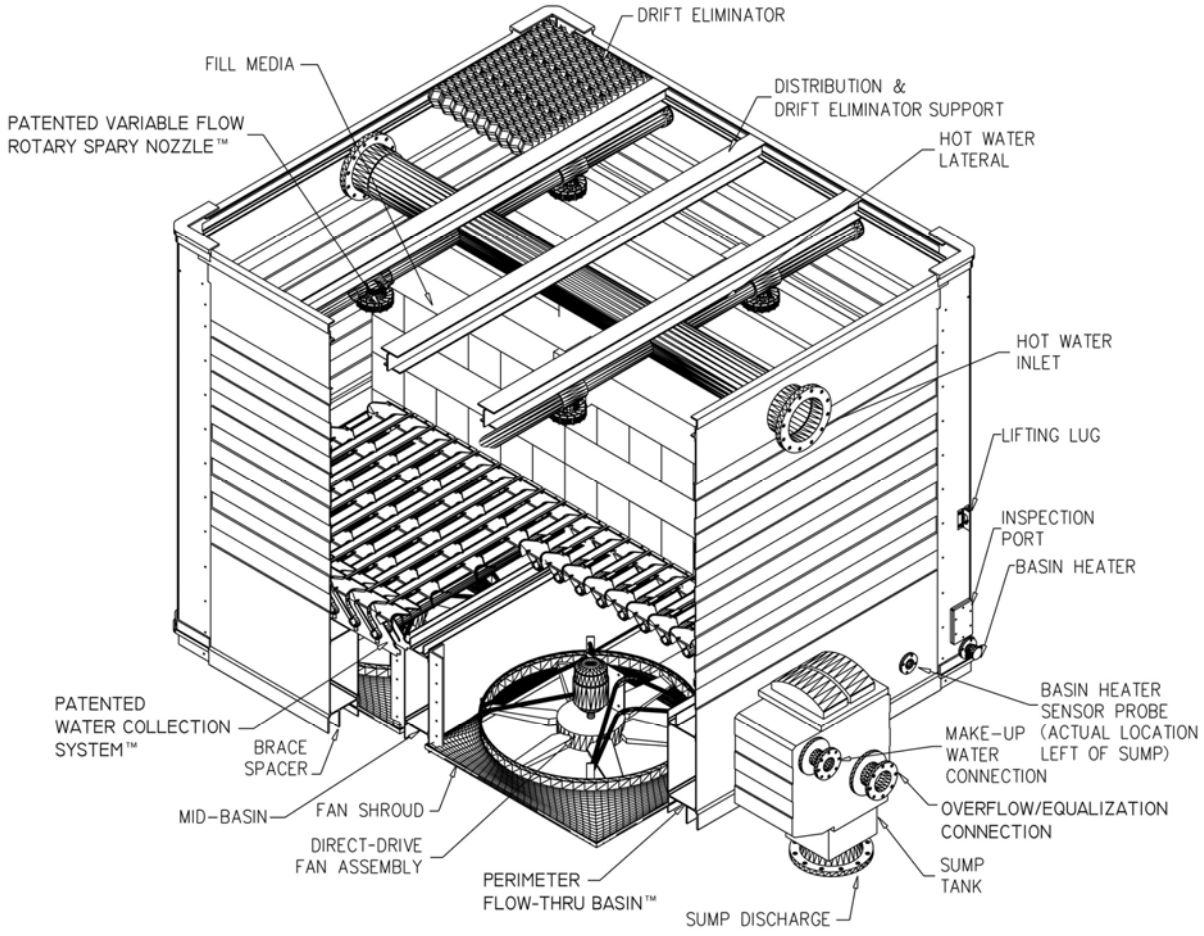


Figure 1 - TTXL 3-D Cut-Away View

A counter-flow cooling tower, as opposed to a cross-flow cooling tower, is distinguished by the airflow and water flow moving in opposite directions (in relationship to one another) inside the tower. In a cross-flow tower, the air and water flow move perpendicular to one another. Figure 2 shows the layout of a Tower Tech counter-flow cooling tower compared to a typical cross-flow tower.

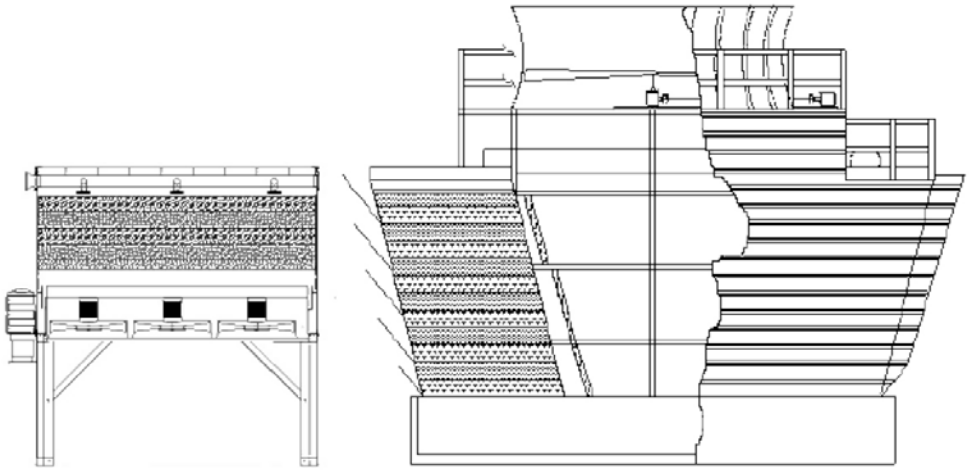


Figure 2 – TTXL versus Conventional Induced-Draft Cross-Flow Tower

The Tower Tech TTXL Series Modular Cooling Tower is characterized as a mechanical forced-draft cooling tower. Mechanical fans are used to provide a known volume of air through the tower. Forced-draft towers have the fan located in the cool, dry, ambient air stream on the entrance face of the tower, pushing air through the tower. Induced-draft towers have the fan located in the hot, moist air stream on the exit face of the tower, drawing air upwards through the tower. Neither the fans nor the motors on a forced-draft cooling tower are subjected to the harsh environment encountered in an induced-draft cooling tower. Figure 3 shows the layout of a Tower Tech mechanical forced-draft cooling tower compared to an induced-draft counter-flow cooling tower.

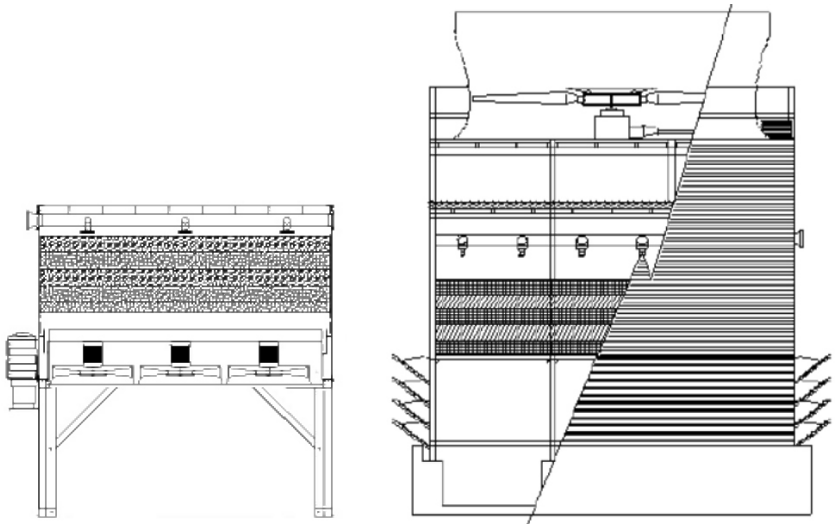


Figure 3 – TTXL versus Conventional Induced-Draft Counter-Flow Tower

The Tower Tech TTXL Series Modular Cooling Tower is also distinguished by its modular design, as shown in Figure 4. This enables the individual modules to be interconnected in numerous configurations to accommodate virtually any cooling capacity. This design is also quickly adaptable to accommodate future expansion of cooling tower capacity.

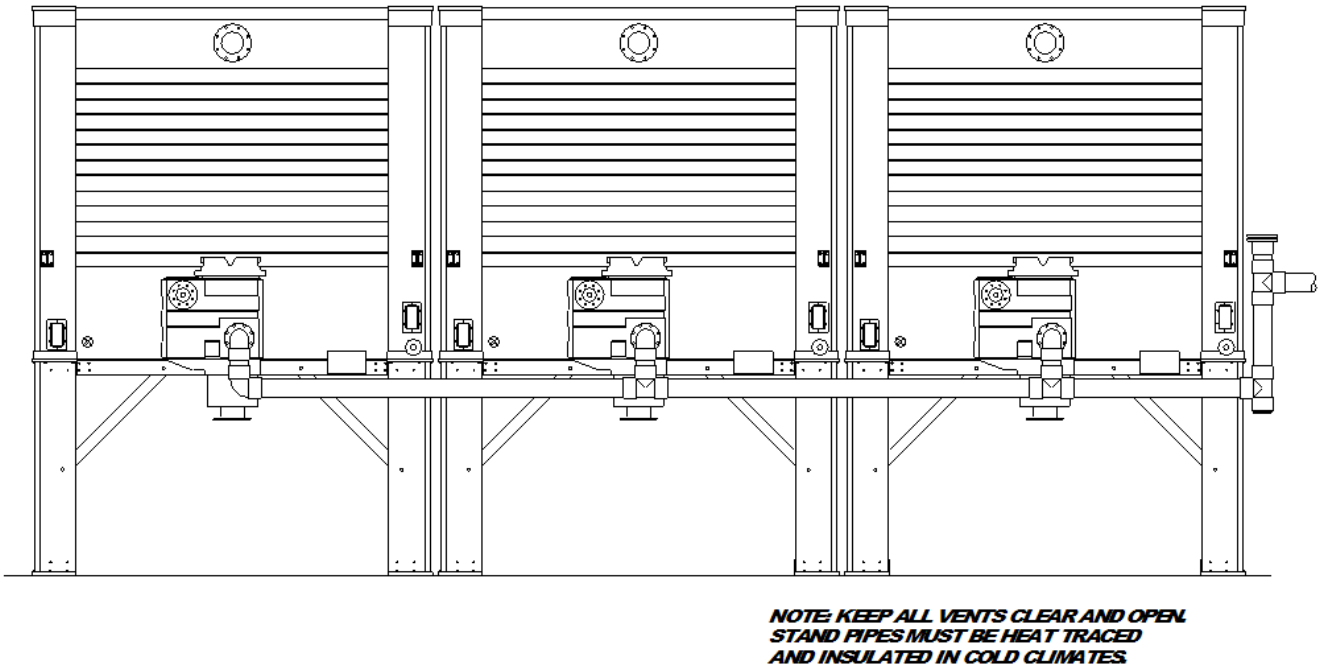


Figure 4 – TTXL Series Modular Cooling Tower Installation

Flow-Thru Basin and Water Collection System

The cold-water basin in the TTXL Series Modular Cooling Tower is comprised of a unique, patented Flow-Thru Basin™ consisting of four perimeter box beams (Perimeter Basin Walls) interconnected to one or more transversal box beams (Mid-Basins). This structure forms the base of each tower module. A unique, patented Water Collection System™ located above the fan motors serves as an air-water separator, capturing cooled water falling from the fill media. The Water Collection System channels the cooled water into the Flow-Thru Basin and is discharged into a sump located at the either end of the module. This unique enclosed system with its high flow velocity (~5-7 fps) contains no quiescent areas for water to stagnate and scrubs the basin walls and floor continually, thereby minimizing the problem of sediment accumulation that is common to all other cooling tower designs.

Figure 5 shows the placement of the Water Collection System, Flow-Thru Basin, motors, and fans within a Tower Tech TTXL Series Modular Cooling Tower.

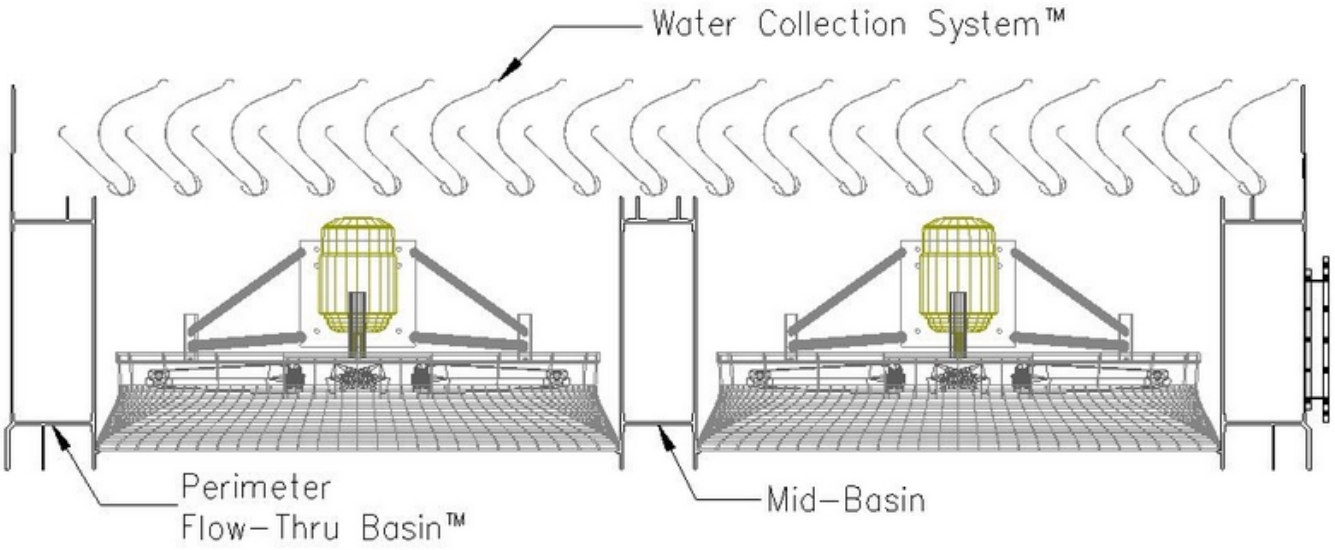


Figure 5 – Water Collection System, Flow-Thru Basin, Mid Basin, Motors, Fans

2.3 Sump Design

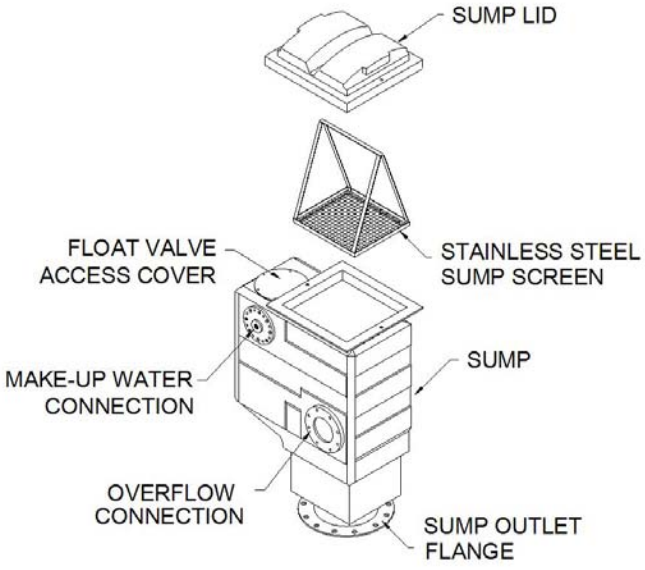


Figure 6 – Sump Layout

Each Tower Tech module may be equipped with a terminally mounted outlet sump (shown in Figure 6) that is flanged for easy hook-up. Standard equipment for each sump includes a threaded make-up water connection, a mechanical float valve, a flanged overflow/ equalization connection, and a sump screen to collect large pieces of debris that may have entered the system.

Sump flange sizes vary depending upon the cooling tower model selected. Table 10 lists typical connection sizes for TTXL Series Modular Cooling Towers.

2.4 Make-Up Connection / Float Valve

The TTXL Series Modular Cooling Tower may be supplied with either a one- or two-inch brass float valve (see Figure 7). The fitting is Female National Pipe Thread (FNPT). All valve components are made of brass or stainless steel. The connection flange is made from high quality plastic to eliminate corrosion. The maximum rated operating pressure for the valve is 25 psi (1.76 kgf/cm^2). **You must install a pressure reducer valve if operating pressure exceeds 25 psi (1.76 kgf/cm^2)**. The make-up water piping should contain an anti-siphon/breaker device before the sump connection: Refer to local codes for details.

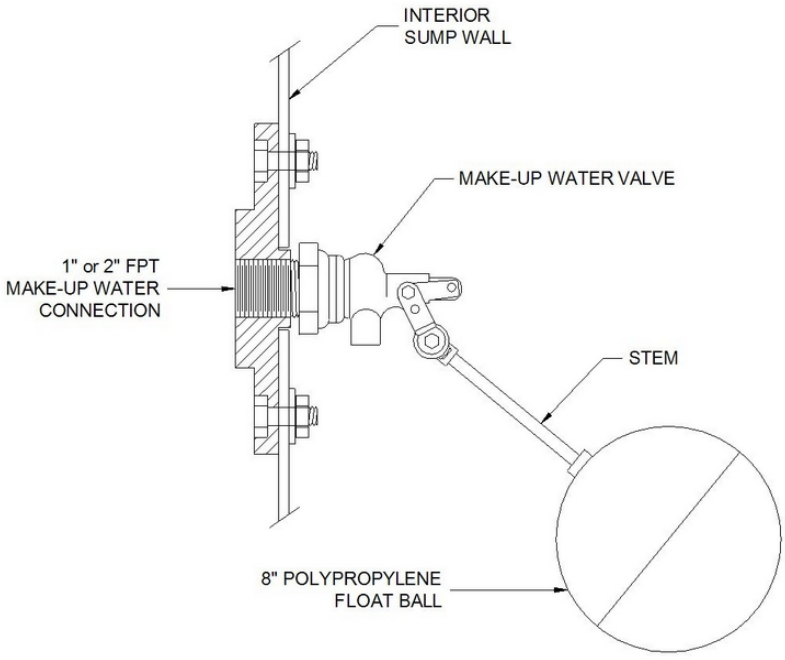


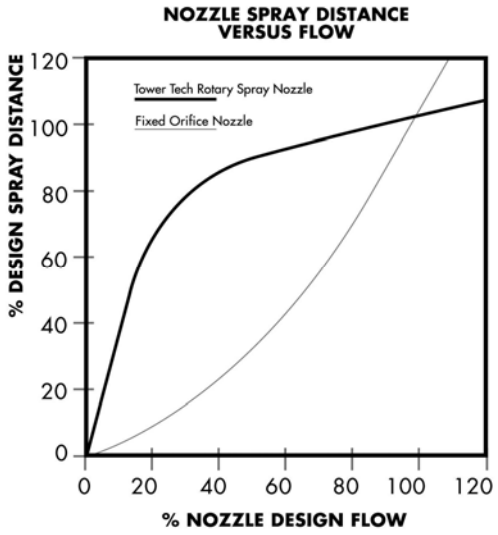
Figure 7 – Mechanical Float Valve

2.5 Rotary Spray Nozzle

Tower Tech's patented variable flow Rotary Spray Nozzle disperses water from the water distribution piping to the fill media. The nozzle requires less pressure to operate than a conventional nozzle, is virtually maintenance free, and improves tower performance.

The Rotary Spray Nozzle requires less pressure head to operate than a conventional nozzle by combining a low-profile spray pattern with a low-pressure orifice. Use of a lateral spray pattern allows the nozzle to be positioned as close as one inch above the surface of the fill material, saving several feet of pump head. In addition, the use of a turbine in the nozzle to atomize the flow is much more efficient than the atomization approach used in a conventional nozzle.

Debris that typically clogs conventional nozzles will pass directly through the Rotary Spray Nozzle. This is accomplished by the four-inch (10.16 cm) nozzle throat/inlet coupled with the brisk rotating agitation action provided by the nozzle's turbine, which spins on a water bearing inside the nozzle. The water bearing minimizes wear of nozzle components thus providing years of virtually maintenance-free service.



Graph 1 – Nozzle Spray; Distance versus Flow

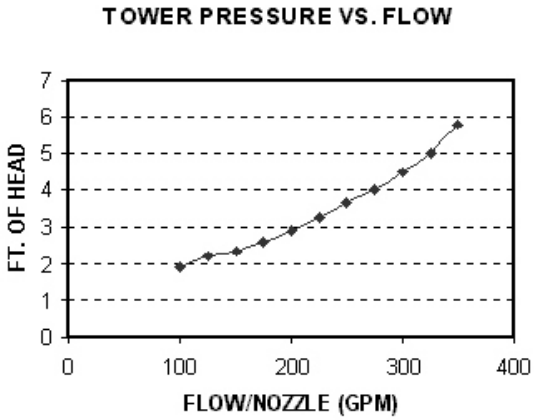
Significant increases in performance can be achieved with the use of the Rotary Spray Nozzle because of improved fill coverage and control of the flow pattern size. The nozzle orifice is shaped to provide a square spray pattern, thereby uniformly wetting the entire fill media. This improves tower performance and reduces the likelihood of scaling due to the occurrence of dry regions within the fill.

The nozzle is also equipped with a spring-loaded orifice to allow the nozzle to automatically adjust to changes in the water flow rate. As shown in Graph 1, the Rotary Spray Nozzle performs exceptionally well from approximately 100 gpm to 300 gpm (6.3 lps to 18.9 lps), which is the approximate upper limit established by tower module hydraulics. Somewhat higher flows may be possible in some tower module sizes; contact Tower Tech engineering manager for specifics. Flows lower than 100 gpm (6.3 lps) are never recommended.

This flexible capability is not present in fixed orifice spray nozzles; they must remain very near design flow to provide the required spray coverage. This innovation allows uniform water loading for a wide variety of flow rates and significantly increases the part load performance as compared to other towers using conventional fixed orifice nozzles. (Refer to Section 9.4.1 "Cold Weather Operations" for important additional information about cold weather operations with a TTXL Series Modular Cooling Tower.)

This uniform spray pattern is accomplished by using a spring-loaded orifice plate that provides a varying cross-sectional area as flow rate changes. This reduces the loss coefficient as flow increases and allows the total pumping pressure of the tower to remain nearly constant from 12 to 16 feet, or 3.7 to 4.8 meters, of head.

By eliminating the extreme pressure increases associated with increased flow rates, the Rotary Spray Nozzle is able to produce a much more consistent spray pattern as flow rates vary. Graph 2 illustrates the change in tower piping head pressure observed at varying flow rates when employing the Rotary Spray Nozzle.



Graph 2 – Tower Pressure versus Flow

As can be seen from the graphs above, the operating parameters of the Rotary Spray Nozzle should remain between 100 gpm and 300 gpm (6.3 lps and 18.9 lps), which is the approximate upper limit established by tower module hydraulics. Somewhat higher flows may be possible in

some tower module sizes; contact Tower Tech engineering manager for specifics. Flows lower than 100 gpm (6.3 lps) are never recommended.

Variable Flow Advantages

Conventional water distribution in cooling towers sacrifices valuable energy saving opportunities. This fact is even more pronounced in today's water filming style heat transfer media. The efficiency of evaporative heat transfer is affected by the air-to-water contact area and the mass flow liquid-to-gas ratio. In general, for a given heat load and water mass flow rate, the more surface area involved, the less required air velocity over the water surface, and consequently the less air-moving fan horsepower. If lower kW/ton is desired, one must purchase more air-to-water contact surface area.

Film media, such as the popular PVC cross-fluted corrugated film block, provided a breakthrough in cooling tower design. It greatly increases the contact surface area without increasing the size of the tower box. Adversely, it suffers quickly from scaling and biomass fouling in very compact air channels that negatively impact the flow of air.

Precise water treatment is required to prevent bio growth fouling and the fill must remain wetted to avoid evaporative scaling. Conventional water distribution uses fixed orifice spray nozzles that produce a round pattern above a rectangular fill pack. The nozzles are placed in a rectangular overlapping pattern to assure full wetting of the fill at the design water flow rate. Water flow rates below the design point will not produce a full spray pattern and void areas will start to appear. Any fill's best efficiency is achieved when the liquid-to-gas ratio is evenly balanced throughout the fill media. Short patterns and overlapping patterns cannot accomplish it. When a conventional cooling tower system is faced with a variable water flow rate (i.e. multiple pump cycling or variable speed pumping) these pattern problems force the operator to isolate whole cooling tower cells to maintain proper water distribution under reduced load in the remaining on-line cells. If this is not done, the tower efficiency will suffer and the fill media will quickly foul. Isolating cells takes away air-to-water contact surface.

What is needed is a cooling tower water distribution system that is able to respond to variable flow rates and keep all of the fill media evenly wetted and in service. This requires a nozzle that responds to flow changes to keep a constant pattern. A square pattern that avoids overlap would be best. Putting such a system on a three-cell tower with three matched pumps would yield the following opportunities: A typical tower would operate at 0.06 kW/ton for the tower alone at full load, 0.06 kW/ton at 2/3 load (two cells operating at 100%), and 0.06 kW/ton at 1/3 load (one cell operating at 100%). Under the same conditions, a constant pattern, variable spray system with variable speed drives on the fan motors would operate at 0.06 kW/ton at full load, 0.024 kW/ton at 2/3 load (all cells operating at 2/3 load), and 0.005 kW/ton at 1/3 load (all cells operating at 1/3 load).

These energy savings can only be achieved through use of a hot water distribution system utilizing the patented Tower Tech Rotary Spray Nozzle, which operates from 100 gpm to 300 gpm (6.3 lps to 18.9 lps).

2.6 Motors

TTXL Series Modular Cooling Towers shipped after October 2010 are equipped with Baldor brand motors that are direct-drive, totally enclosed air over (TEAO), eight-pole, induction-type, inverter-ready, with Class H (minimum) insulation, and L_{10} sealed bearings rated for 100,000-hour life. Standard available motor types:

60Hz 40°C. Available in 3.0 HP (2.2 kW), 5.0 HP (3.7 kW), or 7.5 HP (5.6 kW), at 200V, 230V, 460V or 575V.

60Hz 50°C. Available in 2.2 kW (3.0 HP), 3.7 kW (5.0 HP), or 5.6 kW (7.5 HP), at 380V or 460V.

50Hz 40°C. Available in 2.2 kW (3.0 HP), 3.7 kW (5.0 HP), or 5.6 kW (7.5 HP), at 190V or 380V.

50Hz 50°C. Available in 2.9 kW (4.0 HP) or 4.5 kW (6.0 HP), at 190V or 380V.

Motor type and power level depends on tower model selected and required design conditions. Refer to Figure 8 for a view of motor mounted to fan shroud. Refer to Table 1 for motor data.

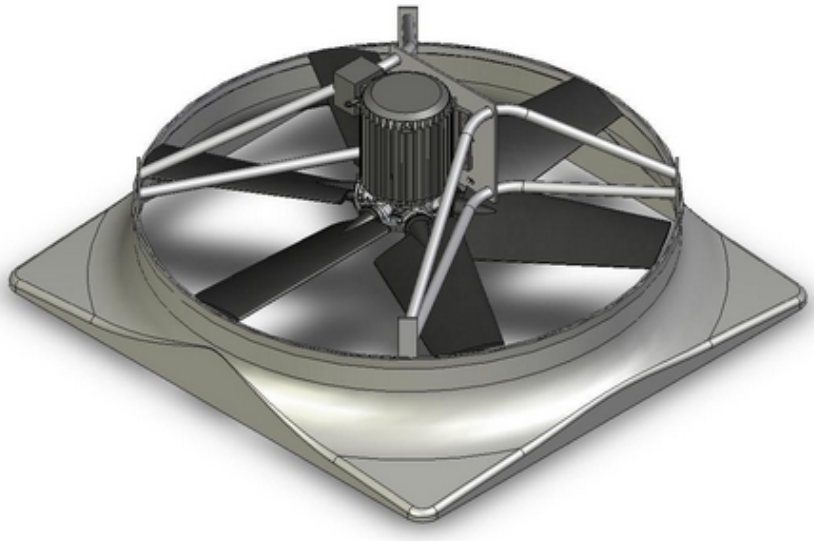


Figure 8 – Motor, Motor Support, Fan, Fan Shroud

Engineering Data

60 Hz, 40° C.

Model	Fan Motors 3 Phase, 60 Hz, 40° C., 200V, 230V, 460V or 575V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Effy [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
i21930	2	2.2	4.4	3.0	6.0	200	12.1	24.2	13.3	26.6	84.0%	865	1.15	6" (150mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						230	11.2	22.4	12.2	24.3							
						460	5.6	11.2	6.2	12.3							
						575	4.5	9.0	5.2	10.4							
i21950		3.7	7.4	5.0	10.0	200	20.0	40.0	22.0	44.0	85.5%	855					
						230	16.6	33.2	18.3	36.5							
						460	8.3	16.6	9.2	18.4							
						575	6.7	13.4	7.7	15.4							
i21975		5.6	11.2	7.5	15.0	200	30.0	60.0	33.0	66.0	81.5%	850					
						230	24.6	49.2	27.7	55.3							
						460	12.3	24.6	13.8	27.5							
						575	10.3	20.6	11.4	22.8							
i31930	3	2.2	6.6	3.0	9.0	200	12.1	36.3	13.3	39.9	84.0%	865	1.15	8" (200mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						230	11.2	33.6	12.2	36.5							
						460	5.6	16.8	6.2	18.3							
						575	4.5	13.5	5.2	15.5							
i31950		3.7	11.1	5.0	15.0	200	20.0	60.0	22.0	66.0	85.5%	855					
						230	16.6	49.8	18.3	54.8							
						460	8.3	24.9	9.2	27.6							
						575	6.7	20.1	7.7	23.1							
i31975		5.6	16.8	7.5	22.5	200	30.0	90.0	33.0	99.0	81.5%	850					
						230	24.6	73.8	27.7	82.9							
						460	12.3	36.9	13.8	41.3							
						575	10.3	30.9	11.4	34.2							
i41930	4	2.2	8.8	3.0	12.0	200	12.1	48.4	13.3	53.2	84.0%	865	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	44.8	12.2	48.6							
						460	5.6	22.4	6.2	24.6							
						575	4.5	18.0	5.2	20.7							
i41950		3.7	14.8	5.0	20.0	200	20.0	80.0	22.0	88.0	85.5%	855					
						230	16.6	66.4	18.3	73.0							
						460	8.3	33.2	9.2	36.7							
						575	6.7	26.8	7.7	30.8							
i41975		5.6	22.4	7.5	30.0	200	30.0	120.0	33.0	132.0	81.5%	850					
						230	24.6	98.4	27.7	110.5							
						460	12.3	49.2	13.8	55.1							
						575	10.3	41.2	11.4	45.6							
041930	4	2.2	8.8	3.0	12.0	200	12.1	48.4	13.3	53.2	84.0%	865	1.15	10" (250mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	44.8	12.2	48.6							
						460	5.6	22.4	6.2	24.6							
						575	4.5	18.0	5.2	20.7							
041950		3.7	14.8	5.0	20.0	200	20.0	80.0	22.0	88.0	85.5%	855					
						230	16.6	66.4	18.3	73.0							
						460	8.3	33.2	9.2	36.7							
						575	6.7	26.8	7.7	30.8							
041975		5.6	22.4	7.5	30.0	200	30.0	120.0	33.0	132.0	81.5%	850					
						230	24.6	98.4	27.7	110.5							
						460	12.3	49.2	13.8	55.1							
						575	10.3	41.2	11.4	45.6							
i51930	5	2.2	11	3.0	15.0	200	12.1	60.5	13.3	69.5	84.0%	865	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	56.0	12.2	60.8							
						460	5.6	28.0	6.2	31.9							
						575	4.5	22.5	5.2	25.0							
i51950		3.7	18.5	5.0	25.0	200	20.0	92.5	22.0	106.4	85.5%	855					
						230	16.6	83.0	18.3	91.3							
						460	8.3	41.5	9.2	45.4							
						575	6.7	33.5	7.7	38.5							
i51975		5.6	28	7.5	37.5	200	30.0	132.5	33.0	152.4	81.5%	850					
						230	24.6	123.0	27.7	138.1							
						460	12.3	61.5	13.8	68.8							
						575	10.3	51.5	11.4	57.0							

Table 1 –Motor Data (page 1 of 7)

Engineering Data

60 Hz, 40° C.

Model	Fan Motors 3 Phase, 60 Hz, 40° C., 200V, 230V, 460V or 575V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Effy [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
061930	6	2.2	13.2	3.0	18.0	200	12.1	72.6	13.3	79.9	84.0%	865	1.15	10" (250mm)	12" (300mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	67.2	12.2	73.0							
						460	5.6	33.6	6.2	37.0							
						575	4.5	27.0	5.2	31.0							
061950		3.7	22.2	5.0	30.0	200	20.0	120.0	22.0	132.0	85.5%	855					
						230	16.6	99.6	18.3	109.5							
						460	8.3	49.8	9.2	55.1							
						575	6.7	40.2	7.7	46.2							
061975		5.6	33.6	7.5	45.0	200	30.0	180.0	33.0	198.0	81.5%	850					
						230	24.6	147.6	27.7	165.8							
						460	12.3	73.8	13.8	82.1							
						575	10.3	61.8	11.4	68.4							
081930	8	2.2	17.6	3.0	24.0	200	12.1	96.8	13.3	106.5	84.0%	865	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	89.6	12.2	97.3							
						460	5.6	44.8	6.2	49.3							
						575	4.5	36.0	5.2	41.4							
081950		3.7	29.6	5.0	40.0	200	20.0	160.0	22.0	176.0	85.5%	855					
						230	16.6	132.8	18.3	146.0							
						460	8.3	66.4	9.2	73.5							
						575	6.7	53.6	7.7	61.6							
081975		5.6	44.8	7.5	60.0	200	30.0	240.0	33.0	264.0	81.5%	850					
						230	24.6	196.8	27.7	221.0							
						460	12.3	98.4	13.8	110.1							
						575	10.3	82.4	11.4	91.2							
101930	10	2.2	22	3.0	30.0	200	12.1	121.0	13.3	133.1	84.0%	865	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	112.0	12.2	121.6							
						460	5.6	56.0	6.2	61.4							
						575	4.5	45.0	5.2	51.8							
101950		3.7	37	5.0	50.0	200	20.0	200.0	22.0	220.0	85.5%	855					
						230	16.6	166.0	18.3	182.5							
						460	8.3	83.0	9.2	91.8							
						575	6.7	67.0	7.7	77.1							
101975		5.6	56	7.5	75.0	200	30.0	265.0	33.0	304.8	81.5%	850					
						230	24.6	246.0	27.7	276.3							
						460	12.3	123.0	13.8	137.6							
						575	10.3	103.0	11.4	114.0							
121930	12	2.2	26.4	3.0	36.0	200	12.1	145.2	13.3	167.0	84.0%	865	1.15	12" (300mm)	12" x 2 [d] (300mm x 2)	2" FNPT (50mm)	6" (150mm)
						230	11.2	134.4	12.2	145.9							
						460	5.6	67.2	6.2	74.1							
						575	4.5	54.0	5.2	62.1							
121950		3.7	44.4	5.0	60.0	200	20.0	220.0	22.0	255.3	85.5%	855					
						230	16.6	199.2	18.3	219.0							
						460	8.3	99.6	9.2	108.9							
						575	6.7	80.4	7.7	92.5							
121975		5.6	67.2	7.5	90.0	200	30.0	318.0	33.0	365.7	81.5%	850					
						230	24.6	295.2	27.7	331.5							
						460	12.3	147.6	13.8	165.2							
						575	10.3	123.6	11.4	136.8							

[a] Baldor motor data. SFA (MMC) refers to Service Factor Amps (Maximum Motor Current). VFD should be sized for SFA (MMC).

[b] Rating is NEMA nominal efficiency. Standard motors, TEAO severe duty, direct drive, with L_{10} 100,000 hour sealed bearings, inverter ready, with quantum shield wiring, class "H" insulation (minimum).

[c] Metric dimensions approximate.

[d] TTXL-12 requires two sump containers. See TTXL-12 drawings for details.

Table 1 –Motor Data (page 2 of 7)

Engineering Data

60 Hz, 50° C.

Model	Fan Motors 3 Phase, 60 Hz, 50° C., 380V or 460V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
i21930	2	2.2	4.4	3.0	6.0	380	6.7	13.4	7.3	14.6	84.0%	865	1.15	6" (150mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						460	5.6	11.2	6.2	12.3							
i21950		3.7	7.4	5.0	10.0	380	10.1	20.2	11.3	22.6	85.5%	855					
						460	8.3	16.6	9.2	18.4							
i21975		5.6	11.2	7.5	15.0	380	15.0	30.0	16.7	33.4	81.5%	850					
						460	12.3	24.6	13.8	27.5							
i31930	3	2.2	6.6	3.0	9.0	380	6.7	20.1	7.3	21.9	84.0%	865	1.15	8" (200mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						460	5.6	16.8	6.2	18.3							
i31950		3.7	11.1	5.0	15.0	380	10.1	30.3	11.3	33.9	85.5%	855					
						460	8.3	24.9	9.2	27.6							
i31975		5.6	16.8	7.5	22.5	380	15.0	45.0	16.7	50.1	81.5%	850					
						460	12.3	36.9	13.8	41.4							
i41930	4	2.2	8.8	3.0	12.0	380	6.7	26.8	7.3	29.2	84.0%	865	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	22.4	6.2	24.8							
i41950		3.7	14.8	5.0	20.0	380	10.1	40.4	11.3	45.2	85.5%	855					
						460	8.3	33.2	9.2	36.8							
i41975		5.6	22.4	7.5	30.0	380	15.0	60.0	16.7	66.8	81.5%	850					
						460	12.3	49.2	13.8	55.2							
041930	4	2.2	8.8	3.0	12.0	380	6.7	26.8	7.3	29.2	84.0%	865	1.15	10" (250mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	22.4	6.2	24.8							
041950		3.7	14.8	5.0	20.0	380	10.1	40.4	11.3	45.2	85.5%	855					
						460	8.3	33.2	9.2	36.8							
041975		5.6	22.4	7.5	30.0	380	15.0	60.0	16.7	66.8	81.5%	850					
						460	12.3	49.2	13.8	55.2							
i51930	5	2.2	11.0	3.0	15.0	380	6.7	33.5	7.3	36.5	84.0%	865	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	28.0	6.2	32.5							
i51950		3.7	18.5	5.0	25.0	380	10.1	50.5	11.3	56.5	85.5%	855					
						460	8.3	41.5	9.2	46							
i51975		5.6	28.0	7.5	37.5	380	15.0	75.0	16.7	83.5	81.5%	850					
						460	12.3	61.5	13.8	69.0							
061930	6	2.2	13.2	3.0	18.0	380	6.7	40.2	7.3	43.8	84.0%	865	1.15	10" (250mm)	12" (300mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	33.6	6.2	37.2							
061950		3.7	22.2	5.0	30.0	380	10.1	60.6	11.3	67.8	85.5%	855					
						460	8.3	49.8	9.2	55.2							
061975		5.6	33.6	7.5	45.0	380	15.0	90.0	16.7	100.2	81.5%	850					
						460	12.3	73.8	13.8	82.8							
081930	8	2.2	17.6	3.0	24.0	380	6.7	53.6	7.3	58.4	84.0%	865	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	44.8	6.2	49.6							
081950		3.7	29.6	5.0	40.0	380	10.1	80.8	11.3	90.4	85.5%	855					
						460	8.3	66.4	9.2	73.6							
081975		5.6	44.8	7.5	60.0	380	15.0	120.0	16.7	133.6	81.5%	850					
						460	12.3	98.4	13.8	110.4							

Table 1 –Motor Data (page 3 of 7)

Engineering Data

60 Hz, 50° C.

Model	Fan Motors 3 Phase, 60 Hz, 50° C., 380V or 460V												Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
101930	10	2.2	22.0	3.0	30.0	380	6.7	67.0	7.3	73.0	84.0%	865	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	56.0	6.2	62.0							
101950		3.7	37.0	5.0	50.0	380	10.1	101.0	11.3	113.0	85.5%	855					
						460	8.3	83.0	9.2	92.0							
101975		5.6	56.0	7.5	75.0	380	15.0	150.0	16.7	167.0	81.5%	850					
						460	12.3	123.0	13.8	138.0							
121930	12	2.2	26.4	3.0	36.0	380	6.7	80.4	7.3	87.6	84.0%	865	1.15	12" (300mm)	12" x 2 [d] (300mm x 2)	2" FNPT (50mm)	6" (150mm)
						460	5.6	67.2	6.2	74.4							
121950		3.7	44.4	5.0	60.0	380	10.1	121.2	11.3	135.6	85.5%	855					
						460	8.3	99.6	9.2	110.4							
121975		5.6	67.2	7.5	90.0	380	15.0	180.0	16.7	200.4	81.5%	850					
						460	12.3	147.6	13.8	165.6							

[a] Baldor motor data. SFA (MMC) refers to Service Factor Amps (Maximum Motor Current). VFD should be sized for SFA (MMC)

[b] Rating is NEMA nominal efficiency. Standard motors, TEAO severe duty, direct drive, with L_{10} 100,000 hour sealed bearings, inverter ready, with quantum shield wiring, class "H" insulation (minimum).

[c] Metric dimensions approximate.

[d] TTXL-12 requires two sump containers. See TTXL-12 drawings for details

Table 1 –Motor Data (page 4 of 7)

Engineering Data

50 Hz, 40° C.

Model	Fan Motors 3 Phase, 50 Hz, 40° C., 190V or 380V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
i21922	2	2.2	4.4	3.0	6.0	190	10.0	20.0	10.9	21.8	84.0%	720	1.15	6" (150mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						380	5.0	10.0	5.5	11.0							
i21937		3.7	7.4	5.0	10.0	190	18.8	37.6	20.3	40.6	85.5%	700	1.10				
						380	9.4	18.8	10.1	20.2							
i21956		5.6	11.2	7.5	15.0	190	28.6	57.2	31.8	63.6	81.5%	700	1.15				
						380	14.3	28.6	15.9	31.8							
i31922	3	2.2	6.6	3.0	9.0	190	10.0	30.0	10.9	32.7	84.0%	720	1.15	8" (200mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						380	5.0	15.0	5.5	16.5							
i31937		3.7	11.1	5.0	15.0	190	18.8	56.4	20.3	60.9	85.5%	700	1.10				
						380	9.4	28.2	10.1	30.3							
i31956		5.6	16.8	7.5	22.5	190	28.6	85.8	31.8	95.4	81.5%	700	1.15				
						380	14.3	42.9	15.9	47.7							
i41922	4	2.2	8.8	3.0	12.0	190	10.0	40.0	10.9	43.6	84.0%	720	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	20.0	5.5	22.0							
i41937		3.7	14.8	5.0	20.0	190	18.8	75.2	20.3	81.2	85.5%	700	1.10				
						380	9.4	37.6	10.1	40.4							
i41956		5.6	22.4	7.5	30.0	190	28.6	114.4	31.8	127.2	81.5%	700	1.15				
						380	14.3	57.2	15.9	63.6							
041922	4	2.2	8.8	3.0	12.0	190	10.0	40.0	10.9	43.6	84.0%	720	1.15	10" (250mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	20.0	5.5	22.0							
041937		3.7	14.8	5.0	20.0	190	18.8	75.2	20.3	81.2	85.5%	700	1.10				
						380	9.4	37.6	10.1	40.4							
041956		5.6	22.4	7.5	30.0	190	28.6	114.4	31.8	127.2	81.5%	700	1.15				
						380	14.3	57.2	15.9	63.6							
i51922	5	2.2	11.0	3.0	15.0	190	10.0	50.0	10.9	54.5	84.0%	720	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	25.0	5.5	27.5							
i51937		3.7	18.5	5.0	25.0	190	18.8	94.0	20.3	101.5	85.5%	700	1.10				
						380	9.4	47.0	10.1	50.5							
i51956		5.6	28.0	7.5	37.5	190	28.6	143.0	31.8	159.0	81.5%	700	1.15				
						380	14.3	71.5	15.9	79.5							
061922	6	2.2	13.2	3.0	18.0	190	10.0	60.0	10.9	65.4	84.0%	720	1.15	10" (250mm)	12" (300mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	30.0	5.5	33.0							
061937		3.7	22.2	5.0	30.0	190	18.8	112.8	20.3	121.8	85.5%	700	1.10				
						380	9.4	56.4	10.1	60.6							
061956		5.6	33.6	7.5	45.0	190	28.6	171.6	31.8	190.8	81.5%	700	1.15				
						380	14.3	85.8	15.9	95.4							
081922	8	2.2	17.6	3.0	24.0	190	10.0	80.0	10.9	87.2	84.0%	720	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	40.0	5.5	44.0							
081937		3.7	29.6	5.0	40.0	190	18.8	150.4	20.3	162.4	85.5%	700	1.10				
						380	9.4	75.2	10.1	80.8							
081956		5.6	44.8	7.5	60.0	190	28.6	228.8	31.8	254.4	81.5%	700	1.15				
						380	14.3	114.4	15.9	127.2							

Table 1 –Motor Data (page 5 of 7)

Engineering Data

50 Hz, 40° C.

Model TTXL	Fan Motors 3 Phase, 50 Hz, 40° C., 190V or 380V													Connections [c]			
	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
101922	10	2.2	22.0	3.0	30.0	190	10.0	100.0	10.9	109.0	84.0%	720	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	50.0	5.5	55.0							
101937		3.7	37.0	5.0	50.0	190	18.8	188.0	20.3	203.0	85.5%	700	1.10				
						380	9.4	94.0	10.1	101.0							
101956		5.6	56.0	7.5	75.0	190	28.6	286.0	31.8	318.0	81.5%	700	1.15				
						380	14.3	143.0	15.9	159.0							
121922	12	2.2	26.4	3.0	36.0	190	10.0	120.0	10.9	130.8	84.0%	720	1.15	12" (300mm)	12" x 2 [d] (300mm x 2)	2" FNPT (50mm)	6" (150mm)
						380	5.0	60.0	5.5	66.0							
121937		3.7	44.4	5.0	48.0	190	18.8	225.6	20.3	243.6	85.5%	700	1.10				
						380	9.4	112.8	10.1	121.2							
121956		5.6	67.2	7.5	90.0	190	28.6	343.2	31.8	381.6	81.5%	700	1.15				
						380	14.3	171.6	15.9	190.8							

[a] Baldor motor data. SFA (MMC) refers to Service Factor Amps (Maximum Motor Current). VFD should be sized for SFA (MMC).

[b] Rating is NEMA nominal efficiency. Standard motors, TEAO severe duty, direct drive, with L_{10} 100,000 hour sealed bearings, inverter ready, with quantum shield wiring, class "H" insulation (minimum).

[c] Metric dimensions approximate.

[d] TTXL-12 requires two sump containers. See TTXL-12 drawings for details.

Table 1 –Motor Data (page 6 of 7)

Engineering Data

50 Hz, 50° C.

Model	Fan Motors 3 Phase, 50 Hz, 50° C., 190V or 380V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
i21929	2	2.9	5.8	4.0	8.0	190	16.2	32.4	17.8	35.6	85.5%	710	1.15	6" (150mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						380	8.1	16.2	8.9	17.8							
i21945		4.5	9.0	6.0	12.0	190	24.0	48.0	26.9	53.8	81.5%	715					
						380	12.0	24.0	13.4	26.8							
i31929	3	2.9	8.7	4.0	12.0	190	16.2	48.6	17.8	53.4	85.5%	710	1.15	8" (200mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						380	8.1	24.3	8.9	26.7							
i31945		4.5	13.5	6.0	18.0	190	24.0	72.0	26.9	80.7	81.5%	715					
						380	12.0	36.0	13.4	40.2							
i41929	4	2.9	11.6	4.0	16.0	190	16.2	64.8	17.8	71.2	85.5%	710	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	32.4	8.9	35.6							
i41945		4.5	18.0	6.0	24.0	190	24.0	96.0	26.9	107.6	81.5%	715					
						380	12.0	48.0	13.4	53.6							
041929	4	2.9	11.6	4.0	16.0	190	16.2	64.8	17.8	71.2	85.5%	710	1.15	10" (250mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	32.4	8.9	35.6							
041945		4.5	18.0	6.0	24.0	190	24.0	96.0	26.9	107.6	81.5%	715					
						380	12.0	48.0	13.4	53.6							
i51929	5	2.9	14.5	4.0	20.0	190	16.2	81.0	17.8	89.0	85.5%	710	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	40.5	8.9	44.5							
i51945		4.5	22.5	6.0	30.0	190	24.0	120.0	26.9	134.5	81.5%	715					
						380	12.0	60.0	13.4	67.0							
061929	6	2.9	17.4	4.0	24.0	190	16.2	97.2	17.8	106.8	85.5%	710	1.15	10" (250mm)	12" (300mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	48.6	8.9	53.4							
061945		4.5	27.0	6.0	36.0	190	24.0	144.0	26.9	161.4	81.5%	715					
						380	12.0	72.0	13.4	80.4							
081929	8	2.9	23.2	4.0	32.0	190	16.2	129.6	17.8	142.4	85.5%	710	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	64.8	8.9	71.2							
081945		4.5	36.0	6.0	48.0	190	24.0	192.0	26.9	215.2	81.5%	715					
						380	12.0	96.0	13.4	107.2							
101929	10	2.9	29.0	4.0	40.0	190	16.2	162.0	17.8	178.0	85.5%	710	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	81.0	8.9	89.0							
101945		4.5	45.0	6.0	60.0	190	24.0	240.0	26.9	269.0	81.5%	715					
						380	12.0	120.0	13.4	134.0							
121929	12	2.9	34.8	4.0	48.0	190	16.2	194.4	17.8	213.6	85.5%	710	1.15	12" (300mm)	12" x 2 [d] (300mm x 2)	2" FNPT (50mm)	6" (150mm)
						380	8.1	97.2	8.9	106.8							
121945		4.5	54.0	6.0	72.0	190	24.0	288.0	26.9	322.8	81.5%	715					
						380	12.0	144.0	13.4	160.8							

[a] Baldor motor data. SFA (MMC) refers to Service Factor Amps (Maximum Motor Current). VFD should be sized for SFA (MMC).

[b] Rating is NEMA nominal efficiency. Standard motors, TEAO severe duty, direct drive, with L_{10} 100,000 hour sealed bearings, inverter ready, with quantum shield wiring, class "H" insulation (minimum).

[c] Metric dimensions approximate.

[d] TTXL-12 requires two sump containers. See TTXL-12 drawings for details.

Table 1 –Motor Data (page 7 of 7)

2.7 Fans

Figure 9 – Typical 6-bladed 9WR Fan

High efficiency axial fans with a unique airfoil design are used on all TTXL Series Modular Cooling Towers (refer to Figure 9). The fan blades are made of high-strength, fiberglass reinforced polypropylene held in place by a die cast aluminum-silicon alloy hub. The high-efficiency fan blades are adjustable-pitch and thus can be set at various pitch angles to allow for maximum performance. After installation, the fans are adjusted to allow a nominal ¼-inch (6.4 mm) tip clearance from the throat of the fan shroud. Minimum balancing tolerances are based on ISO balancing standard TC/108, DR 1940. A G6.3 balancing grade is used. TTXL fan models vary based on motor power (refer to Table 2A and Table 2B).

Motor Hertz	Motor Power	No. of Blades	Pitch Angle (Degrees)	Blade Profile
60	3.0 HP	4	23	7WR
60	5.0 HP	8	26	7WR
60	7.5 HP	6	23	9WR
50	2.2 kW	6	29	7WR
50	2.9 kW	8	28	7WR
50	3.7 kW	8	31	7WR
50	4.5 kW	4	29	9WR
50	5.6 kW	8	25	9WR

Table 2A – Fan Data Applicable to TTXL towers shipped **before** *February 1, 2012*

Motor Hertz	Motor Power	No. of Blades	Pitch Angle (Degrees)	Blade Profile
60	3.0 HP	3	30	7WR
60	5.0 HP	6	29	7WR
60	7.5 HP	8	29	7WR
50	2.2 kW	6	29	7WR
50	2.9 kW	8	28	7WR
50	3.7 kW	8	31	7WR
50	4.5 kW	4	29	9WR
50	5.6 kW	8	25	9WR

Table 2B – Fan Data Applicable to TTXL towers shipped **after** *January 31, 2012*

2.8 Fan Shroud

Figure 10 – Fan Shroud

The fan shroud used on the TTXL Series towers is made using a hand lay-up process using fiberglass mat and chopped fiberglass strands, or a resin transfer molding process employing fiberglass mat. The shroud's unique design radius (refer to figure 10) provides a smooth transition for the air entering the fan, maximizing fan efficiency and thereby reducing energy costs. Because of the fiberglass construction, the shroud is very lightweight, strong, and resists corrosion indefinitely.

2.9 Fill Media

The most important component of a cooling tower may be the heat transfer surface or fill. The fill's efficiency is a function of its ability to promote contact between the air and water with a minimum resistance/impedance to airflow. The fill used by Tower Tech meets the rigorous standards of the Cooling Technology Institute (STD-136[88]) by having uniform thickness and hole, air bubble, and foreign matter-free and free of other manufacturing defects which may adversely affect performance.

The TTXL Series Modular Cooling Tower contains PVC film fill media stacked to a depth of five feet. The selection of the type of fill media used will vary from one installation to another due to variances in water quality.

- Comfort Cooling, Utility, and Industrial Applications:

  Generally clean to medium quality water applications would benefit from the use of a cross-corrugated fill media with a standard flute size to minimize the potential for plugging while maintaining performance efficiency. (Refer to Table 3 for data on 19mm cross corrugated fill media.) Generally, the selection of CF-1900 is most suitable when:

1. Total suspended solids (TSS) are <25 PPM (TSS <100 PPM where bacterial activity is very low).

2. Make-up water is from uncontaminated sources.

3. Biological and scale control is good.

4. Cycles of concentration are low.

5. Airborne dust is minimal.

6. Oils and grease are not present in the recirculating water.

- Pulp, Paper and Steel Mills:

  Applications with generally poorer water quality may specify vertical-flute fill media to minimize the potential for fill plugging. Such applications may have higher levels of TSS (>500 PPM with no upper limit, 1000 PPM if oil or grease are present or if there is no biological control), make-up water is from surface waters, biological or scale control is poor, and/or oils or grease may be present (up to 25 PPM) in recirculating water. (Refer to Table 3 for data on 38 mm vertical flute fill).

- Entering Water Temperatures:

  PVC fill media is recommended for applications in which the temperature of tower entering hot water does not exceed 130°F (54.4°C) in continuous operation. HPVC fill media is required for applications in which the temperature of tower entering hot water ranges from 130°F to 140°F (54.4°C to 60.0°C) in continuous operation. PVC and HPVC fill media can tolerate temperature excursions of up to 15°F (9.4°C) for up to two hours, if the excursion is supported by the fill media manufacturer's recommendations.

⚠ CAUTION The fill bearing capacity can be affected by the accumulation of silt, dirt, process leaks, and debris. The fill media is supported by Tower Tech's patented Water Collection System. The load bearing capacity of the fill media is 25 psi (11.3 kg-force) during tower operation. Occasional inspection of the fill surface area to assess fouling is recommended to assure that this bearing capacity is not exceeded.

Attribute	19mm Cross-Fluted Fill
Sheet Thickness (nom.)	10 mil (std.), 15 mil (opt.)
Material	PVC (std.), HPVC (opt.)
Standard Fill Log Length	72 in (1800 mm)
Standard Fill Log Depth	12 in (300 mm)
Standard Fill Log Width	12 in (300 mm)
Surface Area	48 ft^2/ft^3 (157.5 m^2/m^3)
Flame Spread Rating	<5 (ASTM E-84)
UV Inhibitor	Yes

Table 3 – Fill Media Data

2.10 Drift Eliminators

The TTXL Series Modular Cooling Tower utilizes a low-pressure sinusoidal-shaped drift eliminator that provides three distinct changes in flow direction to enhance the drift capturing capability of the drift eliminator. The PVC material is virtually impervious to rot, decay, or biological attack. An ultraviolet inhibitor manufactured into the product extends the life expectancy. Refer to Table 4 for drift eliminator data.

Attribute	Specification
Sheet Thickness (nom.)	10 mil (std.), 15 mil (opt.)
Material	PVC (std.), HPVC (opt.)
Standard Module Length	36 in. (900 mm)
Standard Module Depth	5.5 in. (139.7 mm)
Standard Module Width	6 in. (152.4 mm)
Forced Directional Changes	3
Drift Loss	0.0004% or less (EPA 13A)
Flame Spread Rating	<15 (ASTM E84)
UV Inhibitor	Yes

Table 4 – Drift Eliminator Data

2.11 Power and Control Wiring

DANGER **Install a lockable disconnect switch in close proximity and within sight of the cooling tower to protect authorized service personnel. Ensure the switch is separate from all other circuits.**

Do not perform service work on or near the fans without first ensuring the fan motor is electrically disconnected and locked out.

Only a licensed electrician should attempt to troubleshoot any electrical components on Tower Tech Modular Cooling Towers.

Field wiring to the module must conform to the provisions of the National Electric Code (NEC), ANSI / NFPA No. 70 (in U.S.A.), current Canadian Electric Code (CEC) A22.1 (in Canada) and/or local ordinances. The unit must be electrically grounded in accordance with the NEC and CEC (as specified above) and/or local ordinances.

The end-user is responsible for making all field wiring connections.

Each motor is factory pre-wired to a junction box located on the end of the tower module. Optional rotary-type lockout disconnect switches may be specified. All motor wiring is 12-4 AWG except 208/230V 7.5 HP motors which use 10-4 AWG, and 190V 5.6 kW (7.5 HP) motors, which use 10-4 AWG. Wiring is Alpha brand, variable-frequency drive compatible, liquid tight, oil resistant, quantum-shielded, flexible cable. A typical illustration of optional pre-wiring layout is shown in Figure 11.

This Manual shows and describes standard power and control wiring and operating procedures only. Tower Tech will supply an appropriate technical supplement for non-standard power and control wiring and operating procedures upon request.

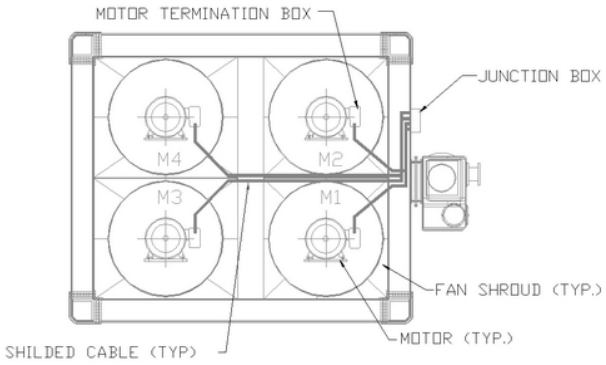


Figure 11 – Typical Wiring Layout

Optionally available are rotary disconnect switches comprised of NEMA-4X enclosures with auxiliary contacts for remote monitoring (refer to Figure 12).

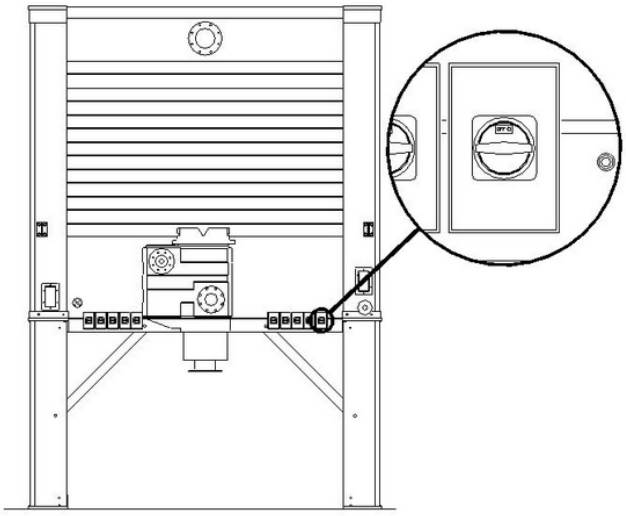


Figure 12 – Optional Rotary-Type Lockout Disconnect Switches

⚠ CAUTION Waterproof-type connectors MUST be used so that water and moisture cannot be drawn into the box or panel when connecting electrical power and control wiring to a junction box or control panel.

Refer to Table 5 for amperage requirements at various motor power levels.

Engineering Data

60 Hz, 40° C.

Model	Fan Motors 3 Phase, 60 Hz, 40° C., 200V, 230V, 460V or 575V												Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
i21930	2	2.2	4.4	3.0	6.0	200	12.1	24.2	13.3	26.6	84.0%	865	1.15	6" (150mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						230	11.2	22.4	12.2	24.3							
						460	5.6	11.2	6.2	12.3							
						575	4.5	9.0	5.2	10.4							
i21950		3.7	7.4	5.0	10.0	200	20.0	40.0	22.0	44.0	85.5%	855					
						230	16.6	33.2	18.3	36.5							
						460	8.3	16.6	9.2	18.4							
						575	6.7	13.4	7.7	15.4							
i21975		5.6	11.2	7.5	15.0	200	30.0	60.0	33.0	66.0	81.5%	850					
						230	24.6	49.2	27.7	55.3							
						460	12.3	24.6	13.8	27.5							
						575	10.3	20.6	11.4	22.8							
i31930	3	2.2	6.6	3.0	9.0	200	12.1	36.3	13.3	39.9	84.0%	865	1.15	8" (200mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						230	11.2	33.6	12.2	36.5							
						460	5.6	16.8	6.2	18.3							
						575	4.5	13.5	5.2	15.5							
i31950		3.7	11.1	5.0	15.0	200	20.0	60.0	22.0	66.0	85.5%	855					
						230	16.6	49.8	18.3	54.8							
						460	8.3	24.9	9.2	27.6							
						575	6.7	20.1	7.7	23.1							
i31975		5.6	16.8	7.5	22.5	200	30.0	90.0	33.0	99.0	81.5%	850					
						230	24.6	73.8	27.7	82.9							
						460	12.3	36.9	13.8	41.3							
						575	10.3	30.9	11.4	34.2							
i41930	4	2.2	8.8	3.0	12.0	200	12.1	48.4	13.3	53.2	84.0%	865	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	44.8	12.2	48.6							
						460	5.6	22.4	6.2	24.6							
						575	4.5	18.0	5.2	20.7							
i41950		3.7	14.8	5.0	20.0	200	20.0	80.0	22.0	88.0	85.5%	855					
						230	16.6	66.4	18.3	73.0							
						460	8.3	33.2	9.2	36.7							
						575	6.7	26.8	7.7	30.8							
i41975		5.6	22.4	7.5	30.0	200	30.0	120.0	33.0	132.0	81.5%	850					
						230	24.6	98.4	27.7	110.5							
						460	12.3	49.2	13.8	55.1							
						575	10.3	41.2	11.4	45.6							
041930	4	2.2	8.8	3.0	12.0	200	12.1	48.4	13.3	53.2	84.0%	865	1.15	10" (250mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	44.8	12.2	48.6							
						460	5.6	22.4	6.2	24.6							
						575	4.5	18.0	5.2	20.7							
041950		3.7	14.8	5.0	20.0	200	20.0	80.0	22.0	88.0	85.5%	855					
						230	16.6	66.4	18.3	73.0							
						460	8.3	33.2	9.2	36.7							
						575	6.7	26.8	7.7	30.8							
041975		5.6	22.4	7.5	30.0	200	30.0	120.0	33.0	132.0	81.5%	850					
						230	24.6	98.4	27.7	110.5							
						460	12.3	49.2	13.8	55.1							
						575	10.3	41.2	11.4	45.6							
i51930	5	2.2	11	3.0	15.0	200	12.1	60.5	13.3	69.5	84.0%	865	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	56.0	12.2	60.8							
						460	5.6	28.0	6.2	31.9							
						575	4.5	22.5	5.2	25.0							
i51950		3.7	18.5	5.0	25.0	200	20.0	92.5	22.0	106.4	85.5%	855					
						230	16.6	83.0	18.3	91.3							
						460	8.3	41.5	9.2	45.4							
						575	6.7	33.5	7.7	38.5							
i51975		5.6	28	7.5	37.5	200	30.0	132.5	33.0	152.4	81.5%	850					
						230	24.6	123.0	27.7	138.1							
						460	12.3	61.5	13.8	68.8							
						575	10.3	51.5	11.4	57.0							

Table 5 –Motor Data (page 1 of 7)

Engineering Data

60 Hz, 40° C.

Model	Fan Motors 3 Phase, 60 Hz, 40° C., 200V, 230V, 460V or 575V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Effy [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
061930	6	2.2	13.2	3.0	18.0	200	12.1	72.6	13.3	79.9	84.0%	865	1.15	10" (250mm)	12" (300mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	67.2	12.2	73.0							
						460	5.6	33.6	6.2	37.0							
						575	4.5	27.0	5.2	31.0							
061950		3.7	22.2	5.0	30.0	200	20.0	120.0	22.0	132.0	85.5%	855					
						230	16.6	99.6	18.3	109.5							
						460	8.3	49.8	9.2	55.1							
						575	6.7	40.2	7.7	46.2							
061975		5.6	33.6	7.5	45.0	200	30.0	180.0	33.0	198.0	81.5%	850					
						230	24.6	147.6	27.7	165.8							
						460	12.3	73.8	13.8	82.1							
						575	10.3	61.8	11.4	68.4							
081930	8	2.2	17.6	3.0	24.0	200	12.1	96.8	13.3	106.5	84.0%	865	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	89.6	12.2	97.3							
						460	5.6	44.8	6.2	49.3							
						575	4.5	36.0	5.2	41.4							
081950		3.7	29.6	5.0	40.0	200	20.0	160.0	22.0	176.0	85.5%	855					
						230	16.6	132.8	18.3	146.0							
						460	8.3	66.4	9.2	73.5							
						575	6.7	53.6	7.7	61.6							
081975		5.6	44.8	7.5	60.0	200	30.0	240.0	33.0	264.0	81.5%	850					
						230	24.6	196.8	27.7	221.0							
						460	12.3	98.4	13.8	110.1							
						575	10.3	82.4	11.4	91.2							
101930	10	2.2	22	3.0	30.0	200	12.1	121.0	13.3	133.1	84.0%	865	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						230	11.2	112.0	12.2	121.6							
						460	5.6	56.0	6.2	61.4							
						575	4.5	45.0	5.2	51.8							
101950		3.7	37	5.0	50.0	200	20.0	200.0	22.0	220.0	85.5%	855					
						230	16.6	166.0	18.3	182.5							
						460	8.3	83.0	9.2	91.8							
						575	6.7	67.0	7.7	77.1							
101975		5.6	56	7.5	75.0	200	30.0	265.0	33.0	304.8	81.5%	850					
						230	24.6	246.0	27.7	276.3							
						460	12.3	123.0	13.8	137.6							
						575	10.3	103.0	11.4	114.0							
121930	12	2.2	26.4	3.0	36.0	200	12.1	145.2	13.3	167.0	84.0%	865	1.15	12" (300mm)	12" x 2 [d] (300mm x 2)	2" FNPT (50mm)	6" (150mm)
						230	11.2	134.4	12.2	145.9							
						460	5.6	67.2	6.2	74.1							
						575	4.5	54.0	5.2	62.1							
121950		3.7	44.4	5.0	60.0	200	20.0	220.0	22.0	255.3	85.5%	855					
						230	16.6	199.2	18.3	219.0							
						460	8.3	99.6	9.2	108.9							
						575	6.7	80.4	7.7	92.5							
121975		5.6	67.2	7.5	90.0	200	30.0	318.0	33.0	365.7	81.5%	850					
						230	24.6	295.2	27.7	331.5							
						460	12.3	147.6	13.8	165.2							
						575	10.3	123.6	11.4	136.8							

[a] Baldor motor data. SFA (MMC) refers to Service Factor Amps (Maximum Motor Current). VFD should be sized for SFA (MMC).

[b] Rating is NEMA nominal efficiency. Standard motors, TEAO severe duty, direct drive, with L_{10} 100,000 hour sealed bearings, inverter ready, with quantum shield wiring, class "H" insulation (minimum).

[c] Metric dimensions approximate.

[d] TTXL-12 requires two sump containers. See TTXL-12 drawings for details.

Table 5 –Motor Data (page 2 of 7)

Engineering Data

60 Hz, 50° C.

Model	Fan Motors 3 Phase, 60 Hz, 50° C., 380V or 460V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
i21930	2	2.2	4.4	3.0	6.0	380	6.7	13.4	7.3	14.6	84.0%	865	1.15	6" (150mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						460	5.6	11.2	6.2	12.3							
i21950		3.7	7.4	5.0	10.0	380	10.1	20.2	11.3	22.6	85.5%	855					
						460	8.3	16.6	9.2	18.4							
i21975		5.6	11.2	7.5	15.0	380	15.0	30.0	16.7	33.4	81.5%	850					
						460	12.3	24.6	13.8	27.5							
i31930	3	2.2	6.6	3.0	9.0	380	6.7	20.1	7.3	21.9	84.0%	865	1.15	8" (200mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						460	5.6	16.8	6.2	18.3							
i31950		3.7	11.1	5.0	15.0	380	10.1	30.3	11.3	33.9	85.5%	855					
						460	8.3	24.9	9.2	27.6							
i31975		5.6	16.8	7.5	22.5	380	15.0	45.0	16.7	50.1	81.5%	850					
						460	12.3	36.9	13.8	41.4							
i41930	4	2.2	8.8	3.0	12.0	380	6.7	26.8	7.3	29.2	84.0%	865	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	22.4	6.2	24.8							
i41950		3.7	14.8	5.0	20.0	380	10.1	40.4	11.3	45.2	85.5%	855					
						460	8.3	33.2	9.2	36.8							
i41975		5.6	22.4	7.5	30.0	380	15.0	60.0	16.7	66.8	81.5%	850					
						460	12.3	49.2	13.8	55.2							
041930	4	2.2	8.8	3.0	12.0	380	6.7	26.8	7.3	29.2	84.0%	865	1.15	10" (250mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	22.4	6.2	24.8							
041950		3.7	14.8	5.0	20.0	380	10.1	40.4	11.3	45.2	85.5%	855					
						460	8.3	33.2	9.2	36.8							
041975		5.6	22.4	7.5	30.0	380	15.0	60.0	16.7	66.8	81.5%	850					
						460	12.3	49.2	13.8	55.2							
i51930	5	2.2	11.0	3.0	15.0	380	6.7	33.5	7.3	36.5	84.0%	865	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	28.0	6.2	32.5							
i51950		3.7	18.5	5.0	25.0	380	10.1	50.5	11.3	56.5	85.5%	855					
						460	8.3	41.5	9.2	46							
i51975		5.6	28.0	7.5	37.5	380	15.0	75.0	16.7	83.5	81.5%	850					
						460	12.3	61.5	13.8	69.0							
061930	6	2.2	13.2	3.0	18.0	380	6.7	40.2	7.3	43.8	84.0%	865	1.15	10" (250mm)	12" (300mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	33.6	6.2	37.2							
061950		3.7	22.2	5.0	30.0	380	10.1	60.6	11.3	67.8	85.5%	855					
						460	8.3	49.8	9.2	55.2							
061975		5.6	33.6	7.5	45.0	380	15.0	90.0	16.7	100.2	81.5%	850					
						460	12.3	73.8	13.8	82.8							
081930	8	2.2	17.6	3.0	24.0	380	6.7	53.6	7.3	58.4	84.0%	865	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	44.8	6.2	49.6							
081950		3.7	29.6	5.0	40.0	380	10.1	80.8	11.3	90.4	85.5%	855					
						460	8.3	66.4	9.2	73.6							
081975		5.6	44.8	7.5	60.0	380	15.0	120.0	16.7	133.6	81.5%	850					
						460	12.3	98.4	13.8	110.4							

Table 5 –Motor Data (page 3 of 7)

Engineering Data

60 Hz, 50° C.

Model	Fan Motors 3 Phase, 60 Hz, 50° C., 380V or 460V												Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
101930	10	2.2	22.0	3.0	30.0	380	6.7	67.0	7.3	73.0	84.0%	865	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						460	5.6	56.0	6.2	62.0							
101950		3.7	37.0	5.0	50.0	380	10.1	101.0	11.3	113.0	85.5%	855					
						460	8.3	83.0	9.2	92.0							
101975		5.6	56.0	7.5	75.0	380	15.0	150.0	16.7	167.0	81.5%	850					
						460	12.3	123.0	13.8	138.0							
121930	12	2.2	26.4	3.0	36.0	380	6.7	80.4	7.3	87.6	84.0%	865	1.15	12" (300mm)	12" x 2 [d] (300mm x 2)	2" FNPT (50mm)	6" (150mm)
						460	5.6	67.2	6.2	74.4							
121950		3.7	44.4	5.0	60.0	380	10.1	121.2	11.3	135.6	85.5%	855					
						460	8.3	99.6	9.2	110.4							
121975		5.6	67.2	7.5	90.0	380	15.0	180.0	16.7	200.4	81.5%	850					
						460	12.3	147.6	13.8	165.6							

[a] Baldor motor data. SFA (MMC) refers to Service Factor Amps (Maximum Motor Current). VFD should be sized for SFA (MMC)

[b] Rating is NEMA nominal efficiency. Standard motors, TEAO severe duty, direct drive, with L_{10} 100,000 hour sealed bearings, inverter ready, with quantum shield wiring, class "H" insulation (minimum).

[c] Metric dimensions approximate.

[d] TTXL-12 requires two sump containers. See TTXL-12 drawings for details

Table 5 –Motor Data (page 4 of 7)

Engineering Data

50 Hz, 40° C.

Model	Fan Motors 3 Phase, 50 Hz, 40° C., 190V or 380V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
i21922	2	2.2	4.4	3.0	6.0	190	10.0	20.0	10.9	21.8	84.0%	720	1.15	6" (150mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						380	5.0	10.0	5.5	11.0							
i21937		3.7	7.4	5.0	10.0	190	18.8	37.6	20.3	40.6	85.5%	700	1.10				
						380	9.4	18.8	10.1	20.2							
i21956		5.6	11.2	7.5	15.0	190	28.6	57.2	31.8	63.6	81.5%	700	1.15				
						380	14.3	28.6	15.9	31.8							
i31922	3	2.2	6.6	3.0	9.0	190	10.0	30.0	10.9	32.7	84.0%	720	1.15	8" (200mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						380	5.0	15.0	5.5	16.5							
i31937		3.7	11.1	5.0	15.0	190	18.8	56.4	20.3	60.9	85.5%	700	1.10				
						380	9.4	28.2	10.1	30.3							
i31956		5.6	16.8	7.5	22.5	190	28.6	85.8	31.8	95.4	81.5%	700	1.15				
						380	14.3	42.9	15.9	47.7							
i41922	4	2.2	8.8	3.0	12.0	190	10.0	40.0	10.9	43.6	84.0%	720	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	20.0	5.5	22.0							
i41937		3.7	14.8	5.0	20.0	190	18.8	75.2	20.3	81.2	85.5%	700	1.10				
						380	9.4	37.6	10.1	40.4							
i41956		5.6	22.4	7.5	30.0	190	28.6	114.4	31.8	127.2	81.5%	700	1.15				
						380	14.3	57.2	15.9	63.6							
041922	4	2.2	8.8	3.0	12.0	190	10.0	40.0	10.9	43.6	84.0%	720	1.15	10" (250mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	20.0	5.5	22.0							
041937		3.7	14.8	5.0	20.0	190	18.8	75.2	20.3	81.2	85.5%	700	1.10				
						380	9.4	37.6	10.1	40.4							
041956		5.6	22.4	7.5	30.0	190	28.6	114.4	31.8	127.2	81.5%	700	1.15				
						380	14.3	57.2	15.9	63.6							
i51922	5	2.2	11.0	3.0	15.0	190	10.0	50.0	10.9	54.5	84.0%	720	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	25.0	5.5	27.5							
i51937		3.7	18.5	5.0	25.0	190	18.8	94.0	20.3	101.5	85.5%	700	1.10				
						380	9.4	47.0	10.1	50.5							
i51956		5.6	28.0	7.5	37.5	190	28.6	143.0	31.8	159.0	81.5%	700	1.15				
						380	14.3	71.5	15.9	79.5							
061922	6	2.2	13.2	3.0	18.0	190	10.0	60.0	10.9	65.4	84.0%	720	1.15	10" (250mm)	12" (300mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	30.0	5.5	33.0							
061937		3.7	22.2	5.0	30.0	190	18.8	112.8	20.3	121.8	85.5%	700	1.10				
						380	9.4	56.4	10.1	60.6							
061956		5.6	33.6	7.5	45.0	190	28.6	171.6	31.8	190.8	81.5%	700	1.15				
						380	14.3	85.8	15.9	95.4							
081922	8	2.2	17.6	3.0	24.0	190	10.0	80.0	10.9	87.2	84.0%	720	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	40.0	5.5	44.0							
081937		3.7	29.6	5.0	40.0	190	18.8	150.4	20.3	162.4	85.5%	700	1.10				
						380	9.4	75.2	10.1	80.8							
081956		5.6	44.8	7.5	60.0	190	28.6	228.8	31.8	254.4	81.5%	700	1.15				
						380	14.3	114.4	15.9	127.2							

Table 5 –Motor Data (page 5 of 7)

Engineering Data

50 Hz, 40° C.

Model TTXL	Fan Motors 3 Phase, 50 Hz, 40° C., 190V or 380V													Connections [c]			
	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
101922	10	2.2	22.0	3.0	30.0	190	10.0	100.0	10.9	109.0	84.0%	720	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						380	5.0	50.0	5.5	55.0							
101937		3.7	37.0	5.0	50.0	190	18.8	188.0	20.3	203.0	85.5%	700	1.10				
						380	9.4	94.0	10.1	101.0							
101956		5.6	56.0	7.5	75.0	190	28.6	286.0	31.8	318.0	81.5%	700	1.15				
						380	14.3	143.0	15.9	159.0							
121922	12	2.2	26.4	3.0	36.0	190	10.0	120.0	10.9	130.8	84.0%	720	1.15	12" (300mm)	12" x 2 [d] (300mm x 2)	2" FNPT (50mm)	6" (150mm)
						380	5.0	60.0	5.5	66.0							
121937		3.7	44.4	5.0	48.0	190	18.8	225.6	20.3	243.6	85.5%	700	1.10				
						380	9.4	112.8	10.1	121.2							
121956		5.6	67.2	7.5	90.0	190	28.6	343.2	31.8	381.6	81.5%	700	1.15				
						380	14.3	171.6	15.9	190.8							

[a] Baldor motor data. SFA (MMC) refers to Service Factor Amps (Maximum Motor Current). VFD should be sized for SFA (MMC).

[b] Rating is NEMA nominal efficiency. Standard motors, TEAO severe duty, direct drive, with L_{10} 100,000 hour sealed bearings, inverter ready, with quantum shield wiring, class "H" insulation (minimum).

[c] Metric dimensions approximate.

[d] TTXL-12 requires two sump containers. See TTXL-12 drawings for details.

Table 5 –Motor Data (page 6 of 7)

Engineering Data

50 Hz, 50° C.

Model	Fan Motors 3 Phase, 50 Hz, 50° C., 190V or 380V													Connections [c]			
TTXL	No. Fans	kW / Fan	kW / Module	HP / Fan	HP / Module	Volts	FLA / Fan	FLA / Module	SFA (MMC) / Fan [a]	SFA (MMC) / Module [a]	Eff'y [b]	RPM	S.F.	Inlet Dia.	Outlet Dia.	Makeup Dia.	Overflow Dia.
i21929	2	2.9	5.8	4.0	8.0	190	16.2	32.4	17.8	35.6	85.5%	710	1.15	6" (150mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						380	8.1	16.2	8.9	17.8							
i21945		4.5	9.0	6.0	12.0	190	24.0	48.0	26.9	53.8	81.5%	715					
						380	12.0	24.0	13.4	26.8							
i31929	3	2.9	8.7	4.0	12.0	190	16.2	48.6	17.8	53.4	85.5%	710	1.15	8" (200mm)	8" (200mm)	1" FNPT (25mm)	4" (100mm)
						380	8.1	24.3	8.9	26.7							
i31945		4.5	13.5	6.0	18.0	190	24.0	72.0	26.9	80.7	81.5%	715					
						380	12.0	36.0	13.4	40.2							
i41929	4	2.9	11.6	4.0	16.0	190	16.2	64.8	17.8	71.2	85.5%	710	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	32.4	8.9	35.6							
i41945		4.5	18.0	6.0	24.0	190	24.0	96.0	26.9	107.6	81.5%	715					
						380	12.0	48.0	13.4	53.6							
041929	4	2.9	11.6	4.0	16.0	190	16.2	64.8	17.8	71.2	85.5%	710	1.15	10" (250mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	32.4	8.9	35.6							
041945		4.5	18.0	6.0	24.0	190	24.0	96.0	26.9	107.6	81.5%	715					
						380	12.0	48.0	13.4	53.6							
i51929	5	2.9	14.5	4.0	20.0	190	16.2	81.0	17.8	89.0	85.5%	710	1.15	8" (200mm)	10" (250mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	40.5	8.9	44.5							
i51945		4.5	22.5	6.0	30.0	190	24.0	120.0	26.9	134.5	81.5%	715					
						380	12.0	60.0	13.4	67.0							
061929	6	2.9	17.4	4.0	24.0	190	16.2	97.2	17.8	106.8	85.5%	710	1.15	10" (250mm)	12" (300mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	48.6	8.9	53.4							
061945		4.5	27.0	6.0	36.0	190	24.0	144.0	26.9	161.4	81.5%	715					
						380	12.0	72.0	13.4	80.4							
081929	8	2.9	23.2	4.0	32.0	190	16.2	129.6	17.8	142.4	85.5%	710	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	64.8	8.9	71.2							
081945		4.5	36.0	6.0	48.0	190	24.0	192.0	26.9	215.2	81.5%	715					
						380	12.0	96.0	13.4	107.2							
101929	10	2.9	29.0	4.0	40.0	190	16.2	162.0	17.8	178.0	85.5%	710	1.15	12" (300mm)	14" (350mm)	2" FNPT (50mm)	6" (150mm)
						380	8.1	81.0	8.9	89.0							
101945		4.5	45.0	6.0	60.0	190	24.0	240.0	26.9	269.0	81.5%	715					
						380	12.0	120.0	13.4	134.0							
121929	12	2.9	34.8	4.0	48.0	190	16.2	194.4	17.8	213.6	85.5%	710	1.15	12" (300mm)	12" x 2 [d] (300mm x 2)	2" FNPT (50mm)	6" (150mm)
						380	8.1	97.2	8.9	106.8							
121945		4.5	54.0	6.0	72.0	190	24.0	288.0	26.9	322.8	81.5%	715					
						380	12.0	144.0	13.4	160.8							

[a] Baldor motor data. SFA (MMC) refers to Service Factor Amps (Maximum Motor Current). VFD should be sized for SFA (MMC).

[b] Rating is NEMA nominal efficiency. Standard motors, TEAO severe duty, direct drive, with L_{10} 100,000 hour sealed bearings, inverter ready, with quantum shield wiring, class "H" insulation (minimum).

[c] Metric dimensions approximate.

[d] TTXL-12 requires two sump containers. See TTXL-12 drawings for details.

Table 5 –Motor Data (page 7 of 7)

Chapter Three: Materials of Construction

3.1 Background

The Tower Tech TTXL Series Modular Cooling Tower is factory pre-assembled. All walls, structural members, and internal components in wetted areas are non-corrosive fiberglass, various plastics (PVC is used exclusively in the hot water distribution system and in other non-structural members), and stainless steel hardware. Non-corrosive materials of construction provide long service life in the hostile chemical environments inherent to cooling towers.

Galvanized metal support systems (located in the hot moist air stream) and chemical wood treatments are major contributors to environmental and maintenance problems associated with conventional cooling towers. Galvanized metals can molecularly break down in the water due to high concentrations of acids and alkalis. Conventional wooden towers are often treated with potentially hazardous chemicals to prolong their life. These substances also leach into the cooling water.

The TTXL Series Modular Cooling Tower minimizes these environmental problems by eliminating galvanized metal and treated wood from the wet areas of the cooling tower design. (The TTXL Series uses impervious plastic/epoxy-coated steel fan guard screens; however, the fan guard screens are located in the non-wetted area below the tower module.)

3.2 Tower Walls

The tower walls provide a perimeter shell around the tower fill media and other internal components. The three sections that comprise the walls, the Perimeter Basin Wall, the Mid-Wall, and the Top-Wall are some of the largest pultruded components in the world. The Perimeter Basin Wall serves as both a structural member and a cold water reservoir. Walls are joined vertically by tongue and groove joints and are sealed using a polyurethane adhesive vibration dampener and sealant to prevent leaks. Transversal Perimeter Basin Walls are joined to longitudinal Perimeter Basin Walls using a fiberglass Corner Enclosure that provides further structural and sealing integrity to the tower box. Stainless steel fasteners are used to bolt the walls together and to join them to the Corner Enclosures. Coated stainless steel fasteners are employed in areas where water hold-up occurs. Refer to Table 6 for details on wall design specifications.

Attribute	Specification
Material Composition	Fiberglass Reinforced Plastic, Isophthalic Resin
Manufacturing Process	Pultrusion
Material Thickness	¼" (6.35 mm) minimum
Flame Spread Rating	94-V0 Flammability Classification (UL 94)
Smoke Rating	650 (ASTM E662)
Self-Extinguishing	Yes (ASTM D635)
UV Inhibitor	Yes (UV resistant fiber layer employed)

Table 6 – Wall Data

3.3 Fan Shroud

The fan shroud used on TTXL Series Modular Cooling Towers (refer to Figure 10) is made using a hand lay-up process utilizing fiberglass mat and chopped fiberglass strands, or a resin transfer molding process utilizing fiberglass mat. Its unique design radius provides a smooth transition for the air entering the fan thus maximizing the fan efficiency and energy savings and likewise reducing extraneous noise. Due to the use of fiberglass mat, the shroud is very lightweight yet strong and will resist corrosion indefinitely.

3.4 Fan Motor Support

Fan motor supports are bolted to the fiberglass shroud (refer to Figure 8), thus allowing the motor, motor support and shroud to interconnect with a minimum of vibration and a minimum of fan tip tolerance. The motor support is manufactured from stainless steel tubing and plate. Motors are mounted to a stainless steel plate that is welded onto the motor support framework. Stainless steel fasteners are used exclusively in its assembly.

3.5 Tower Internals

⚠ CAUTION The standard TTXL Series hot water distribution system and fill media are designed for a maximum tower entering hot water temperature of 130°F (54.4°C) in continuous operation. Excessive tower entering water temperatures will damage the tower's hot water distribution system and fill media. For applications having tower entering hot water temperatures ranging from 130°F to 140°F (54.4°C to 60°C) degrees, CPVC hot water distribution system piping and HPVC fill media are optionally available. PVC fill media can tolerate temperature excursions of up to 15°F (9.4°C) for up to two hours, if the excursion is supported by the fill media manufacturer's recommendations.

TTXL Series internal components are described in Table 7.

Component	Material		Component	Material
Fill Media	10 mil PVC (std.), 15 mil PVC (opt.)		Sub-Structure Legs	FRP (Pultruded)
Drift Eliminators	10 mil PVC (Thermoformed)		Wind Wall Partitions	ABS (Extruded)
Rotary Spray Nozzle	HDPE (Injection Molded)		Modular Base Support & Footpad	Nylon (Injection Molded)
Water Distribution Header & Laterals	PVC		Fan Shroud	Hand Lay-Up Chopped Fiberglass Strands or Resin Transfer Molded Fiberglass (Flame Retardant)
Water Collection System	ABS (Extruded)		Sump Box	PP (Rotationally Molded)
Header Inlet Flange	PVC (Injection Molded)		Inspection Ports	Nylon (Injection Molded)
Hardware	304 Stainless Steel		Motor Support	304 Stainless Steel

Key: FRP = Fiberglass Reinforced Plastic Pultrusion
PVC = Poly-Vinyl Chloride (Self-Extinguishing)
ABS = Acrylonitrile, 1,3-Butadiene, and Styrene Copolymer (Flame Retardant)
PP = Polypropylene

Table 7 – Materials of Construction; Internal Components

Chapter Four: Optional Equipment

4.1 Sub-Structure (Leg) Kit

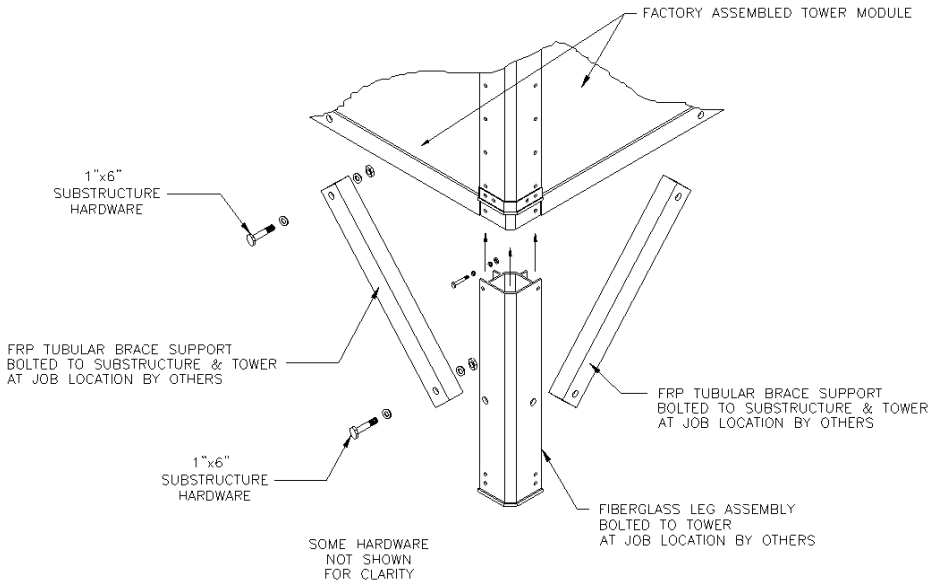


Figure 13 – Tower Sub-Structure

Tower Tech offers a pultruded fiberglass substructure connected to each corner of the tower module. Refer to Figure 13. When installed on Tower Tech sub-structures up to 8 feet (243.8 cm) in height the TTXL Series Modular Cooling Tower is certified to withstand 150 mph/41 psf (241.4 KPH/200 KSM) wind load and to resist certain seismic forces. The sub-structure anchors via glass-reinforced nylon footpads directly to steel, concrete piers, or to a concrete slab. Braces attach to the Perimeter Basin Walls to provide rigid support.

As a general rule, increased leg height will improve tower performance by increasing the air inlet area. Use higher sub-structure leg heights if obstructions adjacent to the tower reduce airflow to the tower. Sub-structure leg heights of 6-foot (182.9 cm) and 8-foot (243.8 cm) are the most common. For air inlets above 12' high the preferred method of installation is with 1-foot (30.5 cm) sub-structure legs ("stub" legs) that mount on top of a raised pier or steel.

Sub-structure kit includes:

- Pultruded fiberglass legs. Typical heights are one foot (30.5 cm), four feet (121.9 cm), six feet (182.9 cm), eight feet (243.8 cm), ten feet (304.8 cm), and twelve feet (365.8 cm).
- Footpad.
- FRP tubular braces. Not required for one-foot (30.5 cm) legs.
- Assembly hardware.

4.2 Motor Control

Tower Tech offers a complete line of optional motor control accessories designed for the TTXL Series Modular Cooling Tower. Tower Tech's optional motor control panels come complete and ready for immediate installation. Panels require main power feed to the main disconnect switch, and a separate 120V control power feed. Panels also require connections to the standard pre-wired junction box or optional individual motor disconnects.

The optional motor control panel is equipped with a cover mounted lockable main disconnect and individual HAND-OFF-AUTO switches for each fan motor. Each internally mounted combination motor starter/adjustable overload protector has an integral lockable circuit breaker to enable individual motor isolation. The control panel comes completely pre-wired. Terminal blocks are provided for the main power feed and the individual fan motor connections, and any externally mounted control input and outputs. The standard enclosure for the optional motor control panel is a NEMA-4 rated, gasketed and powder coated hinged steel box with full back plate. The panel can be furnished with a preprogrammed PLC and temperature input device to control fan cycling and/or a remote variable-frequency drive. Auxiliary contacts and many other options are available for alarm monitoring and building automation control interfacing. Refer to Figure 14 for a typical motor control panel layout. Siemens TOUCH screen is standard on all Tower Tech T9900 control panels ordered after August 31, 2011.

The optional motor control panel should never be mounted on or attached to plumbing or piping equipment.

⚠ CAUTION **Do not mount motor control panels on the tower module's basin walls or casing walls as this will cause basin leakage or wall component failure.**

⚠ CAUTION **All power and motor wiring conduits are to enter and exit the control cabinet at the bottom of the control cabinet. Penetration of the top or sides of the control cabinet will void the electronics warranty.**

⚠ CAUTION **All control wiring conduits are to penetrate the control cabinet on the bottom of the control cabinet, as close to left-hand side as space allows.**

The optional control panel is optionally available with a Programmable Logic Controller (PLC) that can be programmed to cycle the cooling tower fans to maintain the desired cold water temperature set point entered by an operator through the cover-mounted interface LCD panel. The PLC can supply a 4-20 milliamp or 0-10VDC signal to control an external variable-frequency drive (VFD).

When a VFD is used with this control panel, jumper J21-J24, located on Terminal Block #1 (TB1), must be replaced with a dry contact connection (in the VFD) that indicates the operational status of the VFD to the PLC. The dry contact must be normally open (N.O.) when the VFD is operational (active) and normally closed (N.C.) when the drive is in by-pass mode, or when failed. When the VFD is online the dry contact must be N.O. which tells the control panel PLC to energize all motor starter coils, allowing the VFD to maintain the desired cold water temperature set point entered through the control panel without fan cycling from the PLC. When the VFD is in by-pass mode, or when failed, the dry contact must be N.C. which tells the control panel PLC to de-energize the starter coils, and the PLC will maintain the desired cold water temperature set point entered by an operator through the door-mounted LCD interface panel through fan cycling control. Anytime a VFD input to the control panel is used, a separate 120V circuit must be provided for control power within the panel. All 4-20 milliamp or 0-10VDC signal wiring must be shielded twisted pair wiring.

If an owner wants to control the cooling tower through a Building Automation System (BAS), it is recommended that the BAS send a remote temperature set point to the PLC by 4-20mA analog signal, which then sends the signal to the VFD. Both the PLC and VFD have connections allowing for remote start/stop control through their connection points to their terminal blocks. The dry contact connection from the VFD to the tower PLC will still activate the motor starters and initiate VFD control. Any VFD shutdown will put the PLC into fan cycling control as in the previous sequence. This provides redundant control of the cooling tower should the VFD fail, while still allowing the BAS to control the desired tower exiting water temperature.

Tower Tech supplies a complete wiring schematic with all control panels. Custom panels and tower wiring requirements are assigned a discrete project number for easy identification. Standard factory pre-wiring uses shielded 12-4 AWG 460V wiring, however other voltages require use of NEC-appropriate wire sizes. Wiring used in all towers is Alpha brand, VFD compatible, quantum-shielded, liquid tight, oil resistant, flexible cable.

Refer to Figure 14 for a typical motor control panel layout. Siemens TOUCH screen is standard on all Tower Tech T9900 control panels ordered after August 31, 2011.

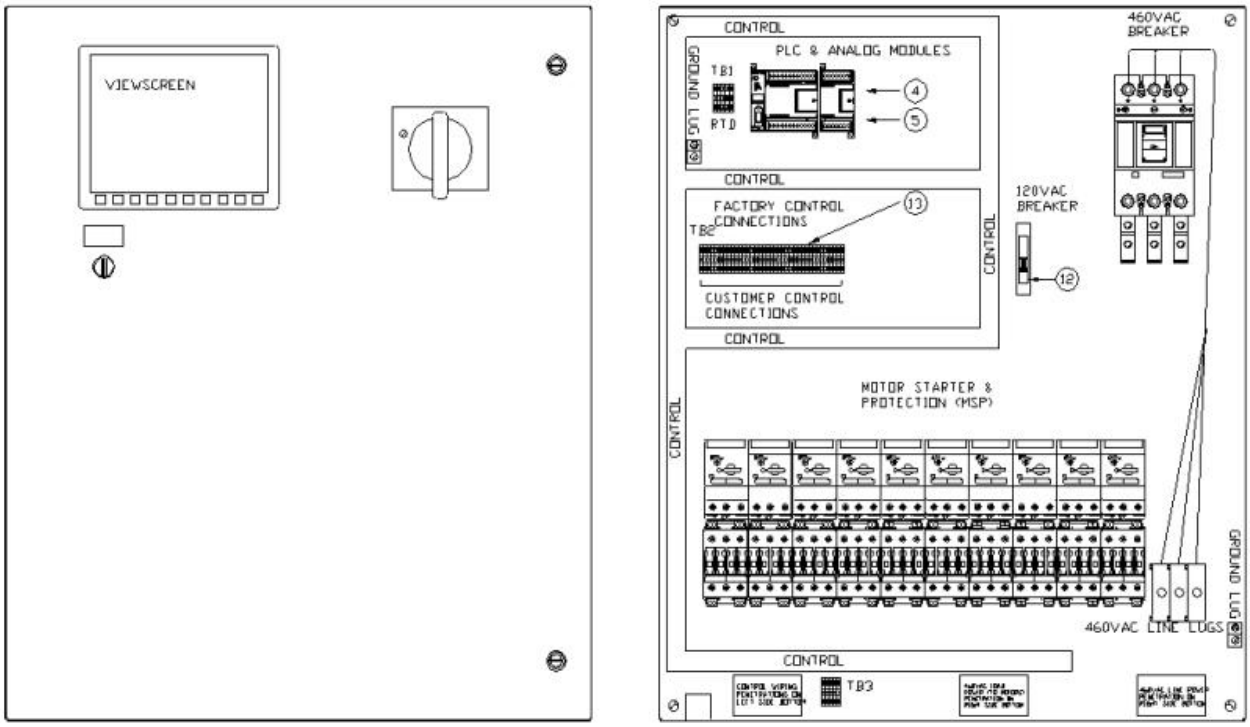


Figure 14 – Typical Motor Control Panel for 10-Fan Cooling Tower Module. (Siemens TOUCH screen standard on all Tower Tech T9900 control panels ordered after August 31, 2011.)

4.3 Variable Frequency Drive

Tower Tech motors are rated for inverter duty. The use of variable-frequency drives (VFD) and solid-state starters provides the tightest temperature control; 0.5°F (.28°C) is typical in most applications. The VFD will speed up or slow down the fans as required to maintain a constant temperature. Consult the VFD manufacturer's user manual for details on programming the VFD unit for use and installation.

Customers are responsible for programming out harmonic and electronic frequencies, and for locating appropriate connection points and ensuring appropriate filters and load reactors are utilized for variable-frequency drives not supplied by Tower Tech. Tower Tech drawings are typical only. All control wiring is to be Belden equivalent, shielded twisted-pair cable, grounded on one end.

For a discussion of the advantages of using VFD with variable flow water distribution, refer to section 2.5.

4.4 Immersion Basin Heater

⚠ CAUTION The immersion basin heater is intended to prevent icing of only the basin water when the tower is not in operation.

For winter operation, Tower Tech offers an optional immersion basin heater with a corrosion- and liquid-proof enclosure. The control unit is a combination controller and probe (temperature and water level sensor) preset to 45°F (7.2°C). The control panel contains the electronic temperature/flow liquid level control, control voltage transformer, and the magnetic contactor used to energize and de-energize the heater(s). The control panel is UL rated NEMA-4X and can control up to two heating units, however, both heaters must be located within the same water basin as the temperature-sensing probe to prevent the possibility of fire. Refer to location of immersion basin heater and probe in Figure 15.

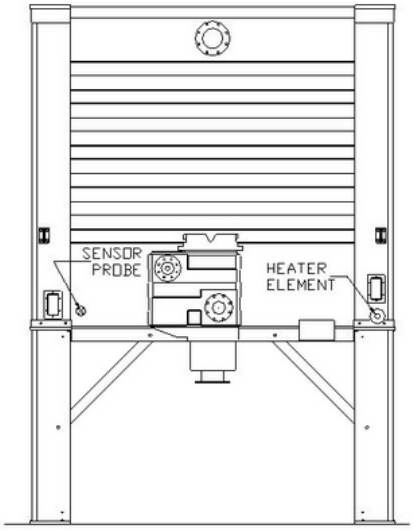


Figure 15 – Immersion Basin Heater and Sensor Probe Location

Consult Section 9.4 for information on installation and start-up of basin heater. Refer to basin heater manufacturer's user manual for complete details on set-up, validation, and operation of the basin heater.

DANGER **Each heater element contains a fused thermal cutoff device that MUST be wired into the safety circuit as detailed in the installation wiring drawing. This cutoff device is wired in series with any other optional safety devices.**

Immersion basin heaters MUST be deactivated when water is flowing through the cooling tower. Failure to do so will result in overheating of the basin heater element and accidental fire.

– For a cooling tower installation having only one pump it is recommended that the heater control system be interlocked with the tower's circulating water pump so the heaters are deactivated when the circulating pump is in operation. Doing so provides further protection against overheating of the basin heater element and accidental fire, and is also necessary for efficient control of free cooling operations.

– For a cooling tower installation having two or more pumps it is recommended that the heater control system be interfaced to a flow or pressure switch located on the inlet piping to the entire cooling tower. Doing so provides further protection against overheating of the basin heater element and accidental fire, and is also necessary for efficient control of free cooling operations.

Tower Tech offers an optional pre-engineered basin heater package for TTXL Series Modular Cooling Towers. Each package includes:

- Standard stainless steel electric immersion heater.
- UL listed control panel in NEMA-4X enclosure.
- Water level and temperature sensor/probe.
- Wiring diagram.
- Installation and operating instructions.
- Required flange fittings for probe and heater pre-installed into tower.

4.5 Vibration Switches

It is Tower Tech's position that TTXL Series Modular Cooling Towers do not require vibration switches because of the small motor size, inherent structural stability of the modular tower, and by using adhesive vibration dampening sealants for many structural connections.

DANGER **Should a customer wish to use a vibration switch, the tower modules must be fitted with a remote method of resetting the vibration switch to ensure that the reset process does not offer a potential for injury. The latter is done at owner's own risk and Tower Tech assumes no liability for damages to personnel or property resulting from the use of a vibration switch.**

4.6 Ultrasonic Liquid Level Sensor

As an alternative to Tower Tech's standard mechanical float valve, you may select the optional ultrasonic liquid level sensor. The liquid level sensor/transmitter should be mounted in a quiescent zone, such as a standpipe extension located off of the tower equalization line, for most accurate measurement. The recommended installation and piping arrangement is shown in Figure 16. The liquid level sensor/transmitter must be used in conjunction with an appropriate continuous relay controller (remote unit) for proper operation and signal detection.

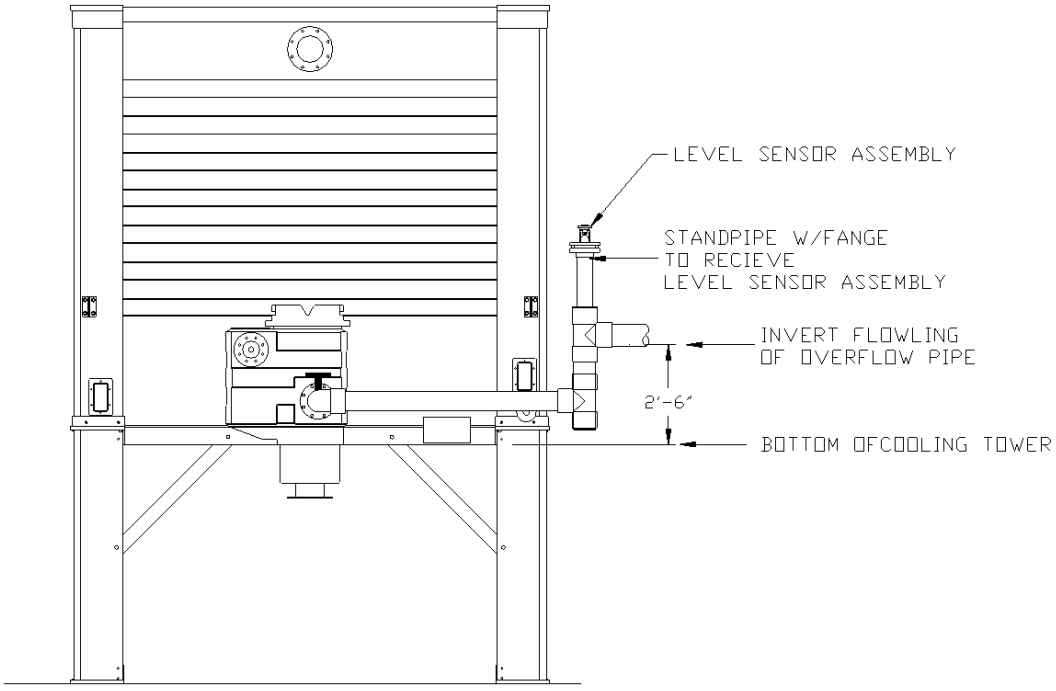


Figure 16A – Ultrasonic Liquid Level Sensor Location

Consult the ultrasonic liquid level sensor manufacturer's user manual for details on set-up, calibration, and installation.

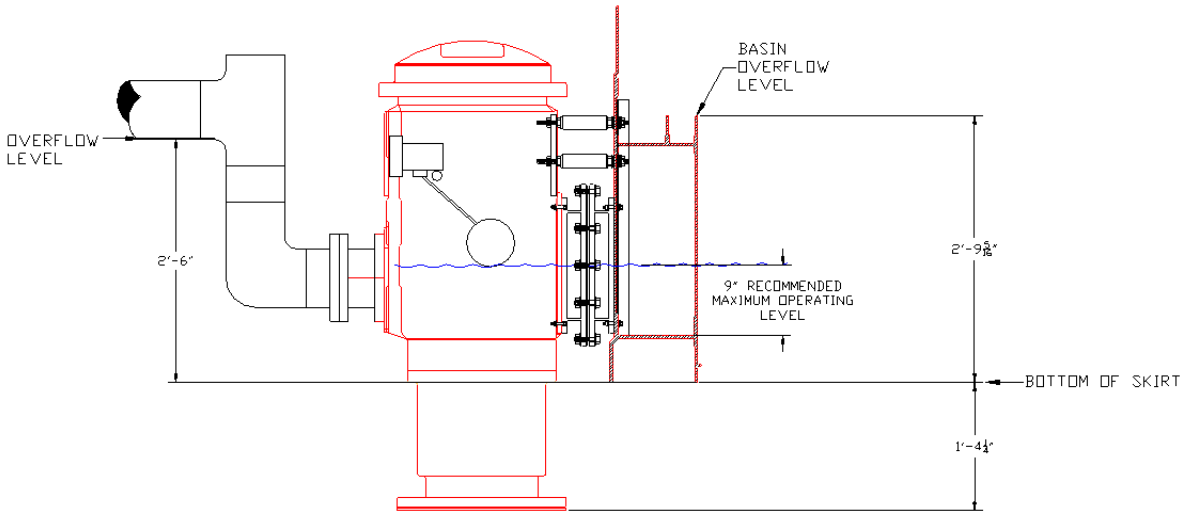


Figure 16B – Sump Level Control Detail

Chapter Five: Preparing for Installation

Approximate dimensional and weight data for the TTXL Series models are shown in Table 8. Consult your drawing set for exact weights and dimensions.

TTXL Model	Weights in Lbs. (kg)		Dimensions per Illustration Below [a] (cm)							
	Shipping	Operating	A	B	C	D	E	F	G	H
i219xx	5,245 (2,379)	9,609 (4,360)	7'-00" (213.4)	3'-06" (106.7)	10'-01" (307.3)	1'-04" (40.6)	4'-00" (121.9)	6'-00" (182.9)	17'-00" (518.2)	13'-06" (411.5)
i319xx	7,040 (3,194)	13,128 (5,956)	7'-00" (213.4)	3'-06" (106.7)	10'-01" (307.3)	1'-04" (40.6)	4'-00" (121.9)	6'-00" (182.9)	17'-00" (518.2)	19'-03" (586.7)
i419xx	8,835 (4,008)	16,641 (7,550)	7'-00" (213.4)	3'-06" (106.7)	10'-01" (307.3)	1'-04" (40.6)	4'-00" (121.9)	6'-00" (182.9)	17'-00" (518.2)	25'-00" (762.0)
0419xx	7,912 (3,590)	13,758 (6,242)	12'-00" (365.8)	6'-00" (182.9)	9'-11" (302.3)	1'-04" (40.6)	6'-00" (182.9)	6'-00" (182.9)	17'-00" (518.2)	13'-06" (411.5)
i519xx	10,630 (4,823)	20,163 (9,148)	7'-00" (213.4)	3'-06" (106.7)	10'-01" (307.3)	1'-04" (40.6)	4'-00" (121.9)	6'-00" (182.9)	17'-00" (518.2)	30'-09" (937.3)
0619xx	11,662 (5,291)	19,727 (8,950)	12'-00" (365.8)	6'-00" (182.9)	9'-11" (302.3)	1'-04" (40.6)	6'-00" (182.9)	6'-00" (182.9)	17'-00" (518.2)	19'-03" (586.7)
0819xx	15,412 (6,993)	25,695 (11,658)	12'-00" (365.8)	6'-00" (182.9)	9'-11" (302.3)	1'-04" (40.6)	6'-00" (182.9)	6'-00" (182.9)	17'-00" (518.2)	25'-00" (762.0)
1019xx	19,162 (8,694)	31,655 (14,362)	12'-00" (365.8)	6'-00" (182.9)	9'-11" (302.3)	1'-04" (40.6)	6'-00" (182.9)	6'-00" (182.9)	17'-00" (518.2)	30'-09" (937.3)
1219xx	22,912 (10,395)	37,623 (17,070)	12'-00" (365.8)	6'-00" (182.9)	9'-11" (302.3)	1'-04" (40.6)	[b]	6'-00" (182.9)	17'-00" (518.2)	36'-06" (1,112.5)

[a] Dimensions are approximate and should not be used for construction purposes. Dimension F may be 1'-00" (30.5 cm), 4'-00" (121.9 cm), 6'-00" (182.9 cm), 8'-00" (243.8 cm), 10'-00" (304.8 cm), or 12'-00" (365.8 cm) depending on project requirements. 12'-00" (365.8 cm) may be specified with prior approval of Tower Tech engineeing manager only. Dimension F on drawing below is 6'-00" (182.9 cm).

[b] TTXL-1219xx requires two sumps. See TTXL-1219xx drawings on Tower Tech website.

Table 8 – Weights and Dimensional Data

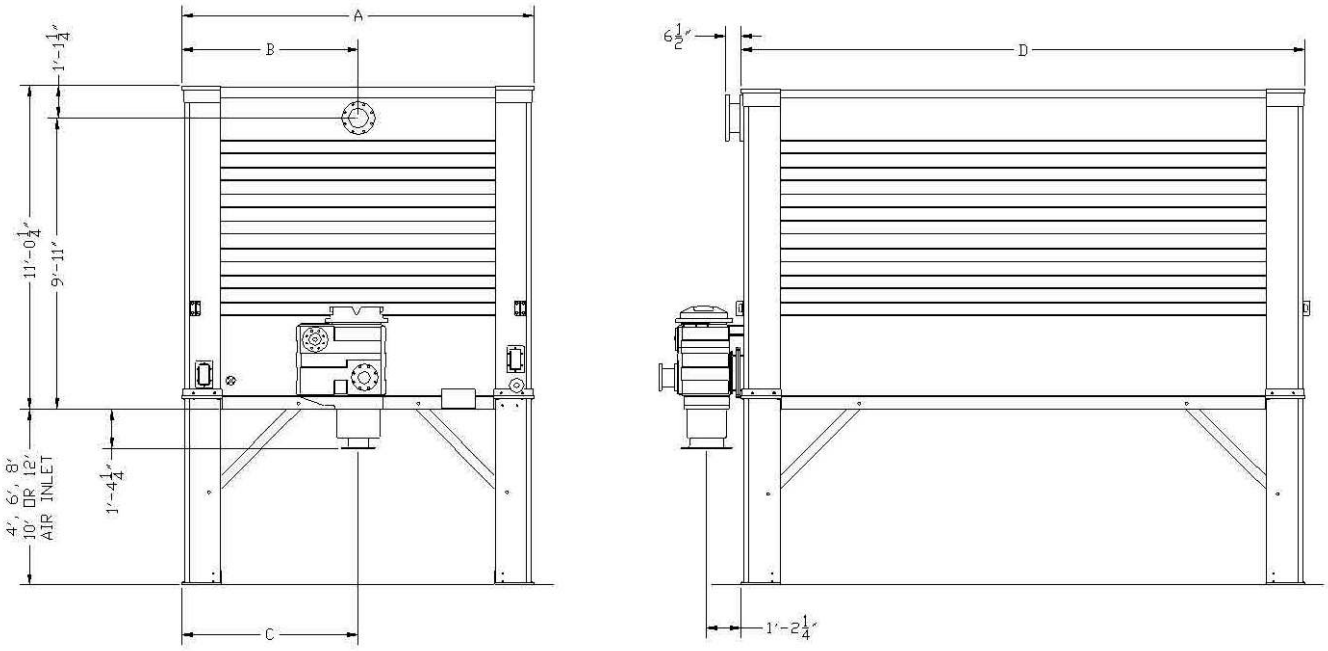


Figure 17 – Dimensional References

5.1 Limitations

The cooling tower module must be installed in accordance with the current edition of the following national and local safety codes:

- National Electric Code.
- Local electric utility requirements.
- Local plumbing and waste water codes.
- Other applicable municipal codes.

Components added to a module to meet local codes are installed at the customer's expense. Tower Tech assumes no responsibility for the impact of such components on the thermal performance or the structural integrity and longevity of the tower. Please see your Tower Tech Sales Engineer for further details.

The size of the module for proposed installation should be based on calculations provided by the client (owner or owner's agent) at the time of tower specification and are made according to generally accepted methods of thermal calculation.

The thermal performance of the TTXL Series Modular Cooling Tower is certified by the Cooling Technology Institute in accordance with its standard STD-201 and has been assigned CTI validation number 08-17-06. This certification is your assurance that the proposed capacities accurately reflect actual cooling tower performance. CTI certification under STD-201 is limited to thermal operating conditions with entering wet bulb temperatures between 55° F and 90°F (12.8°C and 32.2°C), a maximum process fluid temperature of 125°F (51.7°C), a cooling range of 4°F (2.2°C) or greater, and a cooling approach of 5°F (2.8°C) or greater.

5.2 Tower Location

The most suitable location to install a cooling tower from both a performance and safety perspective is a rooftop. However, when this is not possible, use the following guidelines to select a satisfactory location for installation.

⚠ CAUTION Module is designed principally for outdoor installation. Contact your Tower Tech Sales Representative for details on indoor use and necessary equipment accommodations.

5.2.1 Environmental Safety Considerations

A cooling tower module must be installed in a location where contaminated tower-discharge air cannot be drawn into any building fresh-air ducts. The purchaser should obtain the services of a Licensed Professional Engineer or Registered Architect to certify that the location of the tower is in compliance with applicable air pollution, fire, and clean-air codes.

5.2.2 Re-Circulation Considerations

Re-circulation is a condition that arises when warm moisture-laden exhaust air is inadvertently drawn back into a tower's intake. This condition elevates the cooling tower entering wet bulb temperature and affects the tower's capacity to cool to design requirements. Re-circulation commonly occurs when towers are located within enclosed areas or in close proximity to obstructions and other equipment that exhausts hot, humid air. Pumps, control panels, piping, and buildings can all be impediments to the smooth, unimpeded flow of air into a cooling tower. To minimize re-circulation Tower Tech recommends the following:

- Position the top of the cooling tower at least as high as any adjacent walls, enclosures, buildings, shrubbery, winter snow fall lines or other significant structures.

- Minimize the opportunity for exhaust air to migrate downward by placing tower as close to the interfering structure as possible. Note that this should be balanced against the possibility of air restriction.

- If air restriction is a concern it is recommended that enclosures provide air entry or ventilation via louvers, slots, or similar openings.

5.2.3 Interference Considerations

Interference is a condition that arises when the cooling tower is situated down wind or in close proximity to a heat-emitting source. To avoid interference careful locating of the cooling tower is essential. Consider the following:

- A cooling tower should be designed for the entering wet bulb temperatures at the proposed tower location rather than ambient wet bulb for the locality.
- Install the cooling tower upwind of the interference utilizing prevailing summer winds as the guideline.
- Remove any obstructions to free flow of exiting air. Such obstructions create static pressures that negatively impact air velocity through the tower.

5.3 Tolerances

5.3.1 Leveling

Use a level slab or piers in conjunction with a support leg for ground level installation. The thickness and size of the pad should meet local codes and unit weight requirements. Do not tie the slab to a building foundation.

⚠ CAUTION A full level bearing must be provided under each footpad area. Failure to provide may result in damage to the tower ranging from seal leaks to loss of structural integrity.

Maintain level tolerance to ¼-inch (6.35 mm) maximum across the entire length or width of the module.

5.3.2 Foundation/Slab or Pier Requirements

Weights are provided in the drawings for towers. Information provided includes dry shipping weight and operating weight. Roof structures must be able to support the maximum weight of the module and its accessories. Install the module on a solid steel frame or appropriate substructure.

5.3.3 Positioning

Install modules with a minimum of 2 inches (5.1 cm) between them in order to accommodate inherent manufacturing tolerances for the tower and the components.

5.3.4 Piping

All piping and other equipment external to the TTXL Series cooling tower module must be stand-alone or self-supported. Tower Tech recommends the use of an appropriate flexible flange connection on each header inlet to better accommodate minor piping tolerances. Failure to use a flexible flange may result in damage to the tower structure as well as adjacent piping. Final connections to the cooling tower module must be field fitted after tower installation to prevent pipe stress on the tower.

Never support piping, ladders, walkways or stairways from a TTXL Series cooling tower module.

Never attach control panels to plumbing or piping as this may induce vibration.

5.4 Sub-Structure Installation

5.4.1 Installation of Sub-Structures Taller Than One Foot (30.5 cm)

With the cooling tower lifted slightly above the main support beam or pad do the following:

1. Attach each leg (vertical support member) to the cooling tower's module base support using two ½" x 6" stainless steel hex bolts with washers and nuts (finger tighten).

2. Attach two tubular FRP braces to the cooling tower apron and to each pultruded FRP leg using 1" x 6" stainless steel hex bolts with washers and nuts (finger tighten). Refer to Section 5.3 Tolerances for detail.

3. The tower module can be lowered onto its main support beam, pier or pad after the leg and braces are attached. After setting the tower module verify that it is plumb and square.

4. Tighten all 1" dia. Bolts to 50 ft. lbs. (244.2 kilogram-force/m^2). Tighten all bolts less than 1" dia. To 30 ft. lbs. (146.5 kilogram-force/m^2).

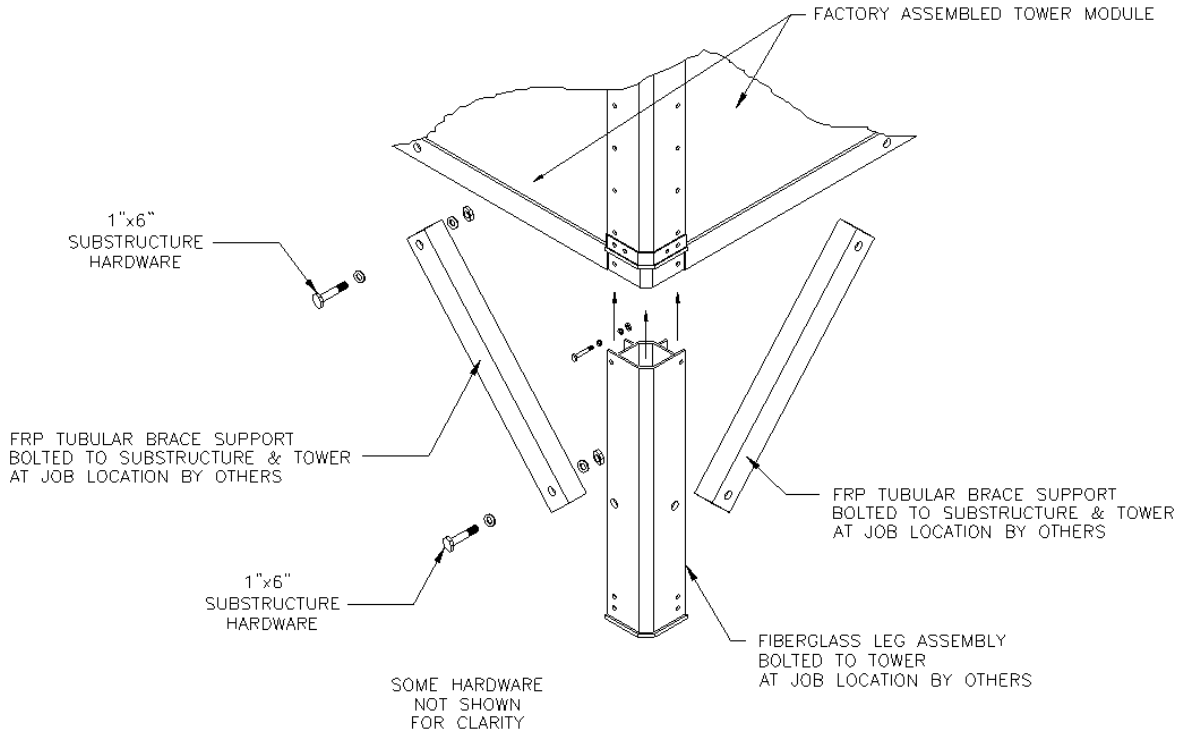


Figure 18 – Installation Detail for Sub-Structures Taller Than One Foot (30.5 cm)

5.4.2 Installation of One-Foot (30.5 cm) Sub-Structure

With the cooling tower lifted slightly above the main support beam or pad do the following:

1. Attach the one-foot (30.5 cm) tall sub-structure leg (vertical support beam) to the cooling tower's modular base support using two ½" x 6" stainless steel hex bolts with washers and nuts per leg (finger tighten).

2. Once the 1' tall sub-structure leg is loosely secured, the cooling tower module can be lowered onto its main support beam or pad. Upon setting the cooling tower verify that the tower is level. Refer to Section 5.3 Tolerances for detail.

5. Tighten all 1" dia. Bolts to 50 ft. lbs. Tighten all bolts less than 1" dia. To 30 ft. lbs. (146.5 kilogram-force/m^2).

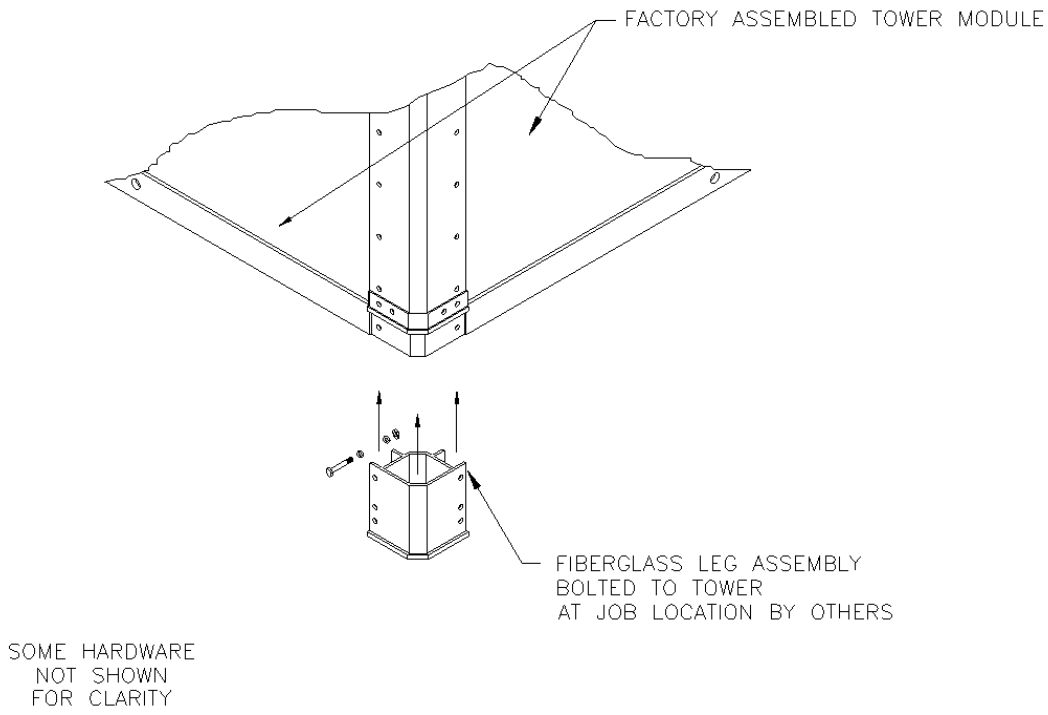


Figure 19 – Installation Detail for 1' Sub-Structure

Chapter Six: Rigging and Handling

DANGER **The lifting points are integral to the tower structure. Damage to the tower caused by improper lifting invalidates the cooling tower warranty**.

6.1 Introduction

Factory assembled TTXL Series Modular Cooling Towers shipped on flatbed trailers should be lifted directly from the trailer to the final point of installation. Sub-structure kit, motor control panel, sump and sump hardware are shipped on a separate pallet on the same trailer as the tower module.

The owner shall be responsible for lifting and placement of the tower. Owner shall furnish all incidental materials required for location of tower in its final position. All work shall be in accordance with requirements of local/municipal governing authorities and all U.S. Occupational Safety & Health Administration safety guidelines.

The accompanying lifting diagrams and procedure are for general information purposes only, and owner shall have full responsibility for the work.

CAUTION All tower operations must be performed as specified by a site-specific safety plan, which is the responsibility of the customer. Only qualified, experienced personnel should perform rigging. Use lifting equipment properly sized for the unit being lifted. Do not attempt to lift a module during high winds or inclement weather. Do not lift a tower without first removing excess water (rainwater, snow melt, ice) from the cooling tower basin, which can drastically increase tower weight.

DANGER **Under <u>NO</u> circumstance should a tower be lifted above any personnel.**

DANGER **Inspect each tower module's lifting hardware prior to lifting tower to check for shipping damage and security of lifting hardware. Never lift a tower module if its lifting hardware is cracked or loose as damage to the tower may result.**

6.2 Procedure

DANGER **Never attempt to lift or move a tower module using a forklift as damage to the tower, as well as injury to personnel, may result**.

CAUTION Excessive side loading can result in leakage caused by broken seals, permanent bending of structural members, or ultimate failure of the casing panels. Place the tower on a sound and level surface whenever ground storage is needed.

1. Check the tower's condition prior to lifting. Report any damage to the manufacturer prior to the acceptance of the tower.

2. Remove any excess water (rainwater, snow melt, ice) from the tower module's cold water basin prior to lifting the tower, as excess water can drastically increase tower weight causing failure of the tower lifting mechanism.

3. Inspect the lifting bracket attachment for cracks or loose hardware. Refer to Figure 20.

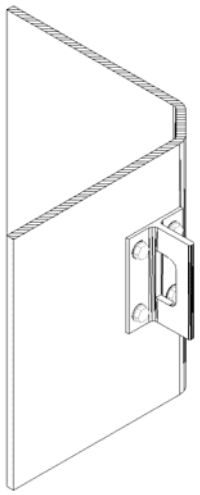


Figure 20 – Lifting Bracket

4. Prepare and position lifting item such as clevis, lifting cables, spreader beam, guide rope and/or any other incidental items needed for a complete and safe lifting operation. Refer to Figure 21 and Table 9 for appropriate lifting cable length and the spreader beam length. Recommended cable and beam lengths are designed to minimize side loading of tower walls. Position crane at the center of the tower, misaligned lifting will damage the tower shell and/or its water tightness.

5. Lift the tower module from the trailer and attach the tower sub-structure. Verify that the cooling tower support platform is level and, if not, provide ample shimming such that full bearing is achieved under the tower's footpads. Uneven tower placement will lead to operational difficulties.

6. Lower the tower module to its final position. Fully tighten the anchoring bolts. Lower the crane and check the tower for stability while it is still attached to the crane.

7. Check tower for plumb and stability then tighten all hardware at leg braces before detaching the crane.

8. Attach the sump box as described in Section 7.1 and proceed with the tower start up operation.

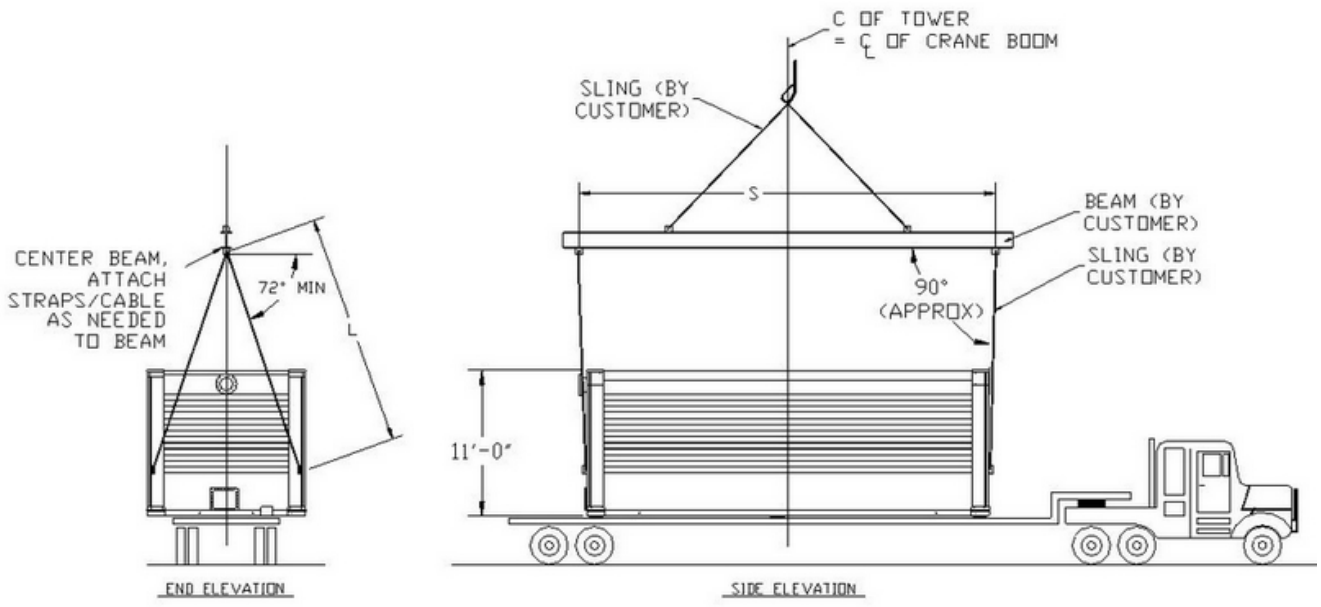


Figure 21 – Tower Lifting Procedure

TTXL Model	Weight in Lbs. * (kg)	Length in Feet (cm)	Beam in Feet (m)
i2xxxx	5,245 (2,379)	20' (6.1 m)	14'-6" (4.4 m)
i3xxxx	7,040 (3,194)	20' (6.1 m)	20'-3" (6.2 m)
i4xxxx	8,835 (4,008)	20' (6.1 m)	26'-0" (7.9 m)
04xxxx	7,912 (3,590)	20' (6.1 m)	14'-6" (4.4 m)
i5xxxx	10,630 (4,823)	20' (6.1 m)	31'-9" (9.7 m)
06xxxx	11,662 (5,291)	20' (6.1 m)	20'-3" (6.2 m)
08xxxx	15,412 (6,993)	20' (6.1 m)	26'-0" (7.9 m)
10xxxx	19,162 (8,694	20' (6.1 m)	31'-9" (9.7 m)
12xxxx	22,912 (10,395)	20' (6.1 m)	37'-6" (11.4 m)

* Tower weights may vary due to optional equipment, residual water from factory testing, rain, etc. Weights shown are guidelines only.

Table 9 – Tower Lifting Data

Chapter Seven: Tower and Peripherals Installation

7.1 Sump Attachment

⚠ CAUTION The sump must be installed before piping can be attached to the module. All piping from the sump must be self-supporting. Flexible coupling connection must be used. Failure to observe these directions may result in leaking or damage to the tower structure.

⚠ CAUTION Attach the sump to the cooling tower module AFTER the tower has been unloaded from the truck and the sub-structure legs have been securely attached.

7.1.1 Procedure

Refer to Figure 22.

1. Remove the two wooden plates from the sump flanges.
2. Remove the sump lid then remove contents packaged inside.
3. Check contents to verify that they are in agreement with packing slip and to ensure that all needed materials are present before proceeding with installation.
4. Do not remove nuts used to attach pipe spacers. Refer to Figure 22.
5. Clean outside surfaces of both sump flanges, both the factory-installed flange (bolted to the tower wall) and the factory installed sump flange.
6. Apply a 3/8-inch (9.5 mm) bead of silicone to the perimeter of each flange.
7. Place the large rectangular gasket on the flange attached to the tower wall.
8. Place one 3/8-inch (9.5 mm) neoprene washer on each of the four all-thread rods. Orient the washer so that the neoprene faces towards the sump wall.
9. Place two 1/2” x 2” bolts in the two outer holes of the flange attached to the tower wall. Orient the bolts so that the head of the bolt faces towards the tower wall.

10. Lift the sump into position and align the four all-thread rods and the two 1/2” x 2” bolts into their corresponding holes.

6. Loosely attach and hand tighten each of the remaining twenty 1/2” x 2” bolts using one flat washer and one nut per bolt. Once all are loosely attached, begin to tighten them from the top center. Tighten to 30 ft. lbs. (146.5 kilogram-force/m^2).

11. Through the sump lid opening access, insert onto each all-thread rod, one 3/8-inch (9.5 mm) neoprene washer, one 2” x 1/2” x 8” (5.1 cm x 1.3 cm x 20.3 cm) FRP backer support, one washer and one nut.

⚠ CAUTION Two FRP backer supports are provided with one backer support having two holes accommodating the two left facing all-thread rods and the second backer support accommodating the two right facing all-thread rods. **REFER TO FIGURE 22**.

12. Set sump screen at the bottom of the sump then attach the ball to the float valve arm.

13. Replace sump lid.

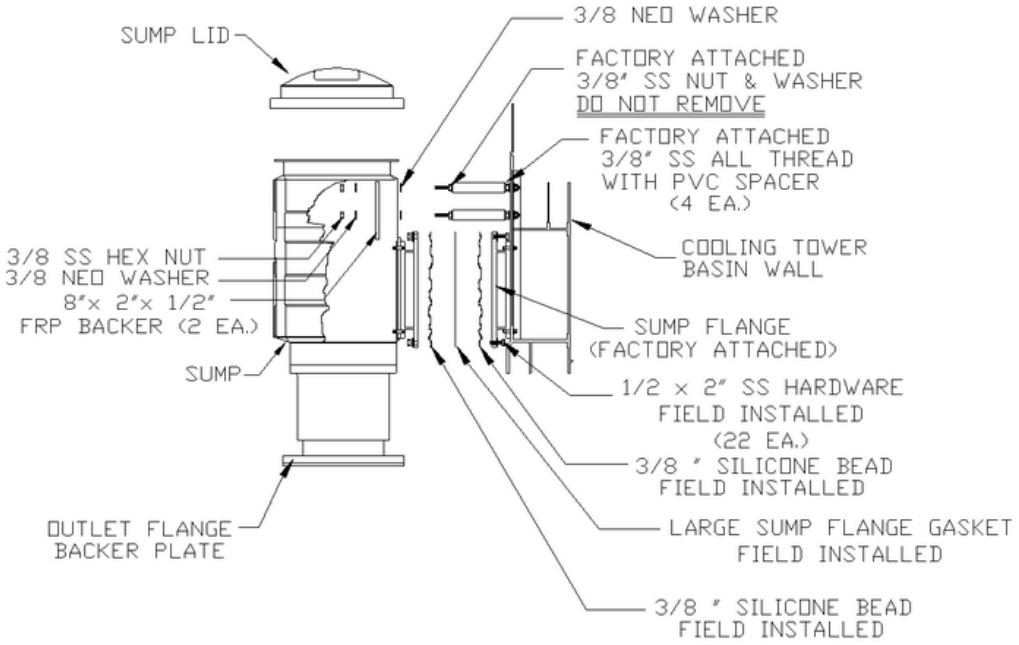


Figure 22 – Sump Installation Detail

7.2 Piping Connections

Standard piping connection locations on a TTXL module are illustrated in Figure 23. Standard dimensions are noted in Table 10. A description of each connection and its related function follows.

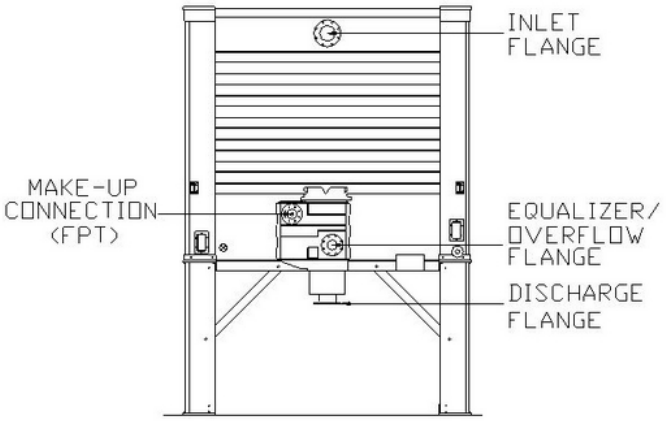


Figure 23 – Standard Piping Connections

Model TTXL	Connections			
	Inlet Dia. (mm)	Outlet Dia. (mm)	Makeup Dia. * (mm)	Overflow Dia. (mm)
i2xxxx	6" (150 mm)	8" (200 mm)	1" FNPT (25 mm)	4" (100 mm)
i3xxxx	8" (200 mm)	8" (200 mm)	1" FNPT (25 mm)	4" (100 mm)
i4xxxx	8" (200 mm)	10" (250 mm)	2" FNPT (50 mm)	6" (150 mm)
04xxxx	10" (250 mm)	10" (250 mm)	2" FNPT (50 mm)	6" (150 mm)
i5xxxx	8" (200 mm)	10" (250 mm)	2" FNPT (50 mm)	6" (150 mm)
06xxxx	10" (250 mm)	12" (300 mm)	2" FNPT (50 mm)	6" (150 mm)
08xxxx	12" (300 mm)	14" (350 mm)	2" FNPT (50 mm)	6" (150 mm)
10xxxx	12" (300 mm)	14" (350 mm)	2" FNPT (50 mm)	6" (150 mm)
12xxxx	12" (300 mm)	12" x 2 (300 mm x 2) **	2" FNPT (50 mm)	6" (150 mm)

* The make-up valve located inside the sump box is designed to operate with an inlet pressure of 25 psi (1.76 kgf/cm^2). Install a pressure reducing valve if local supply pressure exceeds 25 psi.

** TTXL-12 has two 12" (300 mm) outlets.

Table 10 – Standard Pipe Connections Data

⚠ CAUTION Piping should be installed by a licensed plumbing specialist who is familiar with municipal, state and federal regulations.

⚠ CAUTION All piping must be freestanding and not supported by the cooling tower at any time. It is very important that these instructions are followed to prevent damage to the module due to stress and creep.

⚠ CAUTION Over-tightening bolts may result in damage to flanges.

7.2.1 Inlet Connection

The cooling tower inlet connection is located at the top of the module end wall. Tower Tech recommends the use of an appropriate flexible flange connection on the header inlet in order to better accommodate minor piping tolerances. Failure to use a flexible flange connection may result in damage to the tower structure, as well as adjacent piping. Final connections to the cooling tower module must be field fitted after tower installation to prevent pipe stress on the tower, and a compatible gasket should be used between each flange and flexible flange connector to prevent leakage. It is also recommended that a shut-off valve be installed in each inlet pipe to regulate flow to each module and to provide a means of tower isolation.

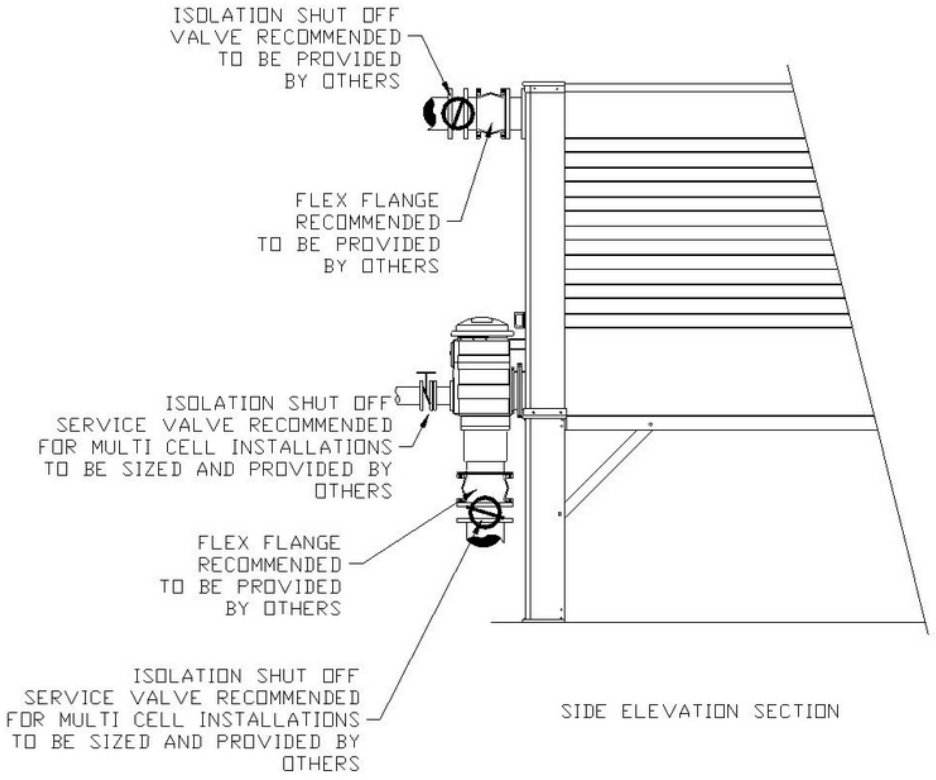


Figure 24 – Connection Flexible Flanges & Flow Control Valves

7.2.2 Discharge Connection

The discharge connection is located on the bottom of the sump. Design the discharge piping for a maximum water velocity of 6 ft/s (1.8 m/s) to prevent excessive suction leading to potential pump cavitation. Velocities of 5 ft/s (1.5 m/s) or less are preferred. Refer to Figure 25 for a detailed view of the discharge flange and its accompanying split ring. It is recommended that a shut-off valve be installed in the discharge pipe to regulate flow from each module. Tighten bolts to 30 ft. lbs. (146.5 kilogram-force/m^2) using a torque wrench.

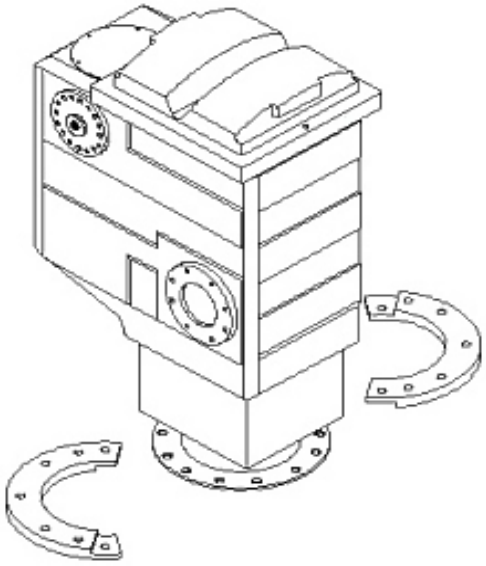


Figure 25 – Discharge Flange and Split Ring

7.2.3 Make-Up Connection

The make-up connection is located on the top left corner of the front of the sump. Apply Teflon tape to the threads of the make-up piping before inserting it into the connection flange to prevent leakage. The make-up valve located inside the sump box is designed to operate with an inlet pressure of 25 psi (1.76 kgf/cm^2). **Install a pressure reducer if local supply pressure exceeds 25 psi (1.76 kgf/cm^2).**

7.2.4 Overflow/Equalization Connection

The six-inch overflow/equalization connection is located on the bottom right corner of the front of the sump. (Note: i2xxxx and i3xxxx tower modules have a four-inch overflow/equalization connection.) In a single-module application, this connection serves as a basin overflow line. In a multi-cell application, this connection serves as a flow level equalization line, as well as a six-inch overflow connection point. This six-inch connection also serves as the mounting point if tower is equipped with optional electronic liquid level control equipment. Refer to Figure 26.

⚠ CAUTION All overflow lines must be equipped with a siphon breaker to prevent the module from being siphoned dry during overflow situations.

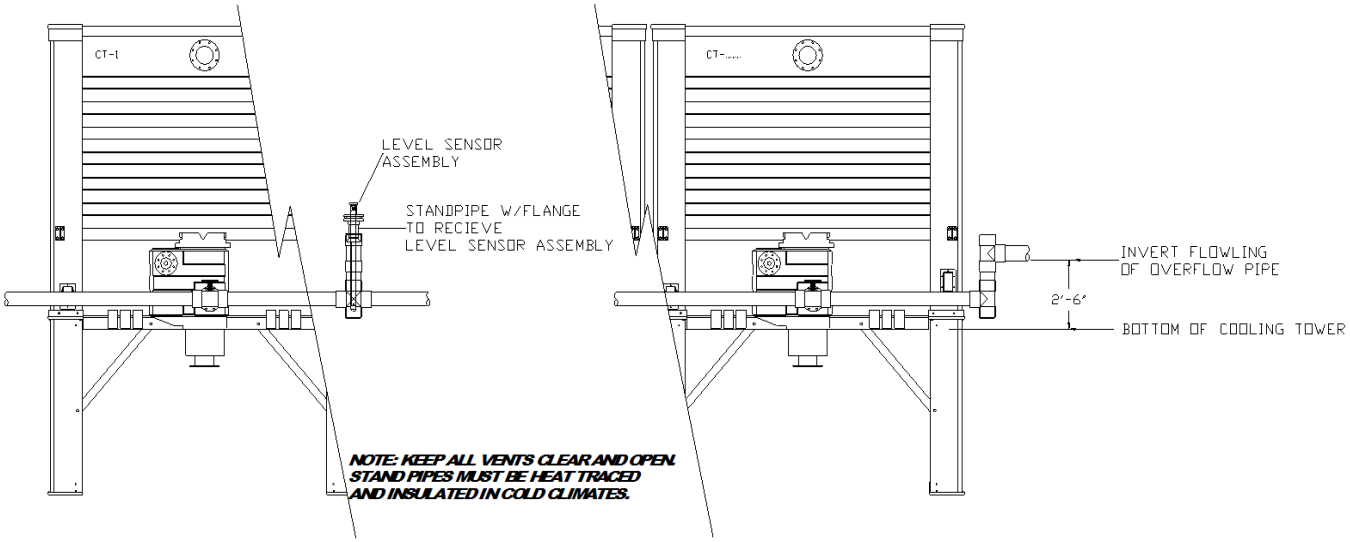


Figure 26 – Typical Overflow/Equalization Piping

⚠ CAUTION In all cases, it is important that the overflow piping be at the specified level.

Chapter Eight: Tower Start-Up

⚠ CAUTION In addition to the tower module's standard sump screen, it is recommended that an additional fine-mesh construction/start-up screen be used during initial cooling tower start-up and after every service event. Placing this additional screen on top of the tower module's standard sump screen will help prevent any debris that may have entered the cooling tower during manufacture, shipment, storage, installation or service from being ingested into heat exchangers and other downline equipment. Monitor the construction/start-up screen for cleanliness approximately once hourly until satisfied that water stream is clear of debris. Clean and replace construction/start-up screen as needed.

To ensure all required parts are shipped with each TTXL Series Modular Cooling Tower, Tower Tech's Shipping Department uses a Sump Parts Packing Checklist. Refer to Figure 27.

JOB NAME:	JOB NUMBER:	MODEL NO.:	TOWER#___.OF___.

SUMP PARTS PACKING CHECKLIST

Leg Kit: Used to connect the 1', 2', 4', 6', 8', legs to the bottom of the Base Support "on the 4 corners of the cooling tower".

Part & Quantity Inspected	OK?	Crew	Spvr	List Size	Reworked By	OK?	QC
16= 1/2"X2 SS Bolts	Y / N					Y / N	
16= 1/2" SS Nuts	Y / N					Y / N	
32= 1/2" SS Washers	Y / N					Y / N	
4= Legs	Y / N			*Circle Size:* 1' 2' 4' 6' 8'		Y / N	
2= Mid Leg, *If applicable*	Y / N					Y / N	

Brace Kit: Used to connect the brace to the tower leg and the bottom tower. (only for Tower legs of 4', 6', & 8')

Part & Quantity Inspected	OK?	Crew	Spvr	List Size	Reworked By	OK?	QC
16= 1" X 2 1/2" SS Bolts	Y / N					Y / N	
16= 1" SS Nuts	Y / N					Y / N	
32= 1" SS Washers	Y / N					Y / N	
8= 4 x 4 x 64 1/4" FRP Brace	Y / N					Y / N	

Mid Leg Kit: Used to connect the Mid Leg to the center of the cooling tower. (Only for 10 Fan Unit).

Part & Quantity Inspected	OK?	Crew	Spvr	List Size	Reworked By	OK?	QC
12= 1" X 2 1/2" SS Bolts	Y / N					Y / N	
12= 1" SS Nuts	Y / N					Y / N	
24= 1" SS Washers	Y / N					Y / N	

Sump Kit: Used to connect the Sump Box to the flange on the cooling Tower.

Part & Quantity Inspected	OK?	Crew	Spvr	List Size	Reworked By	OK?	QC
1= Sump Box Size	Y / N			*Circle Size:* 8" 10" 12" 14"		Y / N	
1= Makeup Flange	Y / N			*Circle Size:* 0" 1" 2"		Y / N	
1= Overflow Flange	Y / N			*Circle Size:* 0" 4" 6"		Y / N	
1= Sump Split Ring 2 Pcs	Y / N			*Circle Size:* 8" 10" 12" 14"		Y / N	
1= 8" Black Plastic Float Ball	Y / N			*Provide only for Makeup Valve*		Y / N	
1= 10" Brass Stem	Y / N			*Provide only for Makeup Valve*		Y / N	
22= 1/2" x 2" SS Bolts	Y / N					Y / N	
22= 1/2" SS Nuts	Y / N					Y / N	
44= 1/2" SS Washers	Y / N					Y / N	
4= 3/8" SS Nuts	Y / N					Y / N	
8= 3/8" SS Washers	Y / N					Y / N	
8= 3/8" SS Neos	Y / N					Y / N	
2= FRP Sump Spacers	Y / N					Y / N	
1= SS Sump Screen	Y / N					Y / N	
1= Tube Clear Silicone	Y / N					Y / N	
1= Large Sump Gasket	Y / N					Y / N	
Comments:							
				Supervisor Approval:	Date:		

QC5027-1 Effective: 12/24/03

Figure 27 – Sump Parts Packing Checklist (page 1 of 3)

PAGE 2

JOB NAME: JOB NUMBER: MODEL NO.: TOWER#___.OF___.

SUMP PARTS PACKING CHECKLIST

Paper Kit: Used for Instructions.

Part & Quantity Inspected	OK?	Crew	Spvr	Size & Type	Reworked By	OK?	QC
1= Operation Manual *(One copy per Job)*	Y / N					Y / N	
1= CD OM *(One copy per Job)*	Y / N					Y / N	
1= Submittal Drawings *(One copy per Job)*	Y / N					Y / N	
1= Copy of the Sump Parts Packing Checklist *(One per Tower)*	Y / N					Y / N	

Rapid Link Kit:

Part & Quantity Inspected	OK?	Crew	Spvr	Size & Type	Reworked By	OK?	QC
1= *(If required)*	Y / N					Y / N	

Basin Heater Kit: Used to heat the Module Cooling Tower water.

Part & Quantity Inspected	OK?	Crew	Spvr	Size & Type	Reworked By	OK?	QC
Basin Heater Controller w/sensor (Quantity varies per Job) *Check Drawings*	Y / N			*Circle Quantity:* 1 / 2 / 3 *Circle one:* With Disconnects / Without Disconnects *Circle one:* 208v / 460v		Y / N	
Heater Element(s)	Y / N			*Circle Quantity:* 1 / 2 / 3 / 4		Y / N	
2" SS Heater Flange *(On Tower)*	Y / N			*Circle Quantity:* 1 / 2 / 3 / 4		Y / N	
3/4" Sensor Flange *(On Tower)*	Y / N			*Circle Quantity:* 1 / 2 / 3 / 4		Y / N	
1= Heater Manual *(If Required)*	Y / N					Y / N	

Flowline Kit: Special Optional Equipment.

Part & Quantity Inspected	OK?	Crew	Spvr	Size & Type	Reworked By	OK?	QC
1= Microspan (Flowline Sensor)	Y / N					Y / N	
1= A.L.C. 52 (flowline Controller Box)	Y / N					Y / N	
1= 6" Vanstone Flange	Y / N					Y / N	
1= 6" Blind Flange w/ Threaded 2" Hole and regular 1" Hole	Y / N					Y / N	
1= Flowline Hardware Kit	Y / N					Y / N	

Comments:

	Supervisor Approval:	Date:

QC5028-1 Effective: 12/24/03

Figure 27 – Sump Parts Packing Checklist (page 2 of 3)

JOB NAME: JOB NUMBER: MODEL NO.: TOWER#___.OF___.

SUMP PARTS PACKING CHECKLIST

Control Panel:

Part & Quantity Inspected	OK?	Crew	Spvr	Size & Type	Reworked By	OK?	QC
1= Control Panel	Y / N			*Circle One:* 208v / 460v		Y / N	
1= Temp Controller (Optional)	Y / N			*Circle One:* With Temp / Without Temp		Y / N	
1= Temp Probe (Optional)	Y / N			*Provided only for Temperature Controller*		Y / N	
1= Control Panel Manual	Y / N					Y / N	

Optional Equipment:

Part & Quantity Inspected	OK?	Crew	Spvr	Size & Type	Reworked By	OK?	QC
	Y / N					Y / N	
	Y / N					Y / N	

Note: If a box is marked B/O for back order on any item, contact the Tower Tech Shipping Dept. Manager @ 405. 979.2125 for the status of the B/O shipment. **All items shipped by Tower Tech have been inspected and counted prior to shipment. All request for missing or incorrect items must be reported on this form by fax within 24 hours of delivery. All request after the 24 hour period will be handled on a billable basis.**

Comments:

TOWER TECH™
The Technology Company

MODEL

SERIAL NO.

DATE MFG.

MANUFACTURED UNDER U.S. PATENTS:
5,227,095 5,143,657 5,152,458 5,487,849 5,487,531 5,545,356 5,958,306
Other Patents Pending
Tower Tech, Rotary Spray Nozzle, SmarTTower, and Water Drop Logo
Are All Trademarks of Tower Tech, Inc.
Tower Tech, Inc., P.O. Box 891810, Okla. City, OK 73173 Phone (405) 290-7788

	Supervisor Approval:	Date:

QC5029-0 Effective: 04/22/03

Figure 27 – Sump Parts Packing Checklist (page 3 of 3)

The assistance of a factory-certified startup technician is recommended to help ensure initial startup of TTXL Series Modular Cooling Tower is performed in accordance with factory procedures. Factory-certified startup technician will use the following checklist for startup, and for classroom and field training of cooling tower operators and maintenance staff. Refer to Figure 28.

Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (Appears Below)

Submit by Email | Print Form

TOWER TECH

Tower Start-up, Warranty Registration, Owner/Operator Training Checklist

Company Name: _____ Project: _____
Address: _____ Date: _____
City: _____ State: _____ Zip Code: _____ Country: _____
Company Contact Names: _____
Cooling Tower Model: _____ Cooling Tower S/N: _____
Ship Date: _____ Module Number _____ of _____ Total Number of Modules on Site: _____
Warranty Terms: _____

GENERAL–PRE WATER / FAN STARTUP

	Good	Needs Attention	N/A
Inspect Sump Installation – Ref. IO&M 7.1			
Have construction screens been installed?	☐	☐	☐
Is there a watertight seal on sump flange gaskets?	☐	☐	☐
Are the sump flange bolts secure?	☐	☐	☐
Is the fiberglass backing plate sealed?	☐	☐	☐
Are appropriate nuts and bolts coated?	☐	☐	☐
Verify Piping & Headers are self supported – Ref. IO&M 5.3.4			
Is piping independently supported, separate from the tower?	☐	☐	☐
Verify Piping Connections – Ref. IO&M 7.2			
Is check valve installed?	☐	☐	☐
Is there a control / isolation valve (hot water)?	☐	☐	☐
Is there a control / isolation valve (cold water)?	☐	☐	☐
Is the overflow / equalization piping installed according to IO&M?	☐	☐	☐
What is the height of the Overflow Pipe from bottom of Tower:_____			
Is the make-up line in place and sealed to the fitting?	☐	☐	☐
Is the inlet / outlet piping installed according to IO&M limits?	☐	☐	☐
Inlet Piping Size:_____ Outlet Piping Size_____			
Verify Electrical Components & Wiring – Ref. Submittals			
Lockable disconnect present within sight of cooling tower?	☐	☐	☐
Is a Tower Tech control panel installed?	☐	☐	☐
Verify Proper Direction of Fan Rotation	☐	☐	☐
Verify All Electrical Terminations Tight & Secure			
Verify field wiring from motors to J-box (or Disconnects)	☐	☐	☐
Verify power feed(s) to tower Control Panel	☐	☐	☐

Comments _____

_____

_____

Inspected By **Date** **Company**

Tower Tech, Inc.
5400 N.W. 5th Street
Oklahoma City, Oklahoma 73127 USA

CUSTOMER SERVICE HOTLINE TEL405.979.2123
Main Tel 405.290.7788 Fax: 405-979-2180
Service@TowerTechInc.com www.TowerTechInc.com

Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (page 1 of 8)

TOWER TECH

Tower Start-up, Warranty Registration, Owner/Operator Training Checklist

Project: _____ **S/N** _____ **Date:** _____

ELECTRICAL / FANS

Fan Startup / Hand Mode (Without Water Flowing)

	Good	Needs Attention	N/A
→ Set HOA switches to OFF			
→ Initiate Power to Control Panel	☐	☐	☐
Verify settings for Thermal Overload Protection.	☐	☐	☐
→ Turn on Motor Disconnects.	☐	☐	☐
Verify that the fan motor resets are not tripped.	☐	☐	☐
→ Bump Fans in Sequence / Verify Fan Rotation.	☐	☐	☐
→ Operate fans in HAND MODE.	☐	☐	☐
→ Power up the rest of the fan sets in 1-minute intervals in HAND mode.	☐	☐	☐
Verify Water Collector Dampers open properly?	☐	☐	☐

Voltage & Amperage Measurements

	Voltages (AC)				Amperages			
	L1-L2	L1-L3	L2-L3	Total	L1	L2	L3	Total
Incoming Main								
Fan 1 (Starter)								
Fan 2 (Starter)								
Fan 3 (Starter)								
Fan 4 (Starter)								
Fan 5 (Starter)								
Fan 6 (Starter)								
Fan 7 (Starter)								
Fan 8 (Starter)								
Fan 9 (Starter)								
Fan 10 (Starter)								
Fan 11 (Starter)								
Fan 12 (Starter)								

PLC CONTROL PROGRAMMING	RECORDED INPUT VALUES
TEMPERATURE SET POINT:	
NUMBER OF FAN STAGES:	
ON DEADBAND TIME:	
OFF DEADBAND TIME:	

Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (page 2 of 8)

TOWER TECH

Tower Start-up, Warranty Registration, Owner/Operator Training Checklist

Project: _____ **S/N** _____ **Date:** _____

Fan Startup / Auto Mode

→ Switch HOAs to OFF – all fans stop	☐	☐	☐
→ Switch HOAs to AUTO – all fan contactors controlled by PLC	☐	☐	☐
→ Set Temp Set Point 10˚ F/C below current temp shown on LCD	☐	☐	☐
Verify Fan Staging Sequence	☐	☐	☐
→ Set Temp Set Point 10˚ F/C above current temp shown on LCD	☐	☐	☐
Verify Fan de-staging Sequence	☐	☐	☐
→ Record amp / voltage readings for L1, L2, L3 for each motor. NOTE: VFD must be in By-Pass Mode for these measurements	☐	☐	☐
→ Set Temp Set Point to Operating Value – **Ref. Submittal Drawings**	☐	☐	☐
Verify that the Water Collection System functions without water drips	☐	☐	☐
Verify air is exiting top of tower modules, not blocked	☐	☐	☐

VFD

Verify Interconnections between VFD & Control Panel	☐	☐	☐
Verify VFD Startup completed by VFD Startup Personnel	☐	☐	☐
Verify VFD Operation of Fan Motors	☐	☐	☐
Record VFD Settings & Operational Values	☐	☐	☐

VFD Inspected by _____ Printed Name _____
Signature

Cell Phone _____ Office Phone _____ Email _____

Company _____ Main Phone _____

Address: _____ Fax _____

City _____ State _____ Zip _____ Country _____

Comments _____

_____

_____

_____

Electrical Inspected By

Printed Name _____ Company _____

_____ Date _____
Signature

Tower Tech, Inc.
5400 N.W. 5th Street
Oklahoma City, Oklahoma 73127 USA

CUSTOMER SERVICE HOTLINE TEL405.979.2123
Main Tel 405.290.7788 Fax: 405-979-2180
Service@TowerTechInc.com www.TowerTechInc.com

Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (page 3 of 8)

TOWER TECH

Tower Start-up, Warranty Registration, Owner/Operator Training Checklist

Project: _____ **S/N** _____ **Date:** _____

WATER STARTUP & FLOW

	Good	Needs Attention	N/A
Filling System – Ref. IO&M 8.1			
Verify Makeup Water Level – **Ref. IO&M 8.2** ***Basin level:*** _____	☐	☐	☐
Startup Valve Settings – Ref. IO&M 8.3.1, 8.3.2			
Hot Water Control / Isolation Valve set for soft start-up, **Ref. IO&M 8.3.1 & 8.3.2**	☐	☐	☐
Cold Water Control / Isolation Valve(s) open, **Ref. IO&M 8.3.1 & 8.3.2**	☐	☐	☐
Overflow / Equalization Valve Open	☐	☐	☐
Bypass Water Valve Open - Water Flowing to Cooling Tower	☐	☐	☐
Water Level Control – Ref. IO&M 8.2			
Make-up Water Valve Open	☐	☐	☐
Circulating Water - Single Pump Operation			
Verify Water Level Control – **Ref. IO&M 8.2**	☐	☐	☐
→ **Slowly Open Hot Water Control / Isolation Valve.**			
→ **Slowly Close Bypass Valve.**			
Verify Water Flow Values – **Ref. Submittal Drawings**	☐	☐	☐
Verify Water Collector Operation	☐	☐	☐
Verify Nozzle Operation, (Visually)	☐	☐	☐
Record Final Valve Settings & Flow Values	☐	☐	☐
Circulating Water - Multiple Pump Operation			
→ **Start Additional Pumps After Basin Level Recovers** (Approx 5-Min. Intervals)			
Verify Water Flow Values – **Ref. Submittal Drawings**	☐	☐	☐
Verify Water Collector Operation	☐	☐	☐
Verify Nozzle Operation (Visually)	☐	☐	☐
Balance Hot, then Cold Water Flow across tower modules – **Ref. Submittal Drawings**	☐	☐	☐
Verify Water Level Control – **Ref. IO&M 8.2**	☐	☐	☐
Inspect the sump screens for start-up debris.	☐	☐	☐
→ **Add Heat Load**			
Verify Water Flow Values – **Ref. Submittal Drawings**	☐	☐	☐
Verify Water Collector Operation	☐	☐	☐
Record Final Valve Settings & Flow Values	☐	☐	☐

Comments _____

_____

_____

Inspected By **Date** **Company**

Tower Tech, Inc.
5400 N.W. 5th Street
Oklahoma City, Oklahoma 73127 USA

CUSTOMER SERVICE HOTLINE TEL405.979.2123
Main Tel 405.290.7788 Fax: 405-979-2180
Service@TowerTechInc.com www.TowerTechInc.com

Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (page 4 of 8)

TOWER TECH

Tower Start-up, Warranty Registration, Owner/Operator Training Checklist

Project: _____ **S/N** _____ **Date:** _____

GENERAL STARTUP

	Good	Needs Attention	N/A
Verify basin walls, seams & joints.	☐	☐	☐
Verify all water flanges & gaskets for water tightness.	☐	☐	☐
Verify tower footpads are securely anchored per IO&M	☐	☐	☐
Verify all braces are securely fastened to legs	☐	☐	☐
Verify all Fan Guard Screens are securely fastened	☐	☐	☐

Comments _____

_____

BASIN HEATERS

Electrical –before Energizing	Good	Needs Attention	N/A
Verify Electrical Components & Wiring – **Ref. Submittal Drawings**	☐	☐	☐
All Wiring Terminations tight & secure	☐	☐	☐
All Heater Element Conduit Openings are Sealed	☐	☐	☐
Pump/Flow Interlock Installed (Prevents Heater Operation with Flowing Water)	☐	☐	☐
Electrical –After Energizing			
Verify that Heater Elements Do NOT Energize with Flowing Water	☐	☐	☐
Verify that Heater Elements Do NOT Energize without water in Basin	☐	☐	☐
Verify Amp draw of Heater Element	☐	☐	☐
Follow all procedures - Basin Heater O&M Manual	☐	☐	☐

Comments _____

_____

_____

Start-up Inspector _____ Printed Name _____
Signature

Company _____ Phone_____ Cell _____ Email_____

Customer _____ Company _____
Signature

_____ Date _____ Email_____
Printed Name

Office Phone _____ Cell _____ Fax _____

Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (page 5 of 8)

Tower Start-up, Warranty Registration, Owner/Operator Training Checklist

SITE PLAN DETAILS (sketch or insert pictures of cooling tower installation)

ELEVATION OF TOWER & SURROUNDING BUILDING/EQUIPMENT (Include Measurements)

PIPING DETAILS

COMMENTS:_____

_____

_____

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Oklahoma City, Oklahoma 73127 USA

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Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (page 6 of 8)

TOWER TECH

Tower Start-up, Warranty Registration, Owner/Operator Training Checklist

Project: _____ **S/N** _____ **Date:** _____

OWNER & OPERATOR TRAINING

		Good	Needs Attention	N/A
1.	Each attendee has seen the cooling tower and its controls beforehand.	☐	☐	☐
2.	Each attendee has signed in on Tower Tech's Sign-In Sheet.	☐	☐	☐
3.	Tower Tech sales video has been shown to each attendee.	☐	☐	☐
4.	Chapter-by-chapter discussion of IO&M Manual has been completed.	☐	☐	☐
5.	Q&A session has been completed at the conclusion of training.	☐	☐	☐

Names of Attendees: _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

Comments _____

Trainer _____ Printed Name _____ Date_____
Instructor Signature

Company _____ Tel _____ Cell _____ Email_____

Customer _____ Printed Name_____
Signature

Company _____ Date _____ Email_____

Office Phone _____ Cell _____ Fax _____

Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (page 7 of 8)

TOWER TECH

Tower Start-up, Warranty Registration, Owner/Operator Training Checklist

Project: _____ **S/N** _____ **Date:** _____

WARRANTY REGISTRATION FORM

Registration Date _____ Work Order # _____

Customer _____ Serial # _____

End User _____ Control Panel S/N _____
(Tower Location if different than customer)

Tower Ship Date _____ Warranty Term _____
(Tower Tech to complete)

Address _____ City _____ St _____ Zip _____
(Tower Location)

Contact _____ Tel _____ Fax _____
(At Tower Location) (Office / Cell, At Tower Location)

Email _____ Other _____
(At Tower Location)

Start-up Completion Date _____ By _____ Tel/ Email _____

O & M Training Completion Date _____ By _____ Tel/ Email _____

Comments:

_____

_____

_____

_____

_____

Acknowledged by: _____ Filed _____ By _____
Tower Tech Warranty Manager Signature & Date Date Initials

Tower Tech, Inc.
5400 N.W. 5th Street
Oklahoma City, Oklahoma 73127 USA

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Service@TowerTechInc.com www.TowerTechInc.com

Figure 28 – Start-up, Warranty Activation, Owner/Operator Training Checklist (page 8 of 8)

8.1 Filling System with Water

1. Open make-up valve(s) and allow basin(s) and piping to fill to the tower overflow.

2. Check all flanged connections and piping for leaks.

3. Bleed air from piping by opening bleed valve at pump until water flows out in a steady stream without interruption.

4. Close bleed valve.

8.2 Controlling Water Level

The TTXL Series Modular Cooling Tower utilizes either an electronically (optional) or mechanically (standard) controlled float valve located in the sump. Refer to the instructions provided by the manufacturer to set the electronic float valve. Note: Level control is pre-set at factory and minimal modifications to the setting, if any, should be needed.

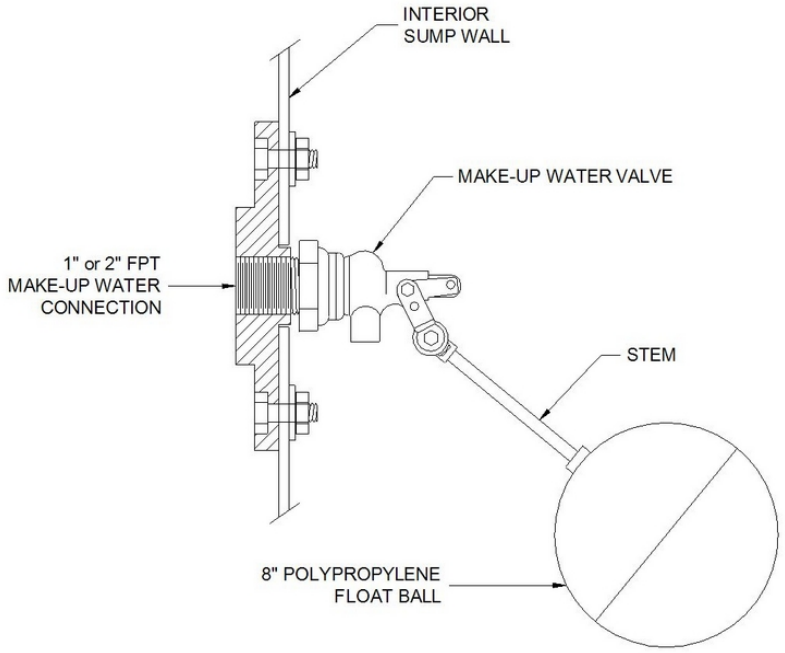


Figure 29 – Mechanical Float Valve

Use the following procedure to set the mechanical float valve. Refer to Figures 29 and 30.

1. Close make-up valve(s).

2. Remove sump lid and make-up valve access cover and set aside. Check sump water level. The proper water level should be within the range of the standard operating level specified in Figure 30.

3. Loosen the nut on the adjustment bolt, then loosen the bolt itself. Do not remove the bolt.

4. Rotate arm and stem to desired water level.

5. Tighten adjustment bolt and nut.

6. Restore water supply and verify that the water level is at the desired operating level.

7. Replace sump lid and make-up valve access cover.

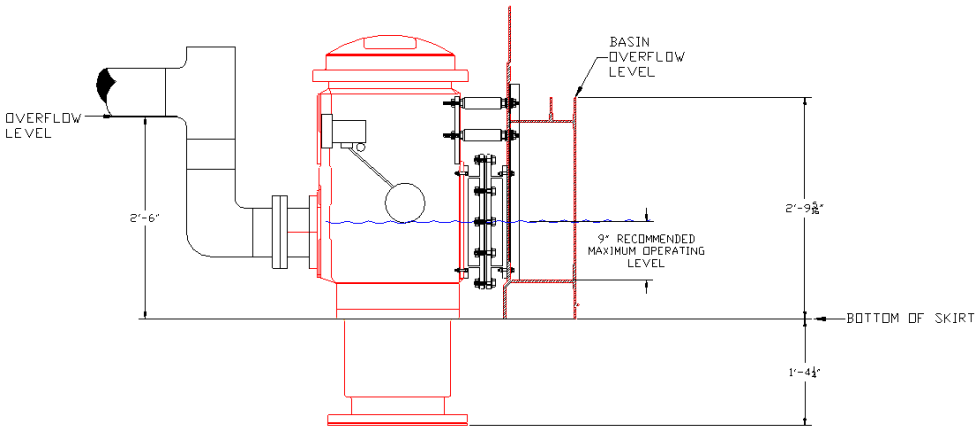


Figure 30 – Sump Level Control Detail

⚠ CAUTION Operating below recommended operating level of 9" (22.9 cm) may cause pump surging.

Overflow is designed to drain water from the basin when water level rises to within 3-3/8" (8.6 cm) of the Water Collection System.

⚠ CAUTION Do not exceed recommended maximum operating level or sufficient head space may not be available to accommodate water during shutdown. Note that the water hold-up volume is based on containing the total amount projected to be in the tower's headers, laterals, and fill, and NOT any of the water in piping outside the cooling tower. Excess water beyond that which can be contained in the basin or evacuated quickly enough via the overflow pipe will empty into the fan shroud, which may cause damage to the fan shroud structure and motor.

8.3 Hydraulics

Refer to Table 11 for respective tower hydraulic data.

TTXL Model	Criterion		
	Minimum Flow - gpm (m^3/h)	Maximum Flow Rate - gpm ** (m^3/h)	Basin Capacity - U.S. Gal (m^3)
i2xxxx	200 (45.4)	600 (136.3)	535 (2.02)
i3xxxx	300 (68.1)	900 (204.4)	810 (3.07)
i4xxxx	400 (90.8)	1200 (272.5)	1085 (4.11)
04xxxx	400 (90.8)	1200 (272.5)	760 (2.88)
i5xxxx	500 (113.6)	1500 (340.7)	1235 (4.67)
06xxxx	600 (136.3)	1800 (408.8)	1050 (3.97)
08xxxx	800 (181.7)	2400 (545.1)	1325 (5.02)
10xxxx *	1000 (227.1)	2700 * (613.2)	1600 (6.06)
12xxxx	1200 (272.5)	3000 (681.4)	1920 (7.27)

* Flow rate above 2,700 gpm (613.2 m^3/h) requires two sumps per tower module.

** Rotary Spray Nozzle rotor disc may spin below 100 gpm (6.3 lps), however this will result in a smaller spray pattern, reduced tower performance and efficiency, and uneven wear of nozzle components. Nozzle operation from 300 gpm to 320 gpm (18.9 lps to 20.2 lps) will result in a larger spray pattern. The rotor disc will spin freely with flows to approximately 320 gpm (20.2 lps) however this flow may exceed tower module hydraulic limits. Nozzle operation above 320 gpm (20.2 lps) may result in uneven wear of nozzle components. Consult Tower Tech engineering manager for more information.

Table 11 – Tower Hydraulic Data

8.3.1 Single Pump Operation Procedure

This procedure describes water level balancing for an installation that is operated by a single system pump.

1. Open inlet water valve(s) to the module(s) approximately 25% open.

2. Start pump.

3. Allow system to operate until the sump float valve(s) closes to allow the make-up water to replenish the water removed from the basin(s) by the pump.

4. If the pump surges, shut off the pump, close the make-up valve(s), and adjust the sump float valve(s) to a higher setting. Repeat Steps 1 through 3.

5. Open the make-up valve(s) to the module(s) to the full open position.

6. Verify the operating level in the module(s) is within the specified range (refer to Figure 28) after the system has equalized.

7. Shut off pump and check sump water level for overflow.

8. If the sump overflows, close the make-up valve(s), lower the float valve(s) setting, and repeat Steps 1 through 8.

8.3.2 Multiple Pump Operation Procedure

⚠ CAUTION Tower Tech cooling towers are designed to be staged ON and OFF in sequence with the start-up and shutdown of system chillers. In certain applications, if pumps are not staged properly, pump surging, chiller shutdown, and/or water overflow into the fan shrouds could occur.

To balance the water level in a multiple pump system:

1. Open inlet water valve(s) to the module(s) approximately twenty-five percent (25%) open and start one pump.

2. Allow the system to operate until the sump float valve(s) closes to allow the make-up water to replenish the water removed from the basin(s) by the pump. If the pump

surges, shut off the pump, close the make-up valve(s), and adjust the sump float valve(s) to a higher setting. Repeat Steps 1 through 3.

3. Open the inlet valve(s) to the module(s) to the full open position and start the second pump. Repeat Steps 3 through 5.

4. Start remaining pumps one at a time by repeating Steps 3 through 5.

5. Verify the operating level in the module(s) is within the specified range after the system has equalized.

6. Shut off one pump.

7. Open drain valves on pumps to simulate evaporation.

8. When sump float valve(s) on module(s) opens, shut off second pump.

9. Shut down remaining pumps one at a time as the sump float valve(s) opens.

10. Close pump drain valves.

11. Check sump water level for overflow. If the sump overflows, shut off the make-up valve, lower the float valve setting, and repeat Steps 1 through 11.

8.4 Initial Fan Start-Up

1. Visually inspect each fan for minimum tip clearance of approximately 1/16” (3.175 mm) before starting fans for first use. If clearance is insufficient, contact a Tower Tech Representative for further instructions. Although tip clearances are quality checked before releasing a TTXL tower, re-inspect them to ensure there was no movement during shipping.

2. Verify that all fan guards are in place and secure.

3. Check for proper fan rotation by energizing each fan motor. Fans rotate in a clockwise direction and push air upwards. Use a qualified electrician to interchange two of the three electrical wires to the motor to correct the rotation if rotation is incorrect.

4. Start each fan and measure the motor amperage. The amperage should not exceed the motor nameplate rating, with service factor, as given in Table 5.

Motor current may run into the service factor in cold weather operating conditions or when the tower does not have a heat load applied.

5. Check the fan staging control to ensure that fans cycle properly. Refer to Section 9.3.

6. Introduce the heat load after checking all of the items listed above.

8.5 Flow Balancing

It is often necessary to balance the water flow entering each cell or pair of cells in multi-cell installations. Remove a section of drift eliminators from the top of each cell to view the water distribution. Flow balancing can be simplified by using isolation valves in both the inlet and discharge piping systems of each module. A typical flow balancing problem and its solution are given below using Figure 31.

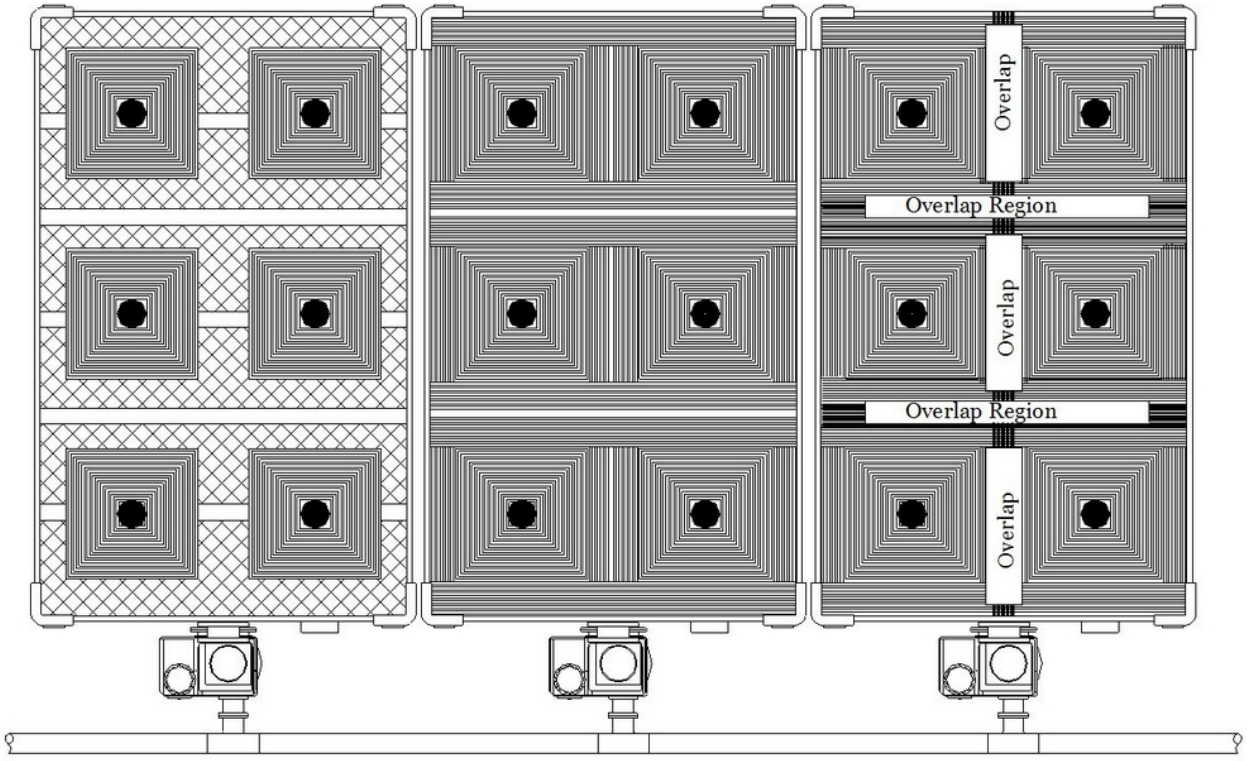


Figure 31 – Typical Flow Balancing Problem (See Below)

Flow Balancing Problem:

Cell #1 (L to R) does not have enough water flow resulting in dry void regions.
Cell #2 has the correct water flow.
Cell #3 has too much water flow resulting in regions of overlapping spray pattern.

Flow Balancing Solution:

Close inlet valve to cell #3 slightly until cells #1 and #3 are like cell #2. It may then be necessary to re-adjust cells #2 and #3.

Rule of Thumb: Always begin flow adjustments with the cell that has the heaviest water flow.

It is recommended that the flow to each tower be balanced using a flow-metering device, such as an ultrasonic meter, as small variations in flow rates may not be visually detectable. These small variations, however, may not allow some towers to function properly, reducing the thermal performance of the system. Once all inlet valves have been adjusted so that each tower receives the same flow rate, some attention must be paid to the tower water levels to insure they are consistent.

In multi-cell installations, pressure differentials in the piping system may cause variations in the water levels of subsequent towers. To equalize these pressure differentials, some adjustments to the discharge piping valves, if equipped, may need to be made. By adjusting the discharge piping valves, the water levels can be equalized, eliminating variations in system performance. These adjustments, however, must be made by qualified personnel to ensure tower performance is not jeopardized.

Chapter Nine: Operation

Due to the TTXL Series Modular Cooling Tower's advanced design there are several operational conditions that will allow efficiency levels not possible in a conventional cooling tower.

9.1 Water Flow Control

The TTXL Series Modular Cooling Tower's Rotary Spray Nozzle makes it possible to supply a wide range of water flow rates to a system. The optimum spray pattern for the nozzle is obtained without significant variation in spray pattern or distribution characteristics when operated from 100 gpm to 300 gpm (6.3 lps to 18.9 lps), which is the approximate upper limit established by tower module hydraulics. Somewhat higher flows may be possible in some tower module sizes; contact Tower Tech engineering manager for specifics. Flows lower than 100 gpm (6.3 lps) are never recommended. Due to the Rotary Spray Nozzle's design, reduced flow rates during part load conditions can be distributed to all towers eliminating the need to shut down individual modules. This allows each module's fill media surface to be fully utilized increasing the efficiency of the system. By ensuring full and continual water coverage of the fill media, scaling is notably reduced. (**The Rotary Spray Nozzle's rotor disc may spin below 100 gpm (6.3 lps) however this will cause uneven wear of nozzle components.** The rotor disc will spin freely with flow to approximately 320 gpm (20.2 lps) however this flow may exceed tower module hydraulic limits; consult Tower Tech engineering manager for specifics. Nozzle operation above 300 gpm (18.9 lps) will result in a slightly larger spray pattern. **Operation above 320 gpm (18.9 lps) may result in uneven wear of nozzle components.**)

Fill media will scale when allowed to intermittently dry out. Scaling affects cooling tower performance.

CAUTION Restarting the cooling tower without resetting inlet isolation valves to 25% may result in water hammering and cause damage to the tower's hot water distribution system header, laterals and or nozzle components.

9.2 Water Temperature

The PVC fill media and PVC hot water distribution system standard in TTXL Series towers are designed for tower entering hot water temperatures not exceeding 130°F (54.4°C) in continuous operation. For applications having hot water temperatures of 130°F to 140°F (54.4°C to 60.0°C) in continuous operation, HPVC fill media and a CPVC hot water distribution system are required.

9.3 Fan Control

9.3.1 Background

Cooling and cost savings benefits may be obtained from cycling the fans on a cooling tower. With the Tower Tech design, each module has a combination of fans that can be staged on or off depending on cooling load requirements. By allowing the total water flow volume in a system to circulate through all the modules rather than just a few, cooling efficiency is increased because of the utilization of the total fill surface area. This increase in efficiency also allows the total fan horsepower usage to be further reduced by eliminating the need for some of the fans to run at low usage times of operation.

With part-load conditions occurring during the majority of the year (namely, spring and fall, or colder seasons), energy savings associated with these conditions can prove very significant. In most geographic climates, full-load conditions occur during less than 10% of the year. Because part-load conditions occur more frequently, efforts to improve system efficiency during these periods can have significant payback rewards.

The Optional Control Panel provides a simple pre-engineered solution for proper control of the fans. It comes complete with a temperature sensor for mounting in a remote thermal well in the discharge water piping of the cooling tower or in the sensor flange provided in the tower module near the discharge sump. The sensor provides the Programmable Logic Controller (PLC) within the panel with the leaving Cold Water Temperature for comparison with the set point for the CWT.

> **⚠ CAUTION** RTDs must be installed in the centerline of a horizontal section of suction piping and at least 12’ from the cooling tower’s attached sump.

The PLC software program controls the staging of the fans to achieve the current set point and match the current load. The fans must be cycled ON and OFF in adjacent pairs, always starting the off-line fans nearest the sump end of the module first and then working toward the “back” end of the module in adjacent pairs. Fans are cycled OFF in

reverse order, with the fans farthest from the sump end stopping first (last on, first off). Failure to cycle fans in this order will result in water blow-by and leakage above the off-line fans nearest the sump end of the tower (rather than below the operating fans).

When operating the tower module with a variable-frequency drive, all fan motors should be operated all of the time, and individual motor overload protection MUST be provided.

For a detailed description of the Optional Control Panel, see Sec.4.2.

For an in-depth discussion of the advantages of variable flow cooling tower operation, refer to section 2.5.

This Manual shows and describes standard power and control wiring and operating procedures only. Tower Tech will supply an appropriate technical supplement for non-standard power and control wiring and operating procedures upon request.

9.4 Cold Weather

9.4.1 Tower Offline During Cold Weather

Any TTXL Series Modular Cooling Tower that will not be operated when ambient temperatures are at or below freezing must have **electrical power to all optional basin heaters must be turned off** and the tower cold water basin must be drained. To drain, remove any of the four Inspection Ports located at each tower module's corners. (Tower modules manufactured after October 2009 also have two Inspection Ports located on the bottom of each Mid-Basin. A tower module manufactured after October 2009 also may contain an optional Basin Drain Kit consisting of a 2-inch stainless steel flange with plastic plug installed in each of two Mid-Basin Inspection Port Covers. To ensure each tower module drains completely, remove any Mid-Basin Inspection Port Cover in each tower module, or any 2-inch plastic plug in each tower module.) Refer to Figure 32. **Refer to Section 9.4.2.**

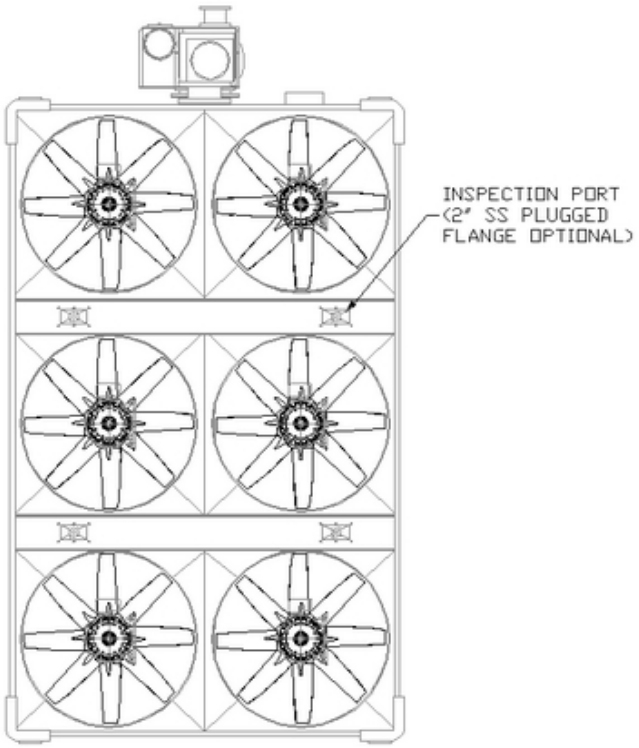


Figure 32 – Mid-Basin Inspection Ports (6-fan tower module shown)

9.4.2 Cold Weather Operations

When the tower will be out of service for an extended period the basin must be drained of water. Drains are to be located in the tower's supply and discharge piping. Also refer to Section 9.4.1. Leave the drain valves open to prevent rain or snow from collecting in the basin, and disable the basin heater. When the cooling tower needs to be shut down without draining the basin, it is recommended that one or more optionally available basin heaters be installed.

Any cooling tower that operates in cold weather may experience freezing. Overflow/equalization piping and stand piping must be heat-traced and insulated. Additionally, a Tower Tech Modular Cooling Tower requires a specific sequence of steps to optimize operations in cold weather: To minimize ice formation and accumulation, the flow rate through each Rotary Spray Nozzle must be 200 gpm (12.6 lps) or greater, and tower leaving water be maintained at or above 45°F (7.2°C).

In freezing conditions it may be helpful to cycle the tower fans OFF periodically in an attempt to remove any ice from within the Water Collection System. Cycle fans OFF more frequently as ambient temperature decreases and tower leaving water temperature is reduced. When temperatures are above 20°F (-6.7°C) ice accumulates more slowly and longer fan cycle times may be used.

The temperature to which water can be cooled without freezing depends on the heat inside the tower module, which is a function of entering hot water temperature, leaving cold water temperature, and water volume. The TTXL Series Modular Cooling Tower with its absence of conventional air inlet louvers, and with its enclosed design and optional ability to stage fans on and off automatically, can often operate in cold weather without significant ice formation. However, it is recommended that VFD be used to reduce air velocity through the cooling tower and thereby lessen the possibility of ice accumulation that could damage the fill media, the Water Collection System, the tower structure, and other components.

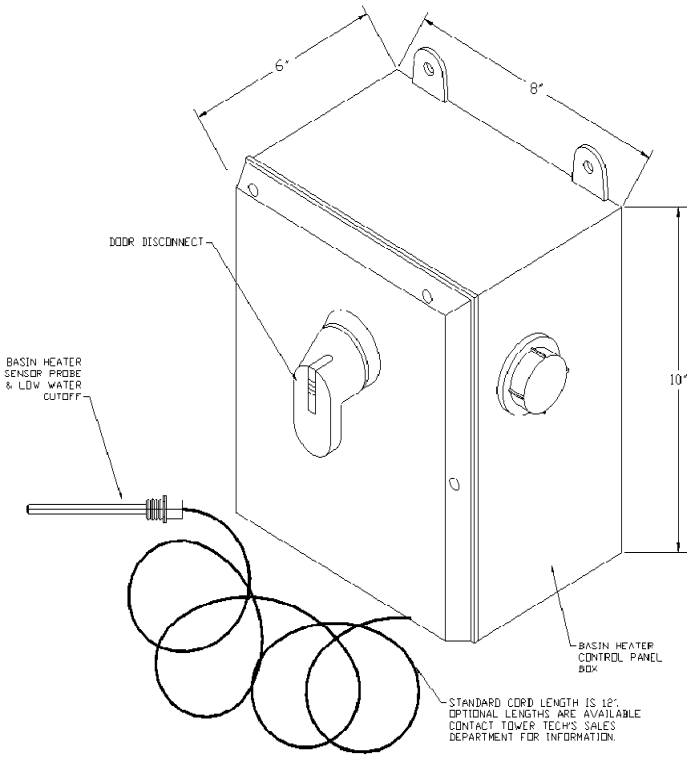


Figure 33 – Basin Heater Control Panel

Maintaining water flow of 200 gpm (12.6 lps) minimum through each Rotary Spray Nozzle (and adhering to the other recommendations in this Chapter) when the ambient air temperature is at or below freezing will maintain sufficient heat in the tower module to prevent accumulation of ice inside or under the tower.

It is recommended that a Tower Tech factory engineer be consulted about cold climate operations and for other design assistance. Variable-frequency drives are especially beneficial in preventing tower icing in areas where the ambient air temperature falls below 20°F (-6.7°C) for extended periods and or where the cooling tower is expected to

produce water colder than 45°F (7.2°C). The latter often occurs in applications where a cooling tower is expected to provide "free cooling" during cold weather operations.

Tower Tech recommends that a TTXL tower not be expected to produce water cooler than 45°F (7.2°C) when the ambient air temperature falls below 20°F (-6.7°C) unless variable frequency drives are utilized, in which case it may be possible to achieve 43°F (6.1°C) leaving water so long as the ambient air temperature remains above 10°F (-12.2°C). Operations in colder conditions may be possible depending on operational variables including but not limited to entering hot water temperature and water flow volume.

⚠ CAUTION It is necessary to flow a minimum of 200 gpm (12.6 lps) through each Rotary Spray Nozzle when the ambient air temperature is below freezing in order to maintain sufficient heat load inside the cooling tower module to prevent accumulation of ice inside the tower.

9.4.3 Optional Basin Heater Installation, Testing, Start-up & Operation

Refer to basin heater user's manual for full installation details.

Optional Basin Heater – General Description

When operating a cooling tower in extreme cold temperatures it is recommended that users specify the use of an electric immersion heater to protect against accidental basin freezing. Tower Tech offers a stainless steel electric immersion heater and control package as optional equipment. The package consists of electric immersion heater element(s), a heater control panel, and a combination temperature/liquid level sensor. This equipment is designed to prevent basin freeze up during shutdown or standby conditions.

The electric immersion heaters are sized (kW rating, voltage, phase, and sensor cord immersion length) for the specific tower, basin size, and climate. Both the heater elements and the control panel are in NEMA-4X enclosures suitable for mounting in outdoor locations.

⚠ CAUTION The basin heater element(s) and control panel(s) are not designed to prevent icing of the tower components during tower operation.

DANGER **Each heater element contains a fused thermal cutoff device that MUST be wired into the safety circuit as detailed in the installation wiring drawing. This cutoff device is wired in series with any other optional safety devices.**

Immersion basin heaters MUST be deactivated when water is flowing through the cooling tower. Failure to do so will result in overheating of the basin heater element and accidental fire.

– For a cooling tower installation having only one pump it is recommended that the heater control system be interlocked with the tower's circulating water pump so the heaters are deactivated when the circulating pump is in operation. Doing so provides further protection against overheating of the basin heater element and accidental fire, and is also necessary for efficient control of free cooling operations.

– For a cooling tower installation having two or more pumps it is recommended that the heater control system be interfaced to a flow or pressure switch located on the inlet piping to the entire cooling tower. Doing so provides further protection against overheating of the basin heater element and accidental fire, and is also necessary for efficient control of free cooling operations.

The heater control panel contains the electronic temperature/low liquid level control, control voltage transformer, and the magnetic contactor used to energize and de-energize the heater element(s). The control panel may control more than one heater element, up to its nameplate voltage, phase, and kW rating, as long as the elements are located in the same tower module basin.

The electronic temperature/low liquid level sensor probe is stainless steel with a 1/2" NPT mounting fitting. It is pre-connected to the control panel with a UL rated outdoor cord.

The sensor has an on/off relay output that de-energizes the heater element(s) whenever the basin liquid temperature is above 45˚F (7.2°C) or whenever the sensor probe is not submersed. A low voltage (12 VAC) is connected across the sensor probe and fitting. When the probe is submersed, a 50 milliamp AC current passes through the conductive liquid from the sensor probe to the mounting fitting, completing the circuit. A break in this circuit indicates low liquid level and de-energizes the heater element(s).

DANGER **Use only Tower Tech-approved combination temperature/liquid sensor probes. Failure to do so may result in accidental fire.**

The 24-V transformer in the control panel provides control voltage for the electronic temperature/low liquid level control and the magnetic contactor(s). The magnetic contactor(s) are used to switch the line voltage to the heater element(s). The operating coil of the contactor is energized by the output relay on the electronic temperature/low liquid level control.

Basin heaters are factory preset (non-adjustable) to maintain a basin temperature of 45ºF (7.2°C). Depending on the size of your cooling tower module, multiple immersion heater elements may be required.

DANGER **Each heater element contains a fused thermal cutoff device that MUST be wired into the safety circuit as detailed in the installation wiring drawing. This cutoff device is wired in series with any other optional safety devices.**

Immersion basin heaters MUST be deactivated when water is flowing through the cooling tower. Failure to do so will result in overheating of the basin heater element and accidental fire.

– **For a cooling tower installation having only one pump it is recommended that the heater control system be interlocked with the tower's circulating water pump so the heaters are deactivated when the circulating pump is in operation. Doing so provides further protection against overheating of the basin heater element and accidental fire, and is also necessary for efficient control of free cooling operations.**

– **For a cooling tower installation having two or more pumps it is recommended that the heater control system be interfaced to a flow or pressure switch located on the inlet piping to the entire cooling tower. Doing so provides further protection against overheating of the basin heater element and accidental fire, and is also necessary for efficient control of free cooling operations.**

Locating Basin Heater Element(s) and Control Panel Enclosure

1. For multiple tower installations having a back-to-back (end-to-end) configuration where each tower requires multiple immersion basin heater elements, verify that a minimum of three feet (.914 m) of access space exists between modules in order to install and later remove the heater element for inspection or service.

2. The control panel can be safely mounted to the tower module's 4.5-inch (11.43 cm) high apron, however care must be taken to remain within the boundaries of the tower apron, avoiding any possibility for penetration of the tower's Perimeter Basin or leaks will result. See Figures 15, 32 and 33 for information regarding the immersion basin heater control panel. Alternatively, the immersion basin heater control panel may be mounted to a corner leg of the tower module. It is recommended that the panel be bolted to a Unistrut mount which is mounted across the leg brace and the leg. If a remote location from the tower is selected for mounting the control panel bear in mind that the unit ships with a standard 12-foot (3.66 m) probe cord length. Longer lengths are optionally available (up to 100 feet, or 30.48 m, in length). Contact your Tower Tech Sales Representative for details.

⚠ DANGER **Use only Tower Tech-approved combination temperature/liquid sensor probes. Failure to do so may result in accidental fire.**

3. Heater element must be inserted into the Tower Tech installed stainless steel flange fitting. The heater element is a 6 kW element manufactured of 304 stainless steel. A NEMA-4X wire junction box is integral to the heater element cap. See Figure 15 for location of the basin heater element.

   Wiring of both the control panel (main input) and of the immersion heater must be completed by a licensed electrician. Only wiring with a temperature rating of 75°C (167°F) and rated to carry the quantity of amperage must be used. All wiring must comply with NEC, CEC, as well as local electrical codes. Refer to the basin heater manual entitled "Cooling Tower Basin Heater Control Panel" (shipped inside the control panel) for details regarding Main Power Input Wiring and Heater Power Wiring.

Optional Immersion Basin Heater: Operating Instructions

Before energizing the main supply disconnect, visually check that the water level is above the sensor probe and that ice has not formed, and adjust the make-up water control valve as needed. The combination temperature/low level control is preset at 45ºF (7.2°C) and the system will not energize if the water level is too low or if the water temperature is above 45ºF (7.2°C). Verify all mechanical and electrical systems are working properly. Complete the system test procedure to verify proper operation (also applies to pre-season test when water temperatures exceed 45ºF, or 7.2°C). Remove all test jumpers before energizing the system.

DANGER **Water Level must be above sensor probe, to prevent accidental fire.**

Under normal operating conditions the energized heater control panel will automatically cycle the heater element(s) ON and OFF if the basin liquid temperature is below 45ºF (7.2°C).

DANGER **Disconnect the heater control panel at its source and tag the circuit out for maintenance before performing the following steps.**

Optional Immersion Basin Heater: Operation Above 45ºF (7.2°C)

a) Disconnect the heater control panel and tag circuit out for maintenance.

b) Remove the heater control panel enclosure cover.

c) Remove the sensor wires connected to terminals T1 and T2 on the combination temperature/low level control and isolate them.

d) Install the 1.5K ohm test resistor supplied with the heater control panel (in bag on inside of cover) across terminals T1 and T2.

e) Install the heater control panel enclosure cover.

f) Energize the system. You should hear the contactor(s) close, energizing the heater(s).

CAUTION Do not operate system unattended or for extended periods with the resistor across terminals T1 and T2. The excessive water temperature could damage the cooling tower.

g) After operation, de-energize the circuit, remove the resistor, and place it back into its storage bag. Check all connections, reconnect sensor wires per the wiring diagram to terminals T1 and T2, replace the cover, and place the system back in service.

Basin Heater Operation If Sensor Probe Is Encased In Ice

a) De-energize the heater control panel and tag circuit out for maintenance.

b) Remove the heater control panel enclosure cover.

c) Install a jumper wire between terminals G1 and G2 on the combination temperature/low level control circuit board.

d) Install the heater control panel enclosure cover.

⚠ CAUTION Do not operate the system unattended or for an extended period of time with the G1-G2 jumper installed. A low liquid level condition could occur and the system will not shut off. This could result in damage to the heater(s) and cooling tower.

e) Energize the system and listen for the contactor closing.

f) Operate the system until the ice is melted around the probe.

g) After operation, de-energize the circuit, remove the jumper, check all connections, replace the cover, and place the system back in service.

Optional Immersion Basin Heater: Installation

This section consists of general information, mechanical installation, electrical installation, and start up.

Optional Basin Heater Installation: General

Carefully plan the locations of heaters, control panels, and probes. Measure the factory supplied probe cord length.

⚠ DANGER **Do not attempt to change the supplied probe cord length.**

The heater control panel should be within sight of the heater if a disconnect switch option is selected. Maintain a water level at least 2 inches (5.1 cm) over the heaters using the makeup water controls (furnished separately with the equipment or by the user). Low water level may lead to overtemperature conditions near the heater. Consider additional safety devices or overtemperature protection.

DANGER **Heater element overtemperature can cause a tower fire.**

Optional Immersion Basin Heater: Control Panel

After selecting the installation site mount the control panel with four 5/16-inch (field supplied) bolts through the mounting feet on the enclosure. Connect the main incoming power conduit to the main power hub and the heater power conduit to the heater power hubs. If alternative conduit hubs are drilled, or if supplied hubs are not used, replace the plastic protective caps inside the hubs with steel plugs. If leakage or condensation is likely to occur in the conduit runs leading to the control panel, install a drain in the bottom of the control panel and form a conduit loop.

Optional Immersion Basin Heater: Temperature/Low Liquid Level Sensor

Mount the combination temperature/low liquid level sensor using the factory installed flange which is install in the basin wall at least one inch (2.5 cm) above and at least six inches (15.2 cm) away horizontally from the stainless steel flange(s) for the heating element(s). Refer to Figures 15, 32 and 33.

DANGER **Do not confine or surround the sensor probe with any type of well, piping, or housing, as it may adversely affect its operation.**

Insert the basin heater sensor probe into the Tower Tech-installed sensor probe flange only. See Figures 15, 32 and 33 for location of the probe flange. Twist the probe in a counter clockwise movement prior to inserting into the flange so that when the probe is properly seated within the flange its wire rests in a relaxed state rather than twisted state. Tighten the locking nut to keep the sensor probe from rotating in the flange. Sensor probe connections to the heater control panel are made at the factory. No electrical installation is required.

Optional Immersion Basin Heater: Main Power Input Wiring

The main incoming power hub and the main power termination points are sized for wires based on the total nameplate kW and voltage. The actual load for a particular installation may be less. Either compute the actual load on the heater control panel

(the total kW of all the heaters connected to it) or use the nameplate rating in determining the wire size required.

Calculate the amperage as follows:

$$\text{Three Phase Amperage} = \frac{\text{Total kW x 1000}}{\text{Voltage x 1.732}}$$

The field supplied branch circuit disconnect switch and the branch circuit protective devices (fusing or circuit breaker) should be sized to carry at least 100% of the current calculated above.

Wiring with a temperature rating of 75ºC should be used. The wiring should be sized for the quantity of incoming wires in the conduit and the amperage of the branch circuit protective device as directed by the NEC/CEC, or any other local directives.

If non-metallic conduit is used, provide a circuit grounding conductor that meets NEC/CEC requirements. Ground lugs are provided in the heater control panel.

Connect the incoming power wire conduit to the incoming power hub provided on the control panel. Make sure the connection is water tight and secure. Pull the incoming power wire into the control panel enclosure and make the connections per the control panel-wiring diagram.

Optional Immersion Basin Heater: Element Power Wiring

One heater control panel may control one or more heaters (up to the maximum nameplate kW rating). The power wiring to the heater(s) must have an ampacity equal to the branch circuit over-current protection device rating, or equal to the rating of sub-circuit fusing if installed in the control panel. Some exceptions to this requirement may apply to a specific installation, such as a tap rules in the NEC/CEC. All heater power wiring should have a temperature rating of 75ºC (167°F), and be rated for the number of wires in the conduit. It must comply with any local codes, NEC, or CEC depending on the installation location. If non-metallic conduit is used, provide a circuit grounding conductor that meets NEC/CEC requirements. Ground lugs are provided in the heater control panel. Connect the heater power wire conduit(s) to the heater power wire hub(s) provided on the control panel. Make sure the connection is water tight and secure. Pull the heater power wire into the control panel enclosure and make the connections per the control panel-wiring diagram. Conduit connections to multiple heaters should be run so that each individual heater is branched off of the run until the conduit terminates at the last heater. Jumpering from one heater to the next is not recommended.

Optional Immersion Basin Heater: Element Safety Wiring

Each heater element contains a fused thermal cutoff device that must be wired into the safety circuit. Wire the safety control circuit per Class 2, Article 725 of the N.E.C. and/or Section 16 of C.E.C. unless wiring is routed in the same conduit as the power wire, in which case Class 2 does not apply and the wiring must be Class 1.

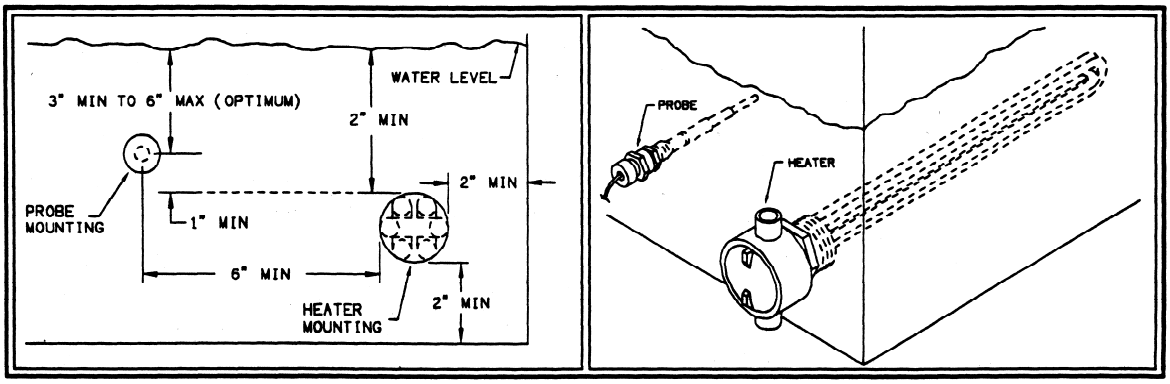


Figure 34 – Location of Basin Heater Probe & Element

Notes:

1. Water level must never fall below two inches above heater elements while heater is energized.
2. Probe must be positioned at least one inch (2.5 cm) above and six inches (15.2 cm) horizontally away from heater. For best performance, probe should be placed between three inches and six inches (7.6 cm and 15.2 cm) below water level.
3. Heater must be positioned at least two inches (5.1 cm) above floor of Perimeter Basin Wall and at least two inches (5.1 cm) from each Perimeter Basin Wall for circulation. For best performance, heater should be placed midway between Perimeter Basin Walls.

Optional Immersion Basin Heater: Start-Up

Once installation is complete, verify proper operation:

a) Check all mechanical and electrical connections to ensure they are tight.

b) Make sure all other system components are installed and ready to operate.

c) Follow the instructions in the basin heater user's manual.

d) Once proper operation has been verified, ensure all jumpers and/or test resistors are removed and permanent wiring is installed and tightened.

Optional Immersion Basin Heater: Troubleshooting

DANGER **Possibly dangerous voltages are present in the equipment. Disconnect electrical service at the source and tag circuit out for maintenance before servicing.**

CAUTION Troubleshooting should only be performed by qualified personnel.

a) Perform a visual inspection of the system to verify:

   1) Basin has adequate liquid level and is not frozen. If liquid level is low check liquid level controls and add water as required. If basin is frozen, refer to above section entitled "Basin Heater Operation If Sensor Probe Is Encased In Ice".

   2) All components appear to be undamaged and in sound operating order. If the heater has a thermal cutoff, check for continuity and replace if open.

b) Check voltage on incoming power lines at the heater control panel. The voltage on all phases should match the nameplate rating. Correct voltage as required.

c) Remove the heater control panel enclosure cover.

d) Disconnect sensor cord and install test resistor across terminals T1 and T2; jumper across terminals G1 and G2.

e) Energize the system:

   1) Measure the voltage at terminals "N" and "24/240" on the circuit board. The voltage should be 21-29 volts. If not, the transformer is faulty and should be replaced.

   2) Measure the voltage at terminals "N" on the circuit board and NO on the relay. The voltage should be between 21-29 volts. If not, the circuit board is faulty and should be replaced.

   3) The green LED light should be ON and the red LED light OFF when the contactor(s) are energized. If not, the contactor(s) are faulty and should be replaced.

4) Remove the test resistor and jumper wire; reconnect the sensor cord.

5) Make sure the liquid level is adequate and at a temperature of 40ºF or below. The green LED light should be ON, the red LED light should be OFF, and the contactor(s) should be energized. If they are not, the cord and sensor are faulty and should be replaced.

f) When the tests are completed and proper operation verified, ensure all jumpers and/or test resistors are removed and permanent wiring is installed and tightened.

g) Replace control panel enclosure cover.

DANGER **Dangerous voltages are present in this equipment. Disconnect electrical service of source and tag circuit out before servicing or replacing components.**

Optional Immersion Basin Heater: Repair

None of the control components are field repairable. Remove and replace any failed components.

Optional Immersion Basin Heater: Maintenance

The system should be inspected annually, just prior to the heating season:

a) Visually inspect the system components for physical damage, overheating, loose connections, leaks, etc. Repair as required.

b) Physically check that all wiring insulation is sound and that all wiring connections are tight. Repair and tighten as required.

c) Check operation.

d) Maintain proper water quality per recommendations of your water treatment consultant. A high chlorine content and/or deposit build-up on the element tubes may reduce heater life. Correct water quality and clean deposits from element tubes as required.

e) Wipe sensor probe to remove any deposit build up.

9.5 Water Treatment

DANGER **The use of untreated water in any cooling tower may cause serious health hazards, including the creation of conditions conducive to the development of Legionella bacteria, which is known to cause Legionnaire's disease. A water treatment program to stop biological contamination must be used for all cooling tower installations in order to reduce such hazards. Do not operate this equipment without a proper water treatment program.**

There are numerous chemical and non-chemical methods currently available for use in treating cooling water. It is beyond the scope of this text to cover the nature and suitability of these methods. However, some general information on what constitutes an effective and complete water treatment program is provided below. In general, a complete program must address the following: 1) scale control; 2) solids control; 3) biological control; and 4) corrosion control (principally for protection of the cooling loop and not the cooling tower).

9.5.1 Scale Control

Although it is commonly understood that scale accumulation has a tremendous impact on the efficiency of chillers and heat exchangers it is a lesser known truth that scale accumulation has an adverse effect on cooling tower thermal efficiency. Even minor visible scale accumulation on cooling tower fill (the tower's heat exchange medium) can prevent the even distribution of water as a thin film across the fill heat exchange surface. In the event that scale accumulation is great it may have a significant impact on static pressures observed within the tower and thus the free and even flow of air through the Water Collection System and fill media. Lastly, significant scale accumulation can impose weight loads upon the tower sufficient to distort walls leading to seal leaks, as well as failures in the water collection system.

Cooling tower water must be controlled for solids, including both dissolved and undissolved solids. Dissolved solids include the scaling ions (e.g. magnesium (Mg), calcium (Ca), sulfate (SO^4), phosphate (PO^4)) and the non-scaling ions (e.g. chloride (Cl), sodium (Na), etc.) Use a tiered approach to control the concentration and impact of dissolved solids on your TTXL Series Modular Cooling Tower and system equipment (e.g. heat exchangers, chillers, etc.): 1) use of scale inhibitor(s) and 2) periodic blowdown or bleed governed by a conductivity or TDS controller. A good rule of thumb for operating Cycles of Concentration is to control the tower's recirculating water conductivity (TDS) at a level which is 3-4 X that measured in the make-up water (applies to water's of average hardness). Exceptions do exist to this rule of thumb depending on

the exact chemical nature of the principal scale ions in the system – see your professional water treater for details.

The TTXL Series Modular Cooling Tower's non-reactive composition allows for most industry accepted scale inhibitors to be used. Scale inhibitor blends typically used are proprietary mixtures of phosphonates (e.g. AMP, HEDP, etc.) and polymers (co and terpolymers, such as polymaleic acid (PMA), phosphinocarboxylic acid (PCA), polycarboxylate copolymer, acrylate polymers) all of which are effective at scale control and have no negative effect on materials used in Tower Tech TTXL Series Modular Cooling Towers. In order for scale control agents to have their best effect it is often necessary to dose the system with acid (e.g. sulfuric acid) to maintain the pH range of 6.5 – 8.5.

⚠ CAUTION If acid is added to the cooling water loop it must be added using an injection quill positioned at the center of the return pipe to the tower and well upstream of the tower to ensure sufficient mixing **before entering tower module**. Failure to do so may result in damage to cooling tower components which are normally resistant materials.

⚠ CAUTION Cooling tower fill media and drift eliminators can be damaged by the use of some chemicals. Always use cleaning and water treatment chemicals in accordance with recommendations of a water treatment contractor.

In addition to the chemicals described above for scale inhibition and/or modification there are numerous non-chemically based methods available in the market and the list of emerging technologies grows yearly. Oxidation-Reduction (Redox) based alloys (copper-zinc) have had an excellent history of scale control in Tower Tech towers. Alternative methods such as ozone must be used with stringent control as ozone radicals are known to embrittle PVC components such as fill media.

9.5.2 Solids Control

Undissolved solids are a measure of the insoluble substances found in suspension in cooling tower waters. Undissolved Solids include larger diameter/heavy particles such as, bacteria, algae, clam/mussel larvae, leaves/twigs, silt in make-up water, dust in air, migrated corrosion particles (free metal oxides). It may also include colloids or complexes generated by using treatment compounds (e.g. stabilizing agents for scale control and crystal modifiers).

The TTXL Series Modular Cooling Tower's absence of side air louvers and open basins dramatically decreases the potential for undissolved solid entry into the circulating loop as compared with conventional tower designs. Further, the presence of a high velocity perimeter basin permits more effective use of centrifugal separators and other in-line physical filtration devices.

Undissolved solids serve as physical foulants which can plug fill thereby reducing tower efficiency, increase chiller head pressures (their deposition increases friction), and damage fill and shell structure by weight imposed. In addition they can contribute to corrosion by preventing the contact of the CI (Corrosion Inhibitor) to the downstream metal surfaces, as well as, promote biofilm formation by shielding microbes from biocides. Controlling these solids is important in allowing lower and more efficient use of treatment chemicals.

An undissolved solids level of 100-150 ppm (particularly those 10 microns or smaller in size) is typically recommended for re-circulating systems. Usually a physical means is used to remove these solids e.g. de-sludgers, cyclones, centrifugal separators, strainers, filters (100 mesh or 150 um particle cut-off), pressurized media filters (sand/gravel beds good for most average industrial applications not exceeding 200 ppm and whose particulates do not exceed 10 um), and cartridge filters (for fine filtering 1 um or less, only chemical plants with stringent downstream requirements will need this; also HVAC systems incoming water 5 ppm or less) are used.

 Solids removal is not a strict requirement for the TTXL Series tower unless 1) the tower is located in a high dust environment, or 2) the downstream process requires higher than normal quality process cooling water in which case it is recommended.

 Blowdown does little in the way of reducing solid loads because there is a chance, albeit remote, that particulates will be positioned near the tower's blowdown valve at the time blowdown or bleed occurs.

 Cyclone or centrifugal separators, as well as other self-cleaning, impervious filtration technologies are preferred over media beds. The latter affords bacteria the opportunity to establish ecological niches insulating them from biocides.

9.5.3 Biological Control

Biological control is important both for safety (e.g. *Legionella*), thermal performance (*Pseudomonas* or slime formers can plug fill), and corrosion control (sulfate reducing bacteria, nitrifying bacteria, and iron reducers can all produce metabolic end products that are damaging to metal surfaces in piping and downstream equipment) reasons.

DANGER **Cooling towers, as well as other water atomizing devices (such as sprinklers, misters, shower nozzles, etc.), are potential vectors for the spread of *Listeria* the causative agent of Listeriosis (a type of pneumoniae). It is crucial that the tower be routinely treated with appropriate biocidal control agents specifically designed to control the proliferation of *Listeria*. Experts agree that oxidizing biocides (chlorine, hypochlorites, hydantoins, chlorine dioxide, sodium bromide with chlorine, and ozone) are the most effective control agents and should be used at a level sufficient to maintain a 0.5 ppm minimum residual chlorine level at all times.**

CAUTION The tower should be located well away from and downwind of building air intakes to further reduce the potential for aerosol to enter buildings. Under no circumstance should a tower be operated without drift eliminators in place and intact.

It is best to combine a non-oxiding and an oxidizing chemical into your cooling water treatment program. Generally the oxidizing biocide (chlorine or bromine based technologies) is administered continually so as to maintain a specific system concentration whilst the non-oxidizing chemical (DBNPA, Quats, glutaraldehyde, isothiazoline) is slug-fed at pre-defined time intervals. Use of both allows for synergisms between their modes of action, as well as, assurance that an antimicrobially resistant sub-population will not occur. It is also recommended that a penetrant or biodispersant (see fouling section) be used in conjunction with the biocide program to enhance the ability of the oxidizing biocide to contact target microbes. This is particularly important if the tower is a process tower wherein organic leaks into the cooling loop are possible.

9.5.4 Corrosion Control

Corrosion control is necessary in TTXL tower systems not for preventing damage to the cooling tower itself, but rather to prevent damage to downstream piping and equipment. The cooling water acts as a delivery mechanism for bringing the corrosion inhibitors to the appropriate metal surfaces. A discussion of corrosion control is beyond the scope of this document however a few things bear noting: A good corrosion inhibitor must: 1) protect all metals involved, 2) act at low concentrations, 3) act under variety of water conditions (pH, temp, other chemicals), 4) have minimal adverse environmental impact.

Chapter Ten: Maintenance

Adequate knowledge of the operation and maintenance of the Tower Tech TTXL Series Modular Cooling Tower will ensure efficient and safe operation. Failure to follow these instructions may result in poor cooling performance, and unnecessary equipment failure. The operation, maintenance and repair of this equipment should be undertaken only by qualified personnel. All such personnel should be thoroughly familiar with the equipment, the associated system and controls, and all procedures dealing with the handling, lifting, installation, operation, maintenance, and repair of this equipment to prevent personal injury and/or property damage.

Tower Tech offers the highest quality replacement parts, materials and services to help customers keep their TTXL Series Modular Cooling Towers operating at peak performance. For details refer to the *Maintenance & Service Plans* brochure located in the flap inside the front cover of this Manual. The brochure describes our Preventive Maintenance Inspection (PMI), Preventive Maintenance Service (PMS), and Service Inspection (SI). Refer to Figure 35.

Figure 35 – Brochure: Maintenance & Service Plans

DANGER **All electrical, mechanical, and rotating machinery constitute a potential hazard, particularly for those not familiar with the design, construction, and operation of same. Accordingly, adequate measures (including the use of a protective enclosure when deemed necessary) should be taken with this equipment, both to safeguard the public from injury and to prevent damage to the equipment and its associated system.**

DANGER **Walking on top of the module is dangerous and could result in serious injury or death. Adequate safety measures must be taken to prevent injury due to falling.**

DANGER **Disconnect any basin heater(s) before draining water from the module's basin. Failure to do so will result in damage to the module, as well as potential for fire to occur.**

10.1 Maintenance Schedule

TTXL Series Modular Cooling Towers are designed to require minimal maintenance. However, the quality of care they receive will affect their service life. The following schedule is given as a minimum checklist to aid in providing the recommended inspection and maintenance of your unit. Refer to Table 12 for recommended maintenance of TTXL components.

Component	Maintenance Frequency	Action To Be Taken	Reference Section
Shell Surfaces	12 months	Visual Inspection for leaks, warping, surface damage	None
Drift Eliminators	12 months	Visual Inspection/Cleaning*	10.1.1
Fill Media	12 months	Visual Inspection/Cleaning*	10.1.2
Rotary Spray Nozzles	6 months	Visual Inspection	10.1.3
Fan Guards	1 month	Visual Inspection/Cleaning*	10.1.4
Fan Blade Clearance	1 month	Visual Inspection	10.1.5
Fan Motors	1 month **	Turn On Briefly	10.1.9
Fan Motors	12 months	Amp/Volt Check	None
Fan Motors	6 months	Visual Inspection	10.1.9
Mechanical Float Valve	3 months	Visual Inspection	10.1.10
Sump Screen	1 month	Visual Inspection/Cleaning*	10.1.11
Immersion Basin Heater	12 months (prior to cold season)	Visual Inspection/Cleaning*	10.1.12
Water Collection System	6 months	Visual Inspection/Cleaning*	10.1.13

***** As required.
** Required only if tower is not operated regularly for an extended period of time.

Table 12 – TTXL Maintenance Schedule

10.1.1 Drift Eliminators

TTXL Series Modular Cooling Towers utilize a low-pressure three pass drift eliminator that is impervious to rot, decay or biological attack. An ultraviolet inhibitor is manufactured into the product to extend life expectancy. Drift eliminators, however, should be inspected once a year (in conjunction with the nozzle inspection). The drift eliminators should be free from any build-up of mud or debris. If cleaning is required, the following procedure should be followed:

1. Remove the drift eliminators. Place gently on an elevated platform or on the ground.

2. Wash the eliminators by spraying with a low-pressure water hose.

3. Turn the eliminators over and spray until remaining debris is removed.

4. Insert the eliminators back into place in the cooling tower.

10.1.2 Fill Media

⚠ CAUTION Distribute personnel loading on the fill media by placing a flat surface, such as a piece of plywood, atop the fill media to prevent damage to the fill and Water Collection System while walking on them.

Inspect the cooling tower fill media regularly depending on the quality of the water being circulated. A typical inspection includes removal of pieces of fill media from all fill layers (starting from the top). Visually inspect the flute openings on the bottom side of the piece to determine if any build-up of algae, bacterial slime or solids has occurred. If build-up is significant, it may be necessary to remove the fill media and clean with water and mild detergent as described for the drift eliminators. If algal growth or bacterial slime is detected, please contact your water treatment professional to control the problem. Overzealous cleaning methods may cause damage to cooling tower components.

⚠ CAUTION Bacterial slime can contribute significant weight loads on the tower beyond that for which it was structurally designed. Damage to tower internals or shell due to bacterial growth excursion will void the TTXL Series Modular Cooling Tower warranty.

10.1.3 Rotary Spray Nozzle

TTXL Series Modular Cooling Towers utilize patented Rotary Spray Nozzles. This nozzle has a large four-inch orifice and a rotating disc that will dislodge nearly all debris commonly seen in cooling towers. While it is unlikely that the nozzle will plug during normal use conditions bi-annual inspection of the nozzles is recommended.

Inspecting the Rotary Spray Nozzle consists of visually inspecting the water distribution pattern. If sticks or large objects are jammed in the nozzle, follow the instructions for removal (refer to Figure 36).

⚠ CAUTION Recommended nozzle operating range is 100 gpm to 300 gpm (6.3 lps to 18.9 lps). Damage to nozzles will occur if operated below 100 gpm (6.3 lps) and above 320 gpm (18.9 lps). **NOTE**: Tower module hydraulic limits may be exceeded if nozzle is operated above 300 gpm (18.9 lps); consult Tower Tech engineering manager before attempting operation above 300 gpm (18.9 lps) per nozzle.

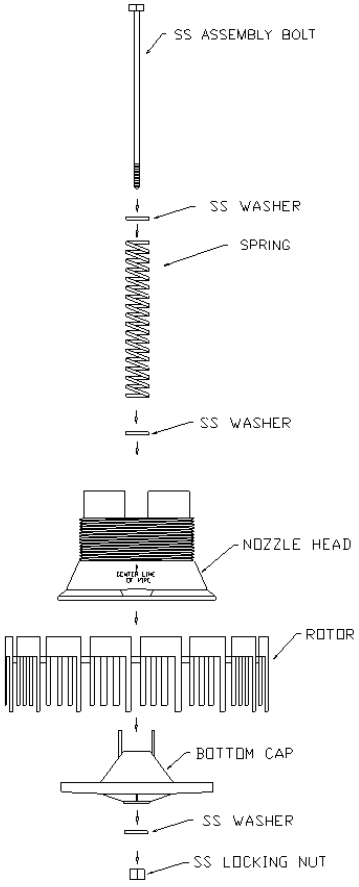


Figure 36 – Exploded View of Rotary Spray Nozzle

⚠ DANGER **The Rotary Spray Nozzle uses a compressed spring. Attempting to disassemble the Rotary Spray Nozzle may cause serious injury. Tower Tech sells replacement Rotary Spray Nozzles as complete assemblies only. Disassembly of Rotary Spray Nozzle voids nozzle warranty.**

To remove the Rotary Spray Nozzle:

1. Expose the Rotary Spray Nozzle by removing the drift eliminators that restrict access.
2. Remove the section of fill media directly below the Rotary Spray Nozzle.
3. Remove the small set screw in nozzle head that locks the Rotary Spray Nozzle in place.
4. Using a strap wrench, unscrew the Rotary Spray Nozzle.
5. Individual Rotary Spray Nozzle components not sold separately. Disassembly of Rotary Spray Nozzle voids nozzle warranty.

⚠ CAUTION If a cooling tower module is valved out seasonally without adjusting flow rates across the remaining cooling tower modules, the Rotary Spray Nozzle's upper flow limit of 320 gpm (20.2 lps) may be exceeded and result in damage to the remaining online nozzles.

10.1.4 Fan Guards

⚠ DANGER **When maintenance is required on fan guards, fans or fan motors it is imperative that lock-out, tag-out procedures be strictly adhered to prevent damage to equipment or personnel.**

Fan guards are mounted in a frame with convenient hinged access. Regularly check the guard for large items such as paper or leaves that might be sucked against the guard. It is important to the performance of the cooling tower that any air restrictions be removed.

To replace a fan guard (refer to Figure 37 for close-up of hinge hardware):

1. Turn off fan and lock and tag out power.
2. Remove the six 1/4" bolts that hold the screen angle to the tower mid basin and perimeter wall using a 7/16" wrench.

3. Unbolt the screen from the hinge by removing the three remaining 1/4” bolts.

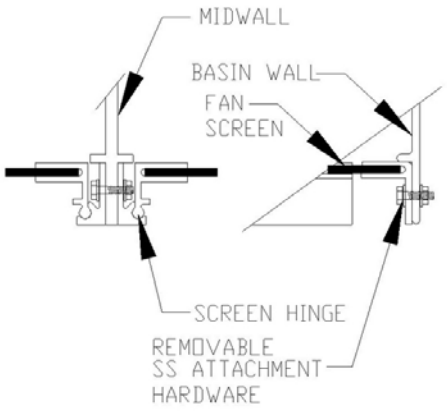


Figure 37 – Close-Up: Fan Guard Hardware

To lower a fan guard (refer to Figure 38):

1. Turn off fan and lock and tag out power.

2. Remove the six 1/4” bolts that hold the screen angle to the tower mid basin and perimeter wall using a 7/16” wrench.

3. At this point you will have full access to the fan and motor.

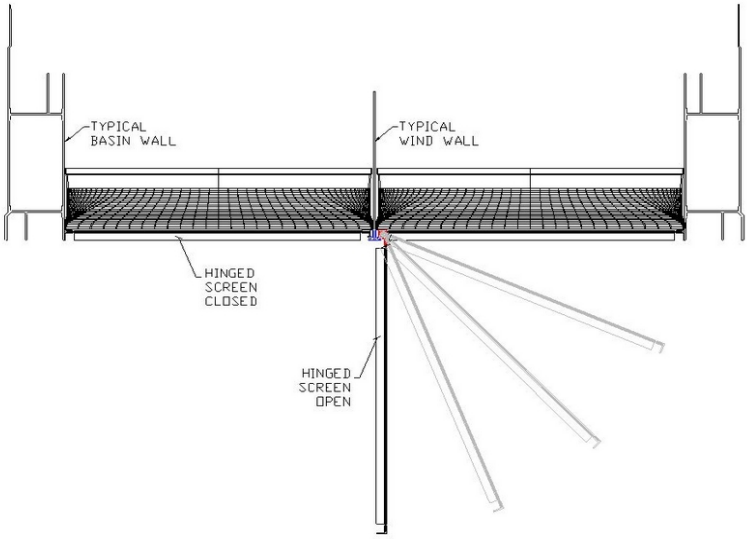


Figure 38 – Opening Fan Guard

10.1.5 Fan Replacement

DANGER **When maintenance is required on fan guards, fans or fan motors it is imperative that lock-out, tag-out procedures be strictly adhered to prevent damage to equipment or personnel.**

Fans are pitched and aligned during assembly. Recommended clearance between fan shroud and fan tip is 1/16-inch (1.6 mm) minimum and 1/2-inch (12.7 MM) maximum. Tower Tech sets fan tip clearance at ¼-inch (6.4 mm) to 3/8-inch (9.5 mm) in the factory. Fan tip clearance should be checked monthly.

To remove a fan:

1. Disconnect power from motor, locking-out and tagging-out the motor/fan to be worked on.
2. Open the fan guard.
3. Support the fan.
4. Remove the bolts from the fan bushing.
5. Thread the bolts back into the threaded holes that are provided in the bushing.
6. Begin tightening the bolts into the bushing evenly until fan is pushed off the bushing. Use a gear-puller if bushing doesn't come off easily.
7. While supporting the fan, tap the bushing gently off the motor shaft.
8. Remove the set key from the motor shaft.
9. Lower the fan to the ground.
10. Mark the fan so that it may be re-installed on the same motor from which it was removed.

10.1.6 Fan Blade Replacement

Individual fan blades should not be replaced without rebalancing the fan. Replace the fan if damage occurs to the blades.

1. Complete steps 1 thru 9 from Checking & Re-Pitching Fan Blades (see Section 10.1.7).

2. Transfer the index tab to replacement fan blade, and place new fan blade into bottom of fan shell half making sure that it is correctly orientated.

3. Proceed with steps 11 thru 19 from Checking & Re-Pitching Fan Blades (see Section 10.1.7).

4. Check fan balance and rebalance fan assembly if needed.

10.1.7 Fan Blade Pitch Adjustment

1. Verify the direction of rotation of the fan with fan operating before removing the fan guard screen.

2. Lock out/tag out the electrical power supply to the fan motors.

3. Remove the fan guard screens from the cells to be worked on.

4. Place a protractor or digital level with degree marks on the upper side of the flat part of the blade, close to the stem, where the blade should have the embossed word "Multi-Wing" on it (place level over the top of the letter "G") and record existing pitch (record the average pitch of all blades of the fan). Refer to Table 2 for correct pitch.

5. Remove the fan assembly from the motor.

6. Record the location and quantity of all balancing washers and nuts holding the hub shell together along with the individual fan blade location on the hub so that you can return all of the parts to their original location.

7. Remove the center Uniboss center hub from the fan shell, marking the orientation first.

8. Remove the bolts that hold the fan shell halves together.

9. Carefully separate the fan shell halves by removing the upper half to expose the fan blades.

10. Locate the index tab on the fan blade, exchange with new index tab for the new pitch angle. Fan Pitch is determined by which index tab is installed to achieve the correct setting.

11. Once the pitch is established by installing the correct index tab for all blades of the fan, replace upper fan shell half and tighten the hub bolts to hold the blades firmly in place. Replace Uniboss center hub and all balancing washers and nuts to their original locations.

12. Recheck the blade pitch after tightening the bolts to ensure that the pitch is correct and record the new pitch setting.

13. Verify that the shell half bolts and Uniboss hub bolts are torqued to 12 ft. lbs. (58.6 kilogram-force/ m^2) using a torque wrench.

14. Re-install the fan assembly onto the motor shaft.

15. Check that the fan is not hitting the shroud.

16. Verify that the taper lock bushing bolts to Uniboss hub are torqued to 12 ft. lbs. (58.6 kilogram-force/m^2) using a torque wrench.

17. Replace the Fan Guard Screens.

18. Remove lock-out/tag-out.

19. Check the fan operation for proper rotation to ensure that there are no other problems and return the unit to service.

10.1.8 Fan Motors Removal / Installation

DANGER **Use lock out/tag out procedures to prevent damage to equipment or personnel when maintenance is required on fan guards, fans, or fan motors.**

To remove a motor:

1. Disconnect power from motor and lock-out and tag-out the motor/fan to be worked on.
2. Open fan guard.
3. Remove fan.
4. Disconnect electrical wiring and conduit.
5. Support the weight of the motor.
6. Loosen the four bolts that connect the motor to the base plate and remove any shims, making note of their placement.
7. Remove the connecting bolts while holding the motor steady.
8. Slowly lower the motor to the ground.

⚠ CAUTION If any of the wire supplied with a fan motor, junction box or safety disconnect requires replacement, use replacement wire of the same gauge and type.

To install a motor, reverse the above procedure.

10.1.9 Fan Motor Lubrication

Standard motors on TTXL Modular Cooling Tower have sealed bearings. If the tower is not operated regularly for an extended period of time, the motors should be turned on briefly once each month. Refer to Table 11.

10.1.10 Mechanical Float Valve

To remove the float valve:

1. Remove sump lid and circular access plate.
2. Remove ball and rod assembly from the adjusting arm.

3. Using proper sized wrench, unscrew the valve from the threaded flange.

To install the float valve:

1. Attach valve to threaded flange.
2. Valve outlet must be pointed straight down.
3. Screw rod and float to adjusting arm.
4. Adjust float for desired water level (refer to Figure 39 for details), then tighten adjusting bolt.

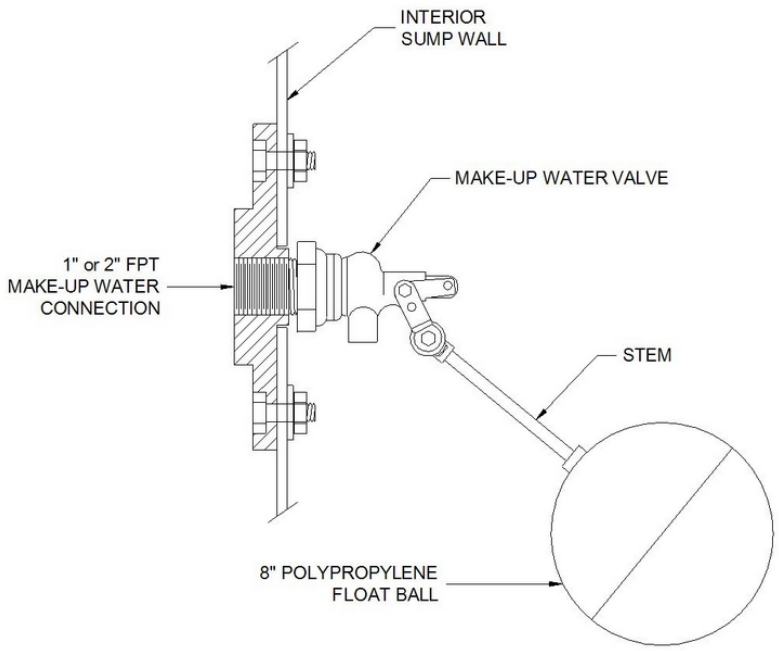


Figure 39 – Mechanical Float Valve

10.1.11 Sump Screen

It is important to visually inspect and document contents retrieved from the sump screen as it can provide valuable information in regards to potential damaging contaminants and preventing their future re-entry into the system. Use a construction start-up screen for extra protection anytime fill media is removed from and reinstalled in the cooling tower.

To remove the sump screen:

1. Shut off pump(s).
2. Remove sump lid.
3. Pull screen out of sump.
4. Empty contents of screen.

To install the sump screen, reverse steps 1 through 3.

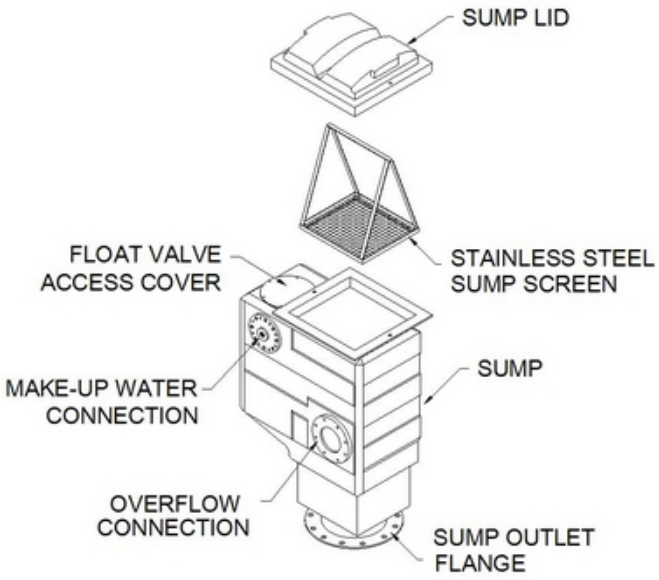


Figure 40 – Sump Layout, Sump Screen Detail

10.1.12 Immersion Basin Heater

Check the system annually, just prior to the start of the winter operating season, as well as anytime the tower is drained.

1. Visually inspect probe, panel, and heater for physical damage, evidence of overheating, loose connections, leaks, etc.

2. Make sure that the conduit plugs are in place for unused connection ports in the heater element wire box.

3. Visually inspect all wiring insulation for integrity and connections for tightness.

4. Wipe sensor probe to remove any build-up.

5. Verify that tower water quality is being properly maintained. Specific attention should be paid to excessive chlorine levels that may shorten heater lifespan.

6. Refer to Section 9.4.3 for details on test procedure to verify that the immersion basin heater energizes properly.

⚠ DANGER **Exercise caution when servicing or troubleshooting the immersion basin heater. Always refer to the basin heater user's manual before starting work. Only qualified personnel should perform maintenance on the immersion basin heater.**

10.1.13 Water Collection System

The TTXL Series Water Collection System is an effective air-water separator that will operate trouble-free for extended time periods if it is periodically inspected and maintained as prescribed herein. The Water Collection System also supports the weight of the fill media and the design water load.

⚠ CAUTION The WCS is permanently installed in the tower module with hardware and caulking materials. Non-Tower Tech factory personnel should never attempt to lift or move the Water Collection System as doing so can permanently damage the tower and void the tower warranty.

The TTXL Series Modular Cooling Tower's Water Collection System is designed so that adjacent fans must be operated in pairs. Thus, in a four-fan tower module, fans #1 and #2 should always operate simultaneously, and fans #3 and #4 should always operate simultaneously.

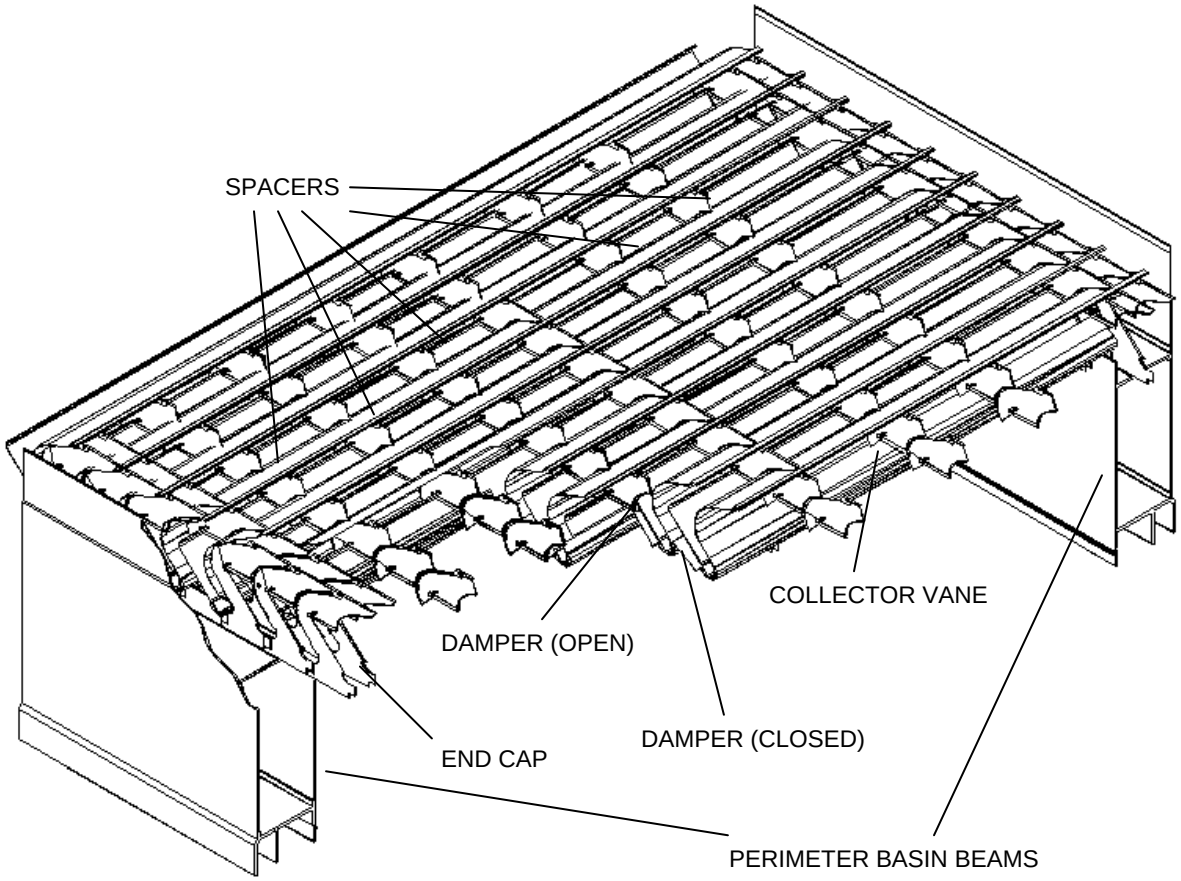


Figure 41 – Water Collection System

The main components of the Water Collection System include:

- Collector Vanes: Each collector vane is approximately eight inches (~20.3 cm) wide and 14 inches (~35.6 cm) high and is installed transversally in the tower module. Collector vanes are a series of overlapping chevron-shaped troughs that capture cooled water falling from the fill media and channel it into the perimeter basin beams. Refer to Figure 41.

- End Caps help hold the collector vanes together and secure the Water Collection System to the Perimeter Basin Wall to prevent leaks. End caps are installed in pairs ~2.5 inches (~6.4 cm) apart at the end of each collector vane. One End Cap is also installed at the center of each collector vane. Refer to Figures 41 and 42.

- Spacers installed ~15 inches (~38.1 cm) apart along the entire length of each collector vane fasten the Water Collection System together. Refer to Figures 41 and 42.

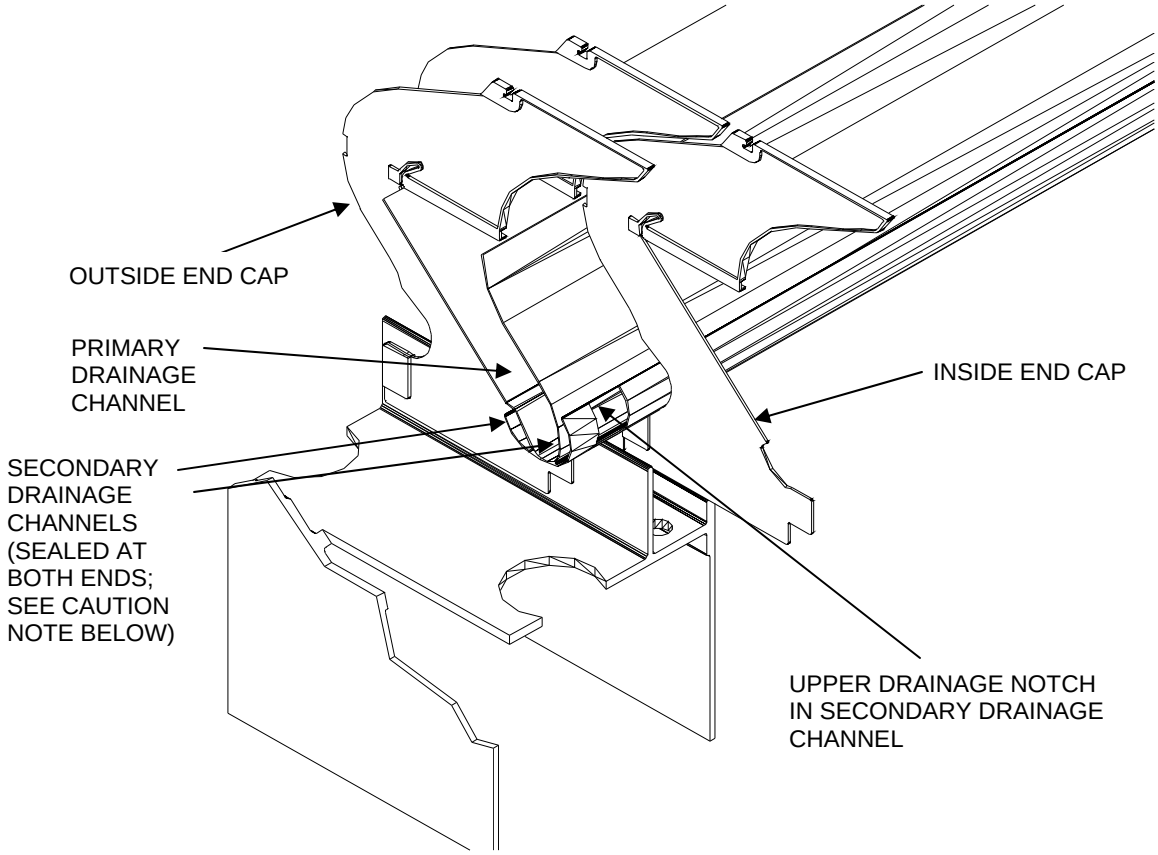


Figure 42 – Close-Up View: Water Collection System

- Secondary Drainage Channels: Located at the bottommost section of a collector vane, secondary channels are designed to capture water drops adhering to the exterior surfaces of a collector vane. If a secondary drainage channel becomes clogged with scale, dirt or debris, it is possible that some water may escape containment. Secondary drainage channels should be inspected periodically, both visually and by feel, to ensure they are free of scale, dirt and debris. Refer to Figure 42.

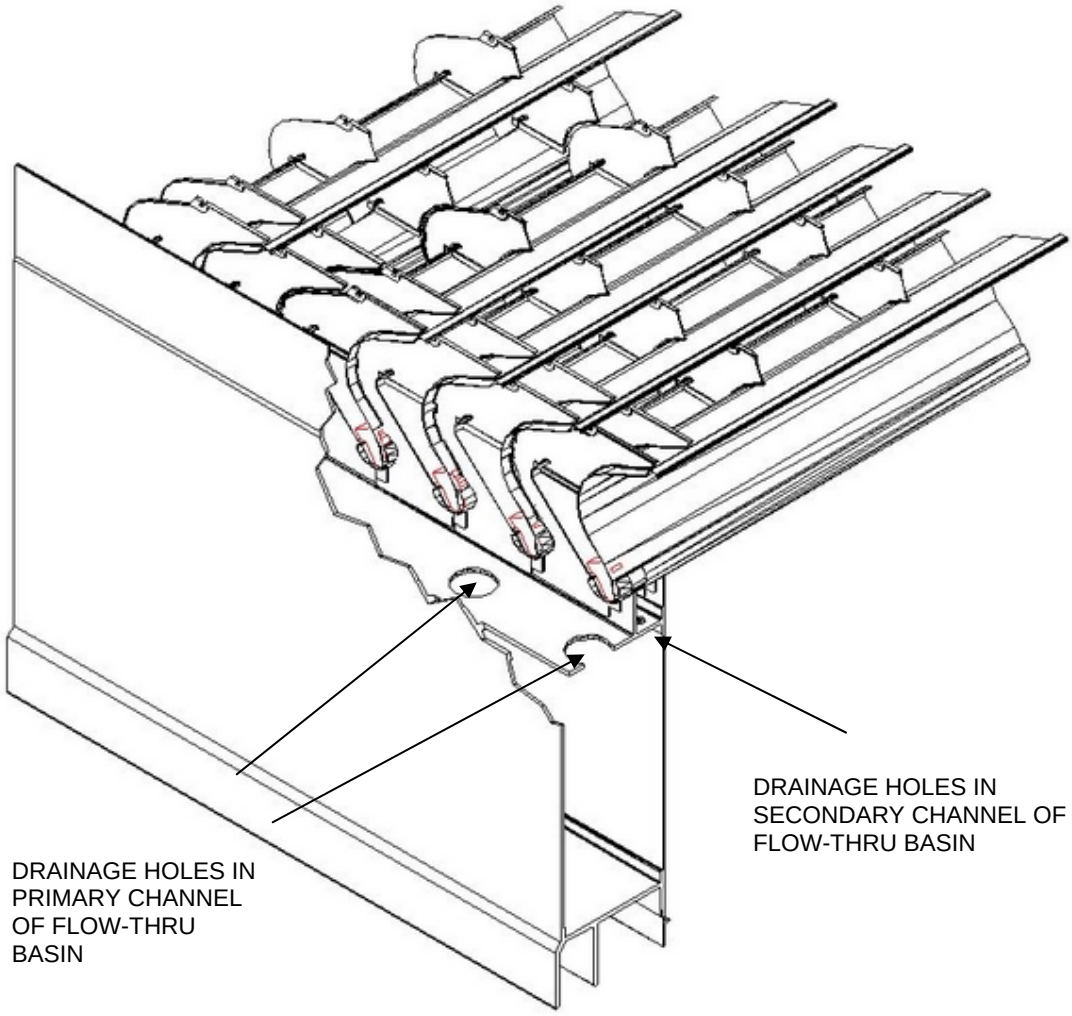


Figure 43 – Flow-Thru Basin Drainage (Perimeter Basin Wall)

- Secondary Drainage Channel Drainage Holes. Each end of a secondary drainage channel has a drainage hole (or notch) located between each pair of end caps. The drainage hole allows any water flowing in a secondary channel to escape into the perimeter basin beam. These holes are hidden from view and can only be felt by hand. If a secondary channel's hole or notch becomes plugged by scale, dirt or debris, water may overflow the secondary channel into the fan area. Refer to Figures 42 and 43.

⚠ CAUTION The ends of Secondary Drainage Channels have been plugged with caulking material at the factory to prevent water leaks. If the caulk is removed, air moving rapidly within the Perimeter Basin Wall can force water flowing in the Perimeter Basin Wall to flow into the Secondary Drainage Channels, quickly filling them to capacity and causing them to overflow. Use care when cleaning Secondary Drainage Channels and Drainage Holes. Do not attempt to force "debris" from the ends of a Secondary Drainage Channel, as doing so may inadvertently dislodge caulking material which helps prevent leaks.

- Dampers. Installed between collector vanes on the bottom of the Water Collection System, dampers are designed to open automatically when the fan beneath it is turned ON, and to close automatically when the fan beneath it is turned OFF. Dampers thereby help contain airborne water drops inside the Water Collection System. Dampers require periodic visual inspection to ensure they are opening and closing fully and freely. Refer to Figure 41.

- Flow-Thru Basin Primary Drainage Holes in the Perimeter Basin Wall allow cooled water exiting the Water Collection System to flow into the Flow-Thru Basin. Refer to Figures 41, 42 and 43.

- Flow-Thru Basin Secondary Drainage Holes in the Perimeter Basin Wall allow any water that escapes primary containment within the collector primary drainage channels to be channeled back into containment within the perimeter basin beam. Refer to Figures 42 and 43.

To access and perform service on the bottom section of the Water Collection System:

1. Disconnect the power to the fan by locking out and tagging out the appropriate motor.

2. Open the fan screen (remove fan from motor shaft if necessary).

3. If a Damper does not fit properly or is sticking, remove the damper from the secondary channel. Each Damper is held in place by an F-shaped side that hinges loosely on the top of the secondary channel. Refer to Figures 41 and 43.

4. Clean the bottom side of the Water Collection System with a power washer. Clean both sides of the collector vanes all the way up to the bottom of the fill media.

If necessary to remove additional scale, dirt and debris, use a straight tool (tilt the tool at a ~75° angle to the direction of the collector vane) by sliding the tool down the entire length of the secondary drainage channel and carefully guiding the tool through the end cap. Locate the notch in the end of the secondary drainage channel by moving the tool gently along the bottom of the secondary drainage channel, then gently dislodge any scale, dirt and debris by pulling toward you and removing it, or by pushing it gently through the notch located near the end of the secondary drainage channel. The end of the secondary drainage channel has been sealed with caulking material at the factory; removal of this material during the cleaning process will damage the Water Collection System and result in leaks.

⚠ CAUTION Do not attempt to push or otherwise force the factory-applied caulking material out of the end of the secondary channel. Doing so will damage the Water Collection System and result in leaks.

5. Use care to avoid cracking or otherwise damaging a damper or collector vane when removing or installing a damper. After installing a damper, make sure it opens and closes fully and freely.

6. Re-seal all end caps and areas where sealant may have been removed during your work, to prevent leakage. Note that during the cleaning process the membranes of sealants and caulks may be breached and may contain small holes that are not easily seen. Always use factory-approved sealants and caulking materials.

7. Reinstall the fan (if it was removed) and fan screens in their correct operating positions.

8. Remove your lock/tag from the control panel or cooling tower.

9. Check for proper operation of each fan and motor, and visually observe each damper for correct operation.

To access and perform service on the upper section of the Water Collection System:

1. Shut off water to-from tower module.

2. Access to the interior of the tower module is through the top of the module. Remove the drift eliminators over the area of the Water Collection System to be accessed.

DANGER **Do not walk on drift eliminators, as they are not designed to safely support the weight of personnel.**

CAUTION The Water Collection System and fill media will support the live load of personnel at 200 lbs./ft^2 (27.7 kg-force), to a maximum of 204 kg total per cooling tower module. **Tower Tech recommends avoiding walking on the fill media or Water Collection System** unless pieces of one-foot x two-foot (30.5 cm x 61.0 cm) plywood are used for load distribution, to minimize the possibility of damaging fill media and Water Collection System.

3. Take note of how the fill media sections are stacked in the tower module.

4. Remove the sections of fill media above the area of the Water Collection System that you wish to access and inspect each log for scale, dirt and debris. Any fill pieces that are heavily contaminated by scale, dirt or other debris should be removed from the tower module and power washed. Any fill pieces not contaminated by scale, dirt and other debris can be stacked temporarily on top of other fill elsewhere in the tower module. If necessary, additional drift eliminator sections may be removed to make room to stack clean fill pieces elsewhere in the tower module. Clean fill media may also be placed temporarily on top of installed drift eliminators, provided that no more than one layer of clean fill is placed on top of installed drift eliminators.

CAUTION When removing fill media, note the location of scale, dirt and debris within the fill media, from top to bottom, i.e. "The top layers of fill contained showed no sign of scaling, but the bottom layer had a slight scale residue." Such information may be helpful as you discuss your tower with a water treater or with Tower Tech's customer service staff.

5. Inspect the top section of the Water Collection System for scale, dirt and debris and remove any scale, dirt and debris by power washing.

6. Reinstall clean fill media in the tower module in the same way it was installed by the factory.

7. Reinstall drift eliminators.

8. Turn on water to-from tower module.

10.2 Spare Parts

The inherent redundancy and reliability of the TTXL's multiple-fan, direct-drive design assures customers that tower performance and efficiency will not be materially impaired if one motor/fan is offline. This redundancy and reliability, and Tower Tech's stock of readily available parts, enable most customers to avoid stocking spare parts. We recommend the following for customers that prefer to maintain a small spare parts inventory:

Part Description	Single Module Installation	Multiple Module Installation
Fans	1	1
Motors	1	1
Rotary Spray Nozzle	1	1

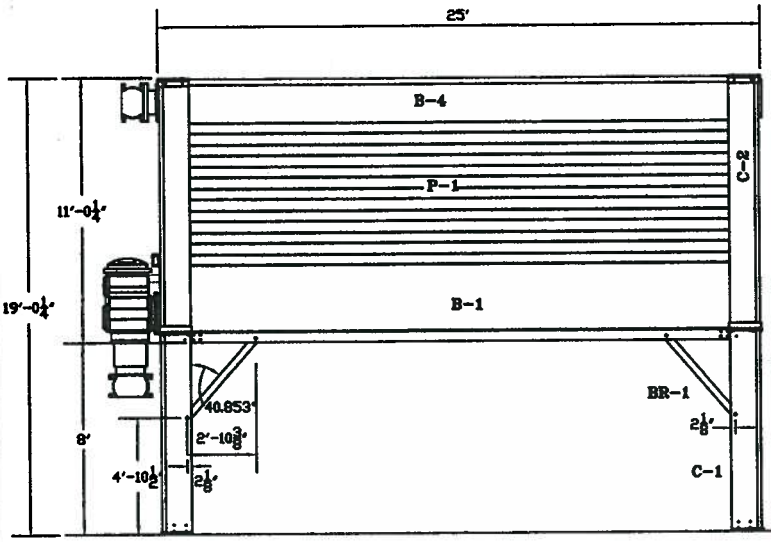
Table 13 – Recommended Spare Parts Inventory

The customer is responsible for selecting, purchasing, and maintaining a parts inventory consistent with its own needs. Tower Tech stocks most tower parts for immediate shipment. For further information contact a Tower Tech Customer Service Representative at (405) 979-2123 or Service@TowerTechInc.com.

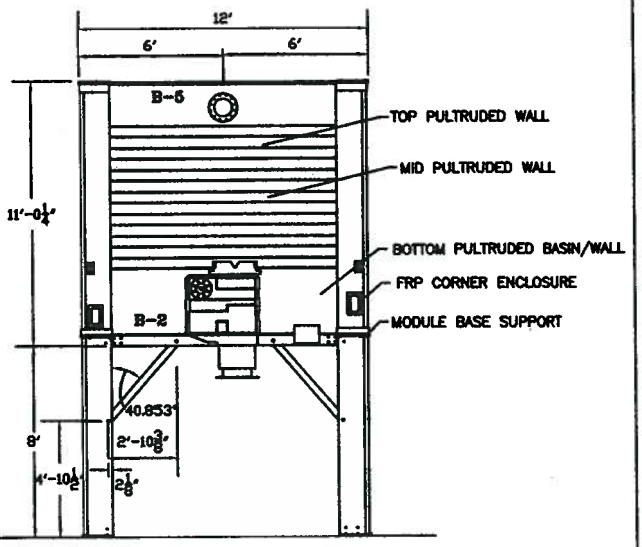
Chapter Eleven: Appendix

11.1 Index of Figures

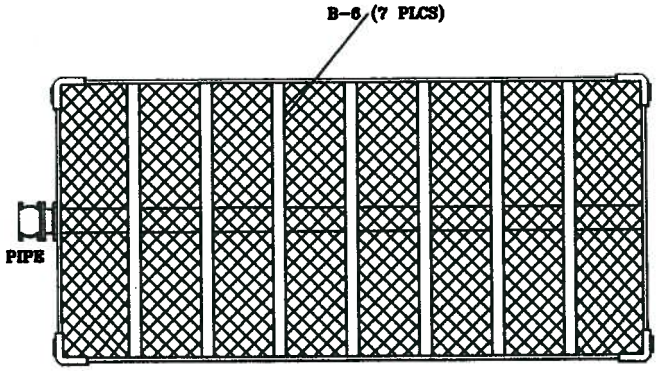
11.2 Index of Tables and Graphs



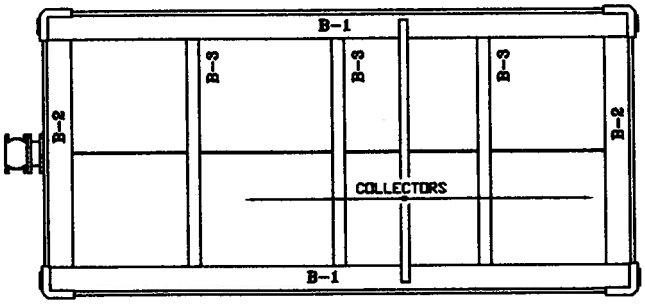
SIDE ELEVATION



FRONT ELEVATION



PLAN @ TOP



PLAN @ BASE

SHIPPING WEIGHT: 13,950 lbs
OPERATING WEIGHT: 25,090 lbs
APPLIED STANDARD: ASCE7-05

REGISTERED PROFESSIONAL ENGINEER
JEROME R. KING
No. C 041288
Exp. 3/31/09
CIVIL
STATE OF CALIFORNIA

I hereby certify that this plan, specification or was prepared by me or under my direct supervision and that I am a duly licensed Engineer under the laws of the State of California.

Date: 1/3/09 Reg. No. C 041288

FOR APPROVAL BY		DATE
APPROVER1		
APPROVER2		APPROVER2
REVISIONS		
NO.	DATE	REVISION
REV1	REVDATE	REVISION
REV2	REVDATE	REVISION
REV3	REVDATE	REVISION

CONAME1
CONAME2
SITE
LOCATION

Modular
TOWERTYPE
Cooling Tower
Model # TTXL-08

TOWER TECH, Inc.
THE TECHNOLOGY COMPANY
TELEPHONE: (405) 390-7768
FAX: (405) 670-2131
E-MAIL: cad@towertechinc.com

DATE:	DATE
DRAWING#:	NUMBER
PROJECT#:	PROJECT
CUST PO#:	PO
DRAWN BY:	DRAWN
CHECKED BY:	CHECKED
TITLE1	S-1
TITLE2	

J.R. KING ENGINEERING

10890 NORTHMARK DRIVE
EDEN PRAIRIE, MN 55344
952 944-1391
952 944-0588 (FAX)

Title:
Fiberglass modular cooling tower – TTXL-08

Purpose:
Analyze and design the components of the fiberglass cooling tower.

References:

1. AISC, Steel Construction Manual, 8th edition
2. Structural Engineering Handbook, 2ND edition
   By Gaylord & Gaylord, 1973 McGraw-Hill
3. Aluminum Structures, 2nd edition
   By J. Randolph Kissell & Robert Ferry
4. Risa3d – Rapid interactive structural analysis,
   three dimensional, computer software

Specifications:

1. Tower Tech tests and material properties data
2. Creative Pultrusions, Inc. material properties data

Design Requirements:
The design loads shall be in accordance with the IBC (International Building Code). Wind, seismic and gravity loadings are applied. The illustrated tower shell and substructure is designed to withstand a wind pressure of 41 psf (ASCE7-05 150 mph wind, exposure C) and a seismic force factor: Cs = .4x weight, category D (Ss =200, S1=150, soil class E).

Procedures:
Procedures are the methodologies indicated in the listed references, as specifically presented within the calculations. To use the AISC equations and built-in sections within risa3d, the fiberglass properties have been put in place of the steel; the printouts that have "Steel" headings are calculated as fiberglass and should be interpreted as such. The properties of the fill material are based on actual in-house tests. Safety factors are calculated and compared to those for steel, aluminum, and wood.

Conclusions:
The analysis and design of the subject cooling tower and their appurtenances have been completed satisfactorily.

J.R. KING

LATERAL WIND:

150 MPH Ex "C"

$q_z = .00256(150)^2 \times .77 \times .9 \times 1 = 41.1 \text{ psf}$

$F_x = q_z G C_f A_f = 41.1(.85) \times 1.3 \times A_f = 45.4 A_f \text{ psf}$

$F_x \div A_f = 190 \text{ ft}^2 = 8.63 \text{K/side}$

SEISMIC FACTORS

$Q = 1.33$

$E_h = 1.33 Q_E$

$E = E_h = 1.33 + .2A_0$

$.7E = S_x = E.$

J.R. KING,

LATERAL FORCES,

SEISMIC FORCES;

ASCE/SEI 7-05 CHAPTER 15

15.4 → 12.8

$C_S = S_{DS}/R/I$ 12.8-2

$C_S \geq .8 S_1/R/I$ 15.4.2

LARGEST SEISMIC ACCELERATIONS.

$S_S = 200\%g$ SOIL CLASS E: $F_V = 2.4$

$S_1 = 150\%g$ $F_A = .9$

$S_{DS} = 2/3 \cdot 9 \times 2 = 1.2$

$S_{D1} = 2/3\ 2.4 \times 1.5 = 2.4$

SEISMIC DESIGN CATEGORY "D"

TABLE 15.4-2 $R = 3$ $\Omega_0 2$ $C_d = 2.5$

$C_S = 1.2/3 = .4$

$C_S \geq .8 \times 1.5/3 = .4$ ← USE.

$V = C_S W = .4 \times 25.1 = 10^K$

J.R.KING
9/24/08

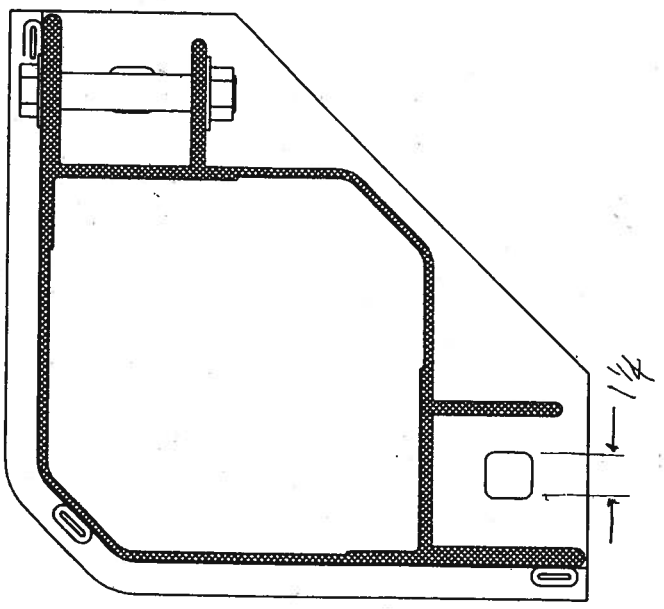
ANCHORING

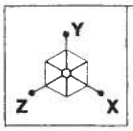
MAXIMUM UPLIFT : 5.5^{k}

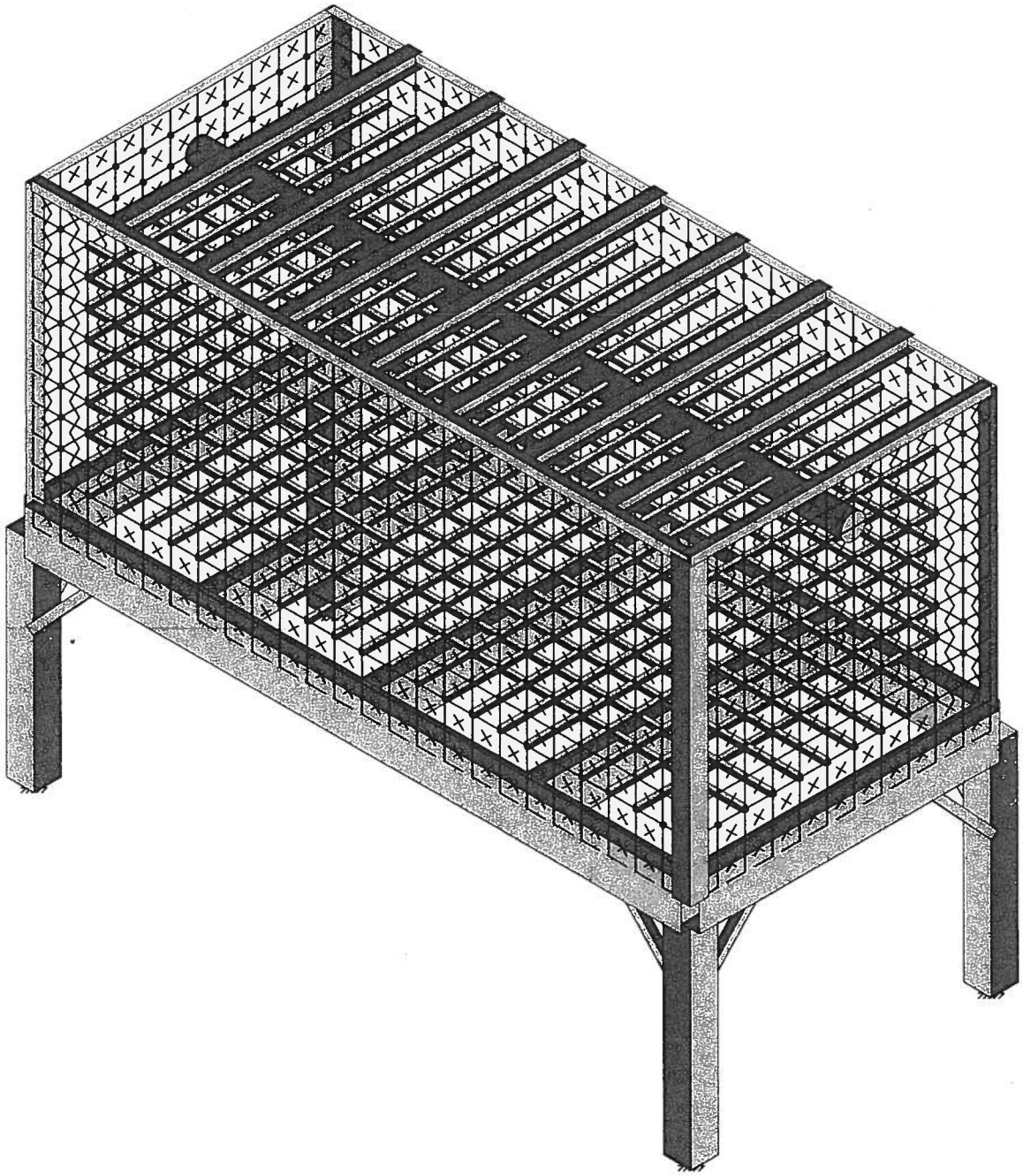
MAXIMUM SHEAR: 2.6^{k} (LONG.), 3.0^{k} (TRANS.)

COLUMN BASE PLATES.

USE 1/4" THICK 2x2 WASHERS:







J.R. King Engineering	Tower Tech TTXL	
Jerry King		Dec 29, 2008 at 9:52 AM
		TTXL-08.r3d

Global

Display Sections for Member Calcs	3
Max Internal Sections for Member Calcs	99
Include Shear Deformation	Yes
Include Warping	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC: ASD 9th
Cold Formed Steel Code	AISI 99: ASD
Wood Code	NDS 91/97: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2002
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	PCA Load Contour
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E5 F)	Density[k/ft^3]	Yield[ksi]
1	fiberglass	2000	500	.12	.44	.11	20

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E5 F)	Density[k/ft^3]
1	FIBERGLASSPL	2000	500	.12	.44	.11
2	RIGID	100000		0	0	0
3	GM3	25	6	.12	.44	0

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rul...	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	C-1	HSS12X12X6	Column	Single Angle	fiberglass	Typical	15.94	357.042	357.042	560.503
2	C-2	L8X8X14	Column	Single Angle	fiberglass	Typical	13.2	79.6	79.6	3.46
3	B-1	HSS20X8X10	Beam	Tube	fiberglass	Typical	30.329	338.386	1439.466	916.421
4	B-2	HSS20X8X10	Beam	Tube	fiberglass	Typical	30.329	338.386	1439.466	916.421
5	B-3	HSS20X8X10	Beam	Tube	fiberglass	Typical	30.329	338.386	1439.466	916.421
6	B-4	L4X4X8	Beam	Single Angle	fiberglass	Typical	3.75	5.56	5.56	.322
7	B-5	L4X4X8	Beam	Single Angle	fiberglass	Typical	3.75	5.56	5.56	.322
8	B-6	W6X20	Beam	Wide Flange	fiberglass	Typical	5.87	13.3	41.4	.24
9	PIPE	PIPE_10.0	Beam	Pipe	fiberglass	Typical	11.1	151	151	302
10	BR-1	HSS3.5X3.5X4	VBrace	Tube	fiberglass	Typical	2.9	5.03	5.03	8.335
11	COLLECTOR	C8X11.5	Beam	Channel	fiberglass	Typical	3.38	1.32	32.6	.13

General Section Sets

	Label	Shape	Type	Material	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	GEN1	RE4X4	Beam	FIBERGLASSPL	16	21.333	21.333	31.573

General Section Sets (Continued)

	Label	Shape	Type	Material	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
2	RIGID		None	RIGID	1e+6	1e+8	1e+8	1e+6
3	FILL	RE2X2	Beam	GM3	4	1.333	1.333	1.973

Load Combinations

	Description	Sol...	PDel...	SR...	BLC	Fac...	BLC	Fac...	BLC	Factor	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Factor
1	IBC 16-8				DL	1														
2	IBC 16-9	Yes			DL	1	LL	1												
3	IBC 16-12 (a..	Yes			DL	1	WLX	1												
4	IBC 16-12 (a..	Yes			DL	1	WLZ	1												
5	IBC 16-12 (b..	Yes			DL	1	SX	.171												
6	IBC 16-12 (b..	Yes			DL	1	SZ	.202												
7	IBC 16-13 (a..	Yes			DL	1	WLX	.75	LL	.75										
8	IBC 16-13 (a..	Yes			DL	1	WLZ	.75	LL	.75										
9	IBC 16-13 (b..	Yes			DL	1	SX	.128	LL	.75										
10	IBC 16-13 (b..	Yes			DL	1	SZ	.151	LL	.75										
11	IBC 16-14 (a)	Yes			DL	.6	WLX	1												
12	IBC 16-14 (b)	Yes			DL	.6	WLZ	1												
13	IBC 16-15 (a)	Yes			DL	.6	SX	.171												
14	IBC 16-15 (b)	Yes			DL	.6	SZ	.202												
15	SEISMIC				SX	1	SZ	1												
16	Deflection				DL	1	6	1												

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed	Area (M...	Surface (...
1	DEAD	DL		-1						
2	FILL	DL						2		
3	WATER	LL						2		
4	WIND-Z	WLZ								528
5	WIND-X	WLX								121
6	DEFLECTION	None				1				

Envelope AISC ASD Steel Code Checks

	Member	Shape	Code Check	Loc[ft]	LC	She...	Loc[ft]	Dir	LC	Fa [ksi]	Ft [ksi]	Fb y-y [ksi]	Fb z-z...	Cb	Cmy	Cmz	ASD ...
1	M30	HSS3.5X3.5X4	.455	2.121	4	.008	4.423	y	5	6.153	12	13.2	13.2	1	.6	1	H1-1
2	M32A	HSS3.5X3.5X4	.455	2.121	4	.007	0	y	13	6.153	12	13.2	13.2	1	.6	1	H1-1
3	M29A	HSS3.5X3.5X4	.387	2.076	6	.008	0	y	5	6.153	12	13.2	13.2	1	.6	1	H1-1
4	M31A	HSS3.5X3.5X4	.366	2.076	5	.011	4.423	y	6	6.153	12	13.2	13.2	1	.6	1	H1-1
5	M30A	HSS3.5X3.5X4	.365	2.076	5	.011	0	y	6	6.153	12	13.2	13.2	1	.6	1	H1-1
6	M31	HSS3.5X3.5X4	.341	2.076	6	.007	4.423	y	13	6.153	12	13.2	13.2	1	.6	1	H1-1
7	M3	HSS12X12X6	.284	4.735	4	.045	0	z	4	9.811	12	13.2	13.2	1	.6	.6	H1-2
8	M4	HSS12X12X6	.284	4.735	4	.045	0	y	4	9.811	12	13.2	13.2	1	.6	.6	H1-2
9	M24	PIPE 10.0	.258	12	4	.032	0		4	1.689	12	13.2	13.2	1	1	.85	H1-2
10	M1	HSS12X12X6	.247	4.735	12	.044	0	z	12	9.811	12	13.2	13.2	1	.6	.6	H2-1

Envelope Plate/Shell Principal Stresses

	Plate		Surf...	Sigma1 [ksi]	LC	Sigma2 [ksi]	LC	Tau Max [ksi]	LC	Angle [rad]	LC	Von Mises [ksi]	LC
1	P206	max	T	.868	3	.067	11	2.61	12	1.475	14	5.473	12
2		min		-.487	4	-5.697	4	.047	5	-.724	5	.086	5
3		max	B	5.701	12	.394	12	2.661	4	2.144	13	5.52	4
4		min		-.135	3	-.931	3	.061	5	.11	11	.108	5
5	P393	max	T	.254	6	-.019	14	2.61	12	2.233	13	5.473	12
6		min		-.487	4	-5.697	4	.133	14	-.251	7	.245	2

Envelope Plate/Shell Principal Stresses (Continued)

	Plate		Surf...	Sigma1 [ksi]	LC	Sigma2 [ksi]	LC	Tau Max [ksi]	LC	Angle [rad]	LC	Von Mises [ksi]	LC
7		max	B	5.701	12	.394	12	2.661	4	2.311	9	5.52	4
8		min		-.058	6	-.265	9	.099	14	-.785	5	.229	14
9	P207	max	T	.927	3	.093	11	2.607	12	1.477	11	5.455	12
10		min		-.466	4	-5.667	4	.035	5	-.612	13	.069	5
11		max	B	5.686	4	.385	12	2.658	4	2.08	13	5.51	4
12		min		-.147	3	-.985	3	.052	5	.068	14	.093	5
13	P394	max	T	.235	6	-.012	14	2.607	12	2.245	2	5.455	12
14		min		-.466	4	-5.667	4	.119	14	-.223	7	.225	2
15		max	B	5.686	4	.385	12	2.658	4	2.336	9	5.51	4
16		min		-.052	6	-.237	10	.09	14	-.755	5	.207	14
17	P196	max	T	5.562	12	.4	12	2.588	4	2.231	2	5.378	4
18		min		-.024	6	-.28	10	.046	5	-.592	10	.085	5
19		max	B	.261	6	0	14	2.585	12	2.231	2	5.39	12
20		min		-.429	4	-5.588	4	.061	5	-.274	7	.107	5

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N3	max	1.485	3	7.988	10	2.97	12	0	2	0	2	0	2
2		min	-2.305	13	-5.478	12	-2.308	6	0	2	0	2	0	2
3	N2	max	1.306	11	11.294	8	3.04	4	0	2	0	2	0	2
4		min	-2.486	5	-2.143	14	-2.555	14	0	2	0	2	0	2
5	N1	max	1.486	3	10.784	8	3.04	4	0	2	0	2	0	2
6		min	-2.308	13	-1.769	14	-2.24	14	0	2	0	2	0	2
7	N4	max	1.305	11	8.778	10	2.97	12	0	2	0	2	0	2
8		min	-2.483	5	-5.478	12	-2.624	6	0	2	0	2	0	2
9	Totals:	max	5.493	11	25.252	2	11.986	12						
10		min	-9.495	5	7.508	13	-9.692	6						

Dynamics Input

Number of Modes	25
Load Combination Number	2 - IBC 16-9
Acceleration of Gravity	32.2 (ft/sec^2)
Convergence Tolerance	0.0001

Response Spectra Data

X Direction Spectra	UBC 91,94 Design Spectra, SoilType 1
Modes Used	All 25 modes
Mode No. for Signs	2
Modal Combination Method	CQC
Damping Ratio	5 Percent

Y Direction Spectra	UBC 91,94 Design Spectra, SoilType 1
Modes Used	All 25 modes
Mode No. for Signs	20
Modal Combination Method	CQC
Damping Ratio	5 Percent

Z Direction Spectra	UBC 91,94 Design Spectra, SoilType 1
Modes Used	All 25 modes
Mode No. for Signs	1
Modal Combination Method	CQC
Damping Ratio	5 Percent

Frequencies / Participation

Mode Number	Frequency (Hz)	Period (Sec)	Percent Modal Participation X Spectra	Y Spectra	Z Spectra
1	2.003	.499			97.246
2	2.279	.439	98.935		
3	3.215	.311			.079
4	3.636	.275	.559		
5	3.948	.253			.001
6	4.997	.2			.283
7	5.544	.18			
8	6.291	.159			
9	7.562	.132			.009
10	7.713	.13		.918	
11	7.949	.126			1.84
12	9.112	.11	.005		
13	9.656	.104			.003
14	9.755	.103			
15	10.964	.091			
16	11.001	.091			
17	12.861	.078			
18	13.17	.076			.001
19	13.392	.075			
20	14.077	.071		85.737	
21	14.084	.071		.906	.004
22	14.612	.068			
23	15.019	.067			
24	15.321	.065		.002	
25	15.535	.064		.473	
Totals :			99.5	88.037	99.469

Specifications for Pultruded Profiles

These "Specifications for Pultruded Profiles" and
"Standard Practice for Classifying Visual Defects"
comprise the entire specification for Tower Tech pultruded profiles.

1. Definitions: As used herein, the term "Buyer" means Tower Tech, Inc.; the term "Supplier" means _____; and the term "Product" or Products" means any or all of the following Tower Tech proprietary pultruded profiles: Perimeter Basin Wall, Center Basin, Mid Wall, Top Wall, Corner Enclosure, Sub-structure Leg.

2. Mechanical Properties: Products will conform to the following mechanical properties:

Mechanical Properties (Coupon Sample, u.n.o.)	ASTM Test Method	Polyester
Properties at 100% at 77°F (90% at or below 100°F, 80% at 100-125°F, 70% at 125-150°F)		
Specific Gravity	ASTM D792	1.75
Density, lb/in cubed	ASTM D792	0.07
Tensile Strength, LW, psi	ASTM D638	35,000
Tensile Strength, CW, psi	ASTM D638	15,000
Tensile Modulus of Elasticity, LW, ksi	ASTM D638	2,500
Tensile Modulus of Elasticity, CW, ksi	ASTM D638	1,000
Compressive Strength, LW, psi	ASTM D695	30,000
Compressive Strength, CW, psi	ASTM D695	14,000
Comp. Modulus of Elasticity, LW, ksi	ASTM D695	2,500
Comp. Modulus of Elasticity, CW, ksi	ASTM D695	1,000
Flexural Strength, LW, psi	ASTM D790	33,000
Flexural Strength, CW, psi	ASTM D790	20,000
Flexural Modulus, LW, ksi	ASTM D790	1,600
Flexural Modulus, CW, ksi	ASTM D790	1,000
Modulus of Elasticity, ksi	Perimeter Basin & Center Basin, Full Section	2,800
Modulus of Elasticity, ksi	Mid Wall & Top Wall, Full Section	2,200
Shear Modulus, ksi	Full Section	420
Shear Strength by Punch, PF, psi	ASTM D732	10,000
Bearing Strength, LW, psi	ASTM D953	45,000
Bearing Strength, CW, psi	ASTM D953	40,000
Izod Impact, Notched, LW, ft-lb/in	ASTM D256	30
Izod Impact, Notched, CW, ft-lb/in	ASTM D256	15
Barcol Hardness	ASTM D2583	45
Possion's Ratio, LW, in/in	ASTM D3039	0.35
Possion's Ratio, CW, in/in	ASTM D3039	0.1+E105

(LW = Lengthwise; CW = Crosswise; PF = Perpendicular to Laminate Face)

Thermal Properties	ASTM Test Method	Polyester
Coef. Of Linear Expansion 10^{-6} in/in/F	ASTM D696	4.4
Thermal Conductivity, Btuh/sq ft/F/in	ASTM C177	4

Flammability	ASTM Test Method	Polyester
Flammability Classification	UL94	VO
Flammability Extinguishing	ASTM D635	Self-extinguishing
NBS Smoke Chamber	ASTM E662	650

Other Properties	ASTM Test Method	Polyester
Water Absorption, % 24 hr.	ASTM D570	0.5 Max
Customer Standard Color	----------	Specific Beige

CREATIVE PULTRUSIONS, INC.

214 Industrial Lane ■ Alum Bank, PA 15521
PHONE: 814-839-4186 ■ FAX: 814-839-4276
Website: www.creativepultrusions.com

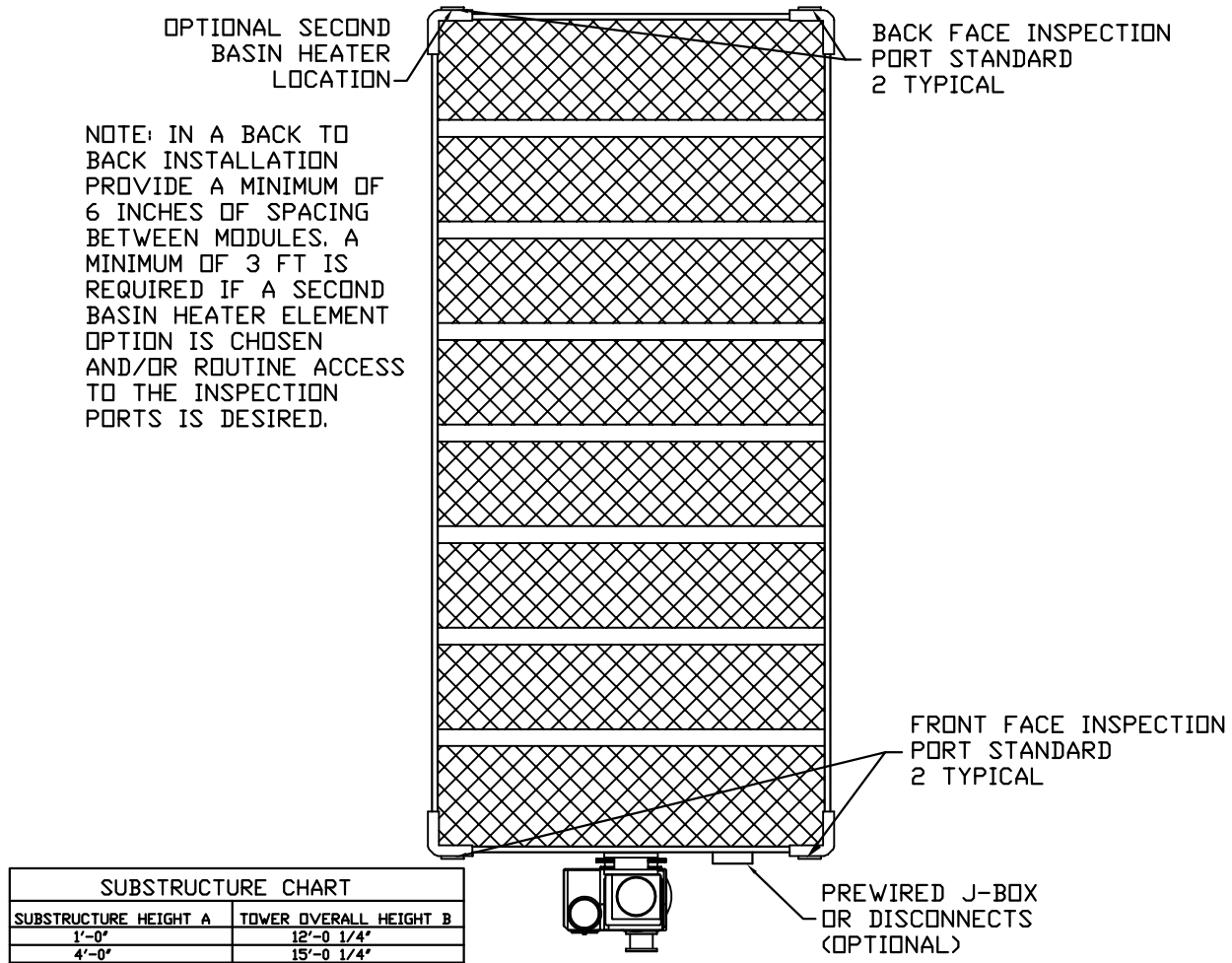
May 14. 2008

TOWER TECH, INC.

Material Properties for the Perimeter Basin Wall and Square Leg Profile

Material Properties	ASTM Test Method	Required at 77°F.
Tensile Strength, LW, psi	ASTM D638	35,000
Tensile Modulus of Elasticity, LW, psi	ASTM D638	2.5E+06
Tensile Strength, CW, psi	ASTM D638	15,000
Tensile Modulus of Elasticity, CW, psi	ASTM D638	1.0E+06
Flexural Strength, LW, psi	ASTM D790	33,000
Flexural Modulus of Elasticity, LW, psi	ASTM D790	1.6E+06
Flexural Strength, CW, psi	ASTM D790	20,000
Flexural Modulus of Elasticity, CW, psi	ASTM D790	1.0E+06
Compressive Strength, LW, psi	ASTM D695	30,000
Compressive Modulus of Elasticity, LW, psi	ASTM D695	2.5E+06
Compressive Strength, CW, psi	ASTM D695	14,000
Compressive Modulus of Elasticity, CW, psi	ASTM D695	1.0E+06
Shear Strength by Punch, PF, psi	ASTM D732	10,000
Bearing Strength, LW, psi	ASTM D953	45,000
Bearing Strength, CW, psi	ASTM D953	40,000
Izod Impact Strength, LW ft.-lbs./in.	ASTM D256	30
Izod Impact Strength, CW ft.-lbs./in.	ASTM D256	15
Barcol Hardness	ASTM D2583	45
Water Absorption, % 24 hours	ASTM D570	0.5 Max.
Flammability Classification	UL 94	V0

LW = Lengthwise
CW = Crosswise
PF = Perpendicular to Laminate Face



SUBSTRUCTURE CHART	
SUBSTRUCTURE HEIGHT A	TOWER OVERALL HEIGHT B
1'-0"	12'-0 1/4"
4'-0"	15'-0 1/4"
6'-0"	17'-0 1/4"
8'-0"	19'-0 1/4"
10'-0"	21'-0 1/4"
12'-0"	23'-0 1/4"

GENERAL INFORMATION:

BASIC DATA (PER CELL):

MIN/MAX GPM RANGE - 800/2,400 MIN/MAX m3/hr RANGE - 181.7/545.1
SEE PROPOSAL DOCUMENTS FOR ACTUAL DESIGN

MOTOR DATA (PER CELL):

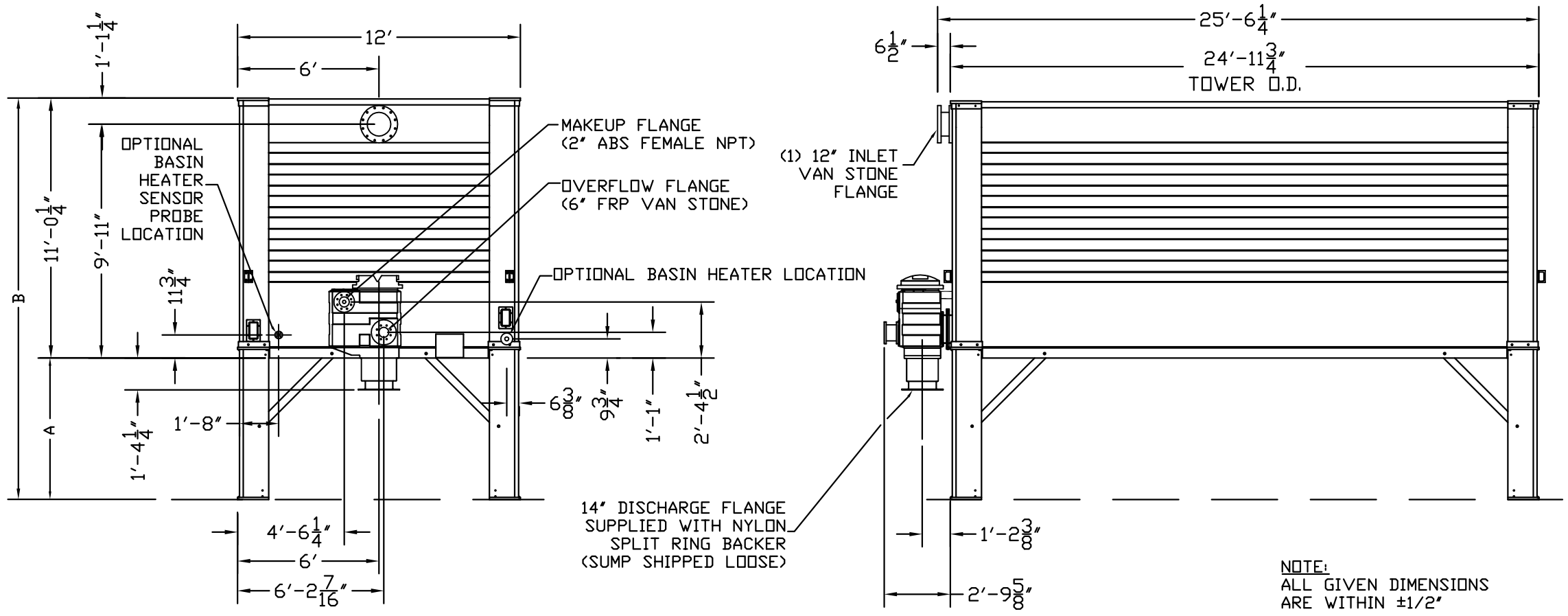
BRAND - BALDOR (OR EQUIV)
EFFICIENCY - HIGH

WEIGHTS (PER CELL):

DRY SHIPPING WEIGHT	15,412 lbs	6,990.8 kg
OPERATING WEIGHT	25,695 lbs	11,655.1 kg

NOTES:

1. ALL EXTERNAL PIPING PROVIDED BY CUSTOMER.
2. EXTERNAL PIPING TO BE 'STAND ALONE' (INDEPENDENTLY SUPPORTED).
3. NO LOAD TO BE APPLIED TO TOWER TECH TOWER OR SUMP.
4. FOR APPROPRIATE WATER LEVEL REFER TO STARTUP SECTION IN TOWER TECH'S DESIGN, INSTALLATION & OPERATION MANUAL.
5. MAKE-UP CONNECTION/FLOAT VALVE CONNECTION FLANGE IS MAKE FROM HIGH QUALITY PLASTIC TO ELIMINATE CORROSION.
6. THE MAXIMUM MAKE-UP WATER INLET PRESSURE IS 25 PSIG. FLOAT VALVE MAY NOT SHUT OFF TIGHT AGAINST HIGHER PRESSURES.



NOTE:
ALL GIVEN DIMENSIONS ARE WITHIN ±1/2"

TOWER TECH Inc.
THE TECHNOLOGY COMPANY
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5400 NW 5th
OKLAHOMA CITY, OKLAHOMA 73127

TOWER TECH, INC.
1-Unit Installation
Plan/Elevation

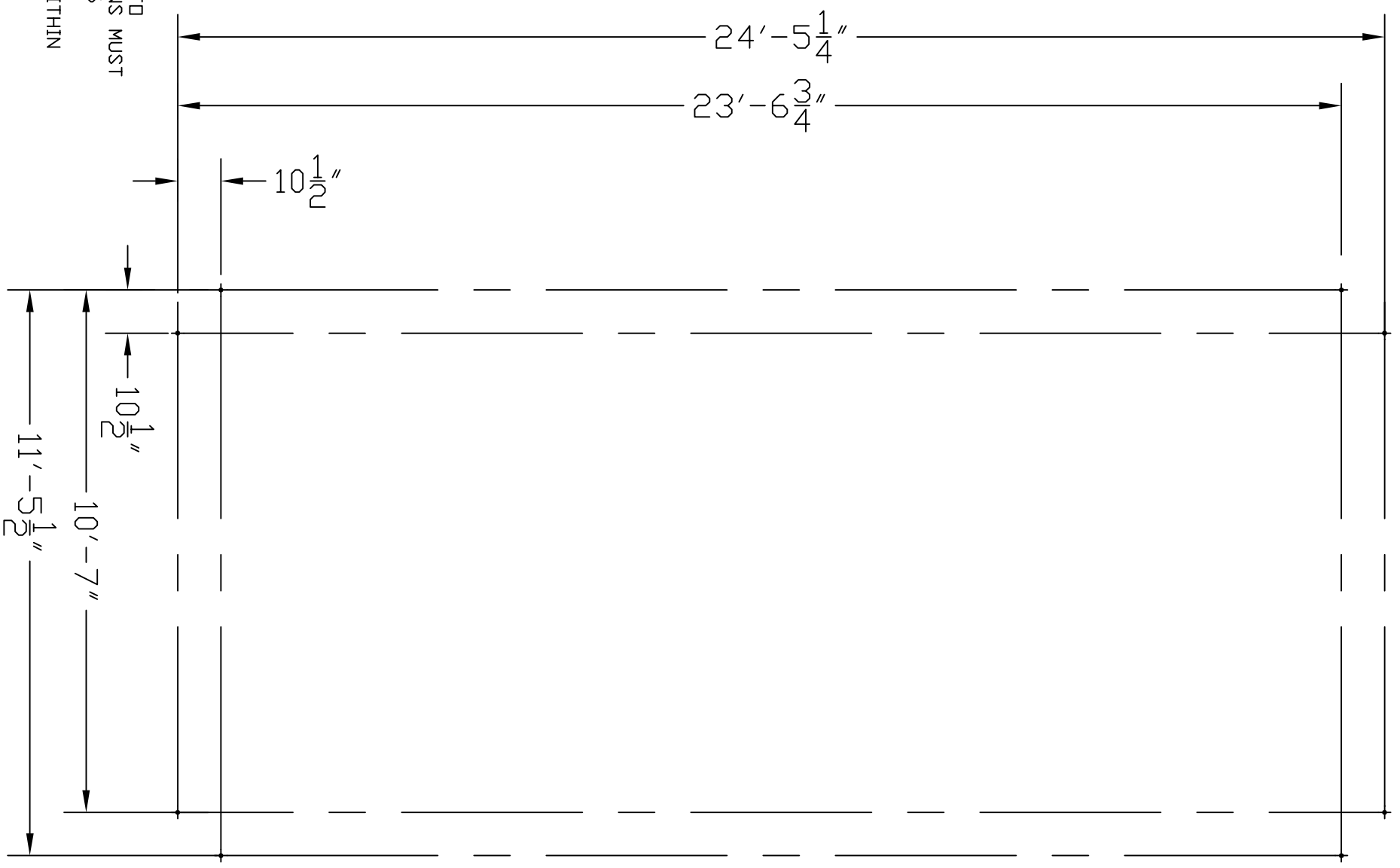
Modular Fiberglass Cooling Tower
Model # TTXL-08XXXXX

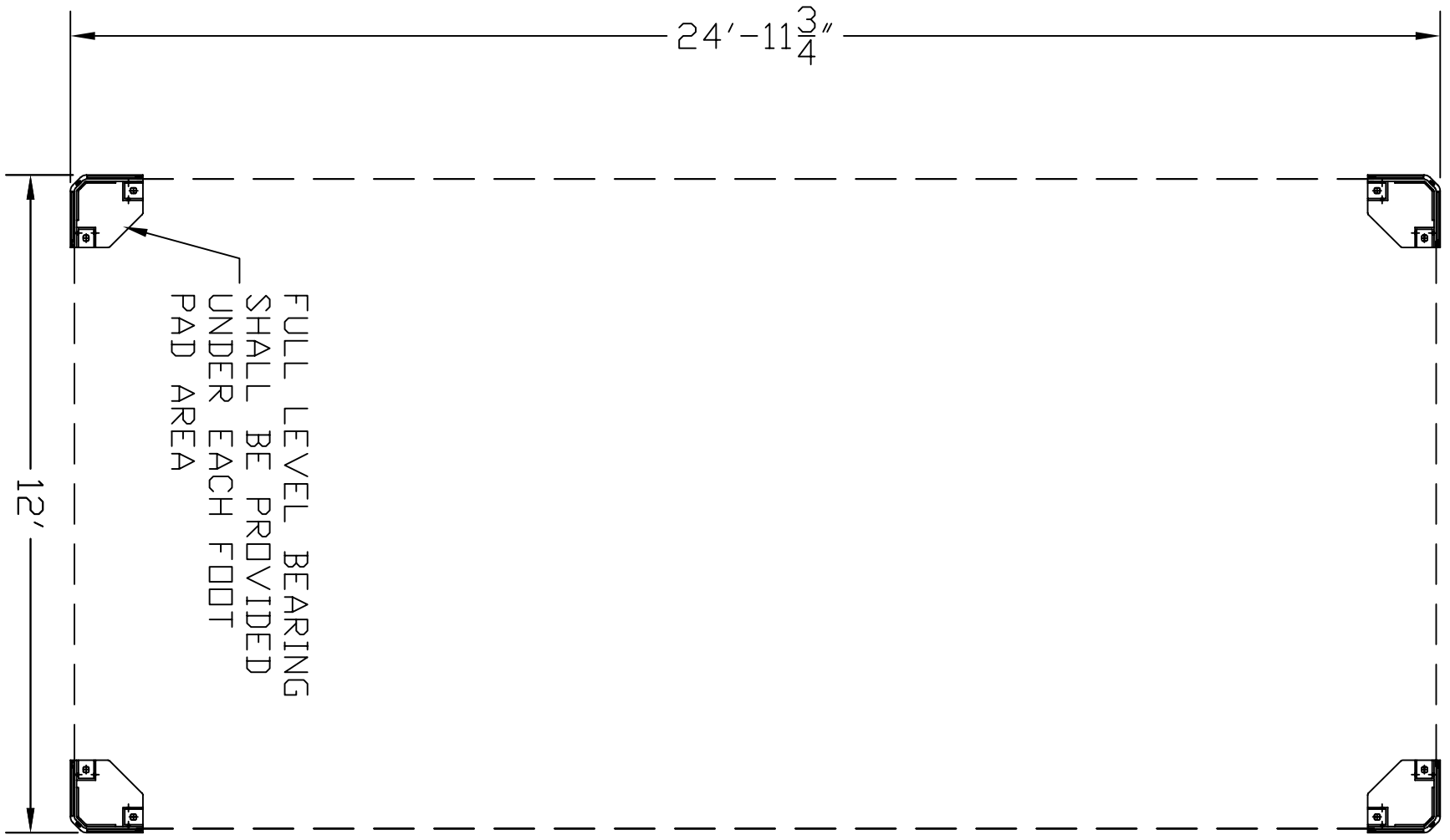
FOR APPROVAL BY	DATE
Tower Tech Design Team	

REVISIONS		
NO.	DATE	REVISION

DATE:	30 NOV 11
DRAWING#:	XL-08-2
PROJECT#:	LIBRARY
CUST PO#:	
DRAWN BY:	RFB
CHECKED BY:	
PLAN & ELEVATION	2

NOTE: FOOT PAD SPACING IN BACK TO BACK INSTALLATIONS MUST BE A MINIMUM OF 6 INCHES. ALL GIVEN DIMENSIONS ARE WITHIN ±¼".





DATE:	21 NOV 11	
DRAWING#:	XL-08-3	
PROJECT#:	LIBRARY	
CUST PO#:		
DRAWN BY:	RFB	
CHECKED BY:		
FOOTPRINT & ANCHOR PAD LAYOUT	3	

FOR APPROVAL BY	DATE
Tower Tech Design Team	

REVISIONS

NO.	DATE	REVISION

TOWER TECH, INC.
1-Unit Installation
TTXL-08 Anchor Pad Layout

Modular
Fiberglass
Cooling Tower
Model # TTXL-08

TOWER TECH, Inc.
THE TECHNOLOGY COMPANY
TELEPHONE: (405) 290-7788
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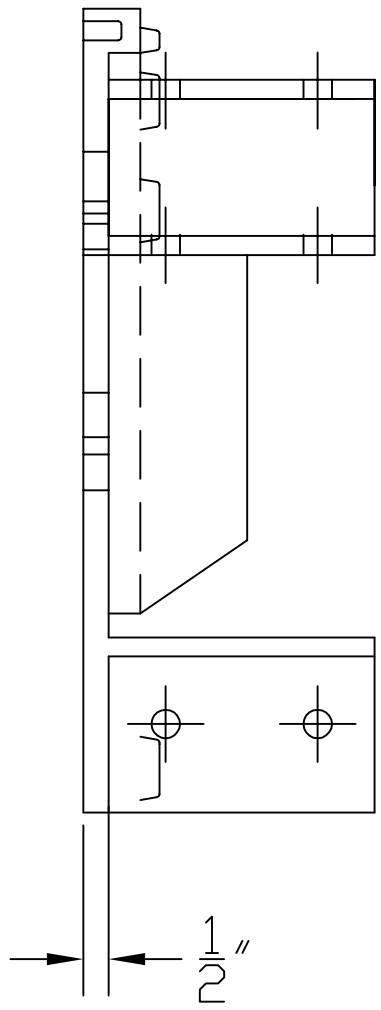
5400 NW 5th
OKLAHOMA CITY, OKLAHOMA 73127

NOTE:

AFTER INSTALLATION OF ANCHOR PAD, A NON-SHRINK GROUT IS TO BE APPLIED IN FOOT SLOTS. BOLT LENGTH, STRUCTURAL STEEL SUPPORT AND CONCRETE PAD TO BE DESIGNED BY CUSTOMER'S ENGINEER. MAXIMUM LOADING IS GOVERNED BY SITE-SPECIFIC REQUIREMENTS FOR WIND AND SEISMIC CONDITIONS.



DATE:	17 NOV 11
DRAWING#:	XL-08-4
PROJECT#:	LIBRARY
CUST PO#:	
DRAWN BY:	RFB
CHECKED BY:	
FOOTPAD DETAIL	4

FOR APPROVAL BY	DATE
Tower Tech Design Team	

REVISIONS

NO.	DATE	REVISION

TOWER TECH, INC.
1-Unit Installation
TTXL-08 Footpad Detail

Modular
Fiberglass
Cooling Tower
Model # TTXL-08

TOWER TECH, Inc.
THE TECHNOLOGY COMPANY
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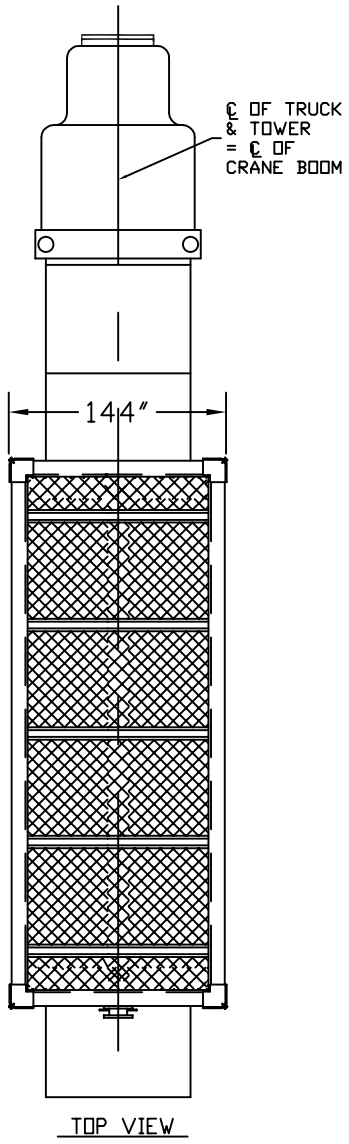


TOP VIEW

TOWER LIFTING/INSTALLATION NOTES:

WARNING:
THE LIFTING POINTS ARE STRUCTURALLY LOCATED WITHIN THE TOWER'S ENVELOPE. ANY DAMAGE TO THE TOWER ENVELOPE CAUSED BY IMPROPER LIFTING MEANS/METHODS SHALL BE REPAIRED AND/OR REPLACED AS NEEDED, AT NO COST TO TOWER TECH, INC., AND MAY INVALIDATE TOWER WARRANTY.

PRIOR TO LIFTING TOWER, REMOVE ANY EXCESS WATER FROM BASIN. WATER IN BASIN CAN DRASTICALLY INCREASE TOWER WEIGHT, CAUSING FAILURE OF TOWER LIFTING MECHANISM.

1. Owner shall be responsible for lifting and placement of tower. Owner shall furnish all incidental materials required for location of tower in its final position. All work shall be in accordance with requirements of governing authorities and all OSHA safety guidelines.
The accompanying lifting diagrams are for general information purposes only, and owner shall have full responsibility for the work. Monitor weather conditions at all times, and suspend operation when inclement weather is expected.

2. Upon arrival of tower module (prior to any lifting operation), the tower shall be inspected on the truck by the owner's representative for general acceptance. Any items of concern related to lifting operations shall be documented and reported (in writing) to Tower Tech's representative. The owner's rep or his crane contractor shall inspect all corner lifting brackets and their bolting to the tower.

3. Prepare & position lifting items such as clevis, lifting cables, spreader beam, guide rope and any other incidental items that are needed for a complete and safe lifting operation. Carefully position crane and lifting assembly directly over the tower module, in order to eliminate any instability during the operation. All lifting connections and parts shall be checked prior to the final lifting operation. Reference table below for tower weights, recommended cable lengths, and/or I-beam lengths. A guide rope (provided by owner) shall be connected to the bottom of the module such that personnel are not positioned under the suspended tower at any time.

4. Should the tower need to be temporarily placed on the ground prior to its final positioning, the tower shall be stored on sound and level surface. Care shall be taken at all times not to distort or rack the tower module's envelope.

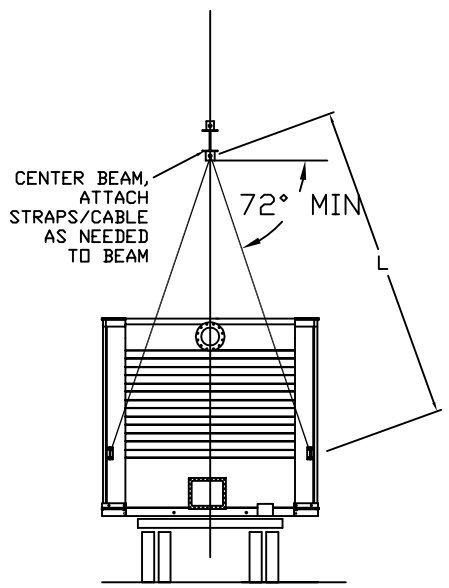
5. Prior to the tower lifting operation, check the pre-installed anchor bolts for alignment. Lift and position the tower near its final location and loosely attach the provided substructure kit and the brace angles. Lower tower into position on the pre-installed anchor bolts. Place proper oversized washer and nut over anchor bolts and tighten as needed. After all anchor nuts are installed, square and plumb tower, and tighten all leg bolts followed by the angle support bracket bolts. All substructure bolts/nuts shall be tightened with 85 ft-lb torque. After all bolts are securely fastened, check overall stability of tower, substructure panels, and tubular brace. Verify that tower is level and stability is adequate for operation. Disconnect crane from lifting brackets.

6. Upon the completion of lifting operation check for plumb and stability again. Attach sump box as shown on sump detail drawing and proceed with the tower start up as described in the Tower Tech Operation and Maintenance Manual.

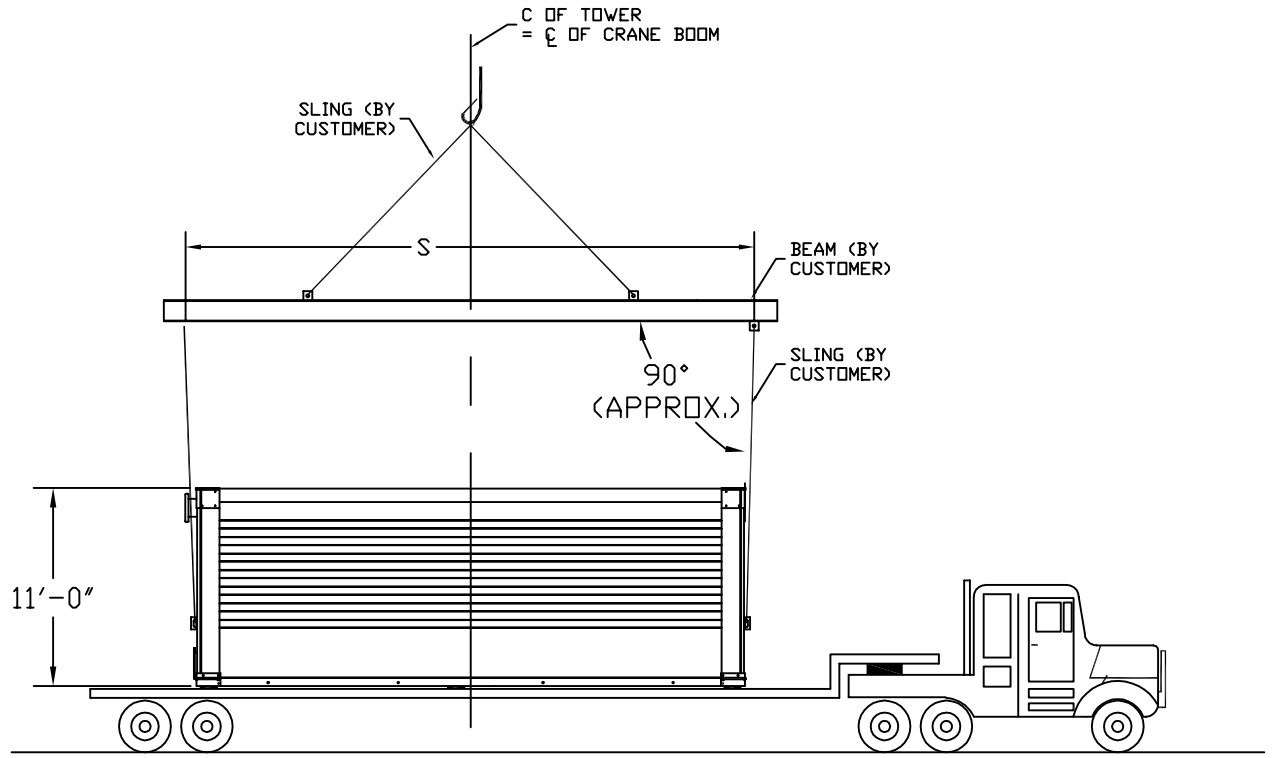
TOWER LIFTING DATA

SERIES #	WEIGHT *		L (ft)	S (min ft)
	lb	kg		
TTXL-12	5,245	2379.1	20	14′-6″
TTXL-13	7,040	3193.3	20	20′-3″
TTXL-14	8,835	4007.5	20	26′-0″
TTXL-04	7,912	3588.8	20	14′-6″
TTXL-15	10,630	4821.7	20	31′-9″
TTXL-06	11,662	5289.8	20	20′-3″
TTXL-08	15,412	6990.8	20	26′-0″
TTXL-10	19,162	8691.7	20	31′-9″
TTXL-12	22,912	10392.2	20	37′-6″

* Tower weights vary, based upon optional equipment, residual water, etc. Weights listed are guidelines only.



END ELEVATION



SIDE ELEVATION

TOWER TECH, Inc.
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TOWER TECH, INC.
1-Unit Installation
TTXL-08 Lift Rigging

Modular
Fiberglass
Cooling Tower
Model # TTXL-08

FOR APPROVAL BY	DATE
Tower Tech Design Team	

REVISIONS		
NO.	DATE	REVISION

DATE:	21 NOV 11
DRAWING#:	XL-08-13A
PROJECT#:	LIBRARY
CUST PO#:	
DRAWN BY:	RFB
CHECKED BY:	
LIFT RIGGING	13A