RICHARD CONSTRUCTION, INC.

Juniper

JUNIPER GTL Project

EQUIPMENT PACKAGE# 902-PK-0001

COOLING WATER / TOWER PACKAGE

MASTER COPY

RICHARD CONSTRUCTION, INC.

FINAL SYSTEM TURNOVER

Date: 1-14-17

Project: Juniper GTL 216-1620

System Number: 902-PK-0001

System is complete, approved, and is issued for Final turnover acceptance for your care, custody and control

Cliff Matlock RCI QA/QC	1-14-17 Date
Del Conwell Client QA/QC	1.14.17 Date
RCI Project Manager	Date
Client Turnover Coordinator	Date

Note: This form does not constitute a full system walkdown for all signees.

Copy to:

Client Project File
Contractor File
Inspection File

Equipment Punch List

Turnover System No.: _____

Test Package No.: _____

Item No.	Isometric / Drawing No.	Rev.	Sht.	Description of Discrepancy	Type of Discrep	Eng. to Review	Order of Magnitude (Estimate)	Foreman Resp. for Work	Date Item Completed	Date Item Verified	Joint Sign-offs

VERIFICATION OF WALK DOWN

RCI QAQC _____ Date _____

Client QAQC _____ Date _____

Client construction Rep _____ Date _____

*Client Plant Rotating Rep _____ Date _____

Type 1 Items (Effecting Equipment Mechanical Completion Sign Offs): Test blinds, wrong bolts, final alignment to equipment, spring hanger stop removal and set to cold setting, equipment shipping stop removal equipment trim, wrong gaskets, instruments, grounding, steam tracing, electrical tracing, electrical, loop checks, etc.

Type 2 Items (Not Effecting Equipment Mechanical Completion Sign Offs): Painting, insulation, grouting of supports, structural items, etc

EXHIBIT A

EQUIPMENT INSTALLATION

Field Installation Checklist Equipment ID# 902-PK-0001

Project: Juniper GTL 216-1620

Location: Westlake La. Area: P

Inspected By: Cliff Matlock Date: 1-14-17

ITEM		INSPECTION DESCRIPTION		YES	NO
1		Shimmed Properly	CM	DC	
2		Oriented correctly	CM	DC	
3		Elevation correct	CM	DC	
4		Plumbness	CM	DC	
5		Anchor bolts tightened	CM	DC	
6		Slide Plates installed correctly		N/A	
7		Fireproofing		N/A	
8		Purge maintenance		N/A	
9		Slide plate material		N/A	
10		Labeled with ID number	CM	DC	
11		Ground wire attached		N/A	
12		Base line thickness recorded		N/A	
13		Pressure test complete (all supports must be in place prior to test)		N/A	
14		Cleanliness	CM	DC	
15		Protective coating		N/A	
16		Insulation		N/A	

Cliff Matlock — RCI QC — 1-14-17 DATE

Client QA — DATE

Client Construction Representative — 1-14-17 DATE

Client Turnover Coordinator — DATE

RICHARD CONSTRUCTION, INC.

QUALITY MANUAL	FIELD INSTALLATION CHECKLIST **EQUIPMENT**	Page 1 of 1

Project No.: _____ Equip. No.: _____

ITEMS TO CHECK	INSTALLATION O.K. (SIGN AND DATE)

Exceptions: _____

_____

_____

RCI QA/QC Representative / Date: _____

Client Representative / Date: _____

PROCESS DATA SHEET				Sheet 1 of 1	
				SPEC	REV. RS
REV	BY	DATE	DESC.		
A	PG	5/28/14	ISSUED FOR DESIGN	PROJ # 13-1200	DATE 5/28/2014
RDS DOC#		13-1200-00-PR29-095		REQ. 1	P.O.
CLIENT:		JUNIPER GTL			
LOCATION:		WESTLAKE, LA		BY CHK'D DA/LG	APPR. BR
PROJECT:		JUNIPER GTL			

US-01-902-PK-0001

(900-PK-001)

COOLING WATER PACKAGE

Modifications to Datasheet

1. Process Data updated to reflect current Cooling Water Balance.

Attached Documents:

	Pages
1. Datasheet for 900-PK-001, Rev 1 - 1/27/14	3

Notes:

1. Cooling Water Towers to be placed on the same location and to have the same footprint than the existing 4-cell ones (B-9401W, B-9401E). Existing Foundations are also to be Reused.

COOLING TOWER

		Rev	Desc	Date	By	App
Client:		0	IFD	06/18/13	GF	LB
Location:	Westlake, LA	1	for XTLH	01/27/14	SCJ	LB
Project Name:	Juniper					
Project No:						

RDS DOC #:	13-1200-00-PR29-095
Equip Tag(s):	(900-PK-001)
	US-01-902-PK-0001
Data Sheet #:	1010-SGCE-311-DAT-00061
Qty Req:	1

					Rev
1	**GENERAL INFORMATION**				Rev
2	Manufacturer	* (Note 1)	Model Number	*	1
3	Type	*	Number of Cells	*	
4	Weight (Dry / Wet), lb	*	Material of Construction	*	
5	**** CASE 1 ** (NOTE 3)**	**PROCESS INFORMATION**		**** CASE 1 ****	
6	Capacity, gpm	~~8500~~ 13256	Duty, btu/hr	~~146,300,000~~ 152,444,000	1
7	Wet Bulb, °F	81	Dry Bulb, °F	90	
8	Relative Humidity, %		Maximum Noise Level, dB		
9	Water Temperature In (Design), F	~~122~~ 111	Water Temperature Out (Design), F	88	1
10	Water Temperature In (Maximum), F		Water Temperature Out (Maximum), F		
11	Water Temperature In (Minimum), F		Water Temperature Out (Minimum), F		
12	Evaporation Loss, %	~~3.3%~~ (Note 2) 2.3%	Drift Loss, %	0.005 (note 2)	1
13	Fan Efficiency, %	*	Required Make-Up Water, GPM	~~386~~ 422	1
14	**** CASE 2 ** (NOTE 3)**	**PROCESS INFORMATION**		**** CASE 2 ****	
15	Capacity, gpm	~~11510~~ 14323	Duty, btu/hr	~~146,300,000~~ 171,876,000	1
16	Wet Bulb, °F	81	Dry Bulb, °F	90	
17	Relative Humidity, %		Maximum Noise Level, dB		
18	Water Temperature In (Design), F	~~113~~ 112	Water Temperature Out (Design), F	88	1
19	Water Temperature In (Maximum), F		Water Temperature Out (Maximum), F		
20	Water Temperature In (Minimum), F		Water Temperature Out (Minimum), F		
21	Evaporation Loss, %	~~2.4%~~ (Note 2) 2.4%	Drift Loss, %	0.005% (Note 2)	1
22	Fan Efficiency, %	*	Required Make-Up Water, GPM	~~386~~ 476	1
23	**SITE DATA & ENVIRONMENTAL LOADS**				
24	**See General Equipment Requirements (Doc. No. XXXXX)**				
25	**DIMENSIONS & HEIGHTS (by vendor)**				
26	Overall Dimensions (W x L x H), ft		Inside of Basin (W x L x D), ft		
27	Operating Level, ft		Air Inlet Height, ft		
28	Tower Height, ft		Fan Cylinder Height, ft		
29	Fan Deck Size (W x L)		Fan Deck Height, ft		
30	**CONSTRUCTION INFORMATION (by vendor)**				
31	Basin Material		Fan Deck Material		
32	Tower Fill Material		Mist Eliminator Material		
33	Fan Cylinder Material		Bolting / Connection Material		
34	Stairways, Y/N		Stairway Description		
35	Ladders, Y/N		Ladder Description		
36	Tower Fill Gauge/Thickness		Tower Fill Design		
37	Mist Eliminator Gauge/Thickness		Mist Eliminator Design		
38	Basin Heater, Y/N		Temperature Maintained w/ Heater, F		
39	Firewalls Between Cells, Y/N		Rating of Firewalls, min		
40	Watertight Partitions Between Cells, Y/N		Watertight Partition Material		
41	Access Doors, Y/N		Number of Access Doors		
42	Size of Access Doors		Location of Access Doors		
43	Flow Control Valves, Y/N		Number of Flow Control Valves		
44	Size of Flow Control Valves		Location of Flow Control Valves		
45	Vibration Monitor Y/N		Vibration Monitor Enclosure		
46	Performance Test, Y/N		Performance Test By		
47	Anchor Bolts By		Erection By		
48	Basin By		Basin Type		

COOLING TOWER

		Rev	Desc	Date	By	App
Client:		0	IFD	06/18/13	GF	LB
Location:	Westlake, LA	1	for XTL H	01/27/14	SCJ	LB
Project Name:	Juniper					
Project No:						

RDS DOC #:	13-1200-00-PR29-095
Equip Tag(s):	(900-PK-001)
	US-01-902-PK-0001
Data Sheet #:	1010-SGCE-311-DAT-00061
Qty Req:	1

WATER DISTRIBUTION SYSTEM (by vendor)

Type		Spray Heads Per Cell	
Header Size		Nozzle Size	
Lateral Size		Required Minimum Inlet Pressure, psig	

FAN(S) (by Vendor)

Manufacturer		Model Number	
Type		Velocity Recover Fan Cylinder, Y/N	
Number of Fans		Fan Diameter, ft	
Fan Blade Material		Fan RPM	
Air Flow Per Fan, CFM		Blades Per Fan	
Blade Pitch		Tip Speed, fpm	

TRANSMISSION (by vendor)

Type		HP	
Gear Ratio		SF	
Number of Belts		Belt Size	
Shaft Diameter		Shaft Material	
Lubrication System			

MOTOR / DRIVE (by Vendor)

NOTES

1) **Spaces marked with an asterisk (*) are to be provided by Vendor.**

2) **Basis for calculations. Vendor to confirm.**

3) ~~**Case 2 represents the maximum cooling tower water requirements expected if a steam turbine (with surface condenser) are installed for mechanical drive of the main syngas compressor.**~~ Case 1 is Normal, Case 2 is Design.

4) Refer to latest revision of the Basic Engineering Design Guidelines. Document (1015-JGTL-321-BED-00001-00) for additional information.

5) Hot water (cooling water return) pressure at ground level: 24 psig.

6) Vendor to guarantee performance as specified under Process Information section. Drift losses are also to be guaranteed.

7) Water distribution system shall be designed to permit flexible operation of the tower, And permit each cell to be taken out of service individually. Nozzle shall be self-draining, Non-Clogging type, Non-Ferrous Material. Maximum allowable nozzle Δp is 10 psi.

COOLING TOWER

		Rev	Desc	Date	By	App
Client:		0	IFD	06/18/13	GF	LB
Location:	Westlake, LA	1	for XTLH	01/27/14	SCJ	LB
Project Name:	Juniper					
Project No:						

RDS DOC #:	13-1200-00-PR29-095
Equip Tag(s):	(900-PK-001)
	US-01-902-PK-0001
Data Sheet #:	1010-SGCE-311-DAT-00061
Qty Req:	1

SKETCH

Line

Rev

SPX.
COOLING TECHNOLOGIES

Pack In
Station: None

Production Order	: 2701494	**Down Load Number**	: 691
Material	: 2438390	**Old Material Number**	: NC-10100890-A1
Quantity	: 1.000 ZCE	**Packed by (Name)**	: PG
Model Number	: NC8413XAS5GGF	**Packed by (Date)**	: 4-24-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2022897		KIT FSTN FIELD INSTALL W/STACK	1.00	1		take	MM
2024304		KIT FSTN MECH EQUIP PLATFORM	1.00	1			
2026590		KIT FSTN LDR&GR LVR SGL FACE W/O	2.00	2			
2026592		KIT FSTN LDR&GR CASE FACE W/LDR	1.00	1			
2032102		KIT FSTN HC VALVE 10" GALV BASIN	1.00	1			
2034404		KIT FSTN SAFETY CAGE INSTAL	1.00	1			
2044617		KIT FSTN VIB SWITCH S300	1.00	1			
085761X		HARDWARE SAFETY GATE	1.00	1		CAT	PG
122986X		KIT CUSTOMER LITERATURE	1.00	1		take	MM

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10015 - Options

Production Order : 2701494
Material : 2438390
Quantity : 1.000 ZCE
Model Number : NC8413XAS5GGF

Down Load Number : 691
Old Material Number : NC-10100890-A1
Packed by (Name) : PG
Packed by (Date) : 4-24-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2023614	L47	SHEET HMG 3MMX76.0X788.7	1.00	1		cit	PG
2026452	Q47	ASSEMBLY HDG OVERFLOW	1.00	1			
2028215	L38	SHEET HMG 4MMX101.6X292.9	2.00	2			
2028216	L39	SHEET HMG 4MMX171.4X286.6	2.00	2			
2028217	L40	SHEET HMG 4MMX190.5X959.8	1.00	1			
2031528	M98	SHEET HMG 3MMX324.0X343.3	1.00	1			
2036903	D31	GRP RECOVERY STACK	2.00	2		skid	
2036904	D35	GRP RECOVERY STACK - FLATSPOT	2.00	2		1	
2062715	Q48	PIPE PVC 4DIAX1'-11 1/8	1.00	1		cit	
2072784	VIB	SWITCH VIBRATION MARLEY M-6	1.00	1		tote	MR
2088586	Q29	VALVE 20" X 3/8"DIA S304 STEM	1.00	1			
012450X**	Z11	SEALER POLYURETHANE	2.00	2			
378869X	Q31	VALVE 8"DIA PLASTIC FLOAT	1.00	1			
404343X	Q14	GASKET FULL FACE 1/4THK 18DIA	1.00	1			
654236X	N39	GASKET 1/4X10IDX13OD	2.00	2			
A66275	N45	GASKET FULL FACE 1/4THK 10DIA	2.00	2			

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10018 - Options - Valves

Production Order	: 2701494	Down Load Number	: 691		
Material	: 2438390	Old Material Number	: NC-10100890-A1		
Quantity	: 1.000 ZCE	Packed by (Name)	: PE		
Model Number	: NC8413XAS5GGF	Packed by (Date)	: 4-24-15		

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
C12525	N40	VALVE HCF 10-11	2.00	2	—	dt	PE

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10020 - TOWER

Production Order : 2701494
Material : 2438390
Quantity : 1.000 ZCE
Model Number : NC8413XAS5GGF

Down Load Number : 691
Old Material Number : NC-10100890-A1
Packed by (Name) : PE
Packed by (Date) : 4-24-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2038751	L41	ASSEMBLY ALUM LADDER FOR SAFETY C	1.00	1		Tower	AL
2038752	L42	ASSEMBLY ALUM LADDER FOR SAFETY C	1.00	1		Tower	AL
554378X	L99	SHEET HMG 8GAX2 1/2X12 3/4	2.00	2		Tote	MM

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10021 - Safety Cage

Production Order	: 2701494	**Down Load Number**	: 691
Material	: 2438390	**Old Material Number**	: NC-10100890-A1
Quantity	: 1.000 ZCE	**Packed by (Name)**	: A LUNA
Model Number	: NC8413XAS5GGF	**Packed by (Date)**	: 4/27/15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2034394	L65	ASSEMBLY ALUM SAFETY CAGE	1.00	1		PACKED IN TOWER	AL
2034396	L68	ASSEMBLY ALUM SAFETY CAGE	1.00	1			AL
2035827	L67	ASSEMBLY ALUM SAFETY CAGE	1.00	1			AL
2036873	L66	ASSEMBLY ALUM SAFETY CAGE	2.00	2			AL

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In Station: 10025 - Guardrails

Production Order	: 2701494	**Down Load Number**	: 691
Material	: 2438390	**Old Material Number**	: NC-10100890-A1
Quantity	: 1.000 ZCE	**Packed by (Name)**	: PG
Model Number	: NC8413XAS5GGF	**Packed by (Date)**	: 4-24-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2023483	L52	ASSEMBLY ALUM LADDER	1.00	1		Tower	AL
2028199	L32	ASSEMBLY HDG GUARDRAIL NC8407,11,	2.00	2		SKID	PG
2028200	L33	ASSEMBLY HDG GUARDRAIL NC8407	2.00	2			
2028205	L34	ASSEMBLY HDG GUARDRAIL NC8409	1.00	1			
2028206	L35	ASSEMBLY HDG GUARDRAIL NC8409	1.00	1			
2028207	L37	ASSEMBLY HDG GUARDRAIL NC8409	1.00	1			

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 12010 - CWB

Production Order	: 2701494	Down Load Number	: 691		
Material	: 2438390	Old Material Number	: NC-10100890-A1		
Quantity	: 1.000 ZCE	Packed by (Name)	: AC		
Model Number	: NC8413XAS5GGF	Packed by (Date)	: 4-24-15		

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2028259	L44	SHEET HMG 4MMX206.4X1074.2	1.00	1		4F	AC

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: None

Production Order	: 2701497	**Down Load Number**	: 691
Material	: 2438391	**Old Material Number**	: NC-10100890-A2
Quantity	: 1.000 ZCE	**Packed by (Name)**	: RG
Model Number	: NC8413XAS5GGF	**Packed by (Date)**	: 4-24-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2022897		KIT FSTN FIELD INSTALL W/STACK	1.00	1		tote	MM
2024304		KIT FSTN MECH EQUIP PLATFORM	1.00	1			
2026590		KIT FSTN LDR&GR LVR SGL FACE W/O	2.00	2			
2026700		KIT FSTN WALKWAY 5 1/2" AB-AB	1.00	1			
2031032		KIT FSTN FLUME ONLY NC8401-14 5	1.00	1			
2032102		KIT FSTN HC VALVE 10" GALV BASIN	1.00	1			
2044517		KIT FSTN VIB SWITCH S900	1.00	1			

** Requires an MSDS
Date: 04/22/2015

SPX
COOLING TECHNOLOGIES

Pack In
Station: 10015 - Options

Production Order	2701497	Down Load Number	691
Material	2438391	Old Material Number	NC-10100890-A2
Quantity	1.000 ZCE	Packed by (Name)	PG
Model Number	NC8413XAS5GGF	Packed by (Date)	4-24-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2023614	L47	SHEET HMG 3MMX76.0X788.7	1.00	1		CRT	PG
2026462	Q47	ASSEMBLY HDG OVERFLOW	1.00	1		1	1
2028252	L14	SHEET HMG 1.5MMX143.1X223.8	2.00	2		tote	MM
2028253	L18	SHEET HMG 1.5MMX130.2X130.3	2.00	2		tote	MM
2030743	Q15	SHEET HMG 3MMX190.5X633.2	2.00	2		CRT	PG
2030747	Q11	SHEET HMG 3MMX190.5X632.1	2.00	2		1	1
2031528	M98	SHEET HMG 3MMX324.0X343.3	1.00	1		1	1
2036903	D31	GRP RECOVERY STACK	2.00	2		SKD	1
2036904	D35	GRP RECOVERY STACK - FLATSPOT	2.00	2		1	1
2062715	Q48	PIPE PVC 4DIAX1'-11 1/8	1.00	1		CRT	1
2072784	VIB	SWITCH VIBRATION MARLEY M-5	1.00	1		tote	MM
012450X**	Z11	SEALER POLYURETHANE	4.18	2		1	1
404343X	Q14	GASKET FULL FACE 1/4THK 18DIA	1.00	1		1	1
654236X	N39	GASKET 1/4X10IDX13OD	2.00	2		1	1
A66276	N45	GASKET FULL FACE 1/4THK 10DIA	2.00	2		1	1

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10018 - Options - Valves

Production Order	: 2701497	Down Load Number	: 691
Material	: 2438391	Old Material Number	: NC-10100890-A2
Quantity	: 1.000 ZCE	Packed by (Name)	: PC
Model Number	: NC8413XAS5GGF	Packed by (Date)	: 4-24-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
C12525	N40	VALVE HCF 10-11	2.00	2	—	ST	PE

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In Station: 10020 - TOWER

Production Order	: 2701497	Down Load Number	: 691		
Material	: 2438391	Old Material Number	: NC-10100890-A2		
Quantity	: 1.000 ZCE	Packed by (Name)	: CM		
Model Number	: NC8413XAS5GGF	Packed by (Date)	: 4-24-15		

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
554378X	L99	SHEET HMG 8GAX2 1/2X12 3/4	2.00	2		tote	MM

** Requires an MSDS
Date: 04/22/2015

SPX
COOLING TECHNOLOGIES

Pack In
Station: 10025 - Guardrails

Production Order	:	2701497	Down Load Number	:	691
Material	:	2438391	Old Material Number	:	NC-10100890-A2
Quantity	:	1.000 ZCE	Packed by (Name)	:	PG
Model Number	:	NC8413XAS5GGF	Packed by (Date)	:	4-24-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2023483	L52	ASSEMBLY ALUM LADDER	1.00	1		1 of 1	RE
2028199	L32	ASSEMBLY HDG GUARDRAIL NC8407,11,	2.00	2		SKD	PG
2028200	L33	ASSEMBLY HDG GUARDRAIL NC8407	2.00	2		1	1

** Requires an MSDS
Date: 04/22/2015

SPX
COOLING TECHNOLOGIES

Pack In
Station: 25010 - Struc

Production Order	: 2701497	**Down Load Number**	: 691		
Material	: 2438391	**Old Material Number**	: NC-10100890-A2		
Quantity	: 1.000 ZCE	**Packed by (Name)**	: PG		
Model Number	: NC8413XAS6GGF	**Packed by (Date)**	: 4-24-15		

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2031043	L61	SHEET HMG 1.5MMX295.3X3384.5	2.00	2	—	CT	PG

** Requires an MSDS
Date: 04/22/2015

SPX.
COOLING TECHNOLOGIES

Pack In Station: None

Production Order	: 2702140	**Down Load Number**	: 692
Material	: 2438392	**Old Material Number**	: NC-10100890-A3
Quantity	: 1.000 ZCE	**Packed by (Name)**	: PG
Model Number	: NC8413XAS5GGF	**Packed by (Date)**	: 4-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2022897		KIT FSTN FIELD INSTALL W/STACK	1.00	1		tote	MC
2024304		KIT FSTN MECH EQUIP PLATFORM	1.00	1			
2026590		KIT FSTN LDR&GR LVR SGL FACE W/O	2.00	2			
2026700		KIT FSTN WALKWAY 5 1/2" AB-AB	1.00	1			
2031032		KIT FSTN FLUME ONLY NC8401-14 5	1.00	1			
2032102		KIT FSTN HC VALVE 10" GALV BASIN	1.00	1			
2044517		KIT FSTN VIB SWITCH S300	1.00	1			

** Requires an MSDS
Date: 04/23/2015

SPX.
COOLING TECHNOLOGIES

Pack In Station: 10015 - Options

Production Order : 2702140
Material : 2438392
Quantity : 1.000 ZCE
Model Number : NC8413XAS5GGF

Down Load Number : 692
Old Material Number : NC-10100890-A3
Packed by (Name) : PG
Packed by (Date) : 4-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2023614	L47	SHEET HMG 3MMX78.0X788.7	1.00	1		CFT	PG
2026452	Q47	ASSEMBLY HDG OVERFLOW	1.00	1		1	1
2028252	L14	SHEET HMG 1.5MMX143.1X223.8	2.00	2		tote	MM
2028253	L18	SHEET HMG 1.5MMX130.2X130.3	2.00	2		tote	MM
2030743	Q15	SHEET HMG 3MMX190.5X633.2	2.00	2		CFT	PG
2030747	Q11	SHEET HMG 3MMX190.5X632.1	2.00	2		1	1
2031528	M98	SHEET HMG 3MMX324.0X343.3	1.00	1		1	1
2036903	D31	GRP RECOVERY STACK	2.00	2		SKID	1
2036904	D35	GRP RECOVERY STACK - FLATSPOT	2.00	2		1	1
2062715	Q48	PIPE PVC 4DIAX1'-11 1/8	1.00	1		CFT	1
2072784	VIB	SWITCH VIBRATION MARLEY M-5	1.00	1		tote	MM
012450X**	Z11	SEALER POLYURETHANE	4.18	5		1	1
404343X	Q14	GASKET FULL FACE 1/4THK 18DIA	1.00	1		1	1
654236X	N39	GASKET 1/4X10IDX13OD	2.00	2		1	1
A66275	N45	GASKET FULL FACE 1/4THK 10DIA	2.00	2		1	1

** Requires an MSDS
Date: 04/23/2015

SPX
COOLING TECHNOLOGIES

Pack In
Station: 10018 - Options - Valves

Production Order	: 2702140	Down Load Number	: 692
Material	: 2438392	Old Material Number	: NC-10100890-A3
Quantity	: 1.000 ZCE	Packed by (Name)	: PC
Model Number	: NC8413XAS5GGF	Packed by (Date)	: 4-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
C12525	N40	VALVE HCF 10-11	2.00	2		CRT	PC

** Requires an MSDS
Date: 04/23/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10020 - TOWER

Production Order	: 2702140	**Down Load Number**	: 692		
Material	: 2438392	**Old Material Number**	: NC-10100890-A3		
Quantity	: 1.000 ZCE	**Packed by (Name)**	: RC		
Model Number	: NC8413XAS5GGF	**Packed by (Date)**	: 4-28-15		

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
564378X	L99	SHEET HMG 8GAX2 1/2X12 3/4	2.00	2		tale	

** Requires an MSDS
Date: 04/23/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 25010 - Struc

Production Order	: 2702140	**Down Load Number**	: 692		
Material	: 2438392	**Old Material Number**	: NC-10100890-A3		
Quantity	: 1.000 ZCE	**Packed by (Name)**	: PC		
Model Number	: NC8413XAS5GGF	**Packed by (Date)**	: 4-28-15		

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2031043	L61	SHEET HMG 1.5MMX295.3X3384.5	2.00	2	—	1 of 1	PC

** Requires an MSDS
Date: 04/23/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10025 - Guardrails

Production Order	:	2702140	**Down Load Number**	:	692
Material	:	2438392	**Old Material Number**	:	NC-10100880-A3
Quantity	:	1.000 ZCE	**Packed by (Name)**	:	PG
Model Number	:	NC8413XAS5GGF	**Packed by (Date)**	:	4-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2023483	L52	ASSEMBLY ALUM LADDER	1.00	1		Tower	AL
2028199	L32	ASSEMBLY HDG GUARDRAIL NC8407,11,	2.00	2		SKD	PG
2028200	L33	ASSEMBLY HDG GUARDRAIL NC8407	2.00	2		1	1

** Requires an MSDS
Date: 04/23/2015

SPX
COOLING TECHNOLOGIES

Pack In Station: None

Production Order	2703071	Down Load Number	693
Material	2438393	Old Material Number	NC-10100890-A4
Quantity	1.000 ZCE	Packed by (Name)	PC
Model Number	NC8413XAS5GGF	Packed by (Date)	4-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2022897		KIT FSTN FIELD INSTALL W/STACK	1.00	1		tote	MM
2024304		KIT FSTN MECH EQUIP PLATFORM	1.00	1			
2026590		KIT FSTN LDR&GR LVR SGL FACE W/O	2.00	2			
2026700		KIT FSTN WALKWAY 5 1/2" AB-AB	1.00	1			
2031032		KIT FSTN FLUME ONLY NC8401-14 5	1.00	1			
2032102		KIT FSTN HC VALVE 10" GALV BASIN	1.00	1			
2044517		KIT FSTN VIB SWITCH S300	1.00	1			

** Requires an MSDS

SPX.
COOLING TECHNOLOGIES

Pack In Station: 10015 - Options

Production Order	:	2703071	Down Load Number	:	693
Material	:	2438393	Old Material Number	:	NC-10100890-A4
Quantity	:	1.000 ZCE	Packed by (Name)	:	
Model Number	:	NC8413XAS5GGF	Packed by (Date)	:	9-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2023614	L47	SHEET HMG 3MMX76.0X788.7	1.00	1		CRT	
2026452	Q47	ASSEMBLY HDG OVERFLOW	1.00	1		1	1
2028252	L14	SHEET HMG 1.5MMX143.1X223.8	2.00	2		tote	
2028253	L18	SHEET HMG 1.5MMX130.2X130.3	2.00	2		tote	
2030743	Q15	SHEET HMG 3MMX190.5X633.2	2.00	2		CRT	
2030747	Q11	SHEET HMG 3MMX190.5X632.1	2.00	2			
2031528	M98	SHEET HMG 3MMX324.0X343.3	1.00	1			
2036903	D31	GRP RECOVERY STACK	2.00	2		SKD	
2036904	D35	GRP RECOVERY STACK - FLATSPOT	2.00	2		1	
2062715	Q48	PIPE PVC 4DIAX1'-11 1/8	1.00	1		CRT	
2072784	VIB	SWITCH VIBRATION MARLEY M-5	1.00	1		tote	
012450X**	Z11	SEALER POLYURETHANE	4.18	5			
404343X	Q14	GASKET FULL FACE 1/4THK 18DIA	1.00	1			
654236X	N39	GASKET 1/4X10IDX13OD	2.00	2			
A66275	N45	GASKET FULL FACE 1/4THK 10DIA	2.00	2			

** Requires an MSDS
Date: 04/24/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10018 - Options - Valves

Production Order	:	2703071	**Down Load Number**	:	693
Material	:	2438393	**Old Material Number**	:	NC-10100890-A4
Quantity	:	1.000 ZCE	**Packed by (Name)**	:	RC
Model Number	:	NC8413XAS5GGF	**Packed by (Date)**	:	4-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
C12525	N40	VALVE HCF 10-11	2.00	2		47	RC

** Requires an MSDS
Date: 04/24/2015

SPX
COOLING TECHNOLOGIES

Pack In
Station: 10020 - TOWER

Production Order	: 2703071	Down Load Number	: 693		
Material	: 2438393	Old Material Number	: NC-10100890-A4		
Quantity	: 1.000 ZCE	Packed by (Name)	: PC		
Model Number	: NC8413XAS5GGF	Packed by (Date)	: 4-28-15		

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
554378X	L99	SHEET HMG BGAX2 1/2X12 3/4	2.00	2		tote	MG

** Requires an MSDS
Date: 04/24/2015

SPX.
COOLING TECHNOLOGIES

Pack In
Station: 10025 - Guardrails

Production Order	:	2703071	Down Load Number	:	693
Material	:	2438393	Old Material Number	:	NC-10100890-A4
Quantity	:	1.000 ZCE	Packed by (Name)	:	DC
Model Number	:	NC8413XAS5GGF	Packed by (Date)	:	4-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2023483	L52	ASSEMBLY ALUM LADDER	1.00	1		Tower	MS
2028199	L32	ASSEMBLY HDG GUARDRAIL NC8407,11,	2.00	2		SKD	DC
2028200	L33	ASSEMBLY HDG GUARDRAIL NC8407	2.00	2		1	1

** Requires an MSDS
Date: 04/24/2015

SPX
COOLING TECHNOLOGIES

Pack In
Station: 25010 - Struc

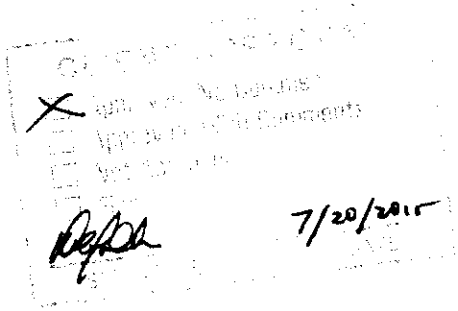
Production Order	:	2703071	Down Load Number	:	693
Material	:	2438393	Old Material Number	:	NC-10100890-A4
Quantity	:	1.000 ZCE	Packed by (Name)	:	PC
Model Number	:	NC8413XAS5GGF	Packed by (Date)	:	9-28-15

Item	Find Num	Description	Qty Req'd	Qty Packed	Qty Short	Crate#	Initials
2031043	L61	SHEET HMG 1.5MMX295.3X3384.5	2.00	2		48	PC

** Requires an MSDS
Date: 04/24/2015

/ **Marley Geareducer**® *Model 2700 and 3000* /

User Manual 02-128C



SPX
COOLING TECHNOLOGIES

/ Maintenance Schedule /

Maintenance Service	Monthly	Semi-annually	Seasonal Startup or Annually
Geareducer Drive:			
Inspect and tighten all fasteners including oil plug		x	x
Check for and repair oil leaks	x	x	x
Check oil level	x	R	x
Change oil		R	R
Make sure vent is open		x	x
Check driveshaft or coupling alignment			x
Inspect and tighten driveshaft or coupling fasteners			x
Check driveshaft or coupling bushing / flex elements for unusual wear			x
Lube Lines (if equipped)			
Check for oil leaks in hoses and fittings	x	R	x

R – Refer to instructions within this manual

Note: It is recommended at least weekly, that the general operation and condition be observed. Pay particular attention to any changes in sound or vibration that may signify a need for closer inspection.

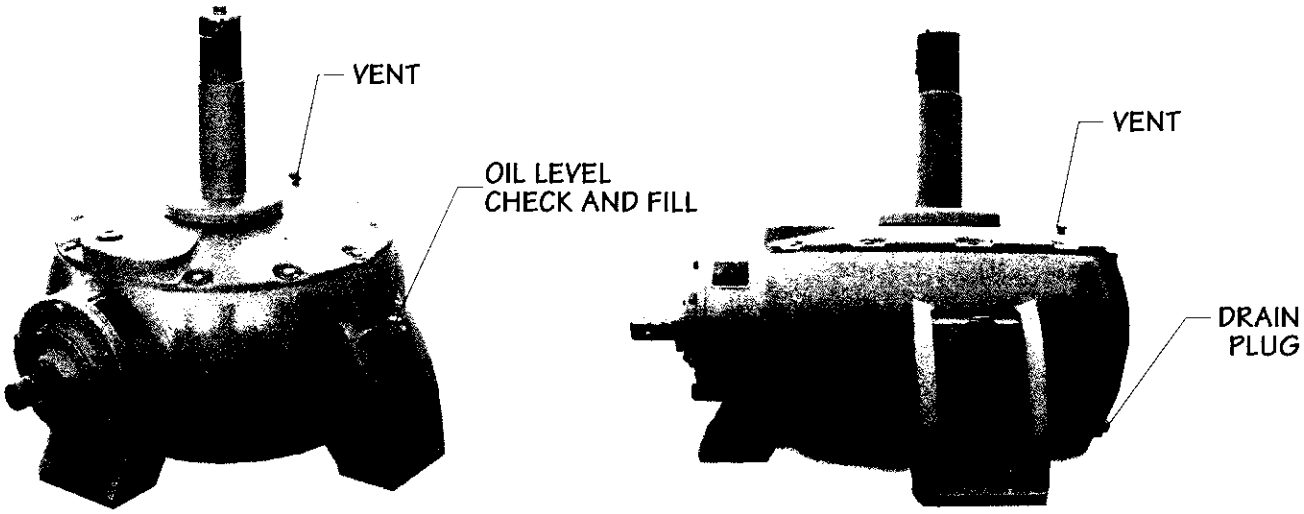


Figure 1 *Service Fittings*

Initial Protection Against Corrosion

As shipped, a Marley Geareducer® is protected internally against corrosion with machine enamel on unmachined parts and with rust-proofing oil and grease on machined surfaces. These coatings normally protect the Geareducer against atmospheric corrosion for storage periods up to six months. However, if oil is added to the Geareducer, it will dissolve the rust-proofing grease and oil, requiring the Geareducer to be operated once a week to keep a protective coating of oil on all interior machined surfaces.

Check Geareducer exterior. If exterior finish has been damaged during shipment or installation, touch up with epoxy paint as required. If Geareducer is equipped with a remote dipstick/oil level gauge and/or drain line, coat any exposed threads at pipe joints to prevent corrosion.

Initial Operation

The Geareducer must be filled with oil to the full oil level mark on the Geareducer case before it is placed in operation. See **Changing Geareducer Oil** section for oil filling instructions.

Geareducers supplied with new towers include oil for the initial filling. Oil is not furnished with Geareducers supplied as spares or on replacement orders. Before operating the mechanical equipment, check to be sure the oil level is at the full mark at the Geareducer and that the external gauge placard (if equipped) full mark corresponds with the "Full" level in the Geareducer. Check any oil lines to be sure there are no leaks.

Be certain that the vent on the Geareducer (and external dipstick/oil level gauge, if present) is not plugged.

In order to assure long service life, the Geareducer and motor must be level, and the drive shaft or coupling must be properly aligned. Refer to the alignment instructions in the Driveshaft or Coupling Manual shipped with the cooling tower. Copies are also available from your local Marley sales representative.

Note—If the tower is equipped with a two-speed motor, allow a time delay of at least 20 seconds when switching from high speed to low speed. Allow a time delay of at least two minutes when changing direction of fan rotation. Failure to provide these delays may significantly reduce equipment service life.

Scheduled Maintenance

Warning—Make certain that mechanical equipment is inoperable during periods of maintenance—or during any situation of possible endangerment to personnel. If your electrical system contains a disconnect switch, lock it out until the period of exposure to injury is over.

Monthly—Check Geareducer oil level. Shut down the unit and allow 5 minutes for the oil level to stabilize. Add oil if required, noting the addition in your maintenance log. If equipped with an external dipstick/oil level gauge, small quantities of oil can be added at that location.

Semi-annually—If using turbine-type mineral oil, change oil—see **Changing Geareducer Oil** for instructions. Check that all the assembly bolts and cap screws are tight, that oil plugs and pipe connections are in place and free from leaks, and that the vent on the Geareducer (and external dipstick/oil level gauge, if present) is clear—a clogged vent can lead to oil leaks. Intermittent operation and extended periods of downtime can cause condensation of water in the oil. If using Marley Gearlube, the oil condition must be inspected every six months—see **Changing Geareducer Oil** for maximizing service life.

Annually—Check mechanical equipment anchor bolts, drive shaft coupling bolts, and coupling set screws. Tighten as required. Check Geareducer exterior yearly and touch up with epoxy paint if required. Coat all exposed threads at pipe joints to prevent corrosion.

Every 5 Years—If using Marley synthetic Gearlube, change oil. To maintain five-year change intervals, use only Marley Gearlube. It is recommended to monitor the oil condition every six months throughout the five-year period per the instructions in **Changing Geareducer Oil**.

Lubricants

To insure maximum performance and service life, it is recommended Marley factory lubricants be used in all Marley Geareducers. Marley lubricants can be purchased through your local Marley sales representative.

If lubricants other than Marley factory lubricants are used, they must not contain any additives (such as detergents or EP additives) which are adversely affected by moisture and could reduce the service life of the Geareducer. The responsibility for use of lubricants other than Marley factory lubricants rests with the customer/owner and the lubricant supplier.

Seasonal temperature changes may require one viscosity of oil for summer operation and another for winter operation. Refer to the tables below for the seasonal selection information.

Winter or Summer	**Severe Duty/High Temperature**
Air Temperature at Geareducer	
Below 110°F (43°C)	Above 110°F (43°C)
ISO 150	**ISO 220**

Table 1 Oil viscosity

Changing Geareducer Oil

Drain the Geareducer oil by removing the drain plug. See **Figure 1** for location. If equipped with an external dipstick/oil level gauge, remove the drain plug at that location, and drain the entire system.

To maximize service life of the Geareducer, remove a sample from the drained oil and look for evidence of foreign material, such as water, metal shavings or sludge, or send the oil sample to an oil analysis lab for inspection. If you find unacceptable condensation or sludge, flush the Geareducer with mineral oil before refilling.

After inspection is complete, fill the Geareducer with **14 gallons** (53 liters) of oil. See Figure 1 for location. If the Geareducer is equipped with an external dipstick/oil level gauge an additional 3 to 4 quarts of oil will be required. Be certain that the vent on the Geareducer (and external dipstick/oil level gauge, if present) is not plugged. Verify that the gauge/drain line is full and that there aren't any leaks at the connections.

Alternate procedure:

If the cooling tower has an external oil gauge and drain line equipped with a three-way valve below the oil level gauge. See **Figure 2**.

1. Remove pipe plug. Turn valve control stem clockwise to open drain.
2. With Geareducer drained, the three-way valve turned clockwise, and the pipe plug removed, connect fill source (usually a hose to a pump, to the three-way valve).

   Pump oil through the hose. Check oil level occasionally by turning the valve control stem counterclockwise and allowing the oil level in the sight glass to stabilize. Continue filling until full level mark is reached.
3. With the oil level at the full mark turn the valve control stem counterclockwise to close the drain and open the valve to the sight glass. Remove the oil filling line and reinstall pipe plug in the three-way valve.

Repair and Overhaul

The Model 2700 and 3000 Geareducer is assembled using specialized tools and fixtures. Bearings and gear sets are unique and not available from other sources. Geareducers can be repaired in the field—however, major repairs require the use of a fully equipped machine shop. Refer to the **Field Repair** section of this manual for further instructions.

If your Geareducer ever needs replacement or repair, Marley recommends returning the unit to a Marley factory service center. Contact your Marley sales representative to discuss course of action. A factory reconditioned Geareducer carries a one year warranty. The Marley Order Number on your cooling tower will be required if the Geareducer is shipped back to the factory for repair. Obtain a ***"Customer Return Material"*** tag from the Marley sales representative in you area.

To find your Marley sales representative call 913 664 7400 or check the internet at spxcooling.com.

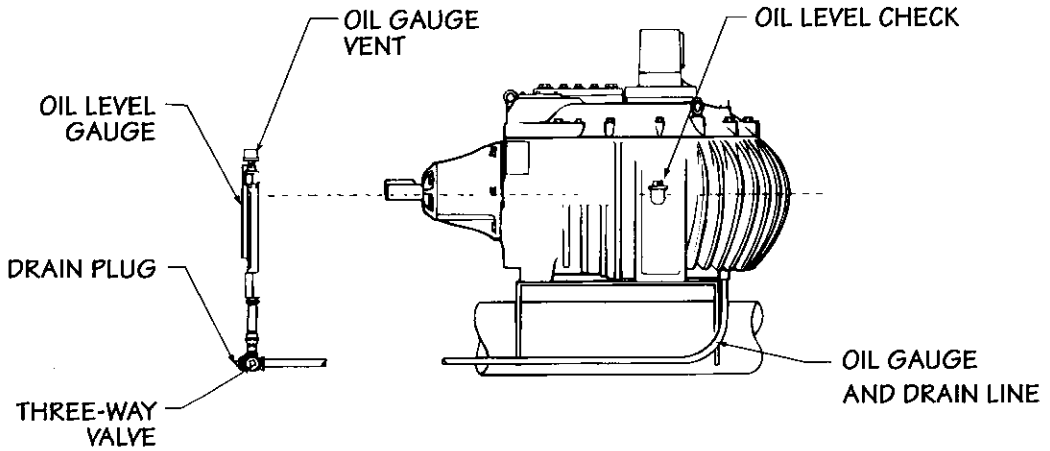


Figure 2 Service Fittings

/ Parts List /

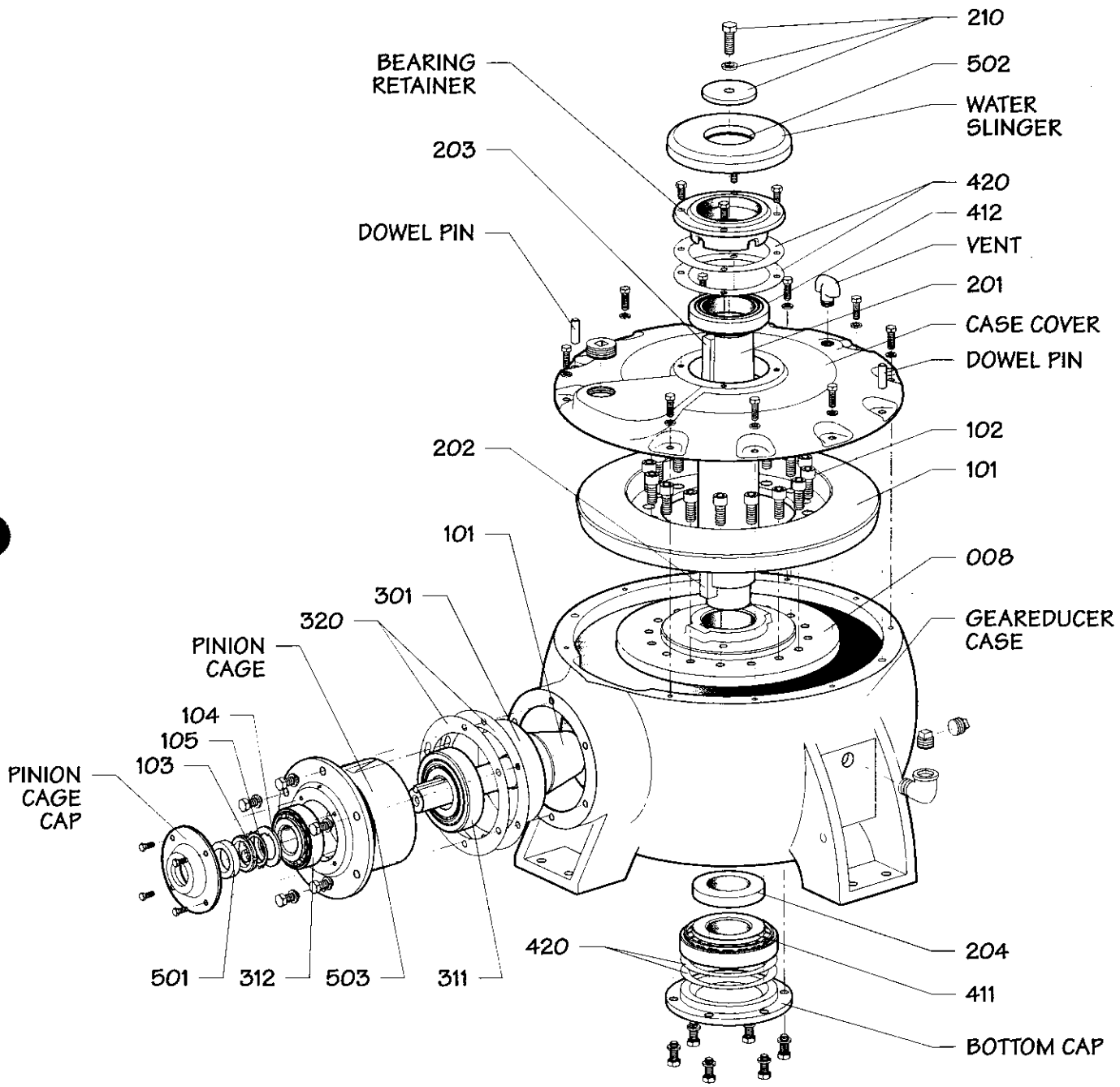


Figure 3

/ Parts List /

Parts List

1 Complete Geareducer Assembly
008 Ring Gear Hub
100 Spiral Bevel Gear Set
- **101** Set of matched spiral bevel gears, including integral pinion shaft with key
  Gear ratios as follows:
  Model 2700

5.77 to 1	7.71 to 1	8.66 to 1	
Model 3000			
5.06 to 1	5.44 to 1	6.14 to 1	6.85 to 1
7.91 to 1	8.80 to 1	9.60 to 1	

102 Ring gear attaching hardware
103 Lock nut
104 Tongue Washer
105 Lockwasher

200 Fan Shaft Set
- **201** Fan Shaft
- **202** Ring gear hub key
- **203** Fan key
- **204** Ring spacer—Model 2700 Geareducer only
- **210** Fan attaching hardware
  Cap screws and washers

301 Oil Slinger
310 Set of Two Pinion Shaft Bearings
- **311** Head, tapered roller bearing
- **312** Tail, tapered roller bearing

320 Pinion Cage Shims

410 Fan Shaft Bearing Set
- **411** Lower tapered roller bearing
- **412** Upper tapered roller bearing

420 Fan Shaft Shims

500 O-Ring Set
- **502** Water slinger O-ring
- **503** Pinion cage O-ring

501 Pinion Shaft Oil Seal

/ Field Repair /

General

Geareducers can be repaired in the field—however, major repairs require the use of a fully equipped machine shop. When field repair or replacement of parts is necessary, the following procedure is recommended for the disassembly and assembly of the unit. If any O-ring, oil seal or gasket is to be reused, care should be taken not to damage it during disassembly. Parts which contain O-rings or seals should not be jerked or twisted past a shoulder or edge. These parts are marked with an asterisk (*) in the description below. O-rings, oil seal and gaskets should be carefully inspected for damage before being reinstalled. Marley recommends that new O-rings and oil seal be installed during a major overhaul.

Disassembly

Part numbers and references—refer to **Figure 3.**

1. Drain oil.
2. Remove outer ring of bolts in pinion cage and remove pinion subassembly*.

Note—The thickness of the shim pack (320) is important in resetting the gears. The shim pack should either be saved or carefully measured with a micrometer. If the gears are to be replaced, record the pinion setting distance that is etched on the pinion gear. See **Figure 4.**

3. Remove water slinger*.
4. Remove bearing retainer and shim pack (420) from top of case.

Note—The thickness of this shim pack is important in the endplay and backlash setting of the gears. The shim pack should either be saved or carefully measured with a micrometer.

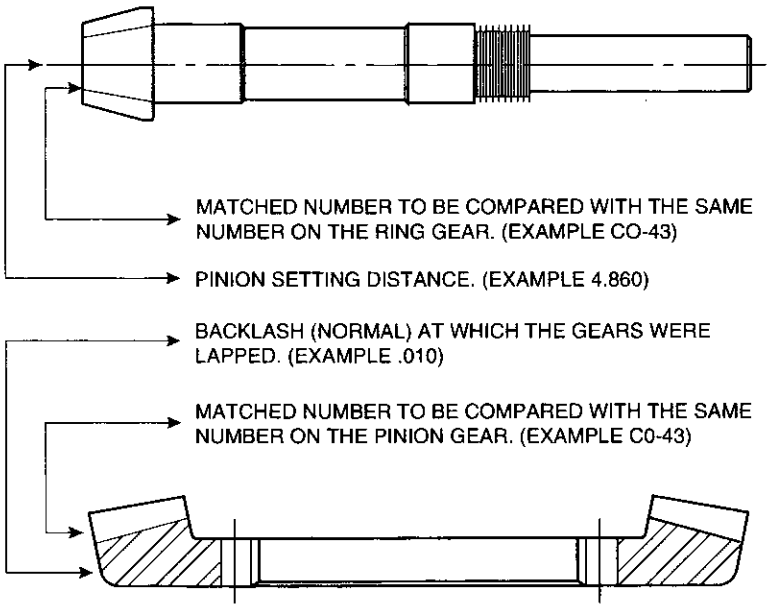


Figure 4 Gear Match Numbers and Setting Data

5. Drive dowel pins down into case.
6. Remove bolts and case cover and lift fan shaft assembly out of the case.
7. Turn case over and remove bottom cap and shim pack (**420**).

Note—The thickness of this shim pack is important in setting the fan shaft bearing endplay and backlash. This pack should be saved or carefully measured with a micrometer.

8. Remove bearing cups (**411** and **412**) from the Geareducer case and cover.

Pinion Cage Disassembly

1. Remove pinion cage cap* from pinion cage.
2. Remove O-ring* (**503**).
3. Remove locknut, lockwasher and tongue washer (103, **105** and **104**) then press pinion shaft (**101**) out of pinion cage. This will free tail bearing cone (**312**).
4. Press oil slinger (**301**) and head bearing cone (**311**) from the pinion shaft.
5. Press bearing cups (**311** and **312**) out of pinion cage.

Fan Shaft Disassembly

1. Remove ring gear (**101**) from the ring gear hub (**008**).
2. Press ring gear hub, ring spacer (**204**—Model 2700 only) and lower bearing cone (**411**) off of the fan shaft (**201**).
3. Remove lower fan shaft key (**202**).
4. Press the top bearing cone (**412**) off of the shaft.

Assembly

Before assembling a new pinion gear in the pinion cage, check match numbers on pinion gear and spiral bevel ring gear to be certain that they are a matched set. Gears are lapped in matched sets at the factory and should not be separated. Numbers are etched on both the pinion and ring gear as illustrated in **Figure 4**.

All parts that are to be reused should be thoroughly cleaned before being reinstalled. Replace bearings if necessary.

Pinion Cage Subassembly

1. Place oil slinger (**301**) on pinion shaft.
2. Press head bearing cone (**311**) on pinion shaft making sure oil slinger and bearing are against gear.
3. Press bearing cups (**311** and **312**) into pinion cage.
4. Lower pinion cage on pinion shaft, until head bearing cone and cup mate.
5. Press tail bearing cone (**312**) on pinion shaft until it mates with its bearing cup.
6. Install locknut, lockwasher and tongue washer (**103**, **105** and **104**). Tighten nuts on bearing cone until 8 to 12 in·lb*f* (904-1356 mN·m) of bearing preload is obtained. Bearing preload is the resistance in the bearings to shaft rotation measured in in·lb*f* required to rotate the shaft at uniform velocity. Preload is necessary to insure the stability of the gear engagement. Bend tab(s) on lockwasher to secure locknut in place.
7. Install O-ring (**503**) in groove on pinion cage.
8. Press oil seal onto pinion shaft.
9. Tighten pinion cage cap screws to 45 ft·lb*f* (61 N·m).
10. Record the pinion setting distance that is etched on the pinion gear. See **Figure 4**.

Installation of Fan Shaft

1. Press ring gear hub (**008**), ring spacer (**204**—Model 2700 only) and the upper and lower bearing cones (**411** and **412**) on the fan shaft (**201**). Install ring gear (**101**) on ring gear hub and tighten cap screws to 75 ft·lb*f* (102 N·m) for Model 2700 or 150 ft·lb*f* (203 N·m) for Model 3000.
2. Install the bottom cap using old shim pack or make up equivalent thickness shim pack (**420**).
3. Press lower fan shaft bearing cup (**411**) in bore.
4. Install fan shaft assembly in case.
5. Press upper fan shaft bearing cup (412) in cover. Apply a bead of sealant to the cover flange inboard of the bolt holes. Install cover on case. Install dowel pins in cover and drive flush with top of cover.
6. Install cap screws and tighten to 45 ft·lb*f* (61 N·m).
7. Install bearing retainer using old shim pack (**420**) or equivalent thickness and tighten cap screws to 45 ft·lb*f* (61 N·m).

8. Measure fan shaft end play with a dial indicator on a surface normal to the plane of rotation. Lift shaft axially and rotate slowly until all axial movement stops. Zero the dial indicator. Lower shaft (zero lifting load) and rotate shaft until axial movement stops. End play will be read directly from the dial indicator. Adjust the fan shaft bearings to .003-.005 (.076-.127mm) end play. The end play is adjusted by adding or removing shims (**420**) under the bearing retainer.

Installation of Pinion Cage

1. Find the difference between the pinion setting distance of the old gear and the new pinion gear and adjust the old shim pack (**320**) or make a new shim pack to compensate for the different setting distances.

   Example:

Pinion setting distance of old gear	6.505
Pinion setting distance of new gear	6.500
Difference	*.005*

   Remove .005 from shim pack.
2. Install pinion cage subassembly into case and tighten cap screws to 75 ft·lb*f* (102 N·m).
3. Engage pinion gear tooth with "X" marked on end between ring gear teeth marked with "Xs". Care must be taken not to damage the pinion gear teeth by forcing them into the ring gear teeth.

Gear Setting Procedure

The proper mounting of the gear set is essential to obtain long life and smooth operation of the gears. The pinion and ring gears were positioned approximately in the preceding steps. The correct gear position is determined by the gear backlash.

1. Based on the backlash etched on the gear set, find the equivalent backlash setting in **Table 2**, Column 2.
2. With the "X" marked tooth on the pinion gear engaged between the two "X" marked teeth on the ring gear, check the backlash with a dial indicator as shown in **Figure 5**. Lock the pinion shaft against rotation. The amount of movement of the fan shaft, measured at a distance equal to the outside radius of the ring gear is the backlash. Obtain backlash setting by adjusting ring gear axially by removing or adding shims (**420**) at bottom bearing cap.

Note—To maintain the previous fan shaft bearing endplay adjustment, a corresponding shim (**420**) adjustment must be made at the bearing retainer.

Example: *Removing .003" shims at the bottom bearing cap requires the addition of .003" shims at the bearing retainer to maintain correct bearing adjustment.*

Recheck the backlash to make sure it is within the proper limits.

3. After the equivalent backlash setting has been obtained with the marked teeth in mesh, check the backlash at two other points on the ring gear (points approximately 120° apart). See **Table 2**, Column 3 for tolerances.

Final Assembly

1. Remove bottom cap and apply a bead of sealant to the bottom cap flange inboard of the bolt holes. Reinstall the bottom bearing cap and tighten the cap screws to 75 ft·lb*f* (102 N·m).
2. Install O-ring (**502**) in water slinger.
3. Install water slinger on fan shaft (**201**).
4. Replace air vent and all pipe plugs.
5. Fill with lubricant selected from **Table 1**.

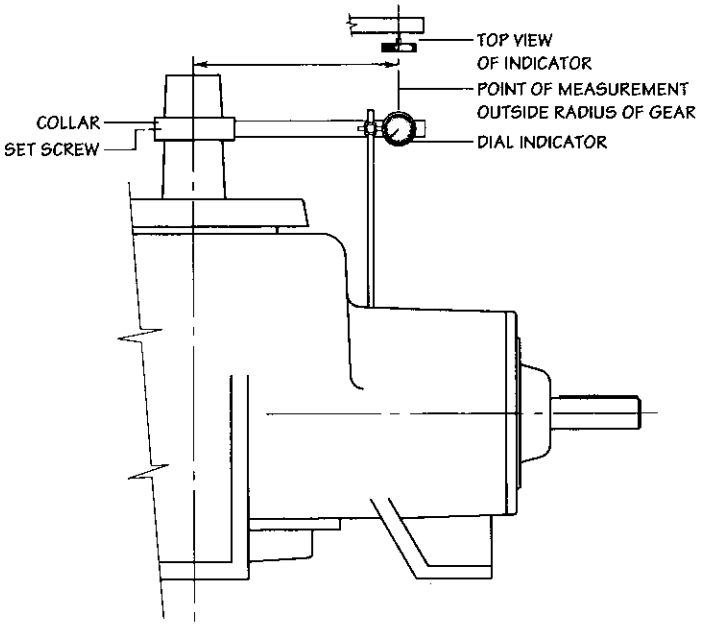


Figure 5 *Gear Backlash Measurement*

Backlash Etched on Gears Normal - inches	**Set the Gears to Backlash** ± .001 Plane of Rotation	Backlash at Check Points may vary from Settings in Column 2 by: ±
.008	.010	.003 / .008
.009	.0115	.003 / .008
.010	.013	.003 / .008
.011	.014	.004 / .010
.012	.015	.004 / .010
.013	.017	.004 / .010
.014	.0185	.004 / .010

Table 2

SPX

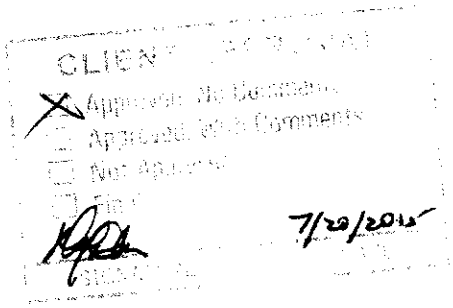
COOLING TECHNOLOGIES

spxcooling.com

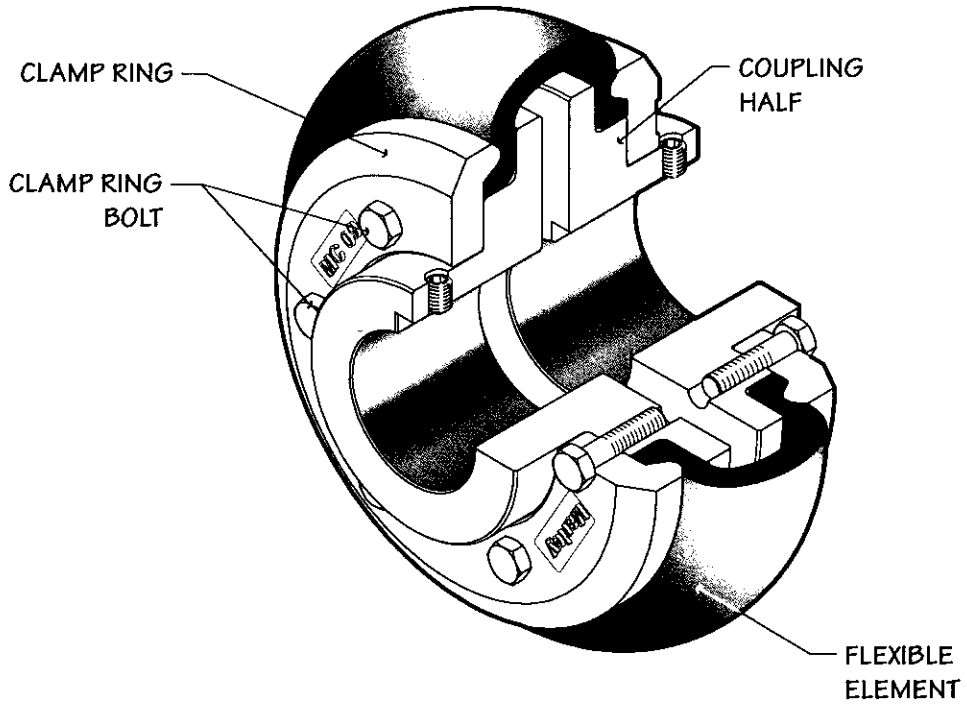
Manual 92-128C

/ **Marley SofTork™** *Series MC Coupling* /

User Manual 07-1205A



SPX
COOLING TECHNOLOGIES

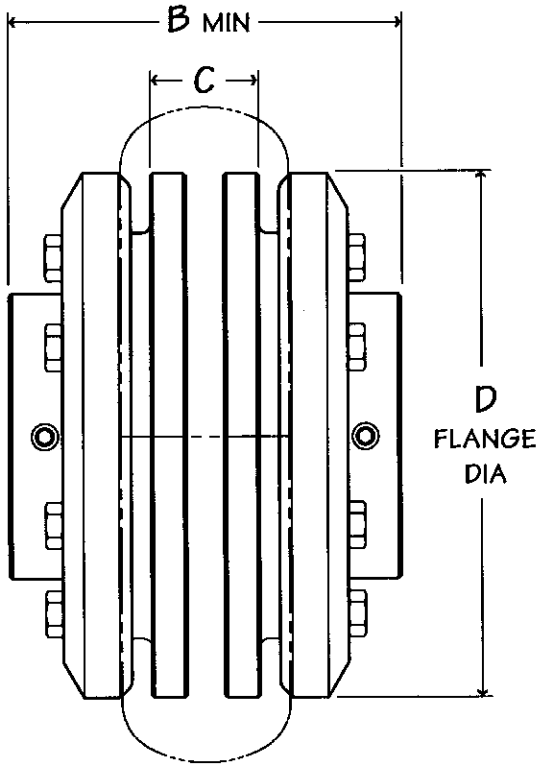


Assembly and Alignment

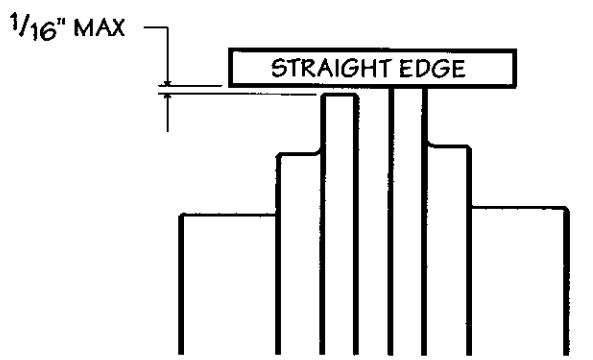
1. Inspect and clean motor and Geareducer® shafts. Remove any burrs on shafts with emery cloth or a fine file. Remove all lubricants from coupling bores and mating surfaces. Install keys in motor and Geareducer shaft keyways.
2. Install a clamp ring on each coupling half using the bolts provided.

   Note: Leave this attachment loose for now, only engaging a few threads of each bolt—it may be necessary to reposition the clamp rings for parallel alignment—**Step 7**.
   Caution: Do not lubricate bolt threads.
3. Slip each coupling half onto its mating shaft. Move the motor and Geareducer into place.

   Note: Clamp ring must be mounted to coupling half before the motor and Geareducer are positioned.
4. Check coupling spacing by measuring dimension **"C"** at the top of the coupling only. Refer to **Table** and **Detail 1**. Slide the coupling halves along the shafts to obtain spacing. The maximum distance between shaft ends is 2". The shafts may protrude through the coupling halves if necessary.
5. Tighten each set screw on its key—24 ft·lb$_f$.



Detail 1



Detail 2

6. Check angular alignment by measuring the **"C"** dimension at 90° intervals (take at least four measurements). The total difference between any two measurements, **C** max – **C** min, must not exceed 1/16". See Detail 1.
7. Check parallel alignment by laying a straight edge across the outside of the coupling halves at several places around its circumference. Parallel misalignment may not exceed 1/16". See **Detail 2.**

   Tip: If the clamp rings are larger in diameter than the coupling halves, remove enough clamp ring bolts to rotate the clamp rings so the straight edge bears directly on the coupling halves.

   If measured misalignment is greater than 1/16", shim the motor and/or Geareducer mounting feet to obtain proper alignment. After adjusting shims, tighten the hold-down hardware and check alignment. Repeat the procedure until proper alignment is achieved. The best alignment is achieved when the straight edge is in contact with the coupling halves at four points as shown in **Detail 2.**
8. With clamp ring bolts holding the clamp ring(s) in place, wrap the flexible element around the clamp rings as shown. Make sure the beads of the element are fully worked down into the seats.
9. Hold the split of the flexible element closed. An 1/8" maximum gap is allowable. Tighten one or two bolts directly opposite the split—enough to hold the flexible element in place. Using both hands, knead the rubber element toward the split. Hold split closed and tighten the next two bolts farthest from split—enough to hold the flexible element in place. Repeat this procedure on all remaining flange bolts. Retighten each bolt in the order shown in **Detail 3** using a torque specified in table.

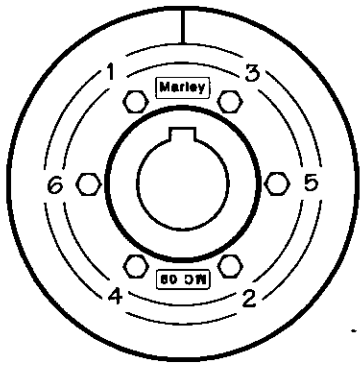
   Note: MC07 couplings have 5 bolts/half, use a similar cross pattern.

   Tighten all bolts a second time to the specified torque.

   Caution: Do not over-torque bolts or you may damage the clamp ring.

Maintenance

1. Marley SofTork couplings do not require lubrication.
2. Thoroughly inspect the coupling at least every six months. Check for looseness of set screws and coupling halves on shafts, and for wear of the flexible element.
3. Contact your Marley sales representative if you need replacement parts. Call 913 664 7400 or check the web at spxcooling.com to locate your nearest rep.



Detail 3

Coupling	B	C	D	Torque ft · lb_f	Cap Screw
MC07	5 1/8"	1 1/2"	5 5/8"	24	5/16" x 1 1/2"
MC09	5 9/16"	1 17/32"	7 3/8"	33	3/8" x 1 1/2"
MC11	6 3/8"	1 9/16"	9 3/16"	33	3/8" x 1 1/2"

SPX

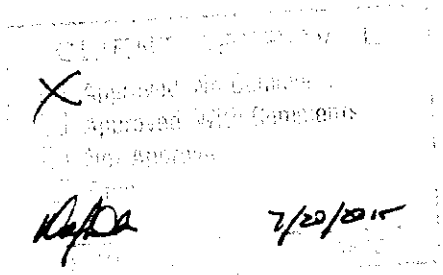
COOLING TECHNOLOGIES

spxcooling.com

M07-1205A

/ **NC®** *Steel Cooling Tower* /

User Manual 09-1150A



Marley
AN SPX BRAND

Contents

Note

This manual contains vital information for the proper installation and operation of your cooling tower. Carefully read the manual before installation or operation of the tower and follow all instructions. Save this manual for future reference.

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

⚠ Warning

Indicates presence of a hazard which can cause severe personal injury, death or substantial property damage if ignored.

⚠ Caution

Indicates presence of a hazard which will or can cause personal injury or property damage if ignored.

Note

Indicates special instructions on installation, operation or maintenance which are important but not related to personal injury hazards.

Preparation

The Marley NC cooling tower purchased for this installation represents the current state of the art in crossflow, induced draft cooling tower design. Thermally and operationally, it is the most efficient cooling tower of its class.

These instructions–as well as those offered separately on motors, fans, Geareducers®, couplings, drive shafts, float valves, etc.–are intended to assure that the tower serves you properly for the maximum possible time. Since product warrantability may well depend upon your actions, please read these instructions thoroughly prior to operation.

If you have questions about the operation and/or maintenance of this tower, and you don't find the answers in this manual, please contact your Marley sales representative. When writing for information, or when ordering parts, please mention tower serial number shown on the nameplate located on the access door.

Safety First

The location and orientation of the cooling tower can affect the safety of those responsible for installing, operating or maintaining the tower. However, since SPX Cooling Technologies does not determine the location or orientation of the tower, we cannot be responsible for addressing those safety issues that are affected by the tower's location or orientation.

⚠ Warning

The following safety issues should be considered by those responsible for designing the tower installation.

- ***access to and from the fan deck***
- ***access to and from maintenance access doors***
- ***the possible need for ladders (either portable or permanent) to gain access to the fan deck or maintenance access doors***
- ***the possible need for handrails around the fan deck***
- ***the possible need for external access platforms***
- ***potential access problems due to obstructions surrounding the tower***
- ***lockout of mechanical equipment***
- ***the possible need for safety cages around ladders***
- ***the need to avoid exposing maintenance personnel to the potentially unsafe environment inside the tower.***

Preparation

Those are only some of the safety issues that may arise in the design process. SPX strongly recommends that you consult a safety engineer to be sure that all safety considerations have been addressed.

Several options are available that may assist you in addressing some of these personnel safety concerns, including:

- a handrail system around the perimeter of the fan deck with either one or two ladders for access to the deck
- ladder extensions (used where the base of the tower is elevated)
- safety cages for fan deck ladders
- external lube lines
- fan cylinder extensions
- flow control/balancing valves
- fan barrier
- access door platform
- motor located outside the tower
- external motor access platform

Tower Location

Space available around the tower should be as generous as possible to promote ease of maintenance–and to permit freedom of airflow into and through the tower. If you have questions about the adequacy of the available space and the intended configuration of the tower, please contact your Marley sales representative for guidance.

Prepare a stable, level support foundation for the tower, utilizing weight, wind load, and dimensional information appearing on appropriate Marley submittal drawings. Supports must be level to insure proper operation of the tower.

⚠ Warning

The cooling tower must be located at such distance and direction to avoid the possibility of contaminated tower discharge air being drawn into building fresh air intake 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.

Receiving and Hoisting

Tower Shipment

Unless otherwise specified, NC towers ship by truck (on flat bed trailers), which lets you receive, hoist, and install the tower in one continuous operation. Single-cell towers ship on one truck. Multicell towers, depending on their size, may require more than one truck.

Responsibility for the condition of the tower upon its arrival belongs to the trucker–as does the coordination of multiple shipments, if required.

Receiving Tower

Prior to unloading the tower from the delivering carrier, inspect the shipment for evidence of damage in transit. If damage is apparent, note the freight bill accordingly. This will support your future recovery claim.

Find and remove the installation instruction drawings and bills of material located in a plastic tote in the cold water basin. This information should be kept for future reference and maintenance purposes.

Hoisting Tower

NC8411 through NC8414 models consist of two modules per cell. The upper module includes hoisting clips at the top of the module. The hoisting clips on the lower module are located near the bottom on the sides of the cold water basin. All other models ship in a single module.

⚠ Caution

NC upper and lower modules must be hoisted and set separately. Do not preassemble modules prior to hoisting.

The hoisting clips for NC8409 are located near the bottom of the tower on the cold water basin sides. The hoisting clips for all other models are located at the top of the tower. A **Hoisting-Installation** label which has hoisting dimensional information is located on the side casing near the tower centerline. Remove tower from the carrier and hoist into place according to the instructions on the label.

⚠ Warning

Hoisting clips are provided for ease of unloading and positioning tower. For overhead lifts or where additional safety is required, safety slings should also be placed under the tower. Under no circumstances should you combine the top and bottom modules of modular models and attempt to hoist them at the same time by utilizing the hoisting clips alone!

Installation

Tower Installation

Note

These installation instructions are intended to help you prepare before your tower arrives. If discrepancies exist between these instructions and those shipped with the tower, the instructions shipped with the tower will govern.

1. Prior to placement of the tower, confirm that the supporting platform is level, and that the anchor bolt holes are correctly located in accordance with Marley drawings.
2. Place tower (or bottom module of NC8411 through NC8414 models) on your prepared supports, aligning anchor bolt holes with those in your supporting steel. Make sure that the orientation agrees with your intended piping arrangement. Attach tower to supporting steel with four ¾" diameter bolts and flat washers (by others). Position flat washers between the bolt head and the tower basin flange.
3. **NC8411 through NC8414 models only.** Before setting top module in place on bottom module, clean any debris from the underside of the top module fill, skid and beams and from the top of the bottom module and remove shipping cover from bottom of top module–replace fasteners at side of module to prevent leaks. Place top module on the top peripheral bearing surface (factory-installed gasket) of bottom module, aligning mating holes as it is set in place. (Make sure that the orientation of the top module agrees with your intended piping arrangement. Sections are 180° reversible with respect to each other.) Attach top module to bottom module with fasteners provided–according to **"NC Field Installation Manual"** Assembly Instructions.

If tower purchased is one fan cell only, ignore steps 4 through 8.

4. If collection basins are to be equalized by the use of Marley standard flumes, unbolt the coverplate from the basin of the cell just installed. The coverplate is located in the center of the basin side.
5. Unbolt temporary coverplate from the basin of the 2nd cell and set 2nd cell (or bottom module of 2nd cell) in place. Align anchor bolt holes and flume openings in basin sides.
6. Install flume according to Field Installation Manual instructions.

Note

It is important that the cells be firmly anchored before the flume is attached to the 2nd cell.

7. Repeat steps 2 and 3 for 2nd top section on NC8411 through NC8414 models.
8. Repeat steps 4 through 7 for any remaining cells.
9. Attach your cold water supply piping to the cold water basin outlet connection in accordance with drawing instructions, utilizing gaskets provided.

⚠ Caution

Do not support your pipe from the tower or outlet connection–support it externally.

Normally, one of the following three outlet arrangements is provided:

Case face connection: This is a factory-installed, galvanized pipe nipple, extending horizontally from the side of the cold water basin. It is both beveled for welding–and grooved for a mechanical coupling. If a weld connection is used, it is recommended that the weld area be protected against corrosion. Cold galvanizing is suggested, applied according to the manufacturer's instructions.

Bottom outlet connection: This is a factory-installed, circular opening in the cold water basin floor of one or more cells. An appropriately-sized circular opening has been provided to accept a 125# ANSI B16.1 flat-face flange connection.

Side outlet sump connection: Unless otherwise specified, sumps are manufactured of heavy duty FRP (fiber-reinforced polyester) construction. Because of their size, they are attached upside down in the basin to prevent damage in shipment. They must be inserted into the square opening prepared in the floor of the cold water basin of one or more cells–sealed against leakage, and attached by machine bolts, according to the installation drawing included. An appropriately-sized circular opening in the vertical face of the sump has been provided to accept a 125# ANSI B16.1 flat-face flange connection.

10. Attach makeup water supply piping to appropriately-sized float valve connection located in cold water basin side wall. Install the drain and overflow according to the **"NC Field Installation Manual"** Assembly Instructions. If you wish to pipe overflow and drain water to a remote discharge point, make those connections at this time also.
11. Attach your warm water return piping to the inlet connections of the tower.

Installation

Note

Fasteners and components provided by others that are to be attached to the tower must be compatible with the cooling tower materials–i.e. fasteners in a stainless steel cold water basin must be stainless steel.

⚠ Caution

Except for the horizontal components of top-mounted piping, and as prescribed on Marley drawings, do not support your pipe from the tower or inlet connection–support it externally.

Normally, one of the following four inlet arrangements is provided:

Standard distribution basin connections: These are circular openings–two per cell–in the top deck of the tower near the air inlet face, provided to accept standard 125# flat-face flanges. Remove the center section of the inlet flume assembly to gain access to attach inlet fasteners. (Refer to **"NC Field Installation Manual"** shipped with tower.)

Marley flow-control valve connections (option): Marley flow-control valves–two per cell–are designed to 1–take the place of the standard elbows normally required for inlet connection, and 2–provide means of regulating flow to both sides of the tower. Remove the center inlet flume assembly to gain access for attachment of valves. (Refer to **"NC Field Installation Manual"** Assembly Instructions shipped with tower.) Valves provide a vertical face for attachment of your standard 125# flange.

Side inlet connection (option): A pipe stub is provided in the casing wall above the access door for connection to the external piping by means of the rubber coupling provided.

Bottom inlet connection (option): An appropriately sized hole and bolt circle–one per cell–is provided in the floor of the cold water basin. Bolt circle is designed to accept a standard 125# flat-face flange.

12. Wire motor in accordance with wiring diagram.

⚠ Warning

For maintenance/safety purposes, SPX recommends a lockout type disconnect switch for all mechanical equipment. In addition to a disconnect switch, the motor should be wired to main power supply through short circuit protection, and a magnetic starter with overload protection.

Installation

Motor Wiring

Wire motor leads as shown on the motor nameplate matching the supply voltage. Do not deviate from the motor nameplate wiring.

Either of following symbols may be shown on the motor nameplate – Δ, Δ Δ, Y, or YY. These symbols represent how the motor is constructed on the inside and in no way have anything to do with a Delta or Wye electrical distribution system serving the motor.

When using a starter:

- Set motor overload protection to 110% of motor nameplate amps. This setting allows the fan motor to operate during cooler weather. During cooler weather it is common for the motor to draw 6 to 10% higher than nameplate amps. High amps are common during tower commissioning when the tower is dry and the ambient air temperature is cool.

Note

Do not start the motor more than four to five times per hour. Short cycling the tower will cause fuses, breakers or O.L.s to operate and will decrease motor life.

When using a *two-speed* starter:

- Motor rotation must be the same at slow speed and high speed.
- Single winding motor requires a starter with a shorting contactor.
- Two-winding motor requires a starter with out a shorting contactor.
- All two-speed starters must have a 20 second time delay relay when switching from high speed to low speed.

Note

Do not start the motor more than four to five times per hour (each low speed start and each high speed start count as one start).

When using a VFD:

Note

Before beginning, ensure that the motor is rated for "Inverter Duty" per NEMA MG-1, part 31.

- Set the VFD solid state overload protection to 119% of motor nameplate amps and set "maximum current parameter" in the VFD to motor nameplate amps. "Maximum current parameter" will reduce fan speed and limit amp draw to nameplate amps during cold weather operation. If furnished with a mechanical O.L. set this at 110% over motor nameplate amps.

Installation

- Motor rotation must be the same in both VFD mode and By-pass mode.
- If cable distance between the VFD and motor is greater than 100 feet a DV/DT output filter is recommended to avoid damage to the motor. 100 feet distance is based on our field experience, the VFD manufacture may state different distances and distance does vary depending on the VFD manufacture.
- Program the VFD for variable torque output. Flux vector and constant torque modes may damage the gearbox.
- Do not start and stop the motor using the safety switch at the motor. If the drive is being commanded to run and the load side is cycled ON and OFF with the safety switch this may damage the VFD.

Using a VFD in cooling applications has advantages over traditional single or two speed motor control. A VFD can reduce the cost of electrical energy being used and provide better temperature control. In addition, it reduces the mechanical and electrical stress on the motor and mechanical equipment. Electrical savings can be large during periods of low ambient temperature when the cooling requirement can be satisfied at reduced speeds. To benefit from these advantages, it is important that the drive be installed correctly.

Marley supplies VFD and VFD controls specifically designed for our cooling products. If you have purchased a Marley VFD and/or controls package, please follow the instructions in the User Manual for that system. Most VFD problems can be avoided by purchasing the Marley drive system. If you are installing a VFD other than the Marley drive, please refer to that drives installation manual.

⚠ Warning

Improper use of a VFD may cause damage to equipment or personal injury. Failure to correctly install the VFD drive will automatically void all warranties associated with the motor and any equipment that is either electrically or mechanically (directly) attached to the VFD drive system. The length of this warranty avoidance will be contingent on properly installing the VFD system and repairing any damage that may have occurred during its operation. SPX Cooling Technologies does not assume responsibility for any technical support or damages for problems associate with non-Marley brand VFD systems.

⚠ Warning

Changing the operational fan speed from the factory settings could cause the fan to operate in an unstable region which may result in damage to the equipment and possible injury.

Installation

Mechanical Equipment:

⚠ Warning

Always shut off electrical power to the tower fan motor prior to performing any maintenance on the tower. Any electrical switches should be locked out and tagged out to prevent others from turning the power back on.

1. If equipped, check oil level in accordance with the Geareducer User Manual for the Geareducer. (Although the Geareducer was filled to the proper level at the factory, tipping during shipment and hoisting may have caused some loss of oil.) If oil is required, fill Geareducer to the proper level with approved lubricant. (See Geareducer User Manual) Check oil level at the Geareducer or dipstick (standpipe located on fan deck, if so equipped) to confirm that the proper level is indicated.
2. Install fan guard according to the installation drawing shipped with the tower. NC8401 through NC8403 models include a single-piece fan guard. NC8405 through NC8414 models include a two-piece fan guard. Models with extended velocity-recovery cylinders do not have fan guards.

⚠ Warning

Improper installation of the fan guard will destroy the structural integrity of the fan guard. Failure of the fan guard could allow operating or maintenance personnel to fall into the rotating fan.

3. Spin the fan manually to assure that all fan blades properly clear the inside of the fan cylinder. Observe the action of the coupling (or drive shaft couplings) to be sure that the motor and Geareducer are properly aligned. If necessary, correct the alignment in accordance with the included manual.

   For Power Belt Drive equipped models observe the action of the sheaves and belts to be sure that the motor is properly aligned with the fan sheave. See the Belt Tensioning and Sheave Alignment section of this manual.

⚠ Caution

It is essential that the fan guard be installed in accordance with the Field Installation Manual shipped with the tower.

4. Momentarily bump (energize) the motor and observe rotation of the fan. The fan should rotate in a counterclockwise direction when viewed from below. If rotation is backwards, shut off the fan and reverse two of the three primary leads supplying power to the motor.

⚠ Caution

If tower is equipped with a two-speed motor, check for proper rotation at both speeds. Check also to see that starter is equipped with a 20 second time delay which prevents direct switching from high speed to low speed. If the fan is intended to be reversed for deicing purposes, make sure that the starter is equipped with a 2 minute time delay between changes of direction. These delays will prevent abnormal stress from being applied to the mechanical equipment and the electrical circuit components.

5. Run the motor and observe the operation of the mechanical equipment. Operation should be stable, and there should be no evidence of oil leakage.
6. If equipped with belt drive check the torque on the fan and motor sheave after 10 to 60 hours of operation. See Bushing Fastener Torque Values of the Belt Tensioning and Sheave Alignment section of this manual.

Note

If the water supply system is not being operated–or if there is no heat load on the system–motor amps read at this time may indicate an apparent overload of as much as 10–20%. This is because of the increased density of unheated air flowing through the fan. Determination of an accurate motor load should await the application of the design heat load.

Installation

Tower Start-Up

⚠ Warning

Among other sources, outbreaks of Legionnaires' Disease have reportedly been traced to cooling towers. Maintenance and water treatment procedures that prevent amplification and dissemination of Legionella and other airborne bacteria should be formulated and implemented BEFORE systems are operated and continued regularly thereafter to avoid the risk of sickness or death.

Water System:

1. New installations should be cleaned and treated with biocides by a water treatment expert before startup.
2. Remove any and all accumulated debris from tower. Pay particular attention to inside areas of cold water basin, hot water basins, louvers and drift eliminators. Make sure that cold water outlet screens are clear and properly installed.
3. Fill the water system to an approximate depth of 7" in the depressed area of the cold water basin at the center of the tower. For models NC8407 through NC8414 fill the water system to an approximate depth of 8". This is the recommended operating water level. Adjust the float valve so that it is 75% open at that level. Continue filling the system until the water reaches a level approximately ⅛" below the lip of the overflow.

Note

If tower is equipped with a standard case face outlet connection, vent accumulated air from the top of the suction hood by removing one or both tap screws provided at that location. Replace these tap screws when venting is complete. (On certain models, the top of the suction hood for 14" diameter side suctions is 1 ¼" above the top of the overflow. In those situations, it is necessary to block the overflow and continue filling the basin to the level where the aforementioned tap screws are submerged before venting.)

4. Completely open all hot water flow control valves. Start your pump(s) and observe system operation. Since the water system external to the tower will have been filled only to the level achieved in the cold water basin, a certain amount of "pump-down" of the basin water level will occur before water completes the circuit and begins to fall from the fill. The amount of initial pump-down may be insufficient to cause the float valve to open. However,

you can check its operation by pressing down on the operating lever to which the stem of the float valve is attached.

Some trial and error adjustment of the float valve may be required to balance the makeup water with tower operation. Ideally, the float valve setting will be such that no water is wasted through the overflow at pump shutdown. However, the water level after pump start-up **must** be deep enough to assure positive pump suction.

5. If the tower is equipped with flow-control valves, adjust them to equalize hot water depth in the distribution basins after reaching design water flow rate. Each basin should have from 3" to 5½" water depth, with uniform depth from basin to basin. Fix valves in this position with the locking bar when depth is correct. Failue to tighten the locking bar after valve adjustment may result in damage to the valve. If the tower is equipped with the Marley internal piping option, the basins are self-balancing and this step is not necessary.

   Uniform distribution depth of 3" to 5½" is essential to efficient tower operation. Contact your Marley sales representative if you are considering a permanent change in circulating water flow rate that would prevent operation within these limits.

6. Continue pump operation for about 15 minutes, after which it is recommended that the water system be drained, flushed, and refilled.

7. While operating the condensing water pump(s) and prior to operating the cooling tower fan, execute one of the two alternative biocidal treatment programs described in the following:

   - Resume treatment with the biocide which had been used prior to shutdown. Utilize the services of the water treatment supplier. Maintain the maximum recommended biocide residual (for the specific biocide) for a sufficient period of time (residual and time will vary with the biocide) to bring the system under good biological control

     or

   - Treat the system with sodium hypochlorite to a level of 4 to 5 ppm free chlorine residual at a pH of 7.0 to 7.6. The chlorine residual must be held at 4 to 5 ppm for six hours, measurable with standard commercial water test kits.

Operation

If the cooling tower has been in operation and then shut down for a duration of time and not drained, perform one of the two previous biocidal treatment programs directly to the cooling water storage vessel (cooling tower sump, drain down tank, etc.) without circulating stagnant water over the cooling tower fill or operating the cooling tower fan.

After biocidal pretreatment has been successfully completed, cooling water may be circulated over the tower fill with the fan off.

When biocidal treatment has been maintained at a satisfactory level for at least six hours, the fan may be turned on and the system returned to service. Resume the standard water treatment program, including biocidal treatment.

Tower Operation

General:

The cold water temperature obtained from an operating cooling tower will vary with the following influences:

1. **Heat load:** With the fan in full operation, if the heat load increases, the cold water temperature will rise. If the heat load reduces, the cold water temperature will reduce.

   Note that the number of degrees ("range") through which the tower cools the water is established by the system heat load and the amount of water being circulated, in accordance with the following formula:

   $$\text{Range} - °F = \frac{\text{Heat Load (Btu/hr)}}{\text{GPM x 500}}$$

   The cooling tower establishes only the cold water temperature attainable under any operating circumstance.

2. **Air wet-bulb temperature:** Cold water temperature will also vary with the wet-bulb temperature of the air entering the louvered faces of the tower. Reduced wet-bulb temperatures will result in colder water temperatures. However, the cold water temperature will not vary to the same extent as the wet-bulb. For example, a 20°F reduction in wet-bulb may result in only a 15°F reduction in cold water temperature.

3. **Water flow rate:** Increasing the water flow rate GPM will cause a slight elevation in cold water temperature, while reducing the water flow rate will cause the cold water temperature to decrease slightly. However, at a given heat load (see formula above), water flow reductions also cause an increase in the incoming hot water temperature. Use care to prevent the

hot water from exceeding 125°F, in order to prevent damage to the tower components.

4. **Air flow rate:** Reducing air flow through the tower causes the cold water temperature to rise. This is the approved method by which to control leaving water temperature.

   If your tower is equipped with a single-speed motor, the motor may be shut off when the water temperature becomes too cold. This will cause the water temperature to rise. When the water temperature then becomes too warm for your process, the motor can be restarted.

Fan cycling limits:

Note

Considering the normal fan and motor sizes utilized on NC towers, anticipate that approximately 4 to 5 starts per hour are allowable.

If your tower is equipped with a two-speed motor, you will enjoy greater opportunity for temperature control. When the water temperature becomes too cold, switching the fan to half-speed will cause the cold water temperature to rise–stabilizing at a temperature a few degrees higher than before. With a further reduction in water temperature, the fan may be cycled alternately from half-speed to off.

Note

Do not start the motor more than four to five times per hour (each low speed start and each high speed start count as one start).

If your tower consists of two or more cells, cycling of motors may be shared between cells, increasing your steps of operation accordingly.

Multicell towers equipped with two-speed motors will maximize energy savings and minimize sound levels if fans are staged so that all fans are brought up to low speed before any fan goes to high speed.

For greater insight on cold water temperature control, please read **"Cooling Tower Energy and its Management"**, Technical Report #H-001-A, available on our website

Operation

Wintertime Operation:

The Marley fill system used in NC cooling towers has air entrance louvers that are molded as an integral part of the fill. This feature makes these towers very forgiving of cold weather operation, even at the low temperature and reduced load conditions encountered in free cooling and other low temperature applications. Nevertheless, during operation in subfreezing weather the opportunity exists for ice to form in the colder regions of the tower.

Note

Slushy, transitory ice forms routinely in the colder regions of the fill of low temperature towers, and is visible through the tower louvers. Such ice normally has no adverse effect on tower operation, but its appearance should be a signal to the operator to undertake ice control procedures.

It is the operator's responsibility to prevent the formation of destructive (hard) ice on the cooling tower fill. Certain guidelines should be followed:

1. Do not allow the tower's leaving water temperature to drop below a minimum allowable level–say 36°F to 40°F. If such low temperature operation is necessary or beneficial to your process, establish the minimum allowable level as follows:

   During the coldest days of the first winter of operation, observe whether any ice is forming on the louver face, particularly near the bottom part of the louver face. If hard ice is present on the louvers, you must increase the allowable cold water temperature. If the coldest possible water is beneficial to your process, ice of a mushy consistency can be tolerated–but routine periodic observation is advisable.

⚠ Caution

If the minimum allowable cold water temperature is established at or near minimum heat load, it should be safe for all operating conditions.

Having established the minimum allowable cold water temperature, maintaining that temperature can be accomplished by fan manipulation, as outlined in **Item 4** under **Tower Operation**. However, in towers of more than one cell, where fans are manipulated sequentially, please realize that the water temperature will be significantly lower in the cell or cells operating at the highest fan speed than the net cold water temperature produced by the

entire tower would indicate. Wintertime operation of multicell towers at low cold water temperature levels requires that the operator be especially watchful.

2. As cold air enters the louvers, it causes the water flowing over the fill to be drawn inward toward the center of the tower. Thus, under fan operation, the louvers and lower periphery of the tower structure remain partly dry, seeing only random splashing from within the tower–plus normal atmospheric moisture from the entering air. Such lightly wetted areas are most subject to freezing.

   Therefore, if excessive ice forms on the louvers, stop the fan for a few minutes. With the fan off, the water flow will increase in the vicinity of the louvers and reduce the ice buildup.

3. Under extended extreme cold conditions, it may be necessary to operate the fan in reverse. This forces warm air out through the louvers, melting any accumulated ice–adequate heat load must be available. Reversal may be at either full or half speed; however, we recommend reversal at half speed. Reverse operation of the fan should be used sparingly and should only be used to control ice, **not** to prevent it. Reverse fan operation should not need to exceed 1 or 2 minutes. Monitoring is required to determine the time required to melt accumulated ice.

⚠ Warning

Reverse operation of fans for prolonged periods during subfreezing weather can cause severe damage to fans and fan cylinders. Ice can accumulate inside fan cylinders at fan blade plane of rotation and fan blade tips will eventually strike this ring of ice, damaging the fan blades or cylinder. Ice can also accumulate on fan blades and be thrown off, damaging fan cylinder or blades. Allow a minimum of 10 minute delay between reverse operation and forward operation during subfreezing weather to permit ice to dissipate from fan blades and fan cylinders. See Fan Drive Caution note in the Mechanical Equipment Installation section of this manual.

4. With no heat load on the circulating water, icing cannot be controlled effectively by air control during freezing weather. **Towers must not be operated with reduced water rate and/or no heat load during freezing weather.** If the circulating water system cannot be shut down, water returning from the process should be made to bypass the tower. If a bypass is used, **all** water must be bypassed without modulation. If the water bypass is directly into the tower's cold water basin, its design must be approved by SPX Cooling Technologies.

Operation

Intermittent Wintertime Operation:

⚠ **Caution**

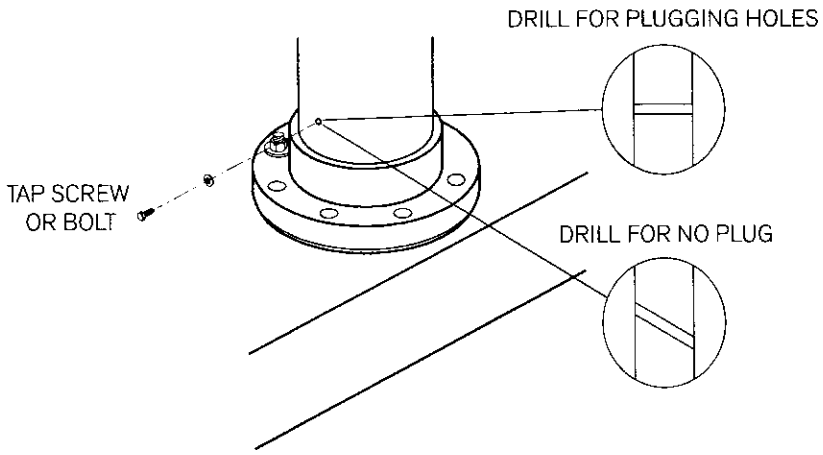
If periods of shutdown (nights, weekends, etc.) occur during freezing weather, measures must be taken to prevent the water in the cold water basin–and all exposed piping, both internally and externally–from freezing.

Several methods are used to combat this, including:

–automatic water basin heater systems available from Marley.

–field installation of heat tracing of piping, both internally and externally.

–field modification to provide a weep hole by drilling a 3⁄16" hole in PVC piping, 7" up from the base of the flange of the internal riser. The hole should be plugged with a 1⁄4" tap screw with sealing washer. For steel piping, drill a 13⁄64" diameter hole 2" up from the base of the flange of the internal riser and tap for a 1⁄4-20 bolt with sealing washer that will be used as a plug. **See figures below for drilling details.** Normally weep holes are plugged during tower operation and plugs removed during downtime in freezing temperatures. To leave the hole unplugged during operation, drill a 3⁄16" hole at an upward angle that will allow the water flow to drain downward into the basin.



⚠ **Warning**

Unless some means of freeze prevention is incorporated into your system, the tower basin and exposed pipework should be drained at the beginning of each wintertime shutdown period.

⚠ **Warning**

If tower basin is drained, verify that all basin heaters have been shut off either by automatic cutoff or disconnect switch.

It is recommended that you discuss your freeze prevention options with your local Marley sales representative.

Operation

Water Treatment and Blowdown

Maintaining Water Quality:

The steel used in NC towers has been galvanized with a heavy zinc coating averaging 2.0 mils in thickness. The NC stainless steel option is even more corrosion resistant than galvanized steel in certain environments. Other materials used (PVC fill, drift eliminators, and louvers, aluminum fans, cast iron Geareducer, etc.) are selected to offer maximum service life in a "normal" cooling tower environment, defined as follows:

Circulating water with a pH between 6.5 and 8; a chloride content (as NaCl) below 500 ppm; a sulfate content (SO4) below 250 ppm; total alkalinity (as $CaCO_3$) below 500 ppm; calcium hardness (as $CaCO_3$) above 50 ppm; a maximum inlet water temperature not to exceed 125°F; no significant contamination with unusual chemicals or foreign substances; and adequate water treatment to minimize scaling.

- Startup Conditions: The water conditions during the initial tower operation are crucial in preventing premature corrosion of galvanized steel (white rust). For at least the first eight weeks of operation, pH should be controlled between 6.5 and 8.0 with hardness and alkalinity levels between 100 and 300 ppm (expressed as $CaCO_3$).
- Chlorine (if used) shall be added intermittently, with a free residual not to exceed 1 ppm–maintained for short periods. Excessive chlorine levels may deteriorate sealants and other materials of construction.
- An atmosphere surrounding the tower no worse than "moderate industrial", where rainfall and fog are no more than slightly acid, and they do not contain significant chlorides or hydrogen sulfide (H_2S).
- Many proprietary chemicals exist for control of scale, corrosion, and biological growth and should be used prudently. Also, combinations of chemicals may cause reactions which reduce treatment effectiveness, and certain chemicals such as surfactants, biodispersants and antifoams may increase drift rate.

Note

Unless you purchased a stainless steel NC, the structure of your NC tower consists primarily of galvanized steel, therefore your water treatment program must be compatible with zinc. In working with your water treatment supplier, it is important that you recognize the potential effects on zinc of the specific treatment program you choose.

Maintenance

Cooling Tower Cleaning:

⚠ **Warning**

Any evaporative-type cooling tower must be thoroughly cleaned on a regular basis to minimize the growth of bacteria, including Legionella Pneumophila, to avoid the risk of sickness or death. Service personnel must wear proper personal protective equipment during decontamination. Do NOT attempt any service unless the fan motor is locked out.

Operators of evaporative cooling equipment, such as water cooling towers, should follow maintenance programs which will reduce to an absolute minimum the opportunity for bacteriological contamination. Public Health Service officials have recommended that "good housekeeping" procedures be followed, such as: regular inspections for concentrations of dirt, scale, and algae; periodic flushing and cleaning; and the following of a complete water treatment program including biocidal treatment.

The visual inspection should take place at least once a week during the operating season. The periodic flushing and cleaning should be done before and after each cooling season, but in any event at least twice a year. The louvers, drift eliminators, and easily accessible fill surfaces should be flushed by use of a moderate-pressure water nozzle, being careful not to cause physical damage. A reliable water treatment program should be installed and maintained. Filtration devices may be employed to reduce the suspended solids concentrations, thus increasing the effectiveness of the water treatment program. See Tower Startup section of this manual.

Blowdown:

A cooling tower cools water by continuously causing a portion of it to evaporate. Although the water lost by evaporation is replenished by the makeup system, it exits the tower as pure water–leaving behind its burden of dissolved solids to concentrate in the remaining water. Given no means of control, this increasing concentration of contaminants can reach a very high level.

In order to achieve water quality which is acceptable to the cooling tower (as well as the remainder of your circulating water system), the selected water treatment company must work from a relatively constant level of concentrations. This stabilization of contaminant concentrations is usually accomplished by blowdown, which is the constant discharge of a portion of the circulating water to waste. As a rule, acceptable levels on which to base a treatment schedule will be in the range of 2-4 concentrations. The following table shows

the minimum amount of blowdown (percent of flow) required to maintain different concentrations with various cooling ranges*:

Cooling Range	Number of Concentrations						
	1.5X	2.0X	2.5X	3.0X	4.0X	5.0X	6.0X
5° F	.78	.38	.25	.18	.11	.08	.06
10° F	1.58	.78	.51	.38	.25	.18	.14
15° F	2.38	1.18	.78	.58	.38	.28	.22
20° F	3.18	1.58	1.05	.78	.51	.38	.30
25° F	3.98	1.98	1.32	.98	.64	.48	.38
Multipliers are based on drift of 0.02% of the circulating water rate.							

* Range = Difference between hot water temperature coming to tower and cold water temperature leaving tower.

EXAMPLE: 700 GPM circulating rate, 18°F cooling range. To maintain 4 concentrations, the required blowdown is 0.458% or .00458 times 700 GPM, which is 3.2 GPM.

If tower is operated at 4 concentrations, circulating water will contain four times as much dissolved solid as the makeup water, assuming none of the solids form scale or are otherwise removed from the system.

Note

When water treatment chemicals are added, they should not be introduced into the circulating water system via the cold water basin of the cooling tower. Water velocities are lowest at that point, which results in inadequate mixing.

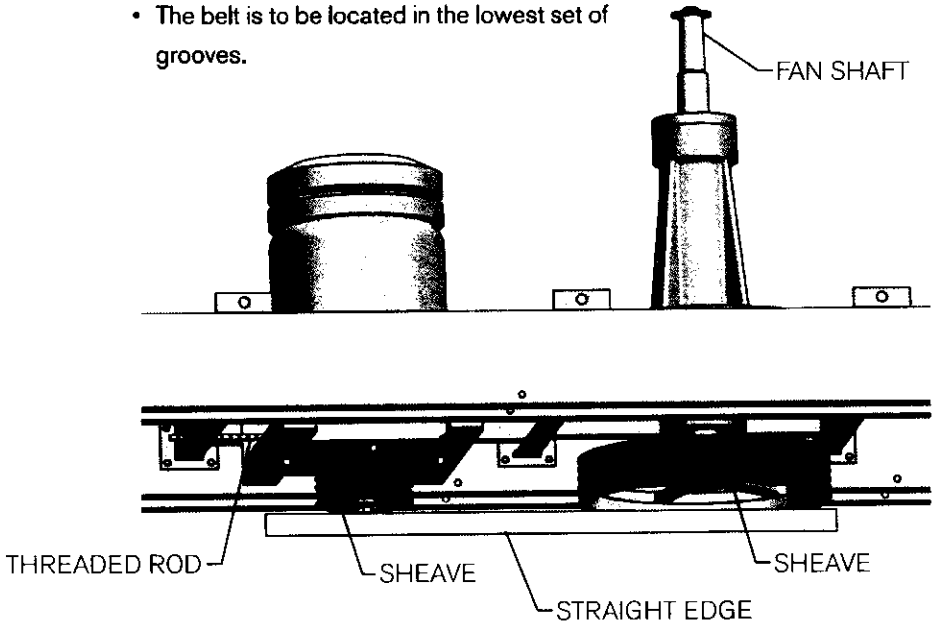
Belt Tensioning

The belt tension is adjusted by loosening the 8 bolts that secure the motor mount frame to the belt drive frame, then loosen the retaining nuts on the two threaded rods and turn the threaded rods to apply proper tension. Apply the same quantity of turns to each threaded rod to insure that the tensioning frame remains parallel to the mechanical support beams. Retighten hardware. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions. Check tension frequently during the first 24-48 hours of run-in operation. Overtensioning shortens belt and bearing life. Keep belts free from foreign material which may cause slipping. Never apply belt dressing as this will damage the belt and cause early failure. A Dodge® V-Belt Tension Tester is an alternate method for tensioning V-belts. Check with you local belt supplier.

Maintenance

Sheave Alignment

- The motor sheave is to be positioned as close as possible to the motor in order to minimize torque on the motor bushings.
- The motor and fan sheaves may have grooves that are not used. The bottom surface of the motor and fan sheaves must be aligned within ⅛" of each other and level within ½° (⅛" in 12) in order to not adversely affect belt and sheave life.
- Alignment can be achieved by placing a straight edge across the sheaves making sure that it is level and measuring down to the bottom surface of both sheaves at four points.
- The belt is to be located in the lowest set of grooves.



Bushing Fastener Torque Values

Bushing	Fastener Size	Torque	
		$ft{\cdot}lb_f$	N·m
SH	¼ - 20	6	8
SDS	¼ - 20	6	8
SD	¼ - 20	6	8
SK	5/16 - 18	13	18
SF	⅜ - 16	22	30
E	½ - 13	35	48
F	9/16 - 12	65	88

Maintenance

Schedule of Tower Maintenance

Some maintenance procedures may require maintenance personnel to enter the tower. Each cased face of the tower has a door for access to the interior of the tower. The NC8401 and NC8402 have a 30" wide by 33" high door. All other models have a 30" wide by 48" high door.

The optional fan deck ladder is designed and intended solely for personnel to gain access to the fan deck. The fan deck ladder should not be used to enter or exit the access doors located on the cased face of the tower unless the optional access door platform is provided.

⚠ Warning

The purchaser or owner is responsible for providing a safe method for entering or exiting the access door. Use of the fan deck ladder to enter or exit the access doors may result in a fall.

Included with this instruction packet are separate Service Manuals on each major operating component of the tower, and it is recommended that you read them thoroughly. Where discrepancies may exist, the separate Service Manuals will take precedence.

The following is recommended as a minimum routine of scheduled maintenance:

⚠ Warning

Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.

Weekly: Inspect for bacterial growth and general operation conditions. Bacterial growth should be reported to your water treatment expert for immediate attention.

Monthly (Weekly at start up): Observe, touch, and listen to the tower. Become accustomed to its normal appearance, sound, and level of vibration. Abnormal aspects relating to the rotating equipment should be considered reason to shut down the tower until the problem can be located and corrected. Observe operation of the motor, coupling (or drive shaft), Geareducer and

fan. Become familiar with the normal operating temperature of the motor, as well as the sight and sound of all components as a whole.

If equipped, check for Geareducer oil leaks. Check the Geareducer as well as any optional oil lines to external oil dipstick/sight glass.

Inspect louvers, drift eliminators and basin trash screens and remove any debris or scale which may have accumulated. Replace any damaged or worn out components. Use of high-pressure water may damage the eliminator and louver material.

Observe operation of the float valve. Depress the operating lever to make sure that the valve is operating freely. Inspect the suction screen for plugging. Remove any debris that may have accumulated.

Check for any buildup of silt on the floor of the cold water basin. Mentally make note of the amount, if any, so future inspections will enable you to determine the rate at which it is forming.

Every 3 months: If equipped, lubricate fan shaft bearings. While rotating equipment by hand, grease the bearings until a bead forms around the seals. Mobil SHC 460 grease is recommended.

Semi-Annually: If equipped, check the belt tension and condition.

If equipped, check Geareducer oil level. Shut down the unit and allow 5 minutes for the oil level to stabilize. Add oil if required.

Clean and disinfect cooling tower with biocides. Systems with biofouling, high general bacterial counts, or positive cultures of legionella may require additional cleaning. Refer to **"Cooling Tower Cleaning"** section of this manual. Consult your water treatment expert as to prudent biological evalution testing.

Note

Geareducer models used on NC cooling towers are designed for 5-year oil change intervals. To maintain five-year change intervals, use only oil designed specifically for these Geareducers. If, after five years, turbine-type mineral oil is used, the oil must be changed semiannually. Refer to the Geareducer Manual for oil recommendations and further instructions.

Annually: Inspect the tower thoroughly, making maximum use of instructions given in the separate service manuals. Check structural bolted connections and tighten as required. Make preventive maintenance repairs as necessary.

Maintenance

Relubricate motor according to the manufacturer's instructions. Refer to the Motor Re-lubrication Instructions of this manual for towers equipped with the motor outside the plenum area.

Check to see that all bolts are tight in the fan and mechanical equipment region, including the fan cylinder and fan guard. Refer to Componet User Manuals for torque values.

Every 5 Years: If equipped, change Geareducer oil. Refer to the Geareducer User Manual for instructions.

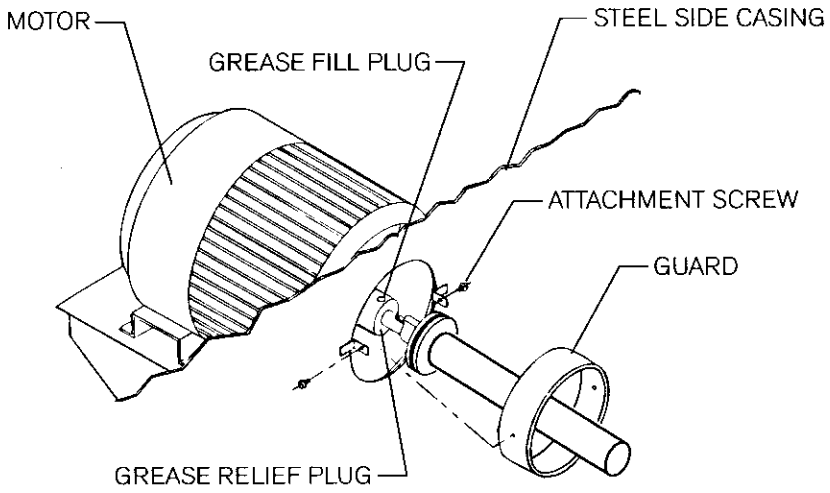
Motor Relubrication Instructions

Motor located outside plenum option

⚠ Warning

Open and lock out disconnect switch to make certain motor cannot be started.

1. Remove guard as shown. Opposite end motor bearing is accessible from outside the tower.
2. Remove grease fill and relief plugs at both shaft extension end and opposite end bearings and remove hardened grease, using clean wire.



3. Insert grease fittings in grease fill openings and add grease until grease is forced out through relief openings.
4. Replace fill plugs and operate mechanical equipment 30 minutes to one hour to purge excess grease at grease relief opening.

5. Reinstall grease relief plugs and reinstall guard.
6. Resume normal tower operation.

Seasonal Shutdown Instructions

When the system is to be shut down for an extended period of time, it is recommended that the entire system (cooling tower, system piping, heat exchangers, etc.) be drained. Leave the basin drains open.

During shutdown, clean the tower (see Warning on cooling tower cleaning in the Maintenance section of this manual) and make any necessary repairs. Pay particular attention to mechanical equipment supports and coupling (or drive shafts).

Following each year's shutdown and cleaning, inspect the tower's metal surfaces for evidence of the need to apply a protective coating. Do not misinterpret grime–and transient rust from the piping system–as a need to have the tower painted. If relatively bright metal can be exposed by cleaning, consider that the galvanizing has remained effective. Unless there is evidence of a generalized failure of the galvanizing, localized touch-up should be all that is required.

To the extent that the galvanizing (zinc coating) still exists, paint will not adhere to it readily. Contact the manufacturer of the coating you intend to use for instructions.

Tower framework: Check structural bolted connections and tighten as required.

Fans: Check fan assembly bolting and tighten as required. Use torque values prescribed in the Fan User Manual.

Fans shaft bearings: If equipped, lubricate fan shaft bearings at close of each operating season, as described in the Maintenance section of this manual.

Electric motors: Clean and lubricate motor at close of each operating season (refer to motor manufacturer's recommendations.) Check motor anchor bolts and tighten as required.

Maintenance

⚠ **Caution**

Do not start motor before determining that there will be no interference with free rotation of the fan drive.

The motor should be operated for three hours at least once a month. This serves to dry out windings and re-lubricate bearing surfaces (refer to Marley **"Electric Motor User Manual"** Manual 92-1475).

At start of new operating season, make sure bearings are adequately lubricated before returning motor to service.

Prolonged Shutdown

If shutdown period is longer than seasonal, contact your Marley sales representative for additional information.

SPX Cooling Technologies Services

Our interest in your NC cooling tower does not end with the sale. Having conceived, designed, and manufactured the most reliable and longest-lasting cooling tower on the market, we want to make sure that you gain the maximum possible benefit from its purchase.

Therefore, the following services are available which are intended to: assure the maximum possible service life under your operating conditions; tailor the operating characteristics to your specific needs; and maintain consistently optimum thermal performance capability. They are available by contacting your Marley sales representative.

Replacement parts: A complete stock of parts and components is maintained at one or more of the various Marley plants. In cases of emergency, they can normally be shipped within 24 hours–by air freight if necessary. However, you would obviously benefit from anticipating your need in advance, thus avoiding the cost of special handling.

Be sure to mention your tower serial number (from the tower nameplate) when ordering parts.

Periodic maintenance: You may wish to contract with SPX for regularly scheduled visits–for the purpose of inspecting and reporting your tower's condition–to make recommendations intended to prevent emergencies– and to perform maintenance considered outside the norm.

This service is not intended to replace the important function performed by your maintenance staff. Their attention assures the tower's routine operating performance, and is invaluable. However, we recognize the unusual manner in which a cooling tower performs its function–as well as the unique forces which act upon it–may be considerations which occasionally require the services of an expert technician.

Maintenance Schedule

Maintenance Service	Monthly	Semi-annually	Seasonal Startup or Annually
Inspect General Condition and Operation	x		x
Observe Operation of:			
Mechanical–motor, fan and drive mechanism	x		x
Makeup valve (if equipped)	x		x
Inspect for unusual noise or vibration	x		x
Inspect and Clean:			
Air inlet	x		x
PVC drift eliminators	x		x
Distribution basin, nozzles and collection basin	x		x
Fan motor exterior	x		x
Check:			
Collection water basin level	x		x
Blowdown–adjust as required	x		x
Geareducer Drive (if equipped):			
Check for loose fasteners including oil drain plug			x
Check for / repair oil leaks	x		x
Check oil level	x		x
Change oil		R	
Make sure vent is open		x	x
Check driveshaft or coupling alignment			x
Check for loose driveshaft or coupling fasteners			x
Check driveshaft or coupling bushings or flex element for unusual wear		x	x
Lube lines (if equipped):			
Check for oil leaks in hoses or fittings	x	R	x
Belt drive (if equipped):			
Fan shaft bearing lubrication (every 3 mo.)		every 3 months	every 3 months
Check and tighten support fasteners			x
Check shaft, sheave and belt alignment			x
Check belt tension and condition		x	x
Check sheave bushing fastener torque			x
Fan:			
Check and tighten blade and hub fasteners			x
Check fan blade pitch and tip clearance			x
Check fan cylinder for loose fasteners			x
Motor:			
Lubricate (grease as required)			R
Check mounting bolts for tightness			x
Operate at least	3 hours a month	3 hours a month	3 hours a month
Basin Heater (if equipped):			
Check for proper operation of temp/low water level sensor			x
Inspect/clean buildup of contaminant from sensor		x	x
Structure:			
Inspect/tighten all fasteners		x	x
Inspect and touch up all metal surfaces			x

R – Refer to Component User Manual

Note: It is recommended at least weekly, that the general operation and condition be observed. Pay attention to any changes in sound or vibration that may signify a need for closer inspection.

Troubleshooting

Trouble	Cause	Remedy
Motor Will Not Start	Power not available at motor terminals	• Check power at starter. Correct any bad connections between the control apparatus and the motor.
		• Check starter contacts and control circuit. Reset overloads, close contacts, reset tripped switches or replace failed control switches.
		• If power is not on all leads at starter, make sure overload and short circuit devices are in proper condition.
	Wrong connections	Check motor and control connections against wiring diagrams.
	Low voltage	Check nameplate voltage against power supply. Check voltage at motor terminals.
	Open circuit in motor winding	Check stator windings for open circuits.
	Motor or fan drive stuck	Disconnect motor from load and check motor and Geareducer for cause of problem.
	Rotor defectve	Look for broken bars or rings.
Unusual Motor Noise	Motor running single-phase	Stop motor and attempt to start it. Motor will not start if single-phased. Check wiring, controls, and motor.
	Motor leads connected incorrectly	Check motor connections against wiring diagram on motor.
	Bad bearings	Check lubrication. Replace bad bearings.
	Electrical unbalance	Check voltages and currents of all three lines. Correct if required.
	Air gap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
	Cooling fan hitting end bell guard	Reinstall or replace fan.
Motor Runs Hot	Wrong voltage or unbalanced voltage	Check voltage and current of all three lines against nameplate values.
	Overload	Check fan blade pitch. See Fan Service Manual. Check for drag in fan drive train as from damaged bearings.
	Wrong motor RPM	Check nameplate against power supply. Check RPM of motor and gear ratio.
	Bearings overgreased	Remove grease reliefs. Run motor up to speed to purge excessive grease.
	Wrong lubricant in bearings	Change to proper lubricant. See motor manufacturer's instructions.
	One phase open	Stop motor and attempt to start it. Motor will not start if single-phased. Check wiring, controls, and motor.
	Poor ventilation	Clean motor and check ventilation openings. Allow ample ventilation around motor.
	Winding fault	Check with Ohmmeter.
	Bent motor shaft	Straighten or replace shaft.
	Insufficient grease	Remove plugs and regrease bearings.
	Too frequent starting or speed changes	Limit cumulative acceleration time to a total of 30 seconds/hr. Set on/off or speed change set points farther apart. Consider installing a Marley VFD drive for fine temperature control.
	Deterioration of grease, or foreign material in grease	Flush bearings and relubricate.
	Bearings damaged	Replace bearings.
Motor Does Not Come Up To Speed	Voltage too low at motor terminals because of line drop	Check transformer and setting of taps. Use higher voltage on transformer terminals or reduce loads. Increase wire size or reduce inertia.
	Broken Rotor bars	Look for cracks near the rings. A new rotor may be required. Have motor service person check motor.
Wrong Rotation (Motor)	Wrong sequence of phases	Switch any two of the three motor leads.

Troubleshooting

Trouble	Cause	Remedy
Geareducer Noise	Geareducer bearings	If new, see if noise disappears after one week of operation. Drain, flush, and refill Geareducer. See Geareducer Service Manual. If still noisy, replace.
	Gears	Correct tooth engagement. Replace badly worn gears. Replace gears with broken or damaged teeth.
Unusual Fan Drive Vibration	Loose bolts and cap screws	Tighten all bolts and cap screws on all mechanical equipment and supports.
	Unbalanced drive shaft or worn couplings	Make sure motor and Geareducer shafts are in proper alignment and "match marks" properly matched. Repair or replace worn couplings. Rebalance drive shaft by adding or removing weights from balancing cap screws. See Drive Shaft Service Manual.
	Fan	Make certain all blades are as far from center of fan as safety devices permit. All blades must be pitched the same. See Fan Service Manual. Clean off deposit build-up on blades.
	Worn Geareducer bearings	Check fan and pinion shaft endplay. Replace bearings as necessary.
	Unbalanced motor	Disconnect load and operate motor. If motor still vibrates, rebalance rotor.
	Bent Geareducer shaft	Check fan and pinion shaft with dial indicator. Replace if necessary.
Fan Noise	Blade rubbing inside of fan cylinder	Adjust cylinder to provide blade tip clearance.
	Loose bolts in blade clamps	Check and tighten if necessary.
Scale or foreign substance in circulating water system	Insufficient blowdown	See "Water Treatment" section of this manual
	Water treatment deficiency	Consult competent water treating specialist. See "Water Treatment" section of this manual
Cold Water Temperature Too Warm (See "Tower Operation")	Entering wet bulb temp. is above design	Check to see if local heat sources are affecting tower. See if surrounding structures are causing recirculation of tower discharge air. Discuss remedy with Marley representative.
	Design wet bulb temp. was too low	May have to increase tower size. Discuss remedy with Marley representative.
	Actual process load greater than design	May have to increase tower size. Discuss remedy with Marley representative.
	Overpumping	Reduce water flow rate over tower to design conditions.
	Tower starved for air	Check motor current and voltage to be sure of correct contract horsepower. Re-pitch fan blades if necessary. Clean louvers, fill and eliminators. Check to see if nearby structures or enclosing walls are obstructing normal airflow to tower. Discuss remedy with Marley representative.
Excessive Drift Exiting Tower	Distribution basins overflowing	Reduce water flow rate over tower to design conditions. Be sure hot water basin nozzles are in place and not plugged.
	Faulty drift elimination	Check to see that integral fill, louvers, and eliminators are clean, free of debris, and installed correctly. If drift eliminators are separate from fill, make sure they are correctly installed in place. Clean if necessary. Replace damaged or worn out components.

Additional Information

Increased load requirements: NC towers are designed so that cells of either equal or unequal capacity can be added in the future. This allows you to compensate for the load increases that normally occur with the replacement or addition of production equipment–and still retain continuity with respect to your cooling tower system.

Tower rebuilding: SPX Cooling Technologies routinely rebuilds and upgrades cooling towers of all materials and manufacture. If your tower ever reaches the limit of its service life, we recommend that you investigate the cost of rebuilding before you routinely order a new replacement tower.

Each NC tower includes a document package containing general orientation drawings, **"NC Field Installation Manual"** Assembly Instructions, and tower component manuals. **These documents contain important information relating to safe installation and operation of the cooling tower.** Field installation is always required for fan guards, piping inlets and piping outlets. Some optional accessories, such as valves, handrails, ladders and safety cages may also require field installation. If installation details are not covered in the **"NC Field Installation Manual"** a separate installation drawing or manual for each purchased option is included in the document package along with bills of material. If you have purchased an option and can't find the appropriate installation drawing, contact your local Marley sales representative before proceeding.

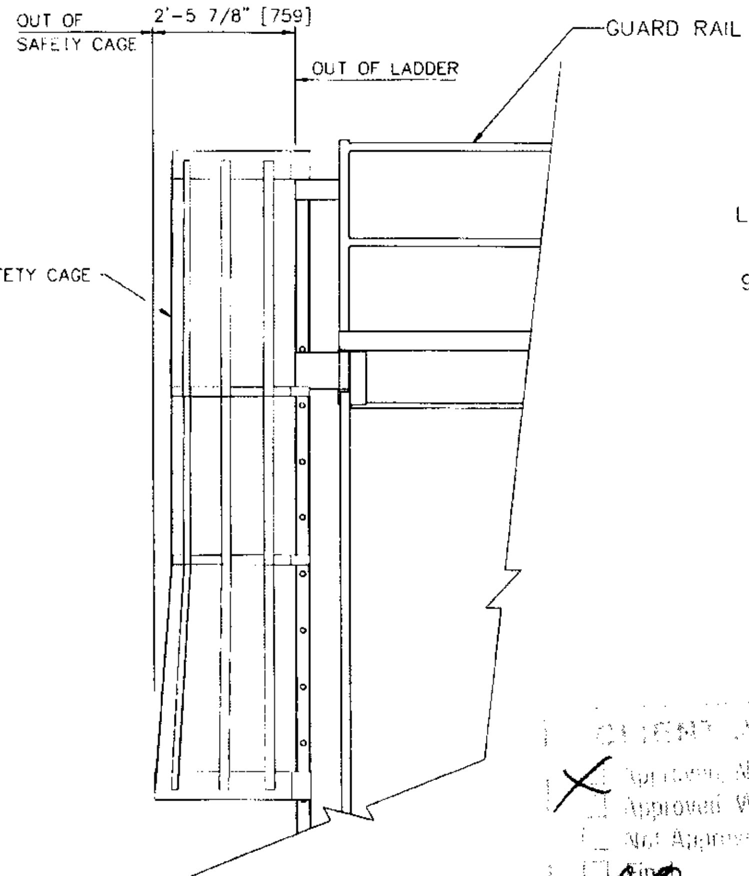
In addition to these specific documents, SPX publishes numerous technical reports including more detailed information on a variety of cooling tower operation and service topics. Your Marley sales representative will be happy to give you copies of these reports at no charge.

For complete parts and service assistance, contact the Marley sales representative in your area. If you need help locating the office nearest you, please phone 913 664 7400 or check the internet at spxcooling.com.

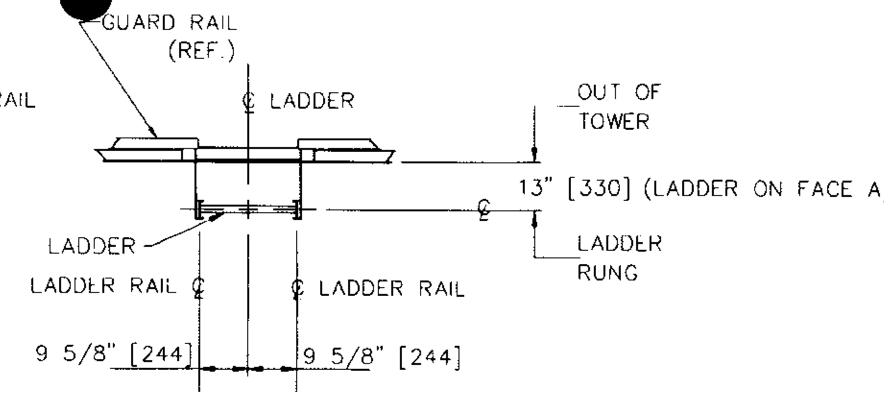
SPX

COOLING TECHNOLOGIES

spxcooling.com



LADDER WITH CAGE ELEVATION



LADDER DETAIL
(PLAN VIEW)

CLIENT APPROVAL
X Approved, No Comments
Approved With Comments
Not Approved
Final
SIGNATURE 7/20/2010 DATE

NOTES

1. THE COOLING TOWER FAN DECK IS NOT CONSIDERED AN ELEVATED WORKING PLATFORM SINCE NORMAL RECOMMENDED MAINTENANCE PROCEDURES ARE LESS THAN THE FREQUENCY OF MAN-HOURS THAT OSHA DEFINES FOR SUCH A PLATFORM, PER OSHA'S 1984 INTERPRETATION OF THEIR REGULATIONS. THIS OPTION AND OTHERS ARE AVAILABLE FOR THOSE CUSTOMERS WHO PREFER THE EXTRA DEGREE OF PROTECTION IT PROVIDES.
2. NORMAL TOWER MAINTENANCE DOES NOT REQUIRE PERSONNEL TO BE ON TOP OF THE TOWER. IF ACCESS TO TOP OF THE TOWER IS NEEDED, THEN LADDER AND HANDRAIL OPTION IS RECOMMENDED.
3. LADDER IS ALL ALUMINUM CONSTRUCTION CONSISTING OF 3" [76] X 1 1/8" [29] I-BEAM SIDE RAILS AND 1 1/4" [32] DIAMETER SERRATED RUNGS.
4. TOWER IS MODIFIED FOR LADDER AND HANDRAIL WITH ALL ATTACHING CLIPS AND HARDWARE PROVIDED WITH THE COOLING TOWER. LADDER AND HANDRAIL ARE ASSEMBLED AND INSTALLED IN THE FIELD BY OTHERS. INSTALLATION DETAILS ARE SHIPPED WITH THE TOWER.
5. TOLERANCE APPLICABLE TO DIMENSIONS SHOWN ARE DEPENDENT UPON FABRICATION, ASSEMBLY AND CONSTRUCTION TOLERANCES. FABRICATION TOLERANCE IS ±1/16" [2] & ASSEMBLY TOLERANCE IS ±1/8" [3]. CONSULT SUPPLIERS OF SUPPORTING STRUCTURE FOR CONSTRUCTION TOLERANCE. ALL OF THE DIMENSIONS SHOWN ARE IN INCHES UNLESS OTHERWISE NOTED.
6. PER O.S.H.A. STANDARDS, SAFETY CAGE IS RECOMMENDED WHEN THE DIFFERENCE IN ELEVATION BETWEEN TOWER FAN DECK AND GRADE EXCEEDS 20' [6096].
7. LADDER EXTENSION IS PROVIDED IN A NOMINAL LENGTH OF 11' [3353]. FIELD MODIFICATION, BY OTHERS, IS REQUIRED FOR AN EXTENSIONS OF A DIFFERENT LENGTH. PER O.S.H.A. STANDARDS, AN ACCESS DOOR PLATFORM IS RECOMMENDED IF TOWER IS ELEVATED.
8. THE ACTUAL LADDER EXTENSION LENGTH (BASE OF TOWER TO GRADE) MUST BE SPECIFIED TO ASSURE THE PROPER BOTTOM ELEVATION OF SAFETY CAGE.
9. ALL DIMENSIONS SHOWN INSIDE OF BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

I-P [SI] UNITS

ECO NUMBER		TITLE				
12250		LADDER DETAILS WITH SAFETY CAGE				SPX COOLING TECHNOLOGIES
REV BY: JMB	CHECKED:					

REV. DATE	DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV
07/06/09	B. GOODING	01/16/09		MN	10009628	1=1	09-117	B

WARNING

The location and orientation of the cooling tower can affect the safety of those responsible for installing, servicing or reparing the cooling tower. Since SPX does not dictate or determine where the tower is located or how iti is oriented, SPX is not responsible for addressing the safety issues that are affected by the tower's location location and orientation. The following safety issues should be considered by those responsible for designing and maintaining the tower installation. Failure to consider and address these issues may result in substantial personal injury or death to those installing, servicing or repairing the cooling tower.

* Access to and from the fan deck.
* Access to and from maintenance access doors.
* Access for cleaning and other service.
* Potential access problems due to obstructions surrounding the tower.
* The possible need for safety cages around ladders.

These are only some of the safety issues that may arise in the design process. SPX strongly recommends that you consult a safety engineer to be sure that all safety considerations have been addressed.

This page intentionally left blank

GETTING STARTED

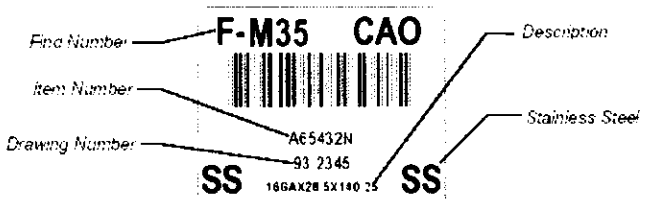
STANDARD FIELD DETAILS

FIELD INSTALLED OPTIONS

This page intentionally left blank

ABOUT THIS MANUAL

To obtain maximum efficiency, it is strongly recommended that this entire manual be read before starting assembly. This assembly manual illustrates the field installation of standard and optional items that your tower may have. Due to shipping limitations these items can not be installed in the factory. Review all manuals, drawings, and bills of material prior to assembly. Contact your SPX Cooling Technologies sales representative should questions arise.
All steel parts are tagged for identification, as shown below.



Find Number: This is a three digit alpha/numeric number that ties everything together. Used throughout this manual, in the text, it's the number in bold type M35, in the figures, it's the number within the circle. It is also the first column in the BILL OF MATERIAL. In the bill of material, all tower hardware components are listed in numerical order by this number.
Item Number: This number is used by SPX to manufacture and inventory the components of your cooling tower. Give this number to your SPX sales representative if an item is missing or a replacement item is required.
Drawing Number: (Reference only) This is the number of the drawing used to fabricate this item.
Description: (Reference Only) All steel parts begin with SHEET or ASSEMBLY followed by the size of the sheet used to fabricate the item or a description of the assembly. Your tower may have a few fiberglass items which begin GRP.
Stainless Steel: This indicates when an item has been made from stainless steel. If the item is made from the standard galvanized material this will not be printed on the tag.

Bills of material (BOM) are separate from drawings and this manual. At the top of each bill there is a Drawing Number and the drawing description which indicates if the items on that bill will be installed per this assembly manual or per a special installation drawing.
The find number, item number, description and quantity of items are all cross referenced on the bill of the material. If a number is missing or hard to read, check the illustrations in this assembly manual first and then the bill of material to see if you can find it. As the tower is prepared for assembly, the quantities of each item should be checked against the bill of material.

NEED HELP!

If anything is missing, damaged, or you need help of any kind, contact your SPX Cooling Technologies Representative as soon as possible. If you need help determining the representative in your area, please call us at 1-800-4MARLEY, or check the internet at www.spxcooling.com

MEASUREMENT SYSTEM

The manual uses both, the English System and Metric System of measurement. All units are in millimeters. Fasteners are denoted in both the English and metric systems. Fasteners are supplied in conformance with the metric system standard unless otherwise noted in the tower bills of material.

TOOLS AND SUPPLIES

Hoist: 2500 (1140kg) pound capacity. For hoisting of motor on towers with field installed motors or MOA.

1/2" electric drill and bit set.

Socket wrench set: Tower mainly uses 13mm, 19mm & 30mm sockets. Have more than one if possible.

Combination wrenches: Mainly 13mm up to 30mm. Adjustable wrenches are OK but not recommended.

Screwdrivers:

Torque wrench: 150 ft lb (203 N-m) capacity.

Caulking guns: Required for application of sealant.

Pipe Wrenches:

Small and large drift pins: (alignment tools) These are extremely important to help line up all the holes. You should have more than one.

Allen wrenches:

Protractor level: For setting fand blade pitch.

Dial Indicator kit: Marley Item No. 115311M. For drive shaft alignment. Needed for motor outside airstream option only.

Scaffolding, portable stairs or other means of temporary access and support.

Impact wrenches (electric or pneumatic) with standard and deep sockets: used to tighten all hardware.

Acetone solvent: About a gallon (4 liters) and clean cotton rags.

Wear protective clothing, gloves, nonslip footwear, hard hat and safety glasses. Fluid Coolers are constructed of steel and could have burrs that can cause cuts. The surface of the steel could be slick. Protection from thrown, or falling objects should be used at all times around a construction site.

JOINT SEALING INSTRUCTIONS

Surface preparation instructions:

*The following information covering surface preparation applies to all sealed joints whether sealer **Z11** or strip sealer **Z12** or **Z13** is being used. Years of experience has shown the instructions on surface preparation and sealing details do result in watertight joints. Inadequate attention to these details will result in joints that leak.*

Do not apply either sealer if temperature is below 40°Fahrenheit (5°Celcius).

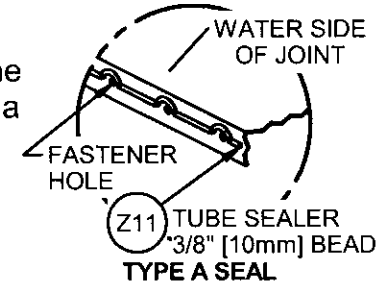
All flanges are to be straight. Rework kinks or bends that exist. Clean surfaces being sealed with acetone. If cloth is used, it must always be clean and dry. **Excercise caution in using solvents, always read labels and instructions.** Care should be taken *not* to wipe dirt or oil onto the cleaned surface from adjacent uncleaned area. Mating surfaces to be sealed must be kept clean and dry prior to assembly. No water, grease or dirt should contaminate cleaned area. Note that stainless steel requires a larger area to be cleaned because oil will recontaminate surfaces quickly. Oil will migrate through punched holes and around sheared edges.

Application instructions for Sealer Z11 (Type A, B, & C seals):

Sealer **Z11** comes in a 1/12th gallon (315ml) cartridge and is applied using a standard caulking gun. Apply sealer to the unassembled parts. The typical joint sealing details shown on this page and the following page are referenced throughout this manual. Care should be taken to fill voids and gaps at joints. After parts have been assembled, trowel excess sealant over joint, taking care to force sealant back into joint, and not out of joint. *Do not use solvent to aid in applying sealer as solvent adversely affects bonding of sealant to metal. Care should be taken to avoid leaving holes or air bubbles in sealant.*

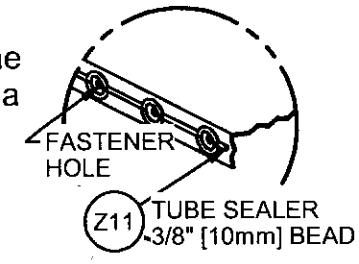
Do not subject sealed joints to waterloading for 48 hours at temperatures of 70°Fahrenheit (21°Celci us) and above. Lower temperature will require a longer cure time.

This symbol is used throughout the manual to indicate the locations where sealer **Z11** is required. The "A" refers to a "Type 'A' Seal" which is a 3/8" (10mm) diameter bead of sealer **Z11** laid along the centerline of a row of holes curving over each hole as it passes. Reference detail at the right.



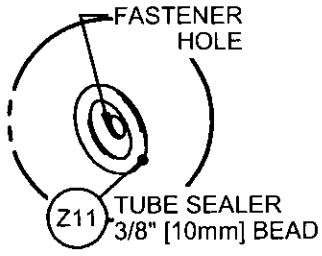
TYPE A SEAL

This symbol is used throughout the manual to indicate the locations where sealer **Z11** is required. The "B" refers to a "Type 'B' Seal" which is a 3/8" (10mm) diameter bead of sealer **Z11** laid along the centerline of a row of holes curving completely around each hole as it passes. Reference detail at the right.



TYPE B SEAL

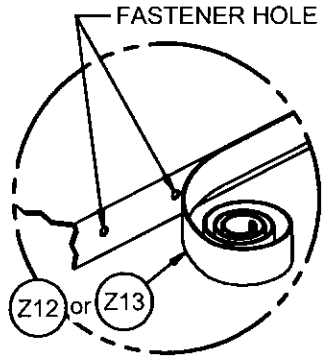
This symbol is used throughout the manual to indicate the locations where sealer **Z11** is required. The "C" refers to a "Type 'C' Seal" which is a 3/8" (10mm) diameter bead of sealer **Z11** laid completely around each hole in a row of holes. Reference detail at the right.



TYPE C SEAL

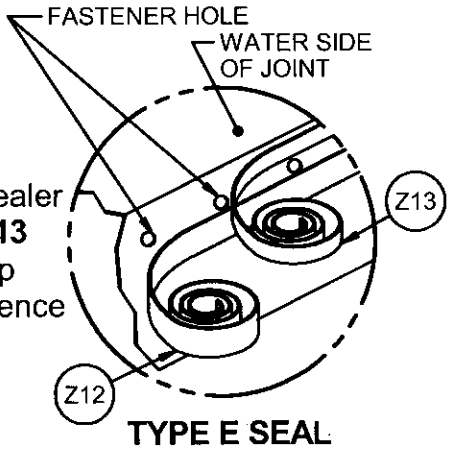
Application instructions for Strip Sealer Z12 & Z13 (Type D, E & F seals):
Strip sealer is supplied in 1/2" (12mm) **Z13** and 1" (25mm) **Z12** widths. It is intended that the 1" (25mm) wide sealer be used unless otherwise noted.
Apply *continuous* pieces of strip sealer to the unassembled parts. *Do not splice pieces except where turning a corner. Cut with a sharp instrument, do not stretch or tear.*
Gaps at joints and corners can be filled by stretching a piece of strip sealer to obtain the proper thickness. Then work it into the joint to fill the gap and create an even surface.
After parts are set together, use a drift pin or other pointed object to puncture sealer at each fastener hole, where required.

This symbol is used throughout the manual to indicate the locations where a single layer of strip sealer **Z12** or **Z13** is required. Reference detail at the right.

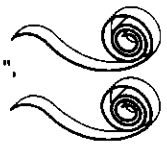


TYPE D SEAL

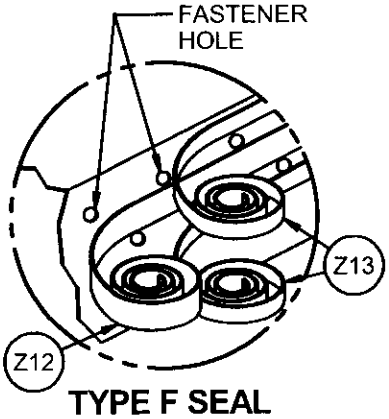
This symbol is used on collection basin joints to indicate the locations where two layers of strip sealer are required. Align bottom edge of strip sealer **Z13** with top edge of bolt holes. Align top edge of strip sealer **Z12** with bottom edge of bolt holes. Reference detail at the right.



TYPE E SEAL



This symbol is used on distribution basin joints to indicate the locations where two layers of strip sealer are required. Align bottom edge of first strip sealer **Z13** with top edge of bolt holes. Align top edge of second strip sealer **Z13** with bottom edge of bolt holes. Reference detail at the right.



TYPE F SEAL

A FEW WORDS ABOUT FASTENERS

Stainless Steel Fasteners:
Stainless steel fasteners are prone to galling. This is when you notice a sudden increase in the force needed to turn a nut before parts are clamped. Apply anti-seize compound to the threads of the bolt before installing the nut. If a nut does not easily spin on a bolt, do not try to force it. Chances are it will seize. Some extra hardware is included to replace problem hardware.

This manual depicts flanged-head fasteners. On stainless steel towers these connection points will consist of a regular hex-head bolt and two washers in place of the flange-head bolt.

Tap Screw Repair:
During installation of tap screws in sheet metal parts, tap screws may strip, not allowing the screw to be fully tightened. if this occurs, place a 3/8" [10mm] nut on the back side of the tap screw and tighten.

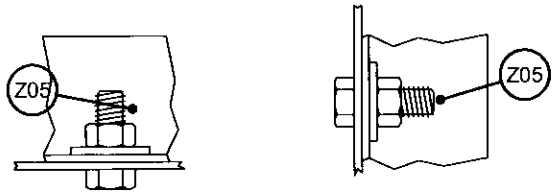
Torque requirements:
The idealized standard fastener torque values for galvanized and stainless steel fasteners are shown in the table below. These values may vary in actual practice. Note that the values shown for stainless steel fasteners are based on the fasteners being lubricated with anti-seize compound.

FASTENER TORQUE		
BOLT DIAMETER	FASTENER TORQUE FOOT-LBS. (NEWTON-METERS)	
	GALVANIZED	* STAINLESS STEEL
8mm	20 (27.1)	20 (27.1)
10mm	20 (27.1)	20 (27.1)
12mm	45 (61)	27 (37)
16mm	90 (122)	44 (60)
20mm	150 (203)	74 (100)

** Values based on fasteners lubricated with anti-seize compund. (Stainless steel only)*

Loctite®
Critical structural and mechanical attachments require extra protection against the nuts vibrating loose during tower operation. This is accomplished on galvanized fasteners by applying Loctite, **Z05**, thread locking compound to the exposed threads of a bolt after the nut has been installed and tightened. Bolts should be installed with the threaded end up or horizontally. Reference details below. *On stainless steel fasteners the use of anti-seize compound makes the use of loctite ineffective. Therefore in these critical areas with stainless steel fasteners, self-locking nuts have been substituted for the standard nuts and loctite will not be used.*

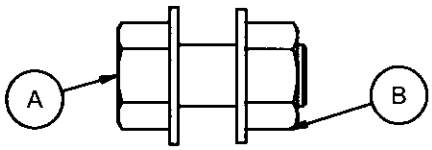
This symbol is used throughout the manual to indicate the locations where Loctite **Z05** is required. Reference details at the right.



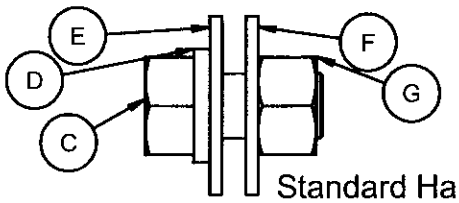
Typical bolted attachment with threaded end of bolt up, or installed horizontally

FASTENER SUBSTITUTION

The find numbers in this manual refer to flange head bolts and nuts. If your tower is not supplied with these, or you need replacement hardware for your tower, the following non-flanged hardware may be substituted.



Flanged Hardware



Standard Hardware

	FIND NO.	DESCRIPTION		FIND NO.	DESCRIPTION
A	VP0	M8 X 25 FLANGED BOLT	C	VM1	M8 X 25 BOLT
			D	W48	M8 SPRING WASHER
			E	W24	M8 FLAT WASHER
	VP1	M8 X 40 FLANGED BOLT	C	VM1	M8 X 40 BOLT
			D	W48	M8 SPRING WASHER
			E	W24	M8 FLAT WASHER
	VP2	M8 X 70 FLANGED BOLT	C	VM1	M8 X 70 BOLT
			D	W48	M8 SPRING WASHER
			E	W24	M8 FLAT WASHER
	VP3	M10 X 25 FLANGED BOLT	C	V07	3/8" X 1" BOLT
			D	W02	3/8" LOCK WASHER
			E	W22	3/8" FLAT WASHER
	VP4	M10 X 40 FLANGED BOLT	C	V10	3/8" X 1 1/2" BOLT
			D	W02	3/8" LOCK WASHER
			E	W22	3/8" FLAT WASHER
	VP6	M10 X 65 FLANGED BOLT	C	V11	3/8" X 2 1/2" BOLT
			D	W02	3/8" LOCK WASHER
			E	W22	3/8" FLAT WASHER
	VP7	M12 X 25 FLANGED BOLT	C	V18	1/2" X 1" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER
	VP8	M12 X 40 FLANGED BOLT	C	V18	1/2" X 1 1/2" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER
	VPA	M12 X 55 FLANGED BOLT	C	V8Q	1/2" X 2 1/2" BOLT
			E	W23	1/2" FLAT WASHER
	VPC	M12 X 65 FLANGED BOLT	C	V22	1/2" X 2 1/2" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER
	VPD	M12 X 100 FLANGED BOLT	C	V25	1/2" X 4" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER
	VPE	M12 X 120 FLANGED BOLT	C	V8Y	1/2" X 4 1/2" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER

	FIND NO.	DESCRIPTION		FIND NO.	DESCRIPTION
A	VPF	M16 X 40 FLANGED BOLT	C	V28	5/8" X 1 1/2" BOLT
			D	W04	5/8" LOCK WASHER
			E	W29	5/8" FLAT WASHER
	VPG	M16 X 65 FLANGED BOLT	C	VB1	5/8" X 2 1/2" BOLT
			D	W04	5/8" LOCK WASHER
			E	W29	5/8" FLAT WASHER
	VPH	M16 X 80 FLANGED BOLT	C	VB2	M16 X 80 BOLT
			D	W04	M16 SPRING WASHER
			E	W29	M16 FLAT WASHER
	VPJ	M16 X 90 FLANGED BOLT	C	VB3	5/8" X 3 1/2" BOLT
			D	W04	5/8" LOCK WASHER
			E	W29	5/8" FLAT WASHER
	VPK	M20 X 45 FLANGED BOLT	C	V32	3/4" X 2" BOLT
			D	W05	3/4" LOCK WASHER
	VPL	M20 X 65 FLANGED BOLT	C	VC4	3/4" X 2 1/2" BOLT
			D	W05	3/4" LOCK WASHER
			E	W30	3/4" FLAT WASHER
	VPM	M20 X 80 FLANGED BOLT	C	V35	3/4" X 3" BOLT
			D	W05	3/4" LOCK WASHER
			E	W30	3/4" FLAT WASHER
	VPN	M20 X 90 FLANGED BOLT	C	V39	3/4" X 3 1/2" BOLT
			D	W05	3/4" LOCK WASHER
			E	W30	3/4" FLAT WASHER

B	X60	M8 FLANGED NUT	F	W24	M8 FLAT WASHER
			G	X47	M8 HEX NUT
	X61	M10 FLANGED NUT	F	W22	3/8" FLAT WASHER
			G	X02	3/8" HEX NUT
	X62	M12 FLANGED NUT	F	W23	1/2" FLAT WASHER
			G	X03	1/2" HEX NUT
	X63	M16 FLANGED NUT	F	W29	5/8" FLAT WASHER
			G	X05	5/8" HEX NUT
	X64	M20 FLANGED NUT	F	X04	3/4" NUT

GENERAL DECAL INSTRUCTIONS

Decals are an important part of the tower assembly. Decals provide instructions, identifications, cautions and warnings deemed necessary for proper operation and safety.

Surface Preparation

Surface must be clean and dry. Oil and dirt may be removed with solvent (such as acetone) or commercial detergent. Wash the area with warm water and dry with a lint-free cloth. Ultimate adhesion will occur 24-28 hours after application should not be undertaken if temperature is below 35 degrees Fahrenheit, or if humidity is greater than 95%.

General Application Instructions

Peel off backing paper, taking care to avoid dirt contamination of the exposed adhesive. Carefully apply decal to the desired location with light pressure to avoid distortion of the vinyl. Once in position, smooth out with a towel. If air bubbles occur, puncture with a pin and smooth down with a towel. The finished decal should be completely flat.

NOTES

This page intentionally left blank

MODULE CONNECTION DETAILS

NC8411 thru NC8414 only

Before top module is hoisted into place on bottom module, clean any dirt and debris from the underside of the top module skid sides and beams. Remove shipping guards from bottom of top module. After top module is in place the modules may be connected near louver columns as shown in *Figure 1*, or inside tower on eliminator face per *Figure 2.*

FIND NO.	PARTS LIST	DESCRIPTION
VPK	VN3	BOLT, M20 X 45MM
	W05**	LOCK WASHER, M20
X64	X04*	NUT, M20

* Use Nyloc Nut for SS fastener

** Lock Washer only required for GALV fastener

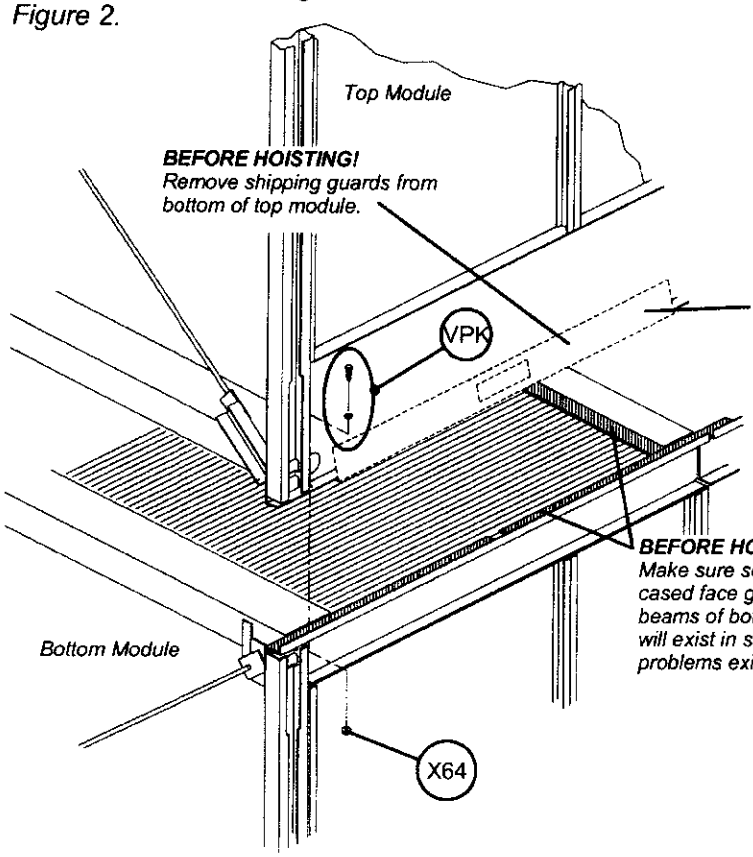


Figure 1

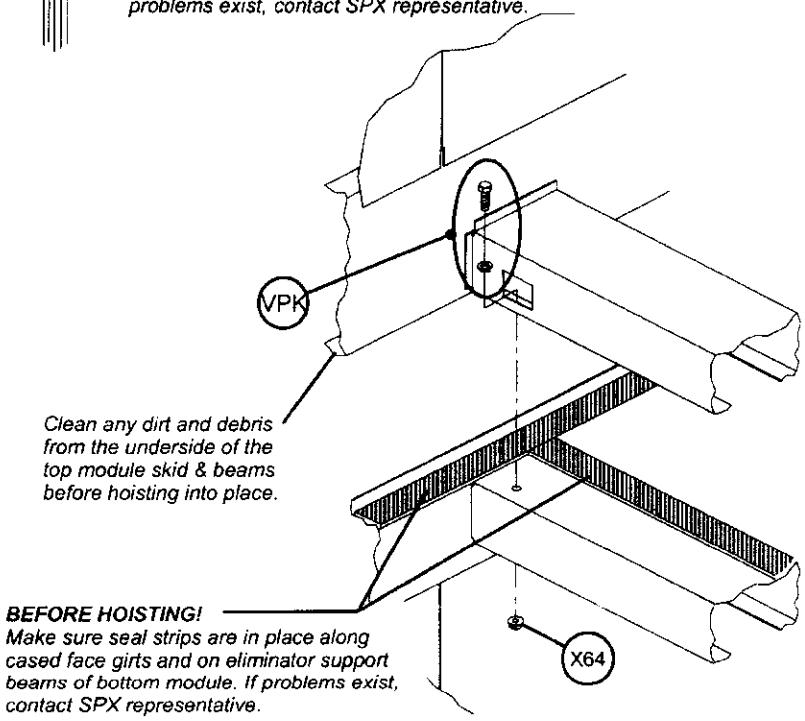


Figure 2

MODULE CONNECTION DETAILS

NC8411 thru NC8414 only

Before top module is hoisted into place on bottom module, clean any dirt and debris from the underside of the top module skid sides and beams. Remove shipping guards from bottom of top module. After top module is in place the modules may be connected near louver columns as shown in *Figure 1*, or inside tower on eliminator face per *Figure 2*.

FIND NO.	PARTS LIST	DESCRIPTION
VPK	VN3	BOLT, M20 X 45MM
	W05**	LOCK WASHER, M20
X64	X04*	NUT, M20

* Use Nyloc Nut for SS fastener

** Lock Washer only required for GALV fastener

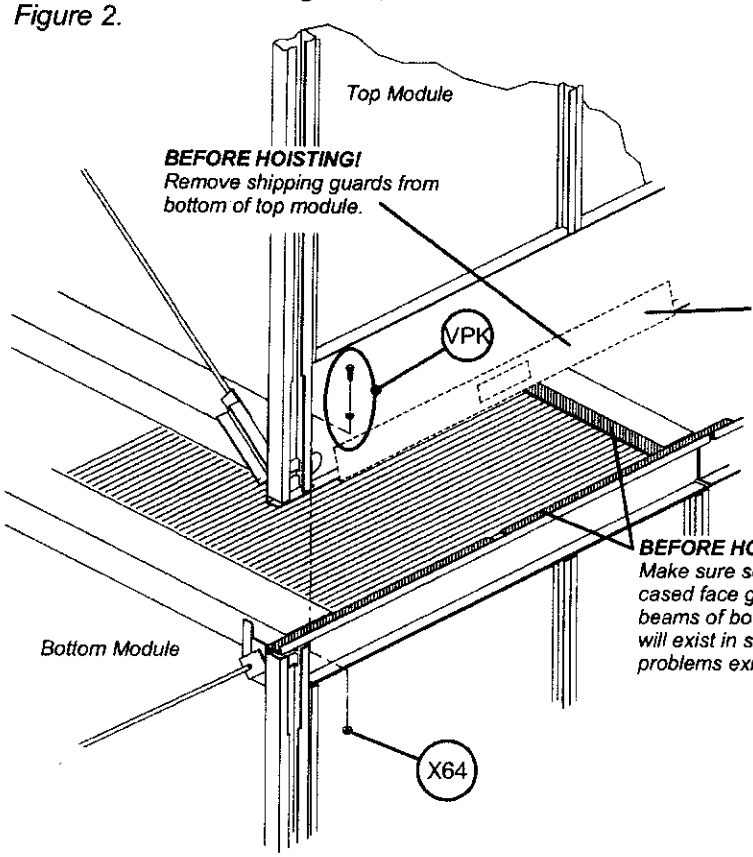


Figure 1

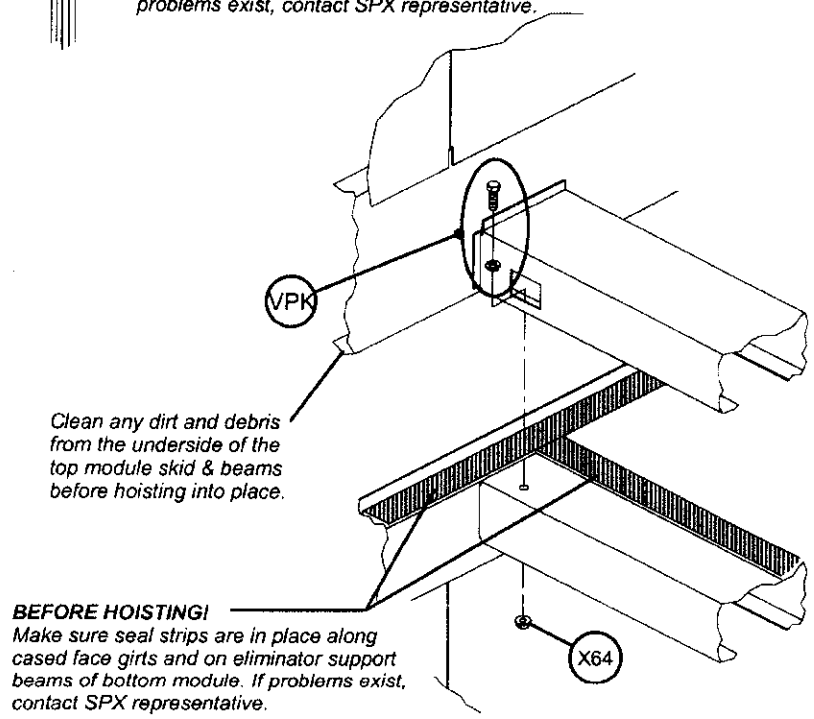
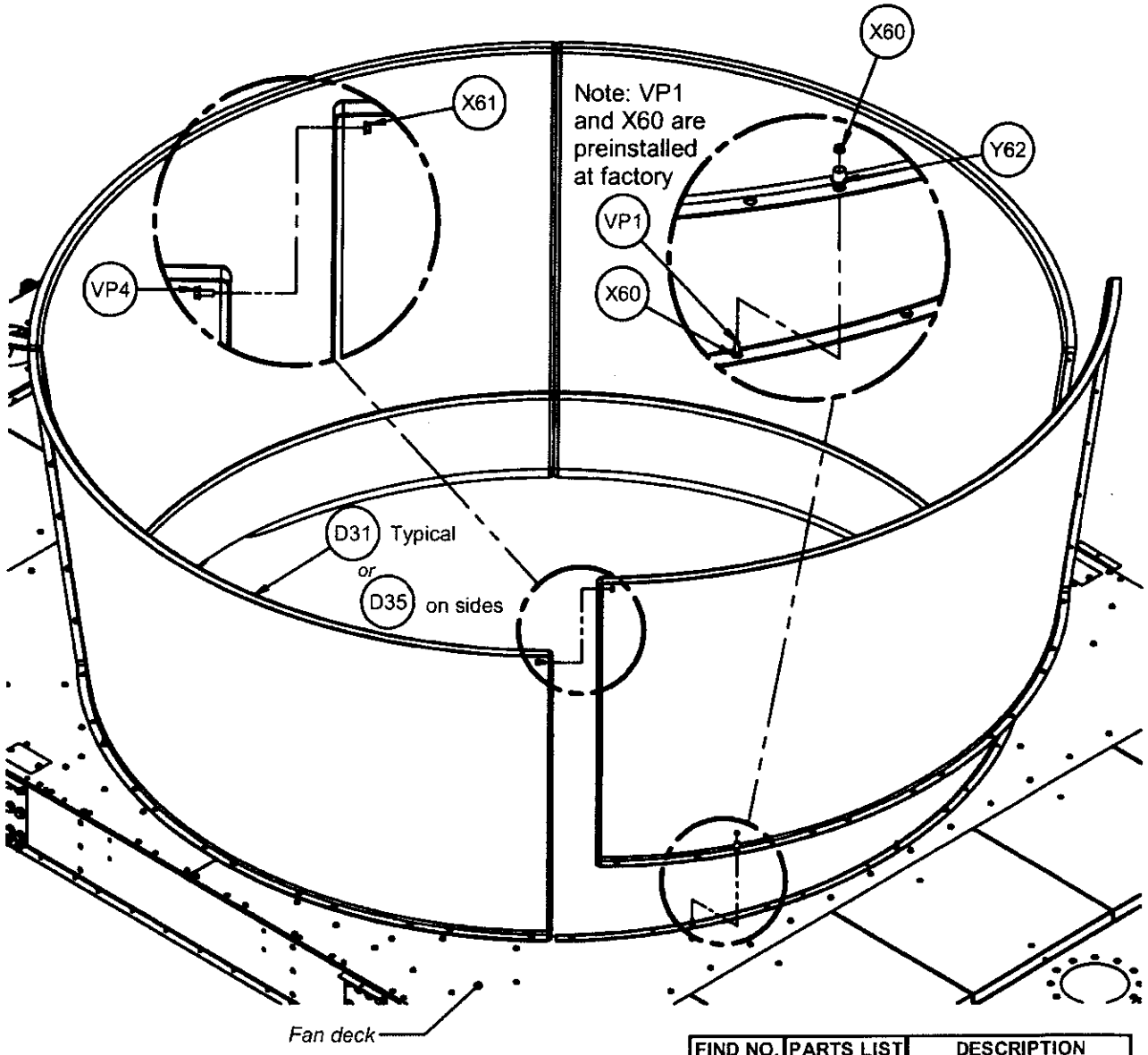


Figure 2



FIND NO.	PARTS LIST	DESCRIPTION
VP1	VM4	BOLT, M8 X 40MM
	W48**	LOCK WASHER, M8
	W24	FLAT WASHER, M8
VP4	V10	BOLT, M10 X 40MM
	W02**	LOCK WASHER, M10
	W22	FLAT WASHER, M10
X60	X47*	NUT, M8
	W24	FLAT WASHER, M8
X61	X02*	NUT, M10
	W22	FLAT WASHER, M10

* Use Nyloc Nut for SS fastener

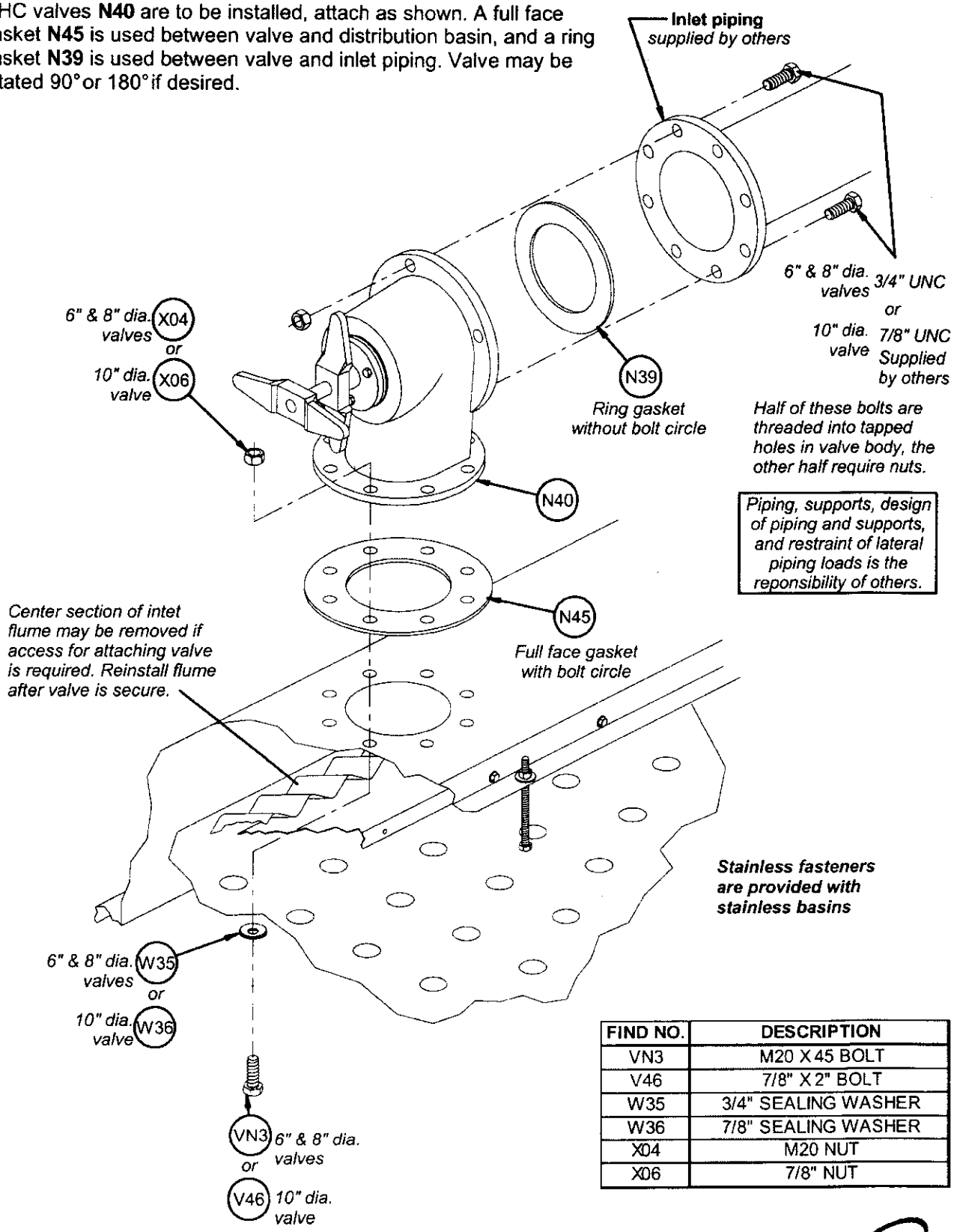
** Lock Washer only required for GALV fastener

VELOCITY RECOVERY STACK

On models with a velocity recovery stack, install fiberglass cylinder segments **D31** per *Figure 1* on top of lower cylinder that extends down from deck. Segments are to straddle tower centerline. Installation hardware for the cylinder segments has been pre-installed at the factory. Fan guard is not required on these models.

INLET PIPING WITH OPTIONAL HC VALVES

If HC valves **N40** are to be installed, attach as shown. A full face gasket **N45** is used between valve and distribution basin, and a ring gasket **N39** is used between valve and inlet piping. Valve may be rotated 90° or 180° if desired.



FIND NO.	DESCRIPTION
VN3	M20 X 45 BOLT
V46	7/8" X 2" BOLT
W35	3/4" SEALING WASHER
W36	7/8" SEALING WASHER
X04	M20 NUT
X06	7/8" NUT

OVERFLOW & DRAIN

All towers must have an overflow and drain, either as the standpipe in the collection basin floor or at the optional coverplate location. The standpipe overflow and drain is installed per *Figure 1.* Bolt coupling assembly **Q47** to bottom of the collection basin floor at the 6" (152mm) diameter hole and bolt pattern. Install standpipe **Q48**. The standpipe is PVC unless an optional heater element is close by, then a steel standpipe will be installed with teflon tape (supplied by others) to protect the threads.

If the optional coverplate drain and overflow is being used, the cutout in the depressed section for the standpipe has been covered with a drain plate that must have plug **Q18** installed per *Figure 2.* If coverplate drain is not being plumbed, install pipe plug **Q18** per *Figure 3.*

FIND NO.	PARTS LIST	DESCRIPTION
VP0	VM1	BOLT, M8 X 25MM
	W48**	LOCK WASHER, M8
	W24	FLAT WASHER, M8
W37	W37	SEALING WASHER, M8
X60	X47*	NUT, M8
	W24	FLAT WASHER, M8

* Use Nyloc Nut for SS fastener

** Lock Washer only required for GALV fastener

Stainless fasteners are provided with stainless basins

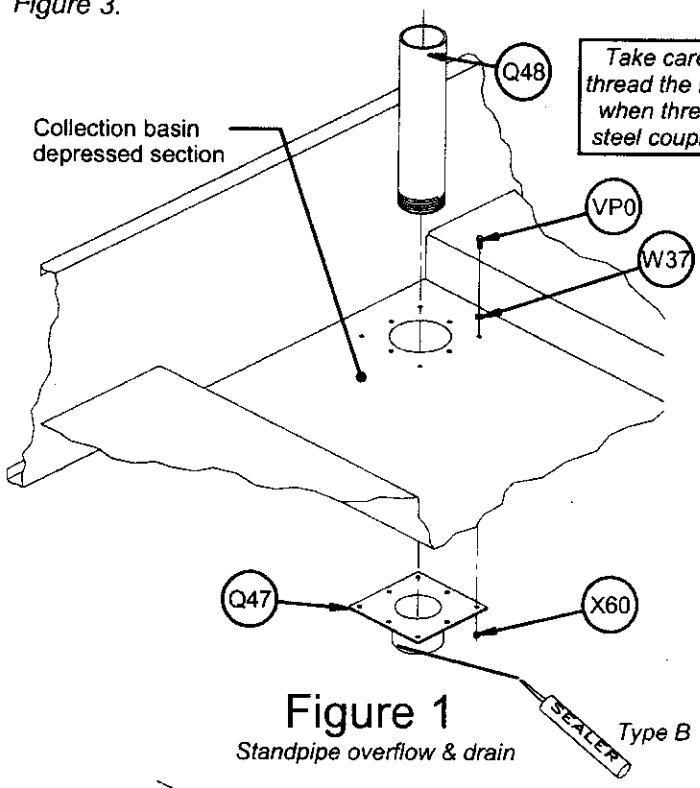


Figure 1
Standpipe overflow & drain

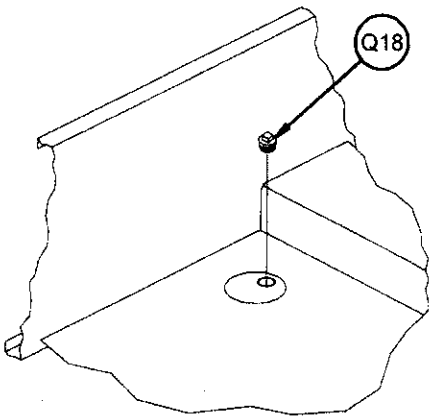


Figure 2
Floor drain plug

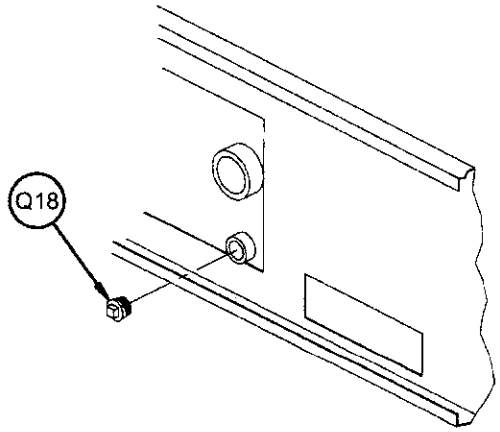


Figure 3
Coverplate drain plug

BOTTOM OUTLET

The typical attachment of customer piping for bottom outlet or equalizer connection using gasket **Q14** is shown in *Figure 1*. **The tower is not designed to support additional piping loads. DO NOT SUPPORT PIPING FROM THE TOWER.**

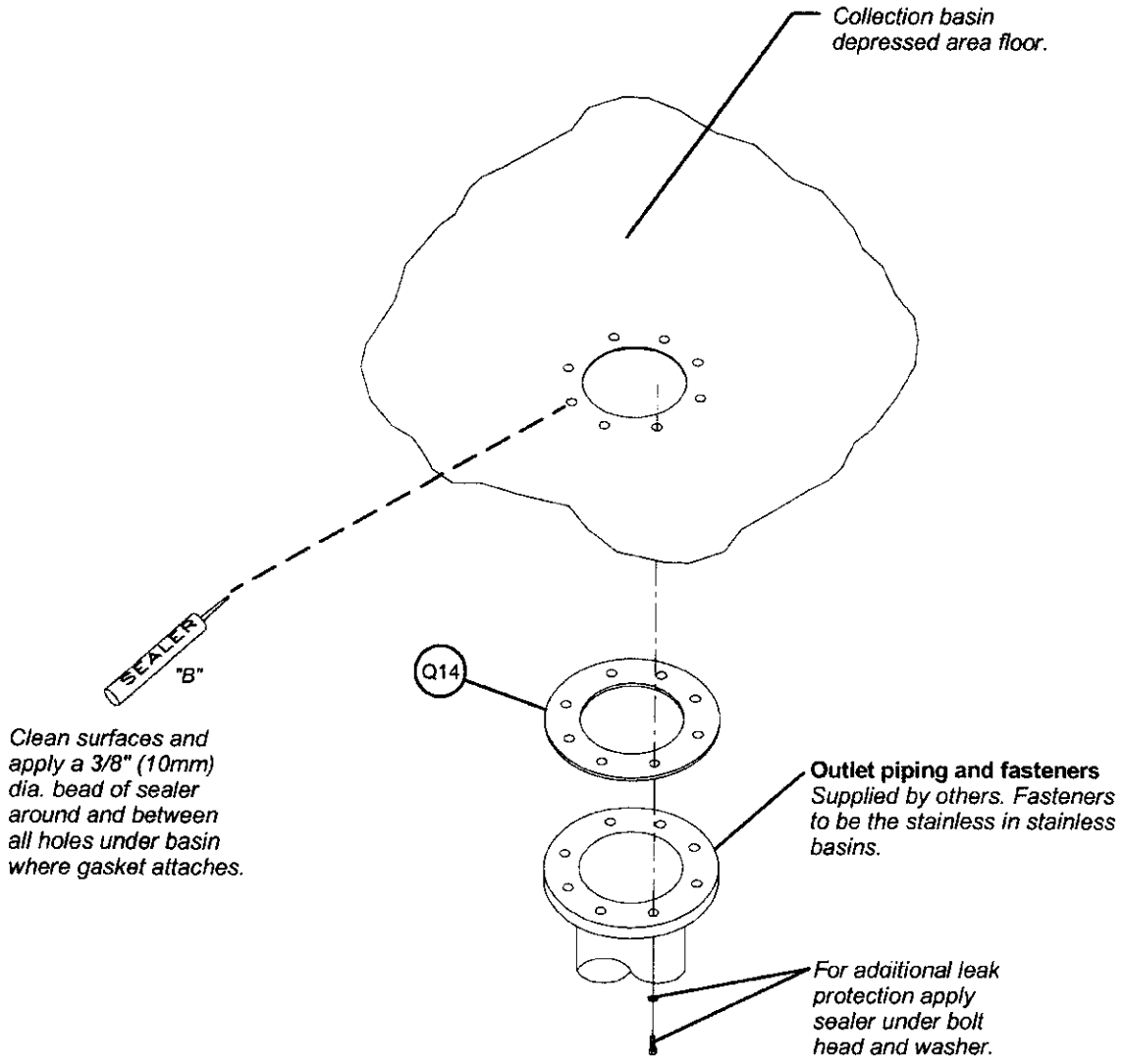
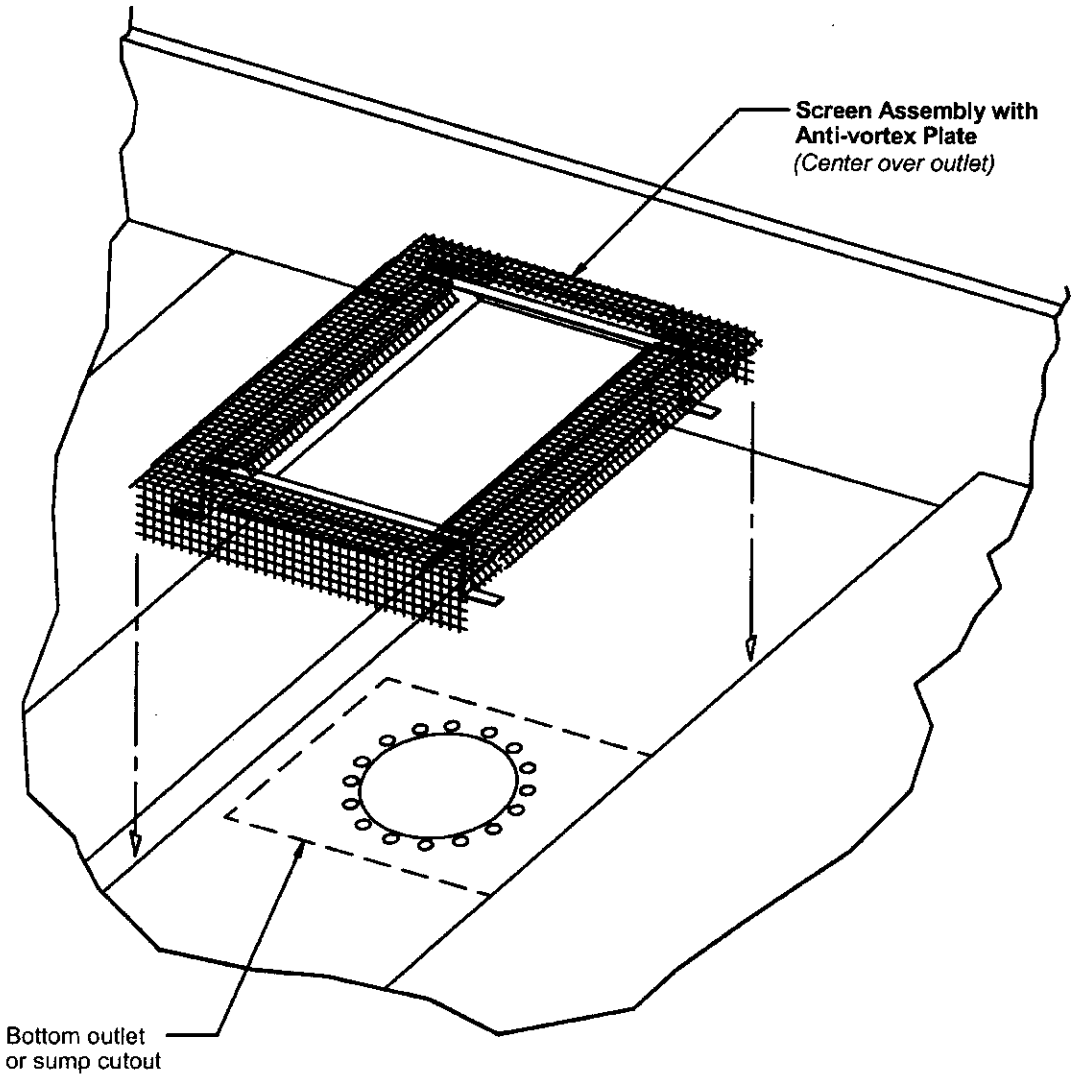


Figure 1

Piping, supports, design of piping and supports, and restraint of lateral piping loads is the reponsibility of others.

ANTI-VORTEX PLATE

On towers with higher outlet flows, a screen assembly with an anti-vortex plate is used as shown in the figure below. Anti-vortex plate is pre-assembled with screens and retainers. Position anti-vortex assembly in depressed area of collection basin centered over outlet.

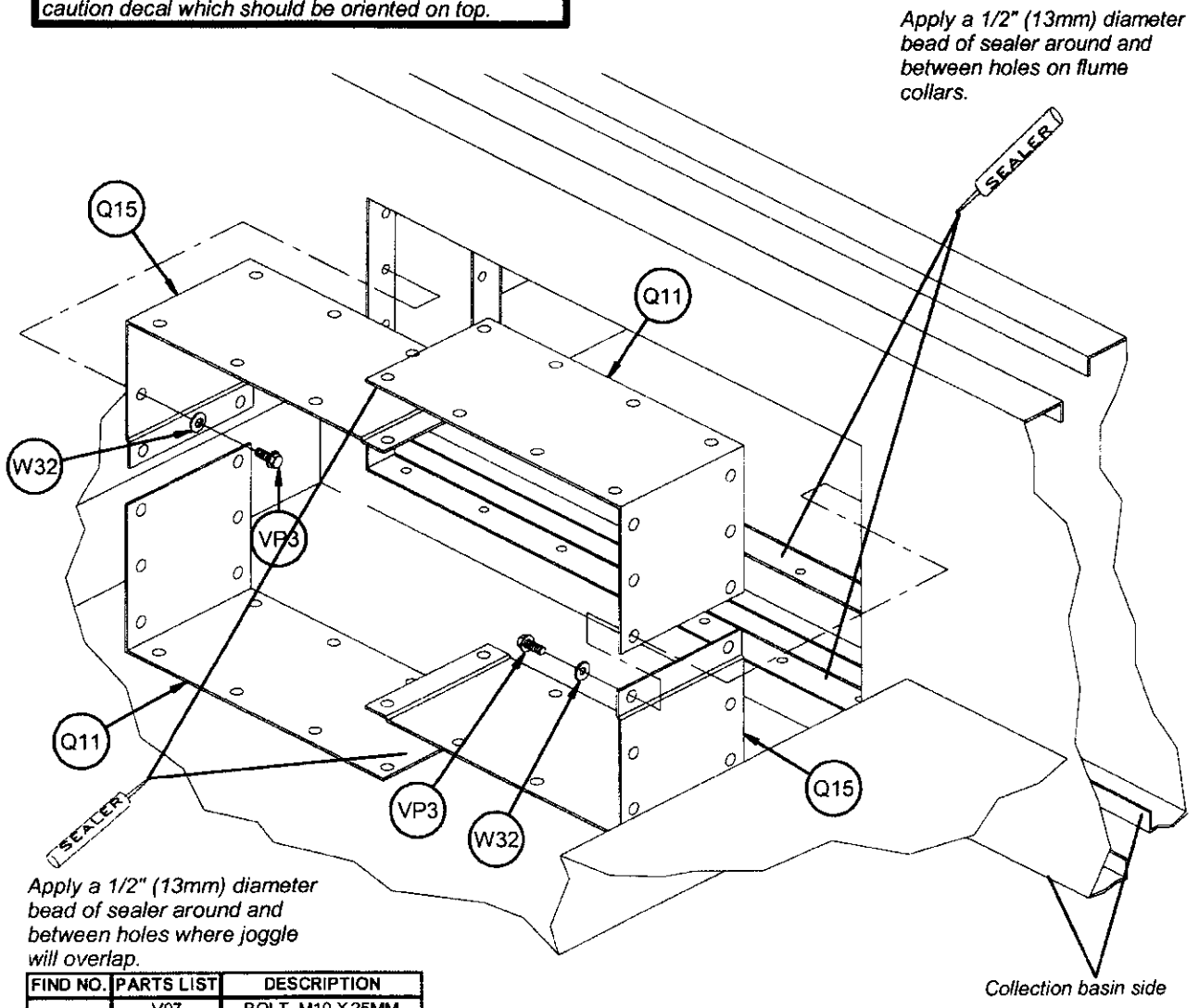


FLUME

If collection basins of multiple towers are to be connected together, a flume is installed per *Figure 1*. Flume collars are shop installed in each tower along with temporary coverplates for shipment. Remove coverplates before continuing. *Note that if a weir gate option (a removable plate used to isolate adjacent towers) has been purchased, the weir gate is shop installed, in one tower, for shipment. The weir gate will be reinstalled, in either tower, after installation of flume per Weir Gate installation instructions.*

IMPORTANT! *Flumes are not a walking surface. Flumes that are 18" (457mm) long and longer have a caution decal which should be oriented on top.*

Note that towers must be aligned before attempting to install flume in place. **Sealing of the flume connections is critical to prevent leaks.** Apply a 1/2" (13mm) bead of sealer **Z11** as indicated, around and between all holes on both flume collars. Install non-joggled flume corners **Q11** first. Apply another bead of sealer around and between holes where joggle will overlap on flume. Compete flume installation by installing joggled flume corners **Q15**. *If weir gate option is purchased, ends of flume corners must be flush to ensure a proper seal.*



FIND NO.	PARTS LIST	DESCRIPTION
VP3	V07	BOLT, M10 X 25MM
	W02**	LOCK WASHER, M10
	W22	FLAT WASHER, M10
W32	W32	SEAL WASHER, 3/8"

Figure 1

* Use Nyloc Nut for SS fastener

** Lock Washer only required for GALV fastener

Fasteners are stainless steel

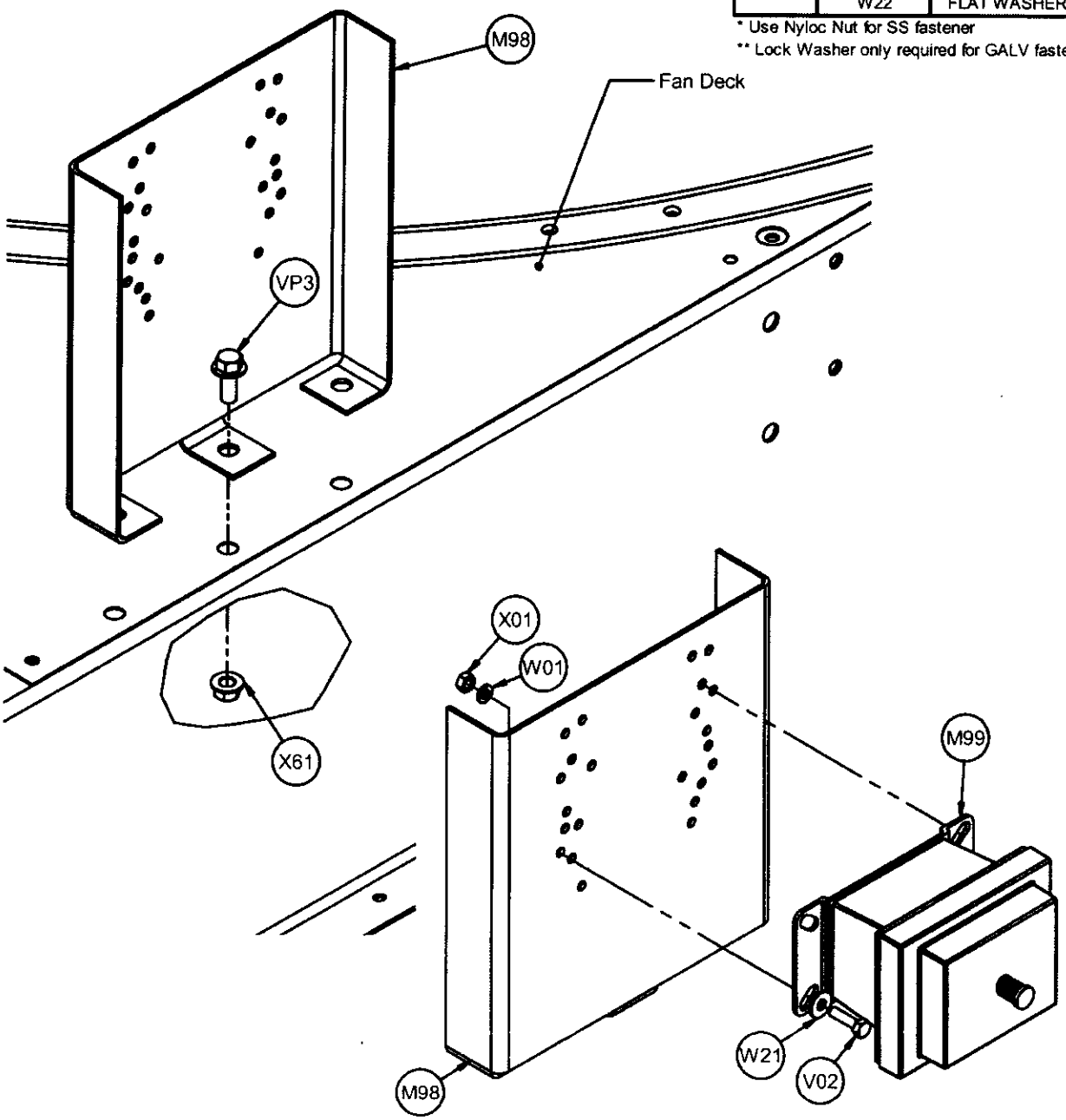
EXTERNAL VIBRATION SWITCH

If your tower is equipped with an external Metrix, Robertshaw, Murphy, or other vibration switch, install bracket **M98** to the fan deck on the motor side of the tower as shown. The bracket may be rotated 180° from position shown on towers without the ladd er and handrail option. Install switch **M99** as shown. If a rainshield is required, it is provided for installation between the beam and the switch using the switch mounting hardware.

FIND NO.	PARTS LIST	DESCRIPTION
V02	V02	BOLT, 1/4" X 1"
VP3	V07	BOLT, M10 X 25MM
	W02**	LOCK WASHER, M10
	W22	FLAT WASHER, M10
W01	W01	LOCK WASHER, 1/4"
W21	W21	FLAT WASHER, 1/4"
X01	W05**	LOCK WASHER, M20
X61	X02*	NUT, M10
	W22	FLAT WASHER, M10

* Use Nyloc Nut for SS fastener

** Lock Washer only required for GALV fastener



WARNING

The location and orientation of the cooling tower can affect the safety of those responsible for installing, servicing or reparing the cooling tower. Since SPX does not dictate or determine where the tower is located or how iti is oriented, SPX is not responsible for addressing the safety issues that are affected by the tower's location location and orientation. The following safety issues should be considered by those responsible for designing and maintaining the tower installation. Failure to consider and address these issues may result in substantial personal injury or death to those installing, servicing or repairing the cooling tower.

* Access to and from the fan deck.
* Access to and from maintenance access doors.
* Access for cleaning and other service.
* Potential access problems due to obstructions surrounding the tower.
* The possible need for safety cages around ladders.

These are only some of the safety issues that may arise in the design process. SPX strongly recommends that you consult a safety engineer to be sure that all safety considerations have been addressed.

This page intentionally left blank

This page intentionally left blank

ABOUT THIS MANUAL

To obtain maximum efficiency, it is strongly recommended that this entire manual be read before starting assembly. This assembly manual illustrates a typical assembly sequence of a basic tower. Some common options are also included. Refer to separate installation drawings for additional optional equipment Review all manuals, drawings and bills of material prior to assembly. These documents are located in a Literature Kit packed with the tower. Contact your SPX Cooling Technologies sales representative should questions arise.

SAFETY

The location and orientation of the cooling tower can affect the safety of those responsible for installing, servicing, or repairing the tower. Since SPX Cooling Technologies does not dictate the location, or orientation of the tower, SPX Cooling Technologies is not responsible for addressing the safety issues that are affected by the tower's location, or orientation. The following safety issues should be considered by those responsible for designing the tower installation. Failure to consider and address these issues may result in substantial personal injury, or death to those involved in installing, servicing, or repairing the cooling tower.

* Access to and from maintenance access doors
* Access for cleaning and other service
* Potential access problems due to obstructions surrounding the tower
* The possible need for ladders (either portable or permanent) to gain access to the maintenance access doors
* The possible need for safety cages around ladders.

These are only some of the safety issues that may arise in the design process. SPX Cooling Technologies strongly recommends that you consult a safety engineer to be sure all safety considerations have been addressed.

SPX Cooling Technologies offers optional equipment that may assist you in addressing some of these safety issues. Consult your sales representative for information on these optional items.

Safety is the first priority at the job site. Cooling towers are constructed of material that could cause injury if not handled properly. It is recommended that Kevlar gloves and sleeves and eye protection be worn at all time when working with steel, PVC and fiberglass. Hardhats should be worn when working with overhead objects.
Steel parts may be heavy and the surfaces may be slick from oil used during fabrication. Take precautions by placing heavy steel parts near or on the ground to minimize the risk of dropping. Although all steel parts are de-burred, the edges of steel can be very sharp and cut easily. Keep a first aid kit handy should the need arise.
Use the above suggestions as well as common sense to create a safe working environment. Take steps to prevent tipping or falling hazards. Protection from thrown or falling objects should be used at all times around a construction site. Keep the worksite and assembly area clean. Check tools periodically and replace tools that could break or malfunction. Follow instruction manuals for all powertools and beware of shock hazards that exist.

NEVER HOLD A PIECE OF STEEL IN PLACE USING ONLY A DRIFT PIN. Drift pins have smooth surfaces and are designed to slide in and out of holes very easily. Drift pins can not hold themselves in place. Parts WILL fall if suspended only by a drift pin.

PARTS
All steel parts are tagged for identification, as shown above.

Find Number: This is a three-digit alpha/numeric number that ties the bill of material (BOM) to the drawings. They are identified in the drawings as the alpha/numeric numbers within the circles. The find numbers on the drawings are used in conjunction with the appropriate BOM to find the correct item numbers needed for installation.

THE SAME FIND NUMBERS MAY BE USED FOR DIFFERENT PARTS ON DIFFERENT TOWER CELLS.

Item Number: This number is used by SPX Cooling Technologies to purchase, manufacture and inventory the components of the modules. Give these item numbers to the project manager if an item is missing or a replacement item is required.

Drawing Number: (Reference Only) This is the number of the drawing used to fabricate the item. This number DOES NOT reference the drawing number where the part is used.

Description: (Reference Only) This number describes the dimensions of the flat pattern of the item. These dimensions MAY NOT correspond to the overall dimensions of the part.

The find number, item number, description and quantity of items are all cross referenced on the bill of material. If a number is missing or hard to read, check the illustrations in this assembly manual first and then the bill of material to see if you can find it. As the tower is prepared for assembly, the quantities of each item should be checked against the bill of material.

NEED HELP!
If anything is missing, damaged, or you need help of any kind, contact your SPX Cooling Technologies Representative as soon as possible. If you need help determining the representative in your area, please call us at 1-800-4MARLEY, or check the internet at www.spxcooling.com

MEASUREMENT SYSTEM
The manual uses both, the English System and Metric System of measurement. All units are in millimeters. Fasteners are denoted in both the English and metric systems. Fasteners are supplied in conformance with the metric system standard unless otherwise noted in the tower bills of material.

TOOLS AND SUPPLIES
Hoist: 2500 pound (1140kg) capacity for hoisting.

Small and large drift pins: (alignment tools) these are extremely important to help line up all the holes.

Combination wrenches: mainly 13mm up to 30mm. May be substituted for impact wrenches.

Socket wrench set: Tower mainly uses 13mm, 19mm & 30mm sockets. have more than one if possible.

Impact wrenches (electric or pneumatic) with standard and deep sockets: used to tighten all hardware.

Torque wrench: 150 ft lb (203 N-m) capacity.

Scoffolding, portable stairs, ladders or other means of temporary access and support

Wear protective clothing, gloves, nonslip footwear, hard hat and safety glasses. Fluid Coolers are constructed of steel and could have burrs that can cause cuts. The surface of the steel could be slick. Protection from thrown, or falling objects should be used at all times around a construction site.

A FEW WORDS ABOUT FASTENERS
Stainless Steel Fasteners:
Stainless steel fasteners are prone to galling. This is when you notice a sudden increase in the force needed to turn a nut before parts are clamped. Apply anti-seize compound to the threads of the bolt before installing the nut. If a nut does not easily spin on a bolt, do not try to force it. Chances are it will seize. Some extra hardware is included to replace problem hardware.

This manual depicts flanged-head fasteners. On stainless steel towers these connection points will consist of a regular hex-head bolt and two washers in place of the flange-head bolt.

Tap Screw Repair:
During installation of tap screws in sheet metal parts, tap screws may strip, not allowing the screw to be fully tightened. if this occurs, place a 3/8" [10mm] nut on the back side of the tap screw and tighten.

Torque requirements:
The idealized standard fastener torque values for galvanized and stainless steel fasteners are shown in the table below. These values may vary in actual practice. Note that the values shown for stainless steel fasteners are based on the fasteners being lubricated with anti-seize compound.

A FEW WORDS ABOUT FASTENERS

Stainless Steel Fasteners:
Stainless steel fasteners are prone to galling. This is when you notice a sudden increase in the force needed to turn a nut before parts are clamped. Apply anti-seize compound to the threads of the bolt before installing the nut. If a nut does not easily spin on a bolt, do not try to force it. Chances are it will seize. Some extra hardware is included to replace problem hardware.

This manual depicts flanged-head fasteners. On stainless steel towers these connection points will consist of a regular hex-head bolt and two washers in place of the flange-head bolt.

Tap Screw Repair:
During installation of tap screws in sheet metal parts, tap screws may strip, not allowing the screw to be fully tightened. if this occurs, place a 3/8" [10mm] nut on the back side of the tap screw and tighten.

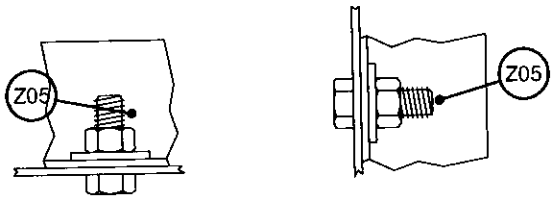
Torque requirements:
The idealized standard fastener torque values for galvanized and stainless steel fasteners are shown in the table below. These values may vary in actual practice. Note that the values shown for stainless steel fasteners are based on the fasteners being lubricated with anti-seize compound.

FASTENER TORQUE		
BOLT DIAMETER	FASTENER TORQUE FOOT-LBS. (NEWTON-METERS)	
	GALVANIZED	* STAINLESS STEEL
8mm	20 (27.1)	20 (27.1)
10mm	20 (27.1)	20 (27.1)
12mm	45 (61)	27 (37)
16mm	90 (122)	44 (60)
20mm	150 (203)	74 (100)

** Values based on fasteners lubricated with anti-seize compund. (Stainless steel only)*

Loctite®
Critical structural and mechanical attachments require extra protection against the nuts vibrating loose during tower operation. This is accomplished on galvanized fasteners by applying Loctite, **Z05**, thread locking compound to the exposed threads of a bolt after the nut has been installed and tightened. Bolts should be installed with the threaded end up or horizontally. Reference details below. *On stainless steel fasteners the use of anti-seize compound makes the use of loctite ineffective. Therefore in these critical areas with stainless steel fasteners, self-locking nuts have been substituted for the standard nuts and loctite will not be used.*

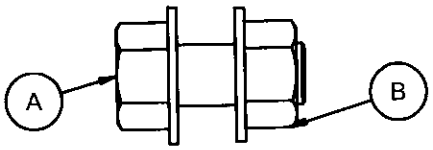
This symbol is used throughout the manual to indicate the locations where Loctite **Z05** is required. Reference details at the right.



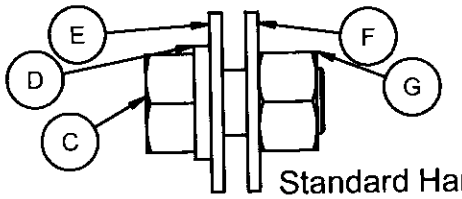
Typical bolted attachment with threaded end of bolt up, or installed horizontally

FASTENER SUBSTITUTION

The find numbers in this manual refer to flange head bolts and nuts. If your tower is not supplied with these, or you need replacement hardware for your tower, the following non-flanged hardware may be substituted.



Flanged Hardware



Standard Hardware

	FIND NO.	DESCRIPTION		FIND NO.	DESCRIPTION
A	VP0	M8 X 25 FLANGED BOLT	C	VM1	M8 X 25 BOLT
			D	W48	M8 SPRING WASHER
			E	W24	M8 FLAT WASHER
	VP1	M8 X 40 FLANGED BOLT	C	VM1	M8 X 40 BOLT
			D	W48	M8 SPRING WASHER
			E	W24	M8 FLAT WASHER
	VP2	M8 X 70 FLANGED BOLT	C	VM1	M8 X 70 BOLT
			D	W48	M8 SPRING WASHER
			E	W24	M8 FLAT WASHER
	VP3	M10 X 25 FLANGED BOLT	C	V07	3/8" X 1" BOLT
			D	W02	3/8" LOCK WASHER
			E	W22	3/8" FLAT WASHER
	VP4	M10 X 40 FLANGED BOLT	C	V10	3/8" X 1 1/2" BOLT
			D	W02	3/8" LOCK WASHER
			E	W22	3/8" FLAT WASHER
	VP6	M10 X 65 FLANGED BOLT	C	V11	3/8" X 2 1/2" BOLT
			D	W02	3/8" LOCK WASHER
			E	W22	3/8" FLAT WASHER
	VP7	M12 X 25 FLANGED BOLT	C	V18	1/2" X 1" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER
	VP8	M12 X 40 FLANGED BOLT	C	V18	1/2" X 1 1/2" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER
	VPA	M12 X 55 FLANGED BOLT	C	V8Q	1/2" X 2 1/2" BOLT
			E	W23	1/2" FLAT WASHER
	VPC	M12 X 65 FLANGED BOLT	C	V22	1/2" X 2 1/2" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER
	VPD	M12 X 100 FLANGED BOLT	C	V25	1/2" X 4" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER
	VPE	M12 X 120 FLANGED BOLT	C	V8Y	1/2" X 4 1/2" BOLT
			D	W03	1/2" LOCK WASHER
			E	W23	1/2" FLAT WASHER

	FIND NO.	DESCRIPTION		FIND NO.	DESCRIPTION
A	VPF	M16 X 40 FLANGED BOLT	C	V28	5/8" X 1 1/2" BOLT
			D	W04	5/8" LOCK WASHER
			E	W29	5/8" FLAT WASHER
	VPG	M16 X 65 FLANGED BOLT	C	VB1	5/8" X 2 1/2" BOLT
			D	W04	5/8" LOCK WASHER
			E	W29	5/8" FLAT WASHER
	VPH	M16 X 80 FLANGED BOLT	C	VB2	M16 X 80 BOLT
			D	W04	M16 SPRING WASHER
			E	W29	M16 FLAT WASHER
	VPJ	M16 X 90 FLANGED BOLT	C	VB3	5/8" X 3 1/2" BOLT
			D	W04	5/8" LOCK WASHER
			E	W29	5/8" FLAT WASHER
	VPK	M20 X 45 FLANGED BOLT	C	V32	3/4" X 2" BOLT
			D	W05	3/4" LOCK WASHER
	VPL	M20 X 65 FLANGED BOLT	C	VC4	3/4" X 2 1/2" BOLT
			D	W05	3/4" LOCK WASHER
			E	W30	3/4" FLAT WASHER
	VPM	M20 X 80 FLANGED BOLT	C	V35	3/4" X 3" BOLT
			D	W05	3/4" LOCK WASHER
			E	W30	3/4" FLAT WASHER
	VPN	M20 X 90 FLANGED BOLT	C	V39	3/4" X 3 1/2" BOLT
			D	W05	3/4" LOCK WASHER
			E	W30	3/4" FLAT WASHER

B	X60	M8 FLANGED NUT	F	W24	M8 FLAT WASHER
			G	X47	M8 HEX NUT
	X61	M10 FLANGED NUT	F	W22	3/8" FLAT WASHER
			G	X02	3/8" HEX NUT
	X62	M12 FLANGED NUT	F	W23	1/2" FLAT WASHER
			G	X03	1/2" HEX NUT
	X63	M16 FLANGED NUT	F	W29	5/8" FLAT WASHER
			G	X05	5/8" HEX NUT
	X64	M20 FLANGED NUT	F	X04	3/4" NUT

LADDER & GUARDRAIL

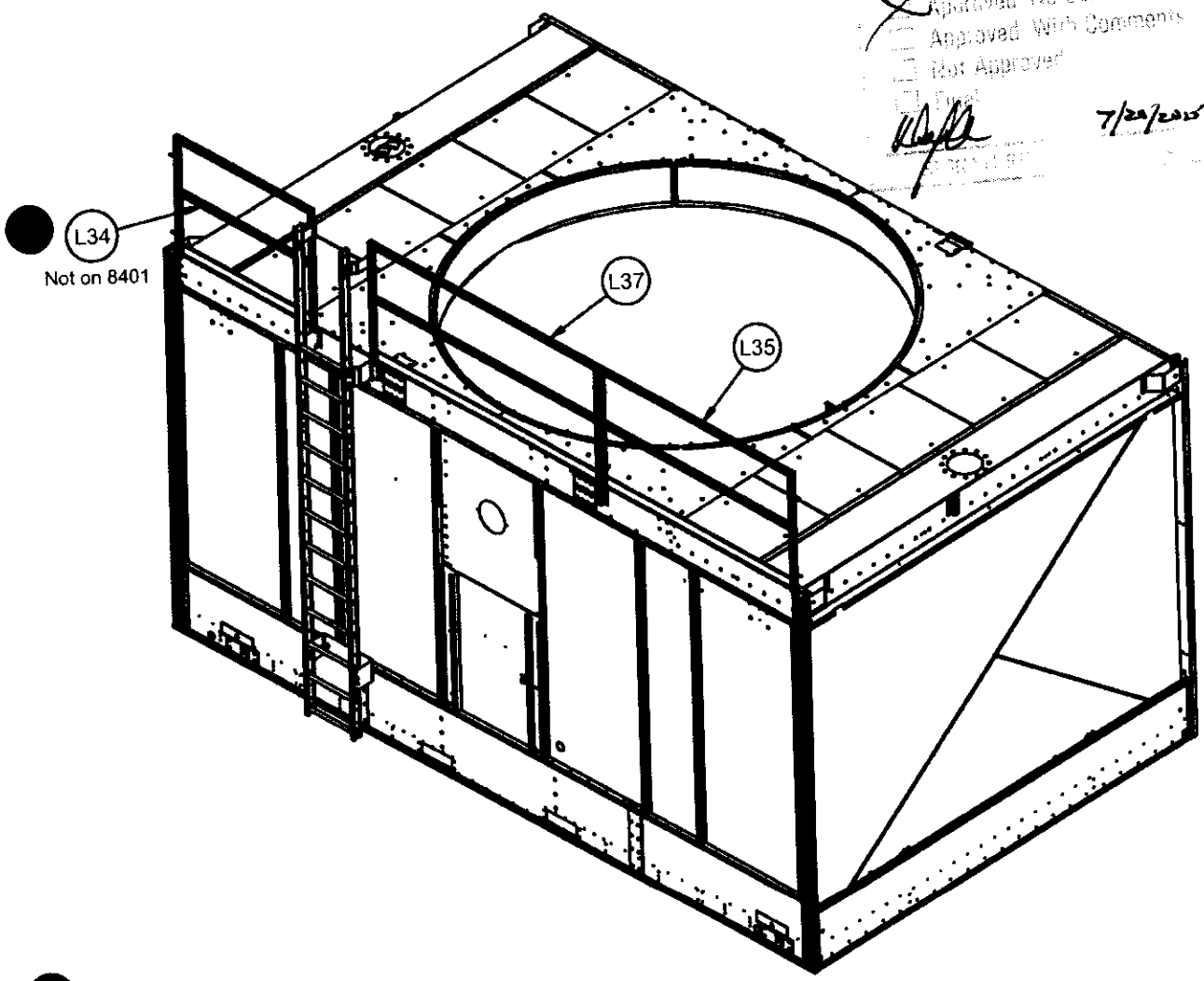
CASE FACE W/ LADDER

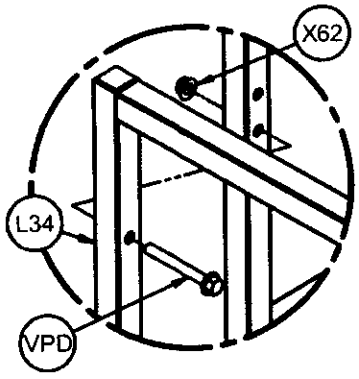
The ladder and guardrail installation required for your tower may vary depending on the optional equipment selected for the tower. The figure numbers are listed in the order that they are intended to be installed and are located on the corresponding page number.

Note: If there is a special option required for the ladder and guardrail, there will be additional drawing(s) that will replace (or be used in conjunction with) the details in this manual.

Note: On stainless steel towers, hardware that attaches directly to the tower will be stainless steel. All remaining hardware will be galzanized. Stainless steel bolts are prone to galling. Generously apply thread lubricant Z21 to threads of bolts before torquing nuts.

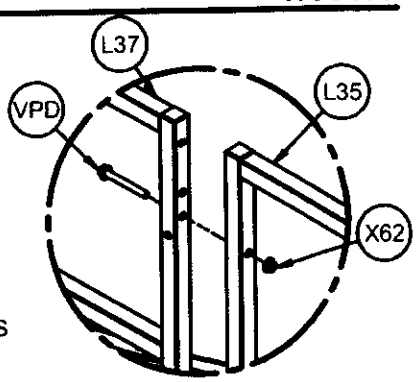
Guardrail Package	Case Face w/ Ladder





DETAIL D

Begin by installing guardrail assembly **L37** to existing post clips. Next install guardrail assembly **L35** to **L37** assembly and to existing louver face guardrail assembly. Install guardrail assembly **L34** to existing post clips and to existing louver face guardrail assembly. Install ladder braces **L38** and **L39** as shown. After completion of installation install plug **L28** into top of all vertical posts.



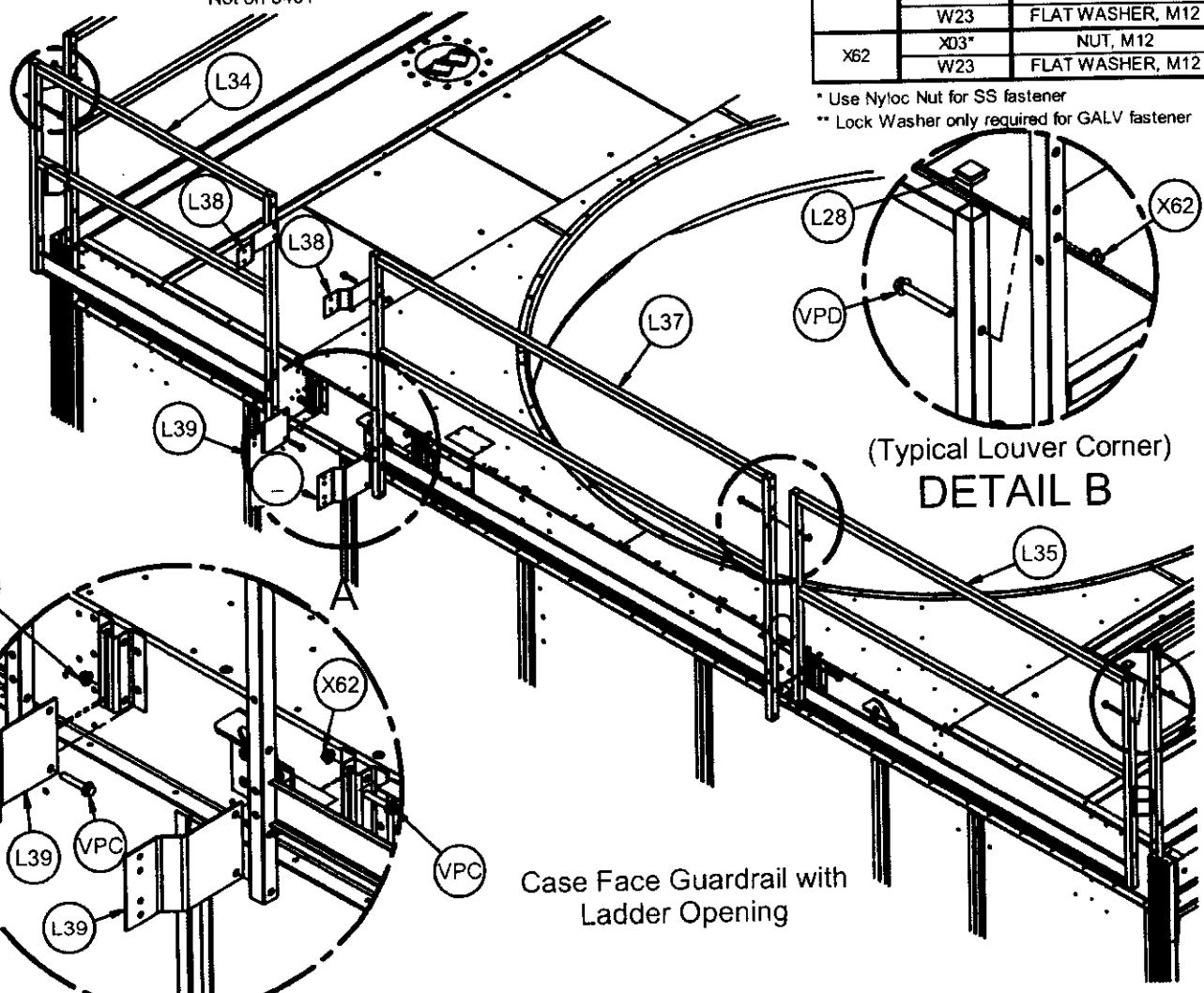
DETAIL C

FIND NO.	PARTS LIST	DESCRIPTION
VPC	V22	BOLT, M12 X 65MM
	W03**	LOCK WASHER, M12
	W23	FLAT WASHER, M12
VPD	V25	BOLT, M12 X 100MM
	W03**	LOCK WASHER, M12
	W23	FLAT WASHER, M12
X62	X03*	NUT, M12
	W23	FLAT WASHER, M12

* Use Nyloc Nut for SS fastener

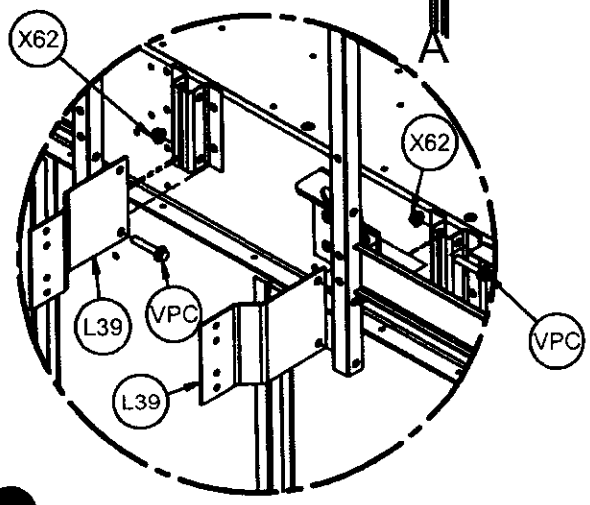
** Lock Washer only required for GALV fastener

Not on 8401



(Typical Louver Corner)

DETAIL B



DETAIL A

Case Face Guardrail with Ladder Opening

Ladder & Guardrail

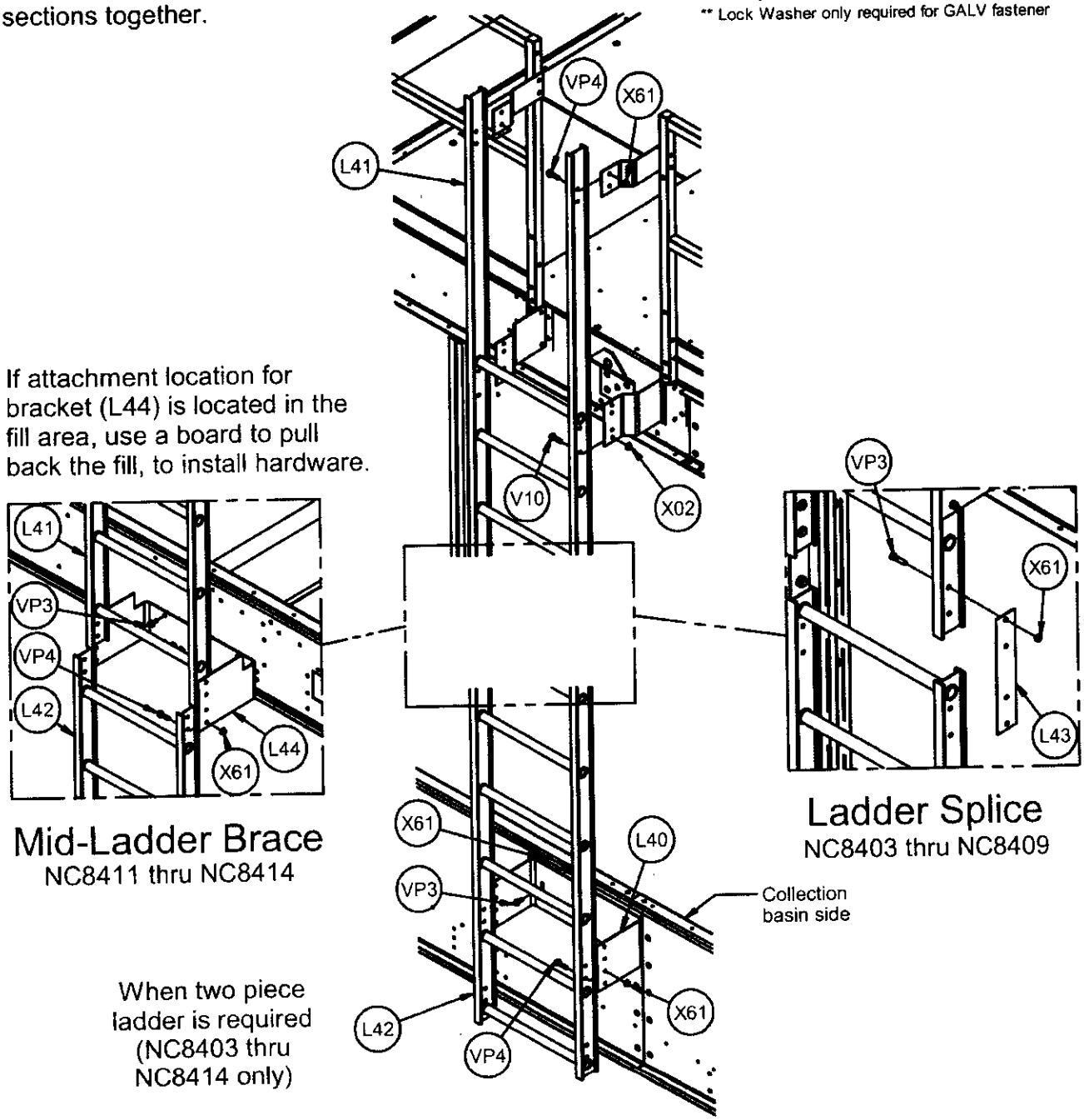
Connect lower ladder brace **L40** to collection basin side.Models NC8411 thru NC8414 require a mid-ladder brace **L44** be attached to the bottom channel of the top module. Bolt ladder section(s) **L41** (and **L42** on models NC8403 thru NC8414) to ladder braces as show. Models NC8403 thru NC8409 require a ladder splice **L43** to connect the ladder sections together.

FIND NO.	PARTS LIST	DESCRIPTION
VP3	V07	BOLT, M10 X 25MM
	W02**	LOCK WASHER, M10
	W22	FLAT WASHER, M10
VP4	V10	BOLT, M10 X 40MM
	W02**	LOCK WASHER, M10
	W22	FLAT WASHER, M10
X61	X02*	NUT, M10
	W22	FLAT WASHER, M10

* Use Nyloc Nut for SS fastener

** Lock Washer only required for GALV fastener

If attachment location for bracket (L44) is located in the fill area, use a board to pull back the fill, to install hardware.



Mid-Ladder Brace
NC8411 thru NC8414

Ladder Splice
NC8403 thru NC8409

When two piece ladder is required (NC8403 thru NC8414 only)

Cased Face Ladder

LADDER & GUARDRAIL

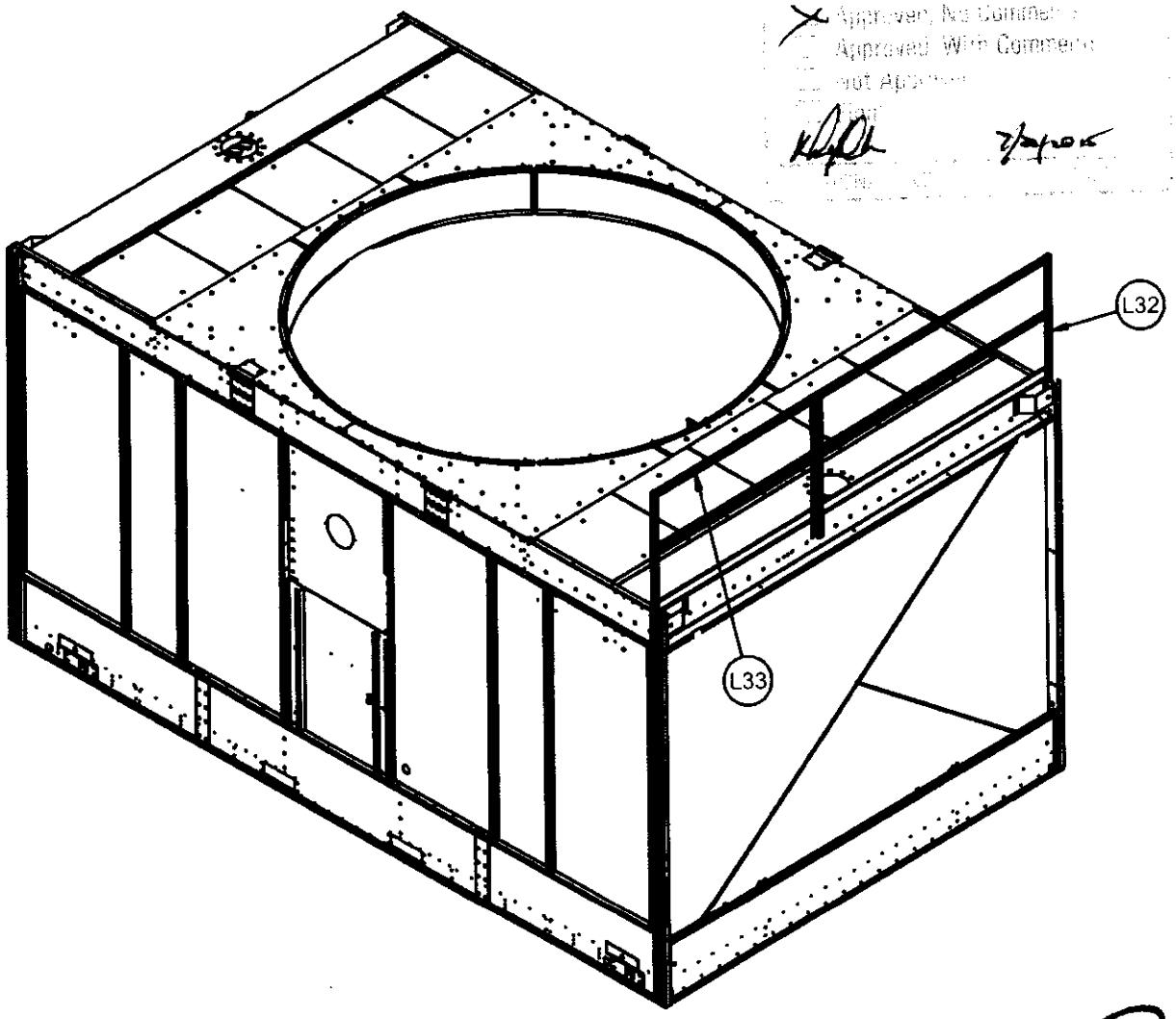
LOUVER FACE W/ NO LADDER

The ladder and guardrail installation required for your tower may vary depending on the optional equipment selected for the tower. The figure numbers are listed in the order that they are intended to be installed and are located on the corresponding page number.

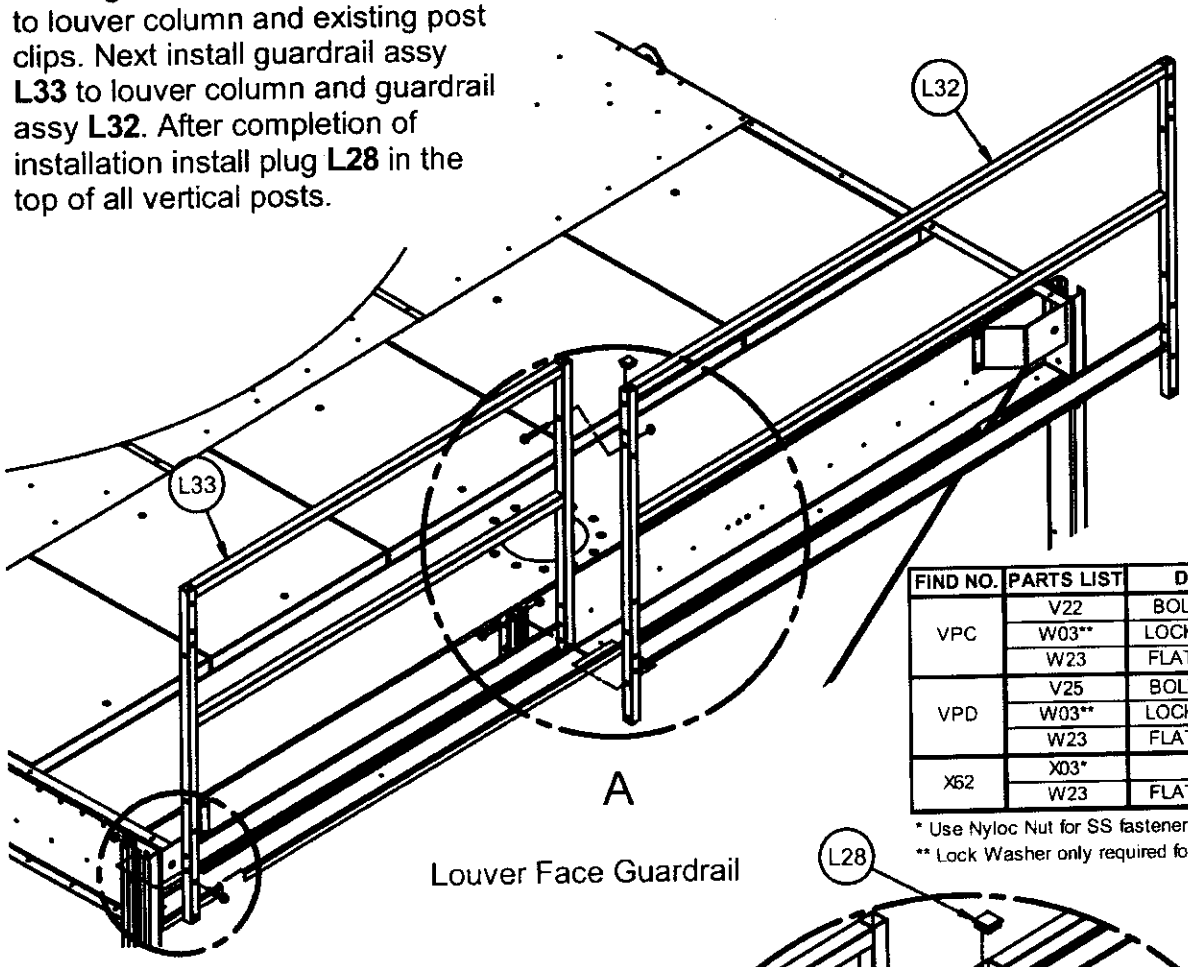
Note: If there is a special option required for the ladder and guardrail, there will be additional drawing(s) that will replace (or be used in conjunction with) the details in this manual.

Note: On stainless steel towers, hardware that attaches directly to the tower will be stainless steel. All remaining hardware will be galzanized. Stainless steel bolts are prone to galling. Generously apply thread lubricant Z21 to threads of bolts before torquing nuts.

Guardrail Package	Louver Face w/ No Ladder



Install guardrail assy **L32** to louver column and existing post clips. Next install guardrail assy **L33** to louver column and guardrail assy **L32**. After completion of installation install plug **L28** in the top of all vertical posts.

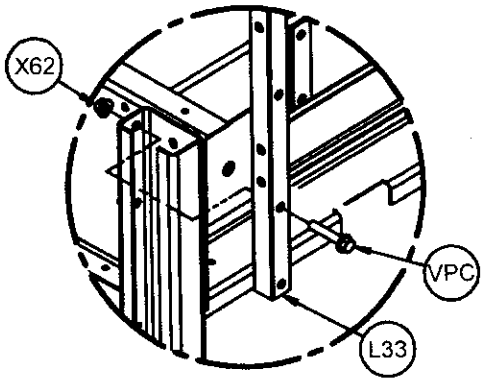


Louver Face Guardrail

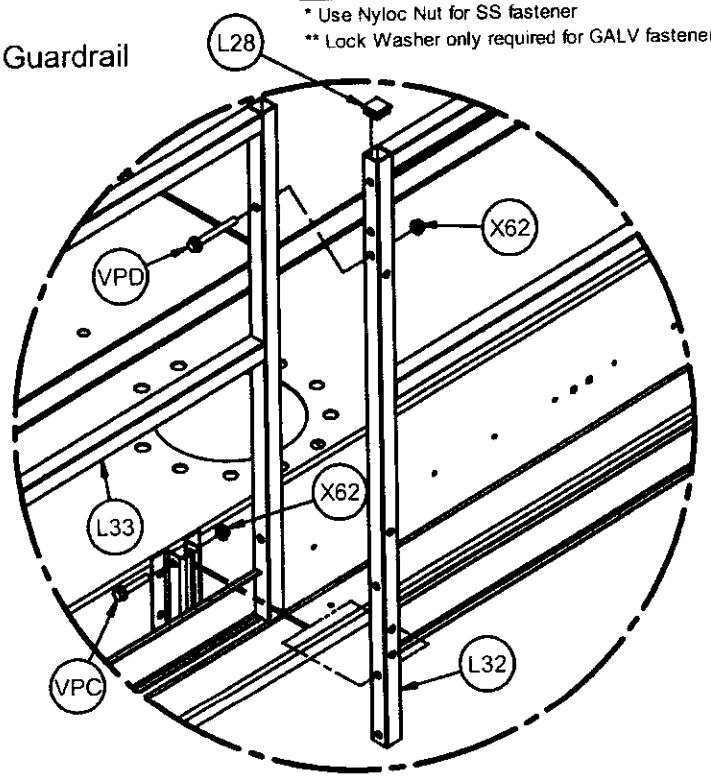
FIND NO.	PARTS LIST	DESCRIPTION
VPC	V22	BOLT, M12 X 65MM
	W03**	LOCK WASHER, M12
	W23	FLAT WASHER, M12
VPD	V25	BOLT, M12 X 100MM
	W03**	LOCK WASHER, M12
	W23	FLAT WASHER, M12
X62	X03*	NUT, M12
	W23	FLAT WASHER, M12

* Use Nyloc Nut for SS fastener
** Lock Washer only required for GALV fastener

B



DETAIL B
(Typical all 4 corners)



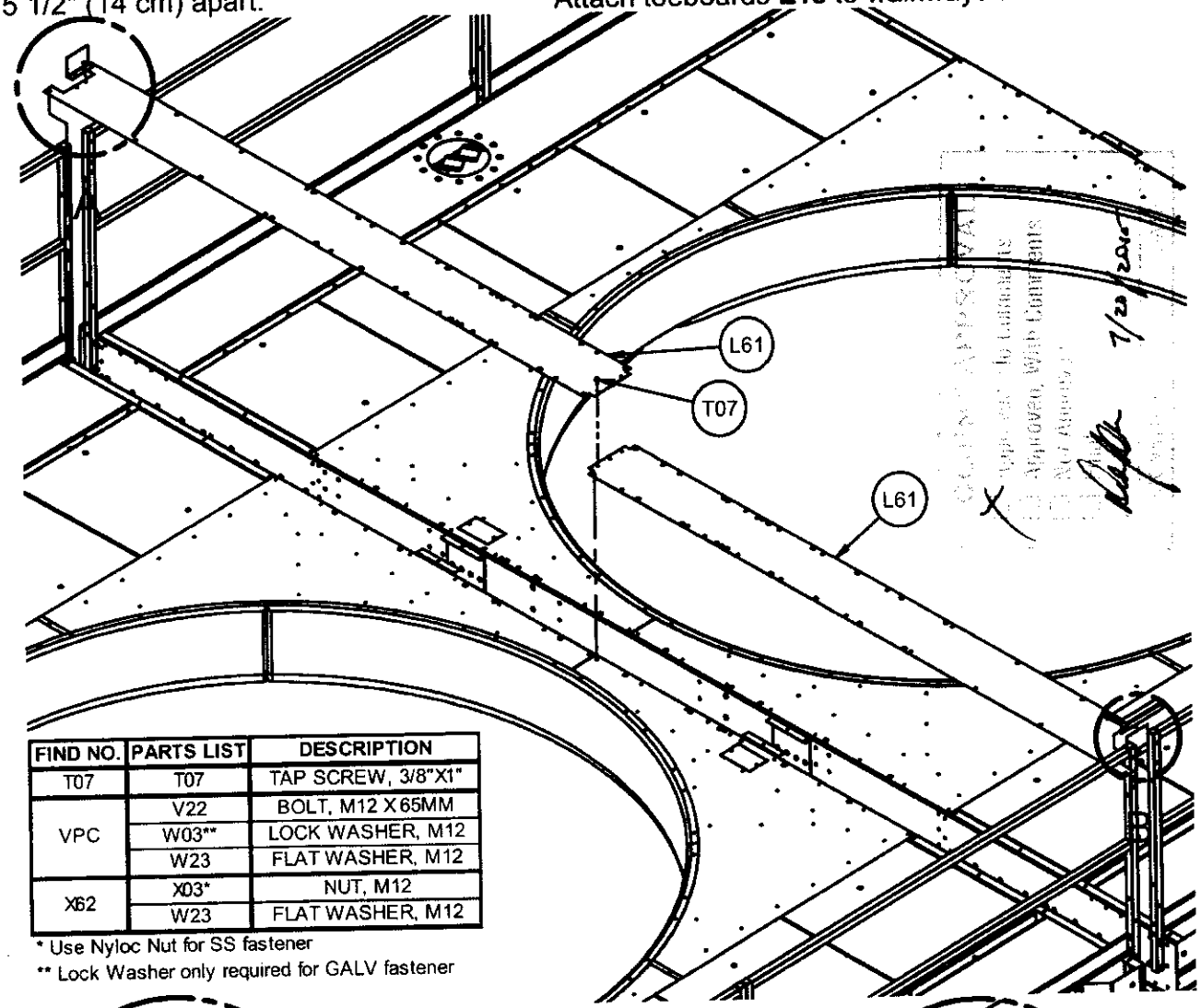
DETAIL A

FAN DECK WALKWAY

The fan deck walkway should be installed after the ladder and guardrail.

Use the figure below to install the walkway between cells when towers are 5 1/2" (14 cm) apart.

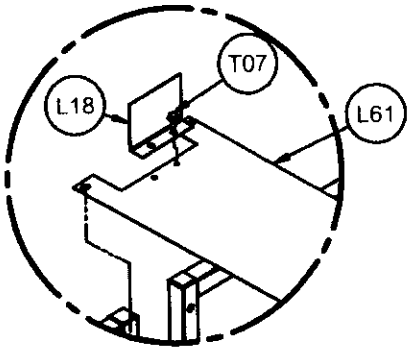
Determine where outside walkways **L61** will attach to tower and remove existing tap screws in fan deck and girt at those locations. The larger diameter holes in the walkway are clearance holes, do not remove fasteners at these locations. Set walkways in place and install. Attach toeboards **L18** to walkways as shown.



FIND NO.	PARTS LIST	DESCRIPTION
T07	T07	TAP SCREW, 3/8"X1"
VPC	V22	BOLT, M12 X 65MM
	W03**	LOCK WASHER, M12
	W23	FLAT WASHER, M12
X62	X03*	NUT, M12
	W23	FLAT WASHER, M12

* Use Nyloc Nut for SS fastener

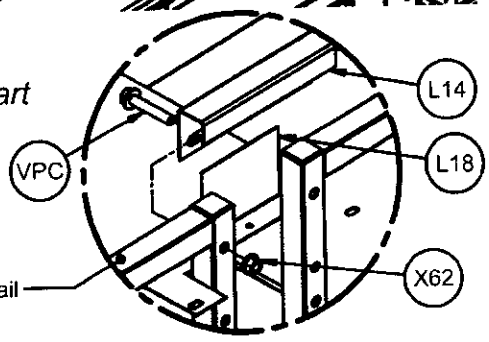
** Lock Washer only required for GALV fastener



DETAIL A

Figure 1

Towers 5 1/2" (14 cm) Apart At Tower Anchor Bolts



DETAIL B

SAFETY CAGE - *Tower without Platform*

NC8413 - NC8414

Ladder Extension Length 0 thru 2'-0"

The safety cage is intended to be installed after the ladder, handrail, and platforms (if applicable) are in place. See the details in those sections for items not shown in this section.

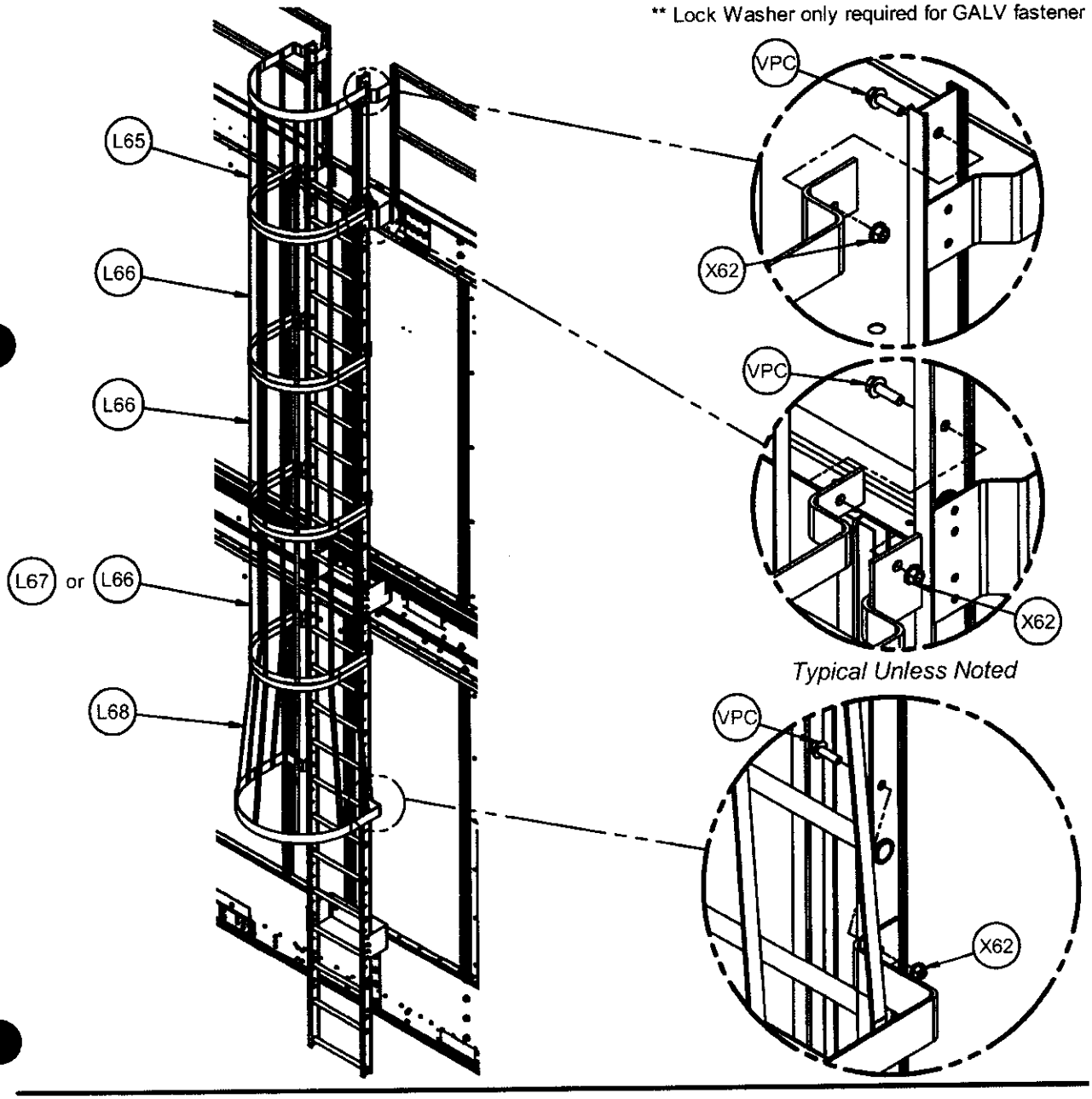
The installation required for your tower will depend upon the ladder extension length (if equiped with a ladder extension) and if an access or MOA platform (or both) are installed on the tower. ***Only safety cages at standard ladder locations are covered by this manual.***

Note: On stainless steel towers, hardware that attaches directly to the tower will be stainless steel. All remaining hardware will be galvanized. Stainless steel bolts are prone to galling. Generously apply thread lubricant Z21 to threads of bolts before torquing nuts.

FIND NO.	PARTS LIST	DESCRIPTION
VPC	V22	BOLT, M12 X 65MM
	W03**	LOCK WASHER, M12
	W23	FLAT WASHER, M12
X62	X03*	NUT, M12
	W23	FLAT WASHER, M12

* Use Nyloc Nut for SS fastener

** Lock Washer only required for GALV fastener



Typical Unless Noted

INTERIOR MECHANICAL ACCESS PLATFORM

NC8412 - NC8414 with 3000 Series Geareducer

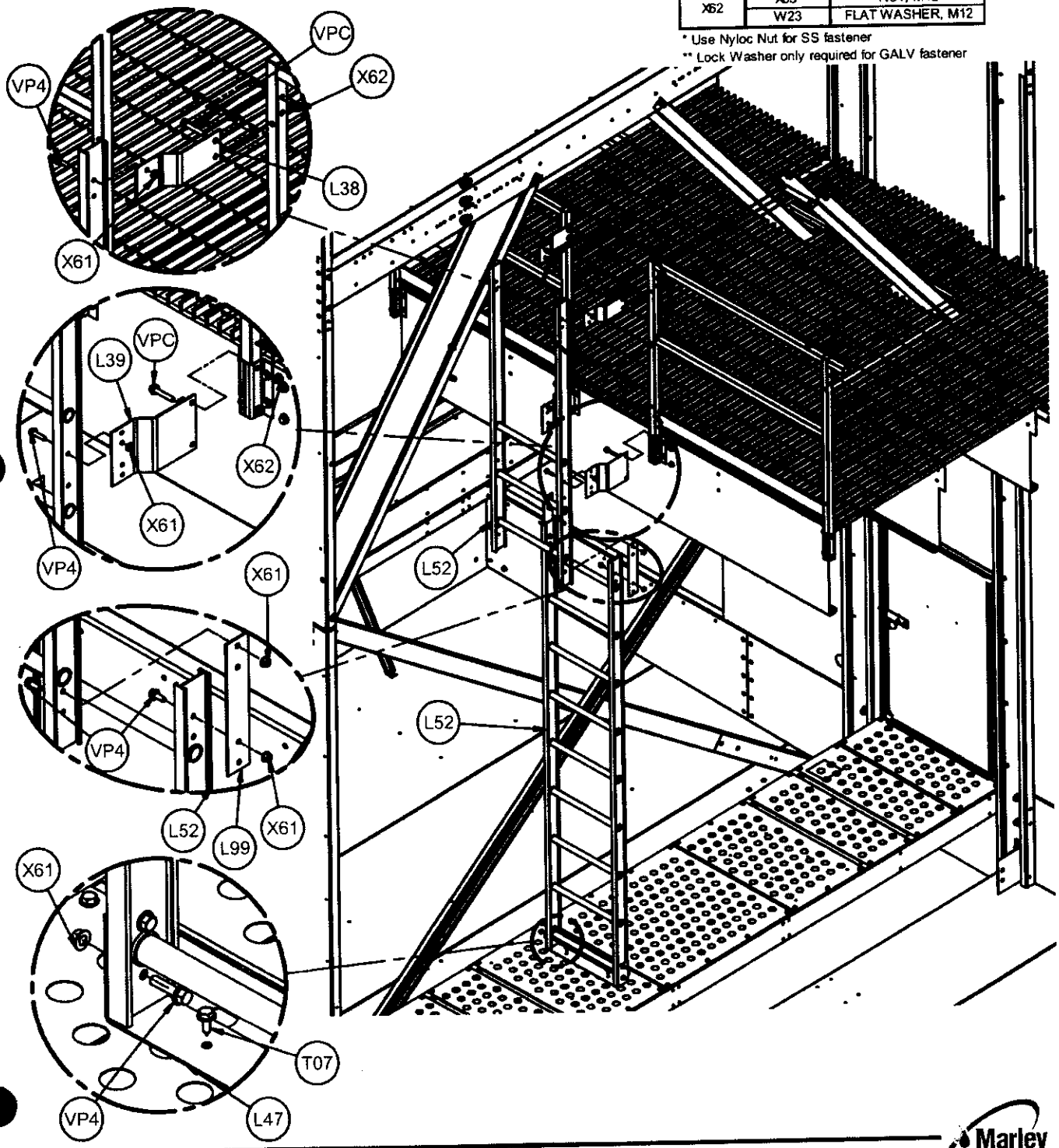
Shop Assembled Towers equipped with an Interior Mechanical Access Platform

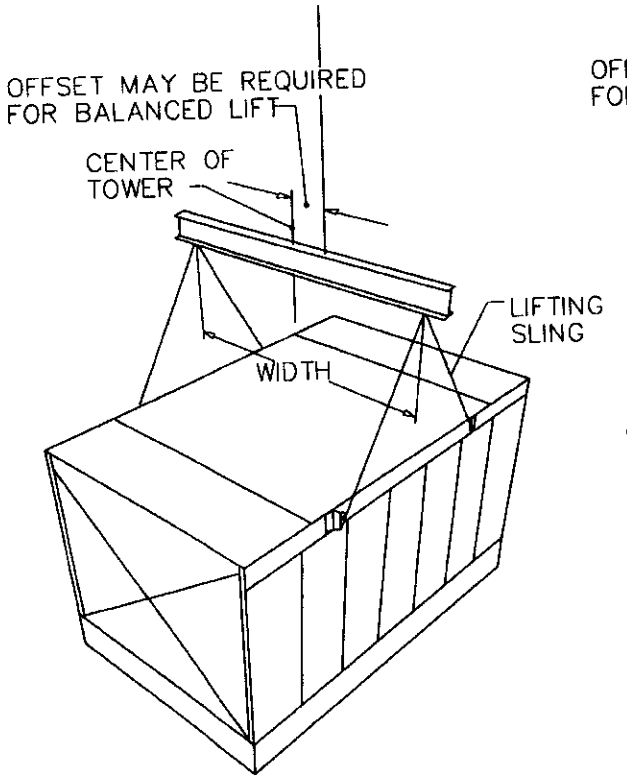
Attach ladder angles **L38** and **L39** to guardrails. Attach ladder support **L47** to plenum walkway. Instal ladder sections **L52** and join at splice with plates **L99** as shown.

FIND NO.	PARTS LIST	DESCRIPTION
T07	T07	TAP SCREW, 3/8"X1"
VP4	V10	BOLT, M10 X 40MM
	W02**	LOCK WASHER, M10
	W22	FLAT WASHER, M10
VPC	V22	BOLT, M12 X 65MM
	W03**	LOCK WASHER, M12
	W23	FLAT WASHER, M12
X61	X02*	NUT, M10
	W22	FLAT WASHER, M10
X62	X03*	NUT, M12
	W23	FLAT WASHER, M12

* Use Nyloc Nut for SS fastener

** Lock Washer only required for GALV fastener

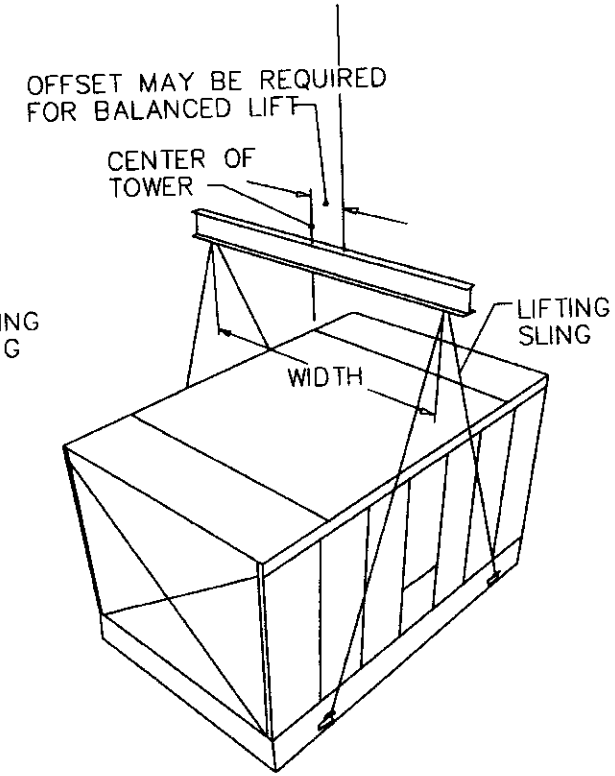




TOWER UNITS WITH
HOISTING CLIPS AT THE TOP

8401 THRU 8407

TOP MODULE OF 8411, 8412, 8413 & 8414



TOWER UNITS WITH
HOISTING CLIPS AT THE BOTTOM

8409

BOTTOM MODULE OF 8411, 8412, 8413 & 8414

TOWER MODEL	TOWER WIDTH	MINIMUM SLING LENGTH
8401	6'-7" [2007]	5'-6" [1676]
8402	8'-6" [2591]	6'-0" [1829]
8403	8'-6" [2591]	8'-0" [2438]
8405	10'-0" [3048]	8'-0" [2438]
8407	12'-0" [3658]	8'-6" [2591]
8409	14'-0" [4267]	17'-6" [5334]
8411 TOP	12'-0" [3658]	9'-0" [2743]
8411 BOTTOM	12'-0" [3658]	16'-6" [5029]
8412 TOP	14'-0" [4267]	9'-0" [2743]
8412 BOTTOM	14'-0" [4267]	16'-6" [5029]
8413 TOP	12'-0" [3658]	9'-0" [2743]
8413 BOTTOM	12'-0" [3658]	16'-6" [5029]
8414 TOP	14'-0" [4267]	9'-0" [2743]
8414 BOTTOM	14'-0" [4267]	16'-6" [5029]

ENGR'S APPROVAL

X Approved, No Comments

☐ Approved, With Comments

☐ Not Approved

☐ Email

7/20/2016

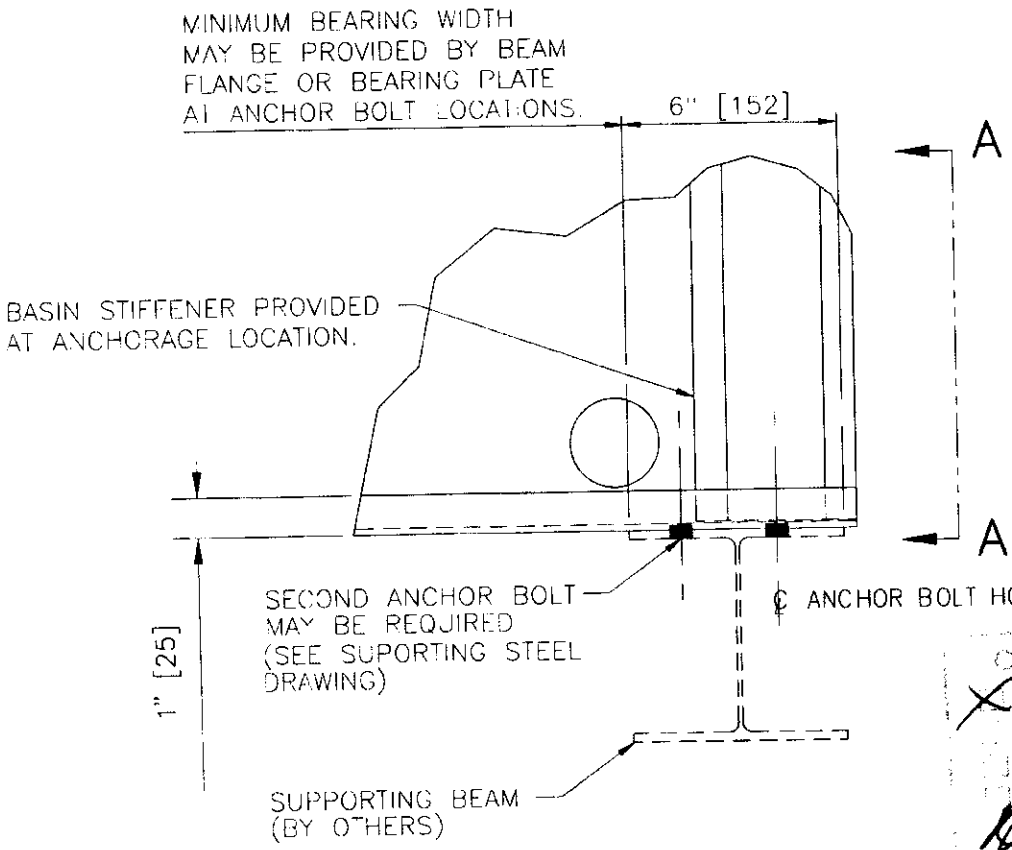
SIGNATURE DATE

NOTES:

1. ALL HOISTING CLIP HOLES ARE 1 1/4" [32].
2. OVERALL LENGTH OF SHACKLE PIN SHOULD NOT EXCEED 5 1/4" [133].
3. FOR OVERHEAD LIFTS OR WHERE ADDITIONAL SAFETY IS REQUIRED, ADD SLINGS BENEATH THE TOWER UNIT.
4. ALL DIMENSIONS SHOWN INSIDE OF BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

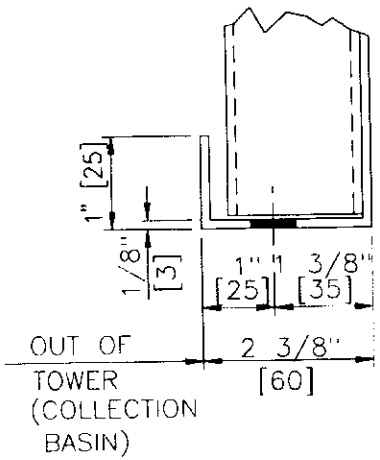
I-P [SI] Units

ECO NUMBER		HOISTING DETAILS 8401 THRU 8414 TOWERS				SPX COOLING TECHNOLOGIES			
REV. BY	CHECKED								
REV. DATE	DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.	
	B. GOODING	01/23/2009		MN		1=1	09-136		



SUPPORT BEARING DETAILS

(PARTIAL CASED FACE A OR C ELEVATION)



SECTION A–A

(LOUVER FACE B OR D)

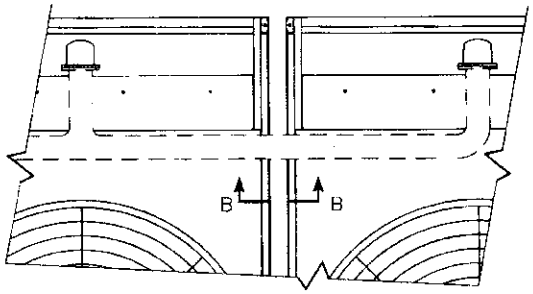
Approved, No Comments
Approved With Comments
Not Approved
7/23/2010
DATE

GENERAL NOTES

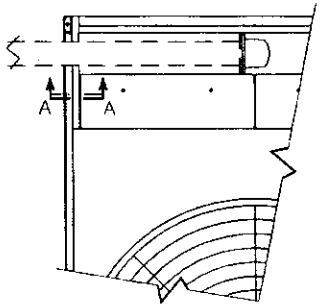
1. TOLERANCE APPLICABLE TO DIMENSIONS SHOWN ARE DEPENDENT UPON FABRICATION, ASSEMBLY AND CONSTRUCTION TOLERANCES. FABRICATION TOLERANCE IS ±1/16" [2] & ASSEMBLY TOLERANCE IS ±1/8" [3]. CONSULT SUPPLIERS OF SUPPORTING STRUCTURE FOR CONSTRUCTION TOLERANCE. ALL OF THE DIMENSIONS SHOWN ARE IN INCHES UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS SHOWN INSIDE OF BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

I-P [SI] UNITS

ECO NUMBER		SUPPORT BEARING DETAILS				SPX. COOLING TECHNOLOGIES			
QTC-CHK		8401 THRU 8414 TOWERS							
REV. BY	CHECKED								
BCG	MN								
REV. DATE	DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.	
02/04/09	B. GOODING	01/16/2009		MN		1=1	09—14	A	

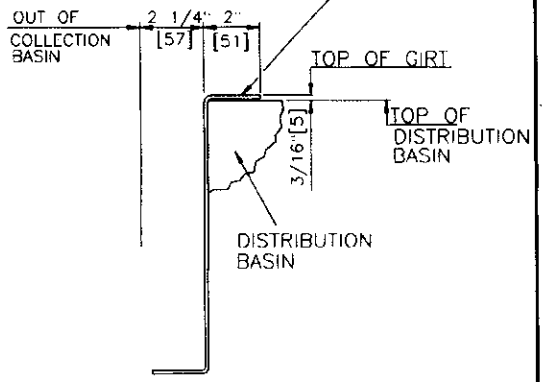


PARTIAL MULTI-CELL PLAN VIEW



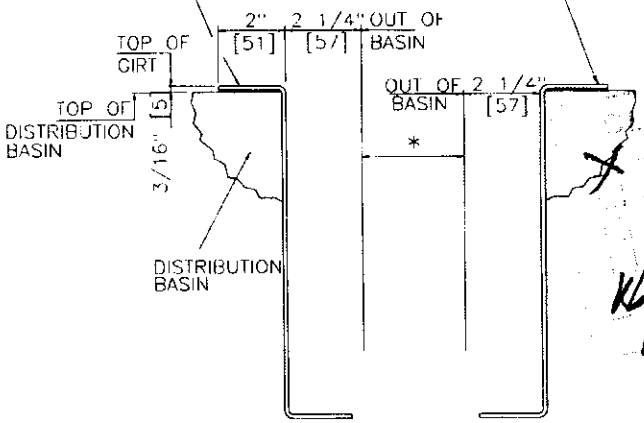
PARTIAL SINGLE CELL PLAN VIEW

MINIMUM REQUIRED BEARING AREA OF A PIPE SUPPORT IS 12 SQUARE INCHES [305 SQUARE mm], USING FULL WIDTH OF FLANGE 2" [51] WIDE X 6" [152] MIN. LENGTH. LENGTH. MAXIMUM VERTICAL LOAD IS 900 POUNDS.



SECTION A-A

MINIMUM REQUIRED BEARING AREA OF A PIPE SUPPORT IS 12 SQUARE INCHES [305 SQUARE mm], USING FULL WIDTH OF FLANGE 2" [51] WIDE X 6" [152] MIN. LENGTH MAXIMUM VERTICAL LOAD IS 900 POUNDS PER FLANGE.



SECTION B-B

*FOR DISTANCE BETWEEN CELLS SEE SUPPORTING STEEL DRAWING

7/20/2015

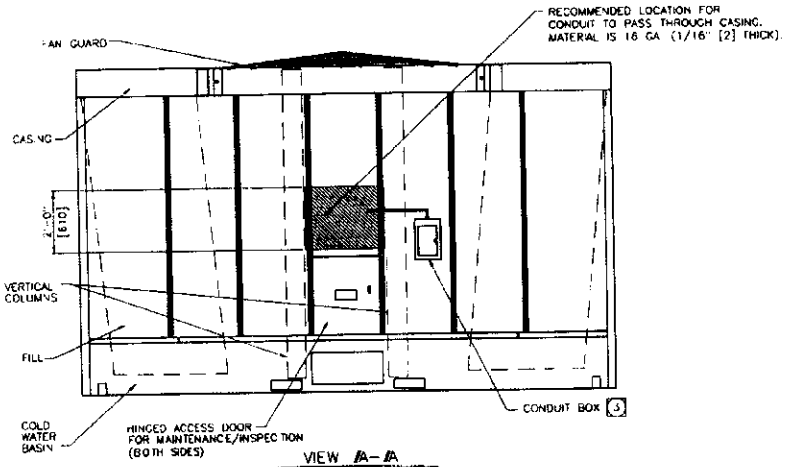
NOTES

1. ALLOW ROOM FOR ENTRY TO THE TOWER ACCESS DOORS. 4'-3" [1295] IS THE MAXIMUM CLEARANCE TO THE NEAREST OBJECT BASED ON THE WIDTH OF OUR OPTIONAL ACCESS DOOR PLATFORM. IF A RISER PIPE IS INSTALLED ON THE MOTOR SIDE OF A TOWER WITH A MOTOR OUTSIDE THE AIRSTREAM OPTION, ADEQUATE CLEARANCE FOR FUTURE MOTOR REMOVAL IS REQUIRED. REFERENCE SCHEMATIC DETAIL DRAWING FOR MOTOR PROJECTION DIMENSION.
2. THE VERTICAL WEIGHT OF PIPING WITHIN THE TOWER PERIMETER MAY BE SUPPORTED BY THE TOWER STRUCTURE. ALL OTHER PIPING SHALL BE SUPPORTED INDEPENDENT OF THE TOWER (SEE SECTION A-A OR SECTION B-B). PIPING, SUPPORTS, DESIGN OF PIPING AND SUPPORTS, AND RESTRAINT OF LATERAL PIPING LOADS SHALL BE SUPPLIED BY OTHERS.
3. ASSEMBLY TOLERANCE IS ±1/8" [3]. CONSULT SUPPLIERS OF SUPPORTING STRUCTURE FOR CONSTRUCTION TOLERANCE. ALL OF THE DIMENSIONS SHOWN ARE IN I-P (INCH-POUND) UNITS UNLESS OTHERWISE NOTED.
4. ON AN 8401-8405 MULTI-CELL USING A MANIFOLD OVER EACH HOT WATER BASIN, THE LADDER NEEDS TO BE LOCATED ON THE CASED FACE OPPOSITE THE INLET.
5. ALL DIMENSIONS SHOWN INSIDE OF BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

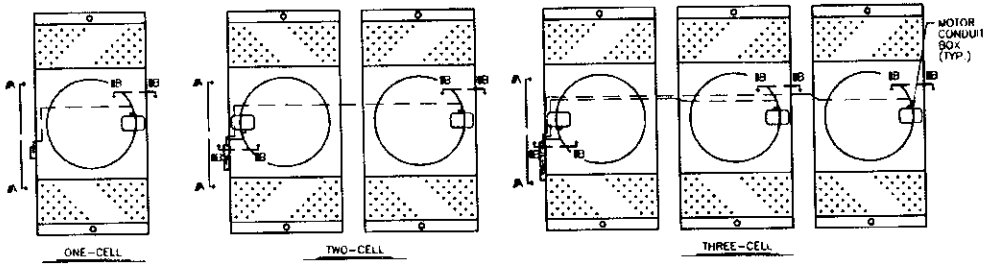
I-P [SI] UNITS

ECO NUMBER		TOP INLET PIPE SUPPORT DETAILS							
QTC-CHK									
REV. BY	CHECKED								
BCG	MN								
REV. DATE	DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.	
02/04/09	B. GOODING	01/16/2009		MN		1=1	09-15	A	

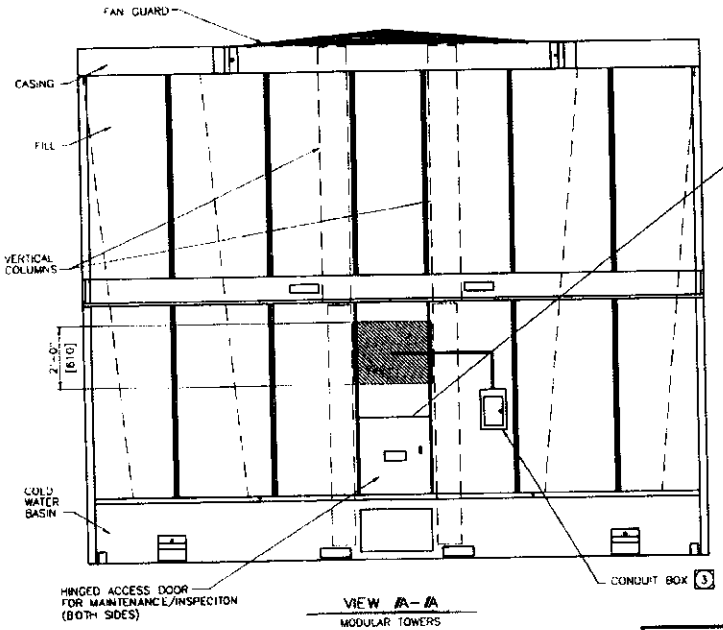
SPX. COOLING TECHNOLOGIES



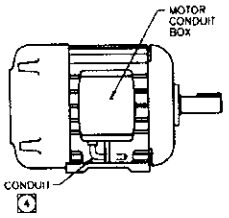
VIEW A-A
NON-MODULAR TOWERS



CONDUIT INSTALLATION KEY PLANS



VIEW A-A
MODULAR TOWERS



SECTION B-B

Approved No Comment
Approved W/o Comments
Not Approved

7/29/2015

GENERAL NOTES

1. ALL CONDUIT, CONNECTIONS, SUPPORTING CLIPS, HANGERS, AND SAFETY SWITCHES ARE SUPPLIED BY OTHERS.
2. ALL WIRING MUST CONFORM TO LOCAL AND NATIONAL CODES.
3. NON-FUSED SAFETY DISCONNECT SWITCHES ARE RECOMMENDED, THREE-POLE FOR SINGLE SPEED MOTORS, SIX-POLE FOR TWO SPEED MOTORS, WITH VOLTAGE AND HORSEPOWER RATED FOR FAN MOTOR, LOCATED IN A NEMA 3 OR 4 WEATHERPROOF ENCLOSURE. ATTACH ENCLOSURE TO EXTERIOR OF TOWER USING VERTICAL FLANGES OF CASING. CONDUIT BOX MUST BE LOCATED AT A LOWER ELEVATION THAN MOTOR.
4. CONDUIT SHOULD BE SUPPORTED APPROXIMATELY EVERY TEN FEET [3048], EXCEPT WHERE NOTED BELOW. IMPORTANT! CONDUIT MUST BE PITCHED DOWN TO ALLOW CONDENSATION TO DRAIN AWAY FROM MOTOR AND OUT OF CONDUIT. CONDUIT MUST BE WATERTIGHT CONDUIT SHOULD BE RIGID EXCEPT AS NOTED BELOW.
   A) APPROXIMATELY 2 FEET [610] OF FLEXIBLE STEEL CONDUIT (SEALTIGHT OR EQUIVALENT) SHOULD BE USED AT THE MOTOR CONDUIT BOX.
   B) A CONDUIT SUPPORT SHOULD BE LOCATED WITHIN 3 FEET [914] OF ALL CONDUIT BOXES.
   C) IF MOISTURE CANNOT DRAIN OUT OF MOTOR CONDUIT BOX, A SMALL (3/16" [5] - 1/4" [6]) DRAIN HOLE MUST BE DRILLED IN BOTTOM OF CONDUIT BOX.
5. CONDUIT MAY BE SUPPORTED ON THE SIDE OF THE INTERIOR BOX BEAMS OR SUSPENDED FROM BOTTOM OF THE BEAM. SEE KEY PLANS AND VIEW A-A FOR LOCATION AT WHICH TO RUN CONDUIT THROUGH TOWER CASING.
6. HOLE(S) CUT IN CASING FOR CONDUIT SHOULD NOT BE FLAME CUT, AND SHOULD NOT BE LARGER THAN NECESSARY TO ACCOMMODATE CONDUIT FITTINGS. SEAL HOLES WITH WATERPROOF CAULKING
7. TOWERS WITH NO LADDER AND HANDRAIL:
   A) ONE CELL TOWERS MAY HAVE DISCONNECT SWITCH LOCATED ON MOTOR FACE OF TOWER.
   B) MULTI-CELL TOWERS SHOULD HAVE DISCONNECT SWITCHES LOCATED TOGETHER. SEPARATE CONDUIT IS REQUIRED FOR EACH MOTOR. ROUTE CONDUIT THROUGH CASING AND ACROSS ADJACENT CELLS AS SHOWN ON INSTALLATION KEY PLAN.
8. TOWERS WITH LADDER AND HANDRAIL:
   DISCONNECT SWITCHES SHOULD BE LOCATED ON LADDER SIDE OF TOWER FOR EASE OF ACCESSIBILITY. SEPARATE CONDUIT IS REQUIRED FOR EACH MOTOR. ROUTE CONDUIT THROUGH CASING AND ACROSS ADJACENT CELLS AS SHOWN IN INSTALLATION KEY PLAN.
9. ALL OF THE DIMENSIONS SHOWN INSIDE BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

I-P (SI) UNITS

ECO NUMBER		RECOMMENDED CONDUIT INSTALLATION				SPX. COOLING TECHNOLOGIES			
REV. BY	CHECKED								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
		B. GOODING	02/05/2009		MN		1=1	09-167	

Project:	Juniper GTL LLC 950 Interstate 10 West Service Rd Westlake LA 70669-5542	For:	Juniper GTL LLC 950 Interstate 10 West Service Rd Westlake LA 70669-5542

Performance Conditions:

Flow Rate: 13,256.00 GPM Hot Water: 111.00F Cold Water: 88.00F Wet Bulb: 81.00F

Motor Capacity per Cell: 100.00 HP Motor Output per Cell: 100.00 HP

Fan Speed RPM: 351.00 Trial Fan Pitch Degrees: 26.00

Order No: 10100890 Model No: NC8413XAS5GGF PO No: 1015-JGTL-323-PAD-00

Sales Office Order No:

Please contact your local sales representative if you have any questions:

SPX Cooling Technologies
191 Hwy 98 West
Tylertown MS 39667
Phone:
Fax:
Email: ricky.wilson@spx.com

Your local sales representative will be happy to quote current parts price and lead time upon request. Go to http://spxcooling.com for a full list of representatives.

This package contains the following user manuals:

Manual	Rev	Description
02-128	C	OM-GRDR 2700&3000
07-1205	A	OM-CPLG MC07 MC09&MC11
09-1150	A	NC 8400 User Manual
2010-1234	A	Marley X7 Fan User Manual
2010-1241		Marley M-5 Vibration Switch User Manual
92-1184	B	WHITE RUST SERVICE MANUAL
92-1308	A	DM-MDT-C DOWNTIME MANUAL
92-1370		PL-HC VALVE 10 12 14 16 18 20
92-1475	A	SM-MOTOR-M MOTOR IOM MANUAL

SPX®
WHERE IDEAS MEET INDUSTRY

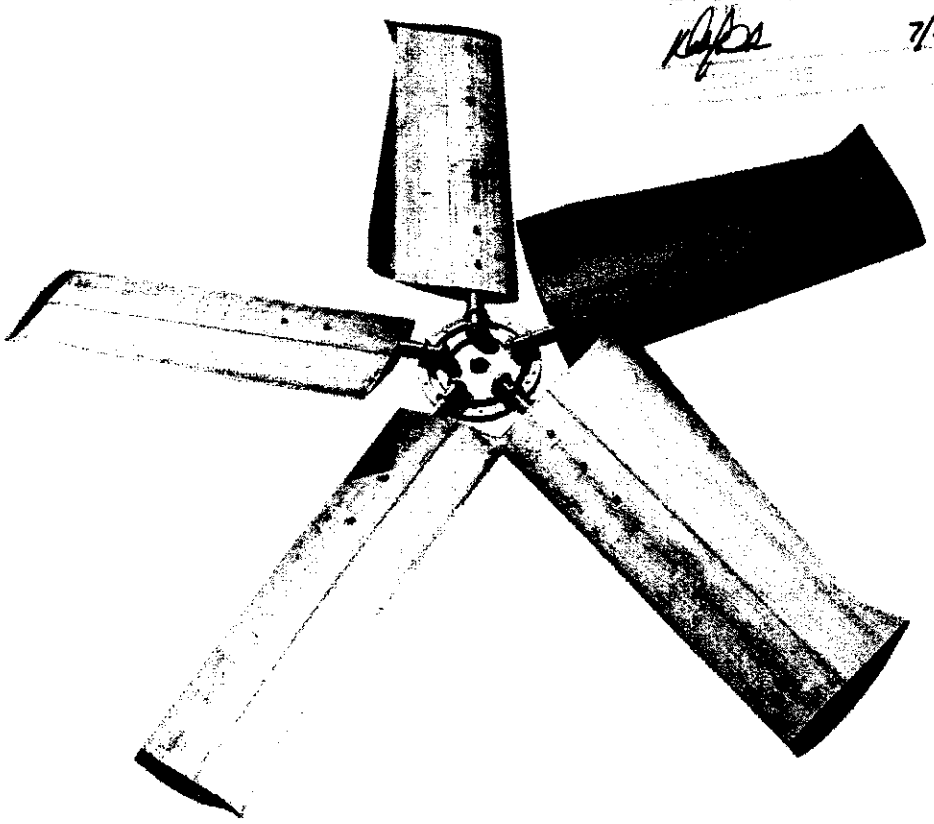
USER MANUAL

Marley X7 Fan

DESIGNED FOR INDUCED-DRAFT COOLING TOWER APPLICATIONS

M2010-1234A ISSUED 3/2012

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.



Marley®

Fan Components

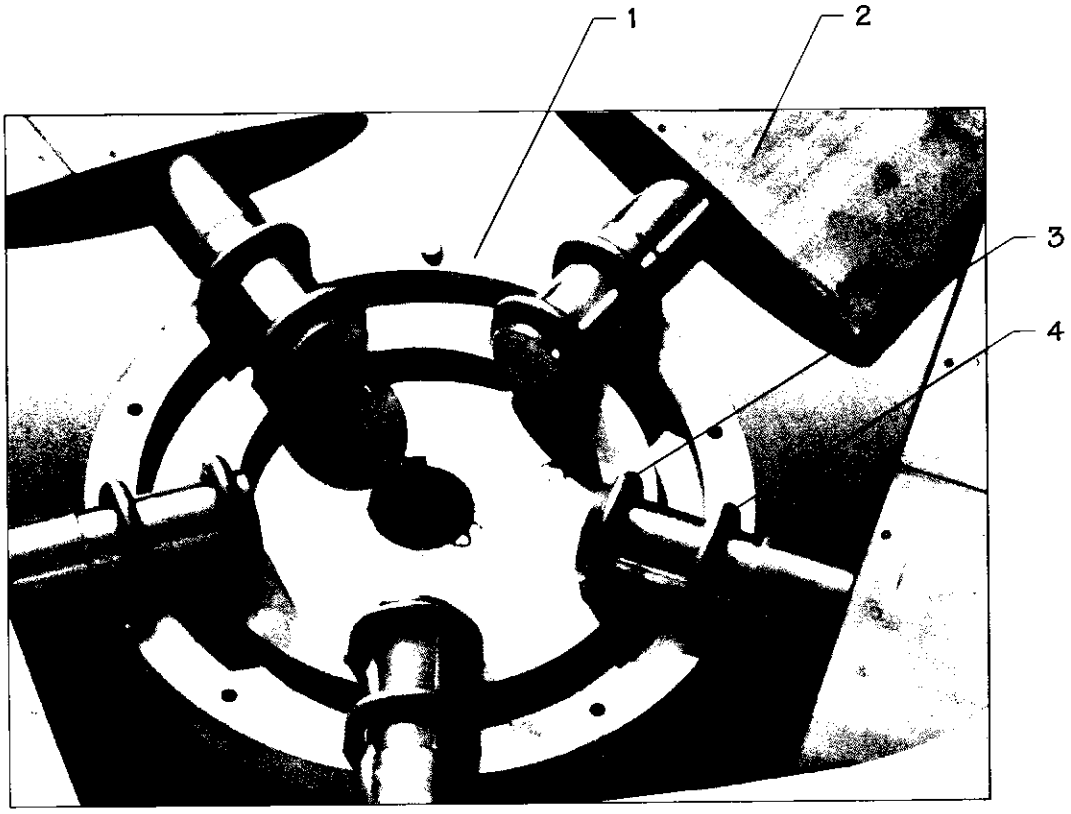


Figure 1–Typical Fan Assembly

Order No. _____

Trial Pitch Angle _____

Final Pitch Angle _____

Speed-rpm _____

Contract hp _____

Fan Assembly Instructions

Note

The following instructions apply to installations having straight bores or tapered output shafts without split taper bushings.

It is convenient to preassemble the fan prior to installation on the driving shaft.

Marley X7 fans are statically balanced as a complete assembly. If fan is shipped unassembled, blades and hubs are match-marked to insure proper re-assembly.

1–Select a large open area corresponding to the fan diameter.

2–Position the fan hub **1** in the center of the work area with the blade sockets up.

3–Place a blade **2** in a blade socket on the hub. On fans where the blades overlap at the hub be sure to have the leading edge under the trailing edge of the forward blade. Refer to **Figure 2**.

4–Ensure the blade shank safety collar is inboard of the inner hub rim. Refer to **Figure 3**.

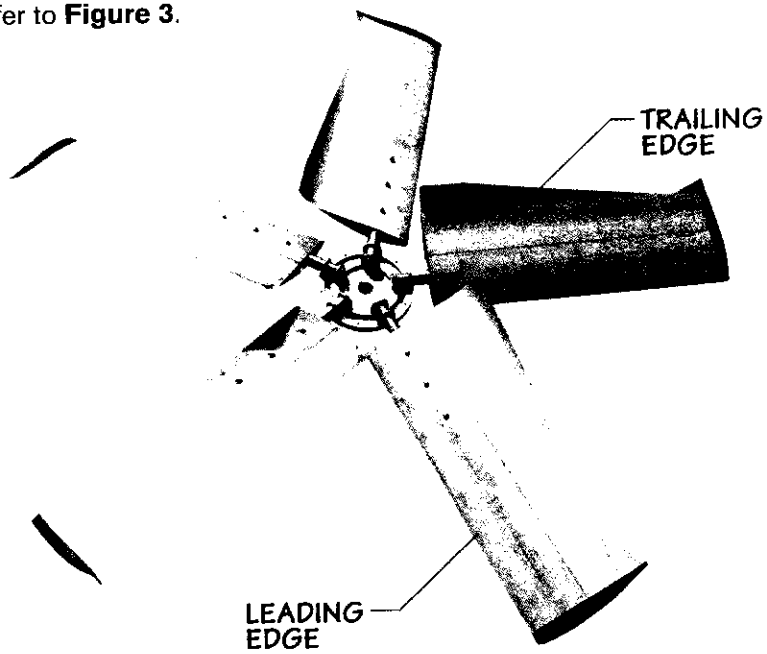


Figure 2

5–Lubricate U-bolt threads and bearing surface of self-locking nuts. Install U-bolt through inner row of holes in the hub. Finger tighten the self-locking nut with flat washer onto U-bolt threads. Progressively tighten each leg of the U-bolt until blade is held in place.

6–Pull blade radially outward to be certain the shank safety collar is in contact with hub inner ring. Refer to **Figure 3**.

7–Repeat steps 5 and 6 as required with the outer U-bolt **4**.

8–Repeat steps 3 through 7 for all blades.

9–Progressively tighten each side of the U-bolt until the blades are barely able to move when twisting the blade.

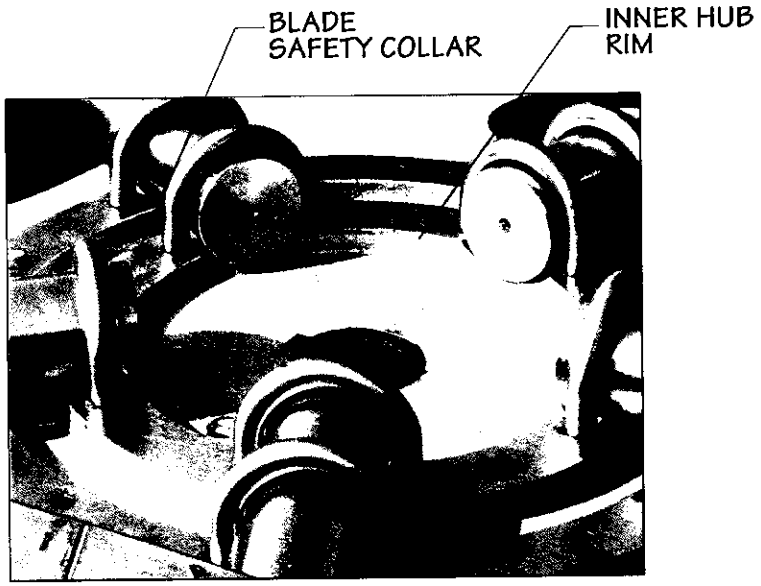


Figure 3

Fan Installation Instructions

1–Be sure motor is locked out.

2–Clean the hub bore and driving shaft extension for the full length of the key.

3–Insert the key in the keyway. The top of the key must be below the top of the shaft by not more than 1/8" (3 mm) . The key is a tight fit across the width and must never be altered.

4–After cleaning, apply a coat of anti-seize compound to the engagement portion of the shaft.

5–Raise the fan assembly above the shaft and slowly lower the hub onto the shaft with the keyways aligned. Make certain the key does not slide down during installation.

6–Install the Hub Retention Cap Screw with Lock Washer. Torque hub retention cap screw to 40 ft·lb$_f$ (54 N·m).

Adjusting Fan Blade Pitch

Note

The trial pitch is the calculated setting for design conditions *(water rate , heat load, air density, and brake horsepower).* ***The trial pitch is provided by SPX*** *(see page 2).*

1–Select a position on the fan circumference and rotate each blade to this common location when setting or checking blade pitch. Support the blade tip to maintain a common rotation plane while setting the fan pitch. The pitch is set by placing a protractor on top of a straight edge or with a digital level that extends across blade near the tip. For flare-tip blades, the pitch is measured across the end cap as shown in **Figure 4**. For full chord blades, the pitch is measured across the aluminum airfoil about 1" inboard of the end cap as shown in **Figure 5**.

2–Be sure all blades are positioned correctly on hub, then set the pitch. Blades should be within ± 1/4° of the desired pitch angle. After the desired setting is obtained, progressively tighten the U-bolt nuts according to **Table 6**. Recheck the pitch angle. If required, loosen the hex nuts and reset the pitch as necessary until the proper pitch angle is obtained.

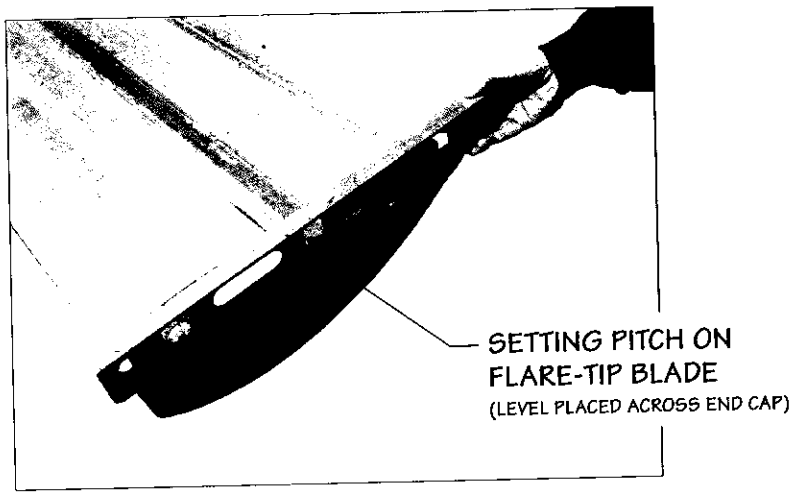


Figure 4

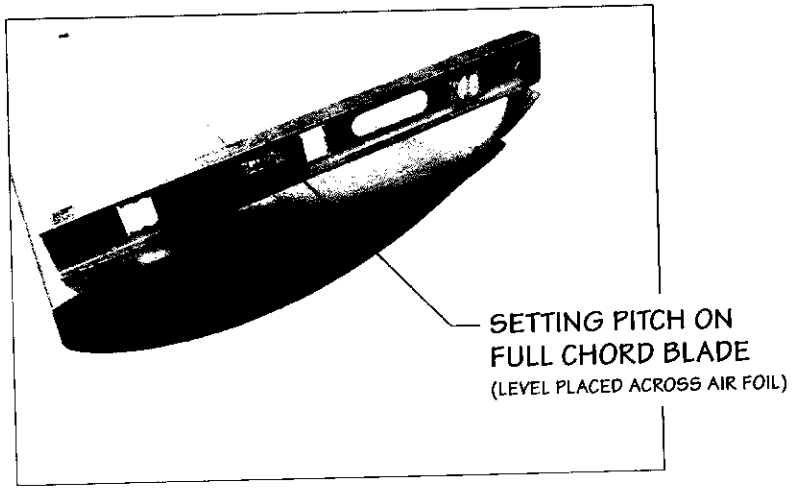


Figure 5

Table 6

Fan Model	Bolt Diameter mm	Torque Wrench Setting	
		$ft{\cdot}lb_f$	N·m
X71	12	40	54
X72	16	70	95

Fan Maintenance

Preventative maintenance will prolong useful life and assure continued trouble-free operation. After the first week and subsequently at six month intervals:

- Torque all hardware to specifications referenced in this manual.
- Visually inspect the fan for airborne debris damage, contact with fan cylinder segments, and corrosive attack. Correct any situations determined detrimental to fan operation.
- Remove any accumulated scale or dirt.
- Clear blade drain holes at fan tip.

Service

Proper identification of your fan is necessary to insure you receive correct replacement parts. The Marley cooling tower serial number can be used to determine the fan and any components installed and maintained as original equipment on a Marley cooling tower. Please provide the Marley sales representative the necessary information when ordering replacement fans or components.

Replacement of individual fan blades may require rebalancing the entire fan.

If rebalancing is desired, contact the Marley sales representative in your area.

Motor Load

The corrected horsepower should be close to but not exceed the contract horsepower specified by SPX. Determine corrected horsepower using the following equation.

Actual volts and amperage must be obtained with the fan running and the specified rate of water flowing over the tower after the motor and Geareducer have reached operating temperature (approximately 30 minutes of operation).

$$HP_C = \frac{VOLTS_A \times AMPS_A \times DENSITY_D}{VOLTS_N \times AMPS_N \times DENSITY_A} \times HP_N$$

HP_C	=	Corrected Horsepower	$VOLTS_N$	=	Nameplate Volts
$VOLTS_A$	=	Actual Volts	$AMPS_N$	=	Nameplate Amperage
$AMPS_A$	=	Actual Amperage	HP_N	=	Nameplate Horsepower
$DENSITY_A$	=	Actual Air Density	$DENSITY_D$	=	Design Air Density

Note

Measurements taken on motors operating with Variable Frequency Drive controls may read up to 15% high from errors in measuring the approximated sine wave. Instruments capable of measuring a squared off wave form accurately should be used for measuring power in this situation.

Do not start the motor more than four to five times per hour (each low speed start and each high speed start count as one start).

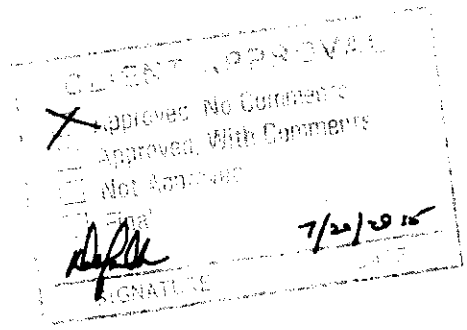
SPX®
WHERE IDEAS MEET INDUSTRY

Marley X7 Fan

DESIGNED FOR INDUCED-DRAFT COOLING TOWER APPLICATIONS

SPX COOLING TECHNOLOGIES, INC.
7401 W 129 ST
OVERLAND PARK, KANSAS USA
P: 913 664 7400
F: 913 664 7439
spxcooling@spx.com
spxcooling.com

ISSUED 3/2012 M2010-1234A



/ Marley M-5 *Vibration Switch* **/**

User Manual 2010-1241

Marley
AN SPX BRAND

Installation

This bulletin should be used by experienced personnel as a guide to the installation of the Marley M-5 vibration switch. Selection or installation of equipment should always be accompanied by competent technical assistance.

⚠ Caution

Before proceeding to install and wire the unit, read and thoroughly understand these instructions. The switch model number should be checked to confirm that you have the correct hazardous area rating for your application.

Installation

1–The sensitive axis of the vibration switch is perpendicular to the mounting base. The preferred mounting is with the sensitive axis in the horizontal plane, since most machines vibrate more in that plane. Mount the switch solidly to the frame of the machine. In most cases the switch or mounting bracket will come preinstalled.

2–Remove the cover and wire the switch(es) into the alarm or shutdown circuit. Do not exceed switch contact ratings listed in the specifications. Keep field wiring away from the moving part of the mechanism.

3–Observe all local electrical codes.

4–All the power must be switched off before opening of the enclosure in an explosive atmosphere.

5–The Vibration Switch must be electrically connected by means of a flameproof cable gland or stopping box certified to EN 50018.

6–For ambient temperatures below +14°F and above +140°F use field wiring suitable for both minimum and maximum ambient temperature.

7–Reinstall the cover by first insuring the sealing gasket is in place and properly seated in the grove in the housing. Place the cover on the unit and install the four cover bolts. Torque the four bolts to 16 ft-lb. Caution should be used to not over-torque the bolts as this could damage the housing and compromise the seal.

8–The temporary conduit entry plugs are placed in the housing to provide physical protection for the threads during shipping. Once the unit is installed in the field these plugs must be replaced. These temporary plugs do not provide adequate environmental protection for the switch when installed in the field.

Installation

Vibration Switch Testing

⚠ Warning

The vibration switch is a safety circuit acting as a run permissive for the VFD or starter controlling the fan motor. Follow lockout / tagout procedures on the fan starting equipment.

⚠ Caution

A special tool is required to adjust the setpoint—do not attempt to adjust. Adjusting the setpoint will VOID the warranty. The setpoint is factory set at 1g which is more than sufficient to allow the mechanical equipment to get up to speed without tripping the motor. The default trip setting should allow for a full voltage start and operation at all speeds.

Note

During installation and testing, if a problem with either the sensitizing or desensitizing setting is suspected or you think the unit is defective, do not attempt to adjust the setpoint. Call 800-462-7539 or 281-940-1802 Field Service or 713-702-8805 Technical Assistance after hours for troubleshooting.

To test the operation of the electrical contacts in the vibration switch please follow one of the provided procedures below. The first test procedure is the recommended procedure to use without having to remove the switch cover.

Test 1 – Do not adjust the setpoint. Loosen the four mounting bolts on the vibration switch support–do not remove. Either lightly tap or shake the vibration switch thus triggering the unit indicating the unit is active. Retighten the mounting bolts and reset the unit.

Test 2 – Do not adjust setpoint. Remove the cover to expose the inside of the switch. Using a screwdriver, toggle the trip plate to force the electrical contacts open and closed. The trip plate is bright metal and measures 1¾" x 1" and is located towards the bottom of the switch. With the adjusting pin located to the left, the normally closed contact will be closed when the right hand side of the trip plate is depressed. Check continuity at the terminal points COMMON and NORM CLOSED or at the fan controller to confirm contacts are operational. A typical control circuit uses a closed contact to allow the fan to run. An open contact means excessive vibration has occurred shutting off the starter or VFD.

Installation

Note

As stated previously, adjusting the setpoint will void the warranty on this switch. If by either accident or intentionally, the setpoint is tampered with, the following instructions are provided indicating how to properly readjust the setpoint. If the proper setpoint cannot be achieved through these steps, then call for technical assistance. In order to adjust the setpoint, a special tool is required and may be furnished upon request from SPX Cooling Technologies.

Turning Setpoint Adjustment Too Far Counter-Clockwise

- If the setpoint adjustment is turned too far counter-clockwise (approximately 3-4 turns) the switch will trip and will not stay in a reset position after depressing the manual reset push-button.
- At approximately 11 turns the switch will trip and cannot be reset because the spring and adjusting rod have dislodged out of position. There is no mechanical stop position when turning counter clockwise. Repair of the internal mechanism can be accomplished in the field by removing the internal switch mechanism from the switch body. The switch mechanism is held in with three screws. Once removed the adjusting rod and spring may be put back into operating position.

Turning Setpoint Adjustment Too Far Clockwise

- The adjusting rod has a nylon stop bushing preventing the rod from being over turned. Once the adjustment bottoms out, the switch is at or beyond the maximum setting and may not trip on vibration.

Getting The Adjustment Position Back To Normal

- Once an adjustment is out of range and the rod and spring have not been dislodged the switch may be adjusted back to normal settings. With the switch cover removed rotate the adjusting rod clockwise until it bottoms out. Push the right hand side of the trip plate down to reset the switch. At this point the NORM CLOSED CONTACT is closed. Rotate the adjusting rod approximately two turns counter-clockwise slowly or until the trip bar moves up with a click. Then rotate the adjusting rod clockwise one full turn. If the cooling product fan start or run position trips the switch then rotate the adjusting rod clockwise in ⅛ increments until the trip holds in.

Installation

Electrical Reset and Startup Lockout

The optional electrical reset circuit consists of an electrical solenoid in series with a thermistor. If the rated voltage is continuously applied to the reset circuit at startup, the reset solenoid energizes for a fixed time interval (approximately 30 seconds), after which time the solenoid is automatically de-energized by the thermistor. This action provides a trip lockout during machine startup roughness. The voltage must be removed from the reset circuit when the fan motor is stopped to allow the thermistor to cool off. The switch mechanism can then be reset electrically by a momentary application of the reset voltage or it can be reset manually.

Note

If the fan motor is restarted immediately after a shutdown, the lockout period will be shortened because the thermistor will be hot. An increase in the ambient temperature will also shorten the lockout period.

Specifications

Function–Armature mechanism trips on high vibration and operates snap action switch(es).

Frequency Range–0 to 3600 RPM.

Reset–Local reset, plus optional remote reset electrical coil. See How to Order ("D").

Start Delay–Applying reset coil voltage at start up holds mechanism from tripping for 20-30 seconds, after which the switch is active. Requires electric reset option.

Temperature Range– -40°F to 160°F

Enclosure–High strength copper-free (4/10 of 1% max) aluminum alloy.

Environmental Rating–NEMA 4, IP 65 & CE Mark (NEMA 4X Optional).

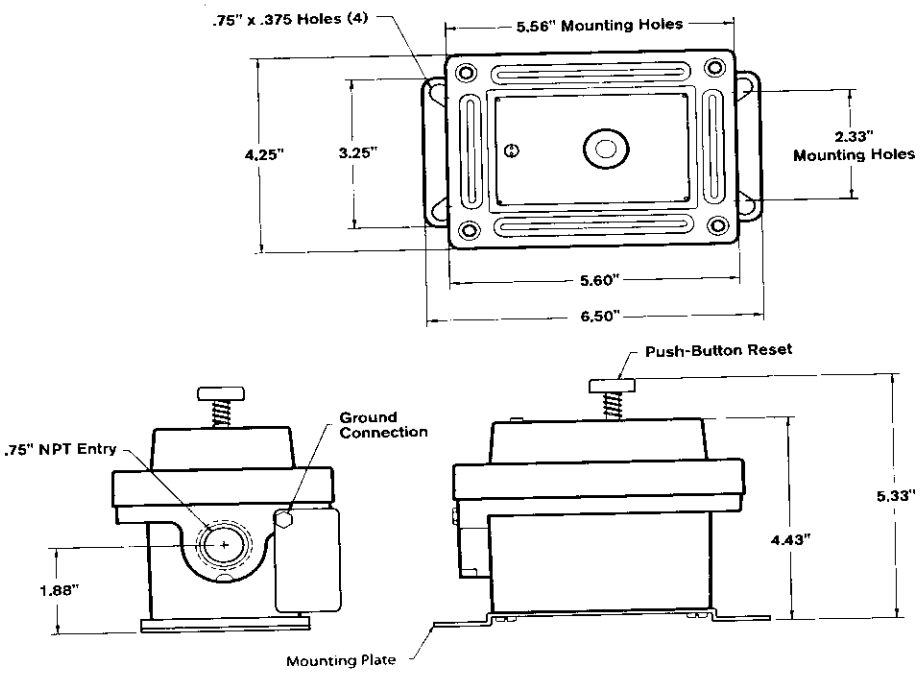
Switch Contact(s) Rating–15 amps, 125, or 480 VAC; ⅛ hp, 125 VAC; ¼ hp, 250 VAC; ½ amp, 125 VDC; ¼ amp, 250 VDC.

Hazard Rating–See How to Order ("A").

Weight–4.0 lb

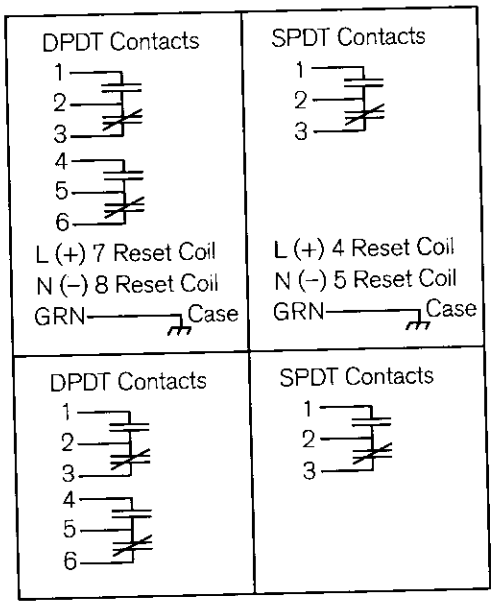
Information

Schematic



Wiring

Dependent on switch configuration



Information

How To Order

For new or replacement vibration switches call 1-800-4Marley

M-5 A B C - D E F

Example: **M-5 111-010**

A **Hazard Rating**

0 = None

1 = UL, cUL Explosion Proof, Class I, Div 1, Groups C and D
Class II, Div 1, Groups E, F and G

2 = UL, cUL Explosion Proof, Class I, Div 1, Groups B, C and D
Class II, Div 1, Groups E, F and G

B **Contacts**

1 = SPDT 2 = DPDT

C **Full Scale Range**

1 = 5g 2 = 2g 3 = 10g

D **Reset Coil and Startup Delay**

0 = None 1 = 115VAC 2 = 230VAC 3 = 24VDC 4 = 115VDC

E **Wiring Entry/Mounting Plate** (retro fit)

1 = ¾" NPT 6 = M20 x 1.5

F **Environmental Rating**

0 (or blank) = NEMA 4, IP65 1 = NEMA 4X, IP65

Tested for compliance with the applicable EC Electromagnetic Compatibility requirements

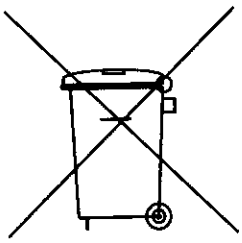
CE

note When Option **C** = 2, Option **D** cannot = 3 for operation in the horizontal axis.
When Option **A** = 1 or **A** = 2, Option **E** cannot = 6

Information

Environmental

Note

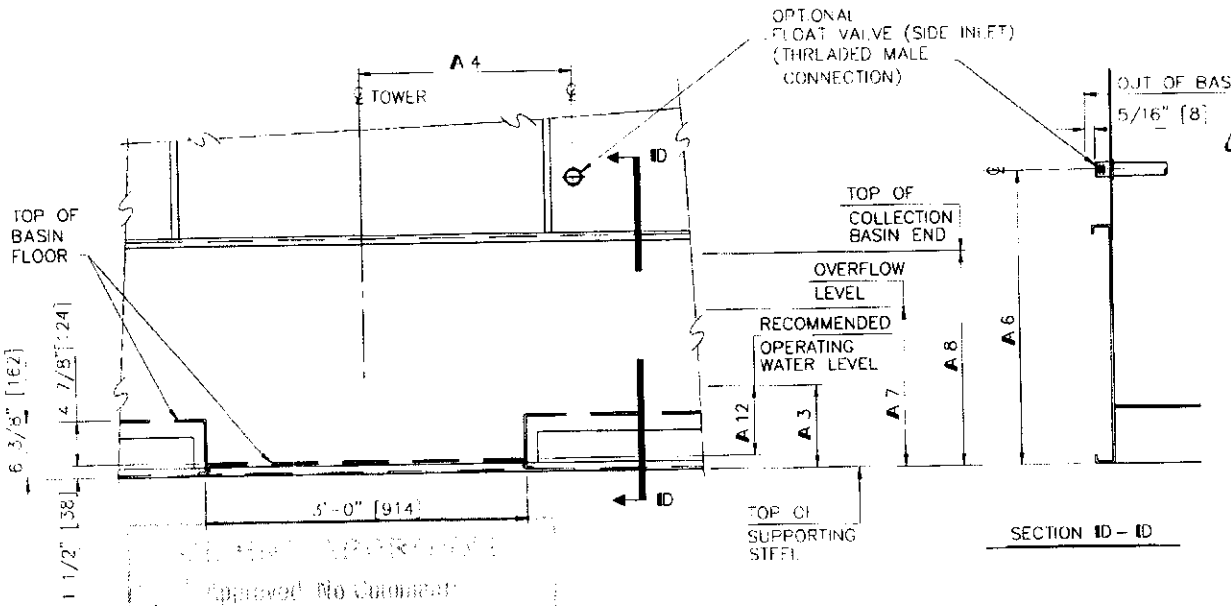


This electronic equipment was manufactured according to high quality standards to ensure safe and reliable operation when used as intended. Due to its nature, this equipment may contain small quantities of substances known to be hazardous to the environment or to human health if released into the environment. For this reason, Waste Electrical and Electronic Equipment (commonly known as WEEE) should never be disposed of in the public waste stream. The "Crossed-Out Waste Bin" label affixed to this product is a reminder to dispose of this product in accordance with local WEEE regulations. If you have questions about the disposal process, please contact SPX Cooling Technologies customer service.

SPX

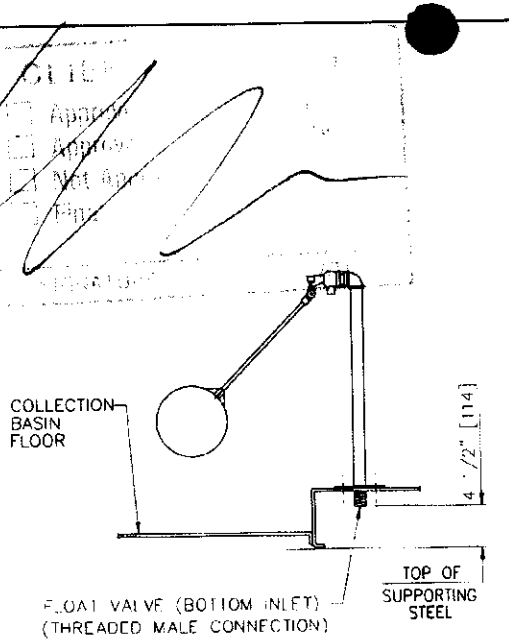
COOLING TECHNOLOGIES

SPXCOOLING.COM



EXTERIOR CELL ELEVATION

(FACES "A" OR "C")



OPTIONAL FLOAT VALVE

(BOTTOM INLET)

SEE "OUTLET PIPING PLAN" DRAWING FOR FLOAT VALVE LOCATION, SIZE & TYPE

TOWER MODEL	DIMENSIONS A3	A4	A6 1" DIAMETER	A6 2" DIAMETER	A7	A8	A12
8401	8 1/2" [216]	1'-6 3/16" [462]	2'-3 11/16" [703]	2'-4 5/16" [716]	1'-3" [381]	1'-8" [508]	7" [178]
8402	8 1/2" [216]	1'-10 1/2" [572]	2'-3 11/16" [703]	2'-4 5/16" [716]	1'-3" [381]	1'-8" [508]	7" [178]
8403	8 1/2" [216]	2'-4 3/8" [721]	2'-6 7/8" [784]	2'-7 3/8" [797]	* 1'-5 1/4" [438]	1'-10 1/4" [565]	7" [178]
8405	8 1/2" [216]	1'-11 7/8" [606]	2'-6 7/8" [784]	2'-7 3/8" [797]	* 1'-5 1/4" [438]	1'-10 1/4" [565]	7" [178]
8407	9 1/2" [241]	2'-2 3/8" [670]	2'-6 7/8" [784]	2'-7 3/8" [797]	* 1'-5 1/4" [438]	1'-10 1/4" [565]	8" [203]
8409	9 1/2" [241]	2'-2 3/8" [670]	2'-6 7/8" [784]	2'-7 3/8" [797]	* 1'-5 1/4" [438]	1'-10 1/4" [565]	6" [203]
8411	9 1/2" [241]	2'-5 3/4" [755]	2'-9 15/16" [862]	2'-10 7/16" [875]	1'-9 1/4" [540]	2'-2 1/4" [667]	8" [203]
8412	9 1/2" [241]	2'-5 3/4" [755]	2'-9 15/16" [862]	2'-10 7/16" [875]	1'-9 1/4" [540]	2'-2 1/4" [667]	8" [203]
8413	9 1/2" [241]	2'-5 3/4" [755]	2'-9 15/16" [862]	2'-10 7/16" [875]	1'-11 1/4" [591]	2'-2 1/4" [667]	8" [203]
8414	9 1/2" [241]	2'-5 3/4" [755]	2'-9 15/16" [862]	2'-10 7/16" [875]	1'-11 1/4" [591]	2'-2 1/4" [667]	8" [203]

* 1'-6 1/2" [470] ON TOWERS WITH 12" OR 14" DIA. SIDE SUCTION OUTLET

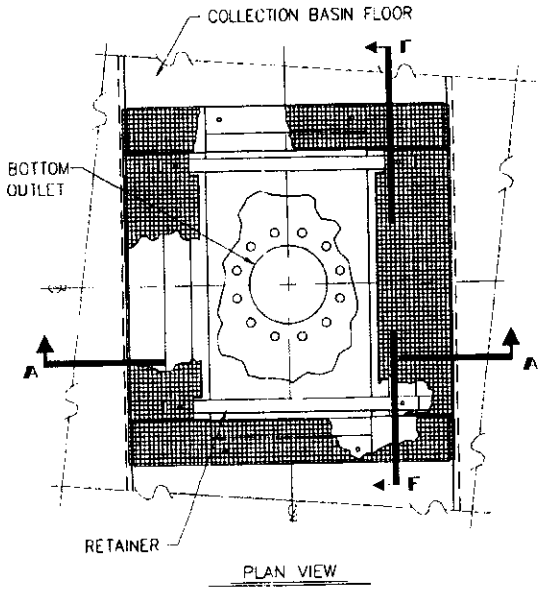
GENERAL NOTES

1. FOR FLOAT VALVE INLET DIAMETER SIZING INFORMATION, SEE DWG 98-22969 [98-22970].
2. TOLERANCE APPLICABLE TO DIMENSIONS SHOWN ARE DEPENDENT UPON FABRICATION, ASSEMBLY AND CONSTRUCTION TOLERANCES. FABRICATION TOLERANCE IS +1/16" [2] AND ASSEMBLY TOLERANCE IS +1/8" [3]. CONSULT SUPPLIERS OF SUPPORTING STRUCTURE FOR CONSTRUCTION TOLERANCE. ALL OF THE DIMENSIONS SHOWN ARE IN INCHES UNLESS OTHERWISE NOTED.
3. ON THE 8401, IF A SUMP OR BOTTOM OUTLET OPTION IS SUPPLIED WITH AN ANTI-VORTEX PLATE, A FLOAT VALVE MAY NOT BE IN THE SAME CELL.
4. ALL DIMENSIONS SHOWN INSIDE OF BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
5. REFER TO SUPPORTING STEEL DRAWING FOR DESIGN OPERATING LOADS.
6. THE RECOMMENDED WATER LEVEL IS FOR CELLS WITH OUTLETS. THE OPERATING WATER LEVEL IN ADJACENT CELLS MAY BE GREATER DEPENDING ON THE GPM, NUMBER OF OUTLES AND FLUME ARRANGEMENT

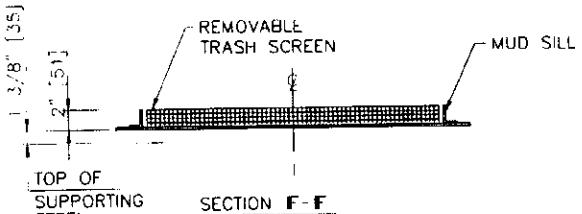
-P [S.] UNITS

ECO NUMBER		COLLECTION BASIN WATER LEVEL DETAILS						
REV BY	CHECKED	8401 THRU 8414 TOWERS						
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV
		M. Nation	12/20/2011	MM	MM		1=1	2011-1417	

SPX. COOLING TECHNOLOGIES

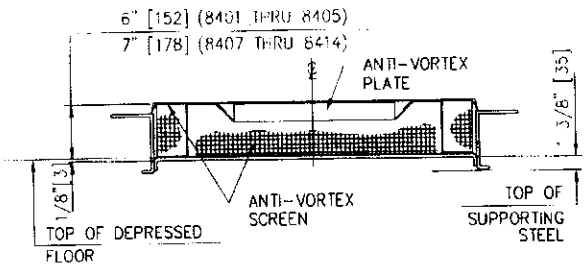


PLAN VIEW



SECTION **F-F**

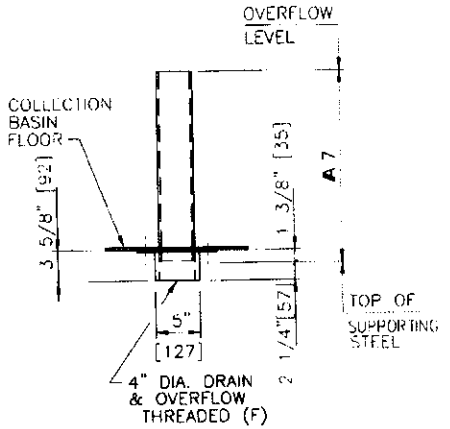
(MUD SILL & SCREEN)
(FOR OUTLETS WITHOUT ANTI-VORTEX PLATE)



SECTION **A-A**

(ANTI-VORTEX PLATE & SCREEN)

TOWER MODEL	DIMENSIONS A7
8401	1'-3" [381]
8402	1'-3" [381]
8403	1'-5 1/4" [438]
8405	1'-5 1/4" [438]
8407	1'-5 1/4" [438]
8409	1'-5 1/4" [438]
8411	1'-9 1/4" [540]
8412	1'-9 1/4" [540]
8413	1' 11 1/4" [591]
8414	1'-11 1/4" [591]



BOTTOM OUTLET WITH ANTI-VORTEX PLATE AND SCREEN

BOTTOM OUTLET WITH MUD SILL AND SCREEN

BOTTOM OUTLET WITHOUT SCREEN

BOTTOM OUTLET EQUALIZER

NOTE: ANTI-VORTEX PLATE AND SCREEN ARE NOT PROVIDED FOR BOTTOM OUTLET EQUALIZER.

SEE "OUTLET PIPING PLAN" DRAWING FOR OUTLET DIAMETER

STANDARD STANDPIPE DRAIN & OVERFLOW

(TYPICAL ALL CELLS)

GENERAL NOTES

1. ALL ACCESSORIES SHOWN ARE PROVIDED WITH THE COOLING TOWER.
2. ALL PIPING SUPPORTS ARE BY OTHERS. DO NOT SUPPORT PIPING FROM TOWER.
3. FLANGE DRILLING SHOWN CONFORMS TO CLASS 125 ANSI B16.1. BOLT HOLES WILL STRADDLE CENTERLINE OF AN OUTLET. THE OUTLET PIPING ATTACHMENT REQUIRES USE OF A FLAT FACED FLANGE, FASTENERS AND SEAL WASHERS(SUPPLIED BY OTHERS) AND A FULL FACED GASKET (PROVIDED WITH THE COOLING TOWER).
4. TOLERANCE APPLICABLE TO DIMENSIONS SHOWN ARE DEPENDENT UPON FABRICATION, ASSEMBLY AND CONSTRUCTION TOLERANCES. FABRICATION TOLERANCE IS ±1/16" [2] AND ASSEMBLY TOLERANCE IS ±1/8" [3]. CONSULT SUPPLIERS OF SUPPORTING STRUCTURE FOR CONSTRUCTION TOLERANCE. ALL OF THE DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
5. ALL DIMENSIONS SHOWN INSIDE OF BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

I-P [SI] UNITS

Approved With Comments
Not Approved
7/20/2012

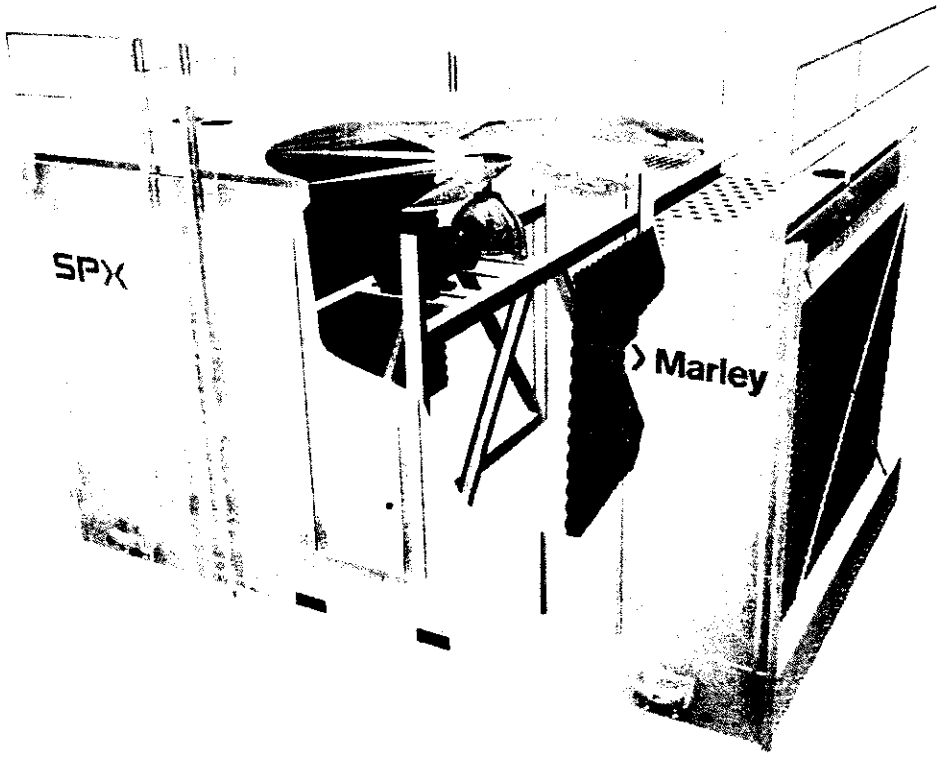
ECO NUMBER		STANDARD BOTTOM OUTLET PIPING DETAILS 8401 THRU 8414 TOWERS				SPX COOLING TECHNOLOGIES			
REV BY	CHECKED								
REV DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV
		M. Nation	12/20/2011	MM	MM		1=1	2011-1419	

SPX

READ BEFORE STARTING

quick start guide

AN INTRODUCTORY TUTORIAL FOR NAVIGATING YOUR MARLEY INSTALLATION MANUAL



X

7/20/2015

Marley®


SPX
Marley

This guide is to be used in preparing your cooling tower for operation.

Your Marley Installation Manual contains drawings that pertain to each individual option that will be installed in the field.

FIRST, MAKE SURE YOU LOCATE THE FOLLOWING ITEMS:

1. **The four tabs separating each section of the manual**
   - Orientation Drawings
   - Bills of Materials
   - Install Manuals and Drawings
   - User Manuals

2. **CD on the inside cover of this binder***
   - This CD contains full digital copies of the Installation Manual.

3. **Blue Plastic tub(s) containing hardware and fastener kits**
   - These tub(s) are located in the wooden crate delivered with the towers.

4. **Ladder, fan cylinder or other optional pieces**
   - Each of these optional pieces will vary according to your specific order. You can find your complete list of options on the opening pages directly behind this quick start guide.

* May only appear when manual binder is shipped with your tower.

WHAT SHOULD I DO NEXT?

1. Locate the unique **serial number** inscribed on the metal plate on the outside of the access door. See Figure 1. **(NC-XXXXXXXX-A1)**

2. Match that **serial number** to the **Master Bill of Materials** (BOM) that will be used to construct the tower.

   The **Master Bill of Materials** is designated as "Page 1" within the **"Bills of Materials"** tab. See Figure 2.

Figure 1

FIELD **SPX Cooling Technologies**
Literature Package Field BOM

Requested By BC_BATCH_NA
11/23/2011 11:17:04
Page 1

Order No. 10047627 Matl No. 2251658 Description MODEL NC8402PLN1BMF
Serial Number NC-10047627-A1
Sub-Matl No.
Description MODEL NC8402PLN1BMF TOWER A, CELL 1 COOLING Lit Pac Indicator F

Find #	Item Number	Qty Per	Total Qty	UM	Description	Drawing / Rev
F E	2019445	1	1	EA	FAN GUARD-GALV-PAC NC8402&3	09-1252 B SEE TWR MANUAL
F F	2019449	1	1	EA	KIT FSTN FIELD INSTALL NC8401-3-SCB S3	FSTN KIT

Figure 2

*You can also locate the **Master Bill of Materials** by the description near the top of the page. The description will list the NC tower itself rather than a field option. See example above.*

3. Each item on the **Master Bill of Materials** has its own **Individual Bill of Materials**. These are located directly behind the **Master Bill of Materials**. They will be numbered in successive pages (Page 2, Page 3... with the Master Bill of Materials being Page 1).

   Check that the **Bill of Materials** for each item has the same serial number listed as on the **Master Bill of Materials**. See Figure 3.

FIELD **SPX Cooling Technologies**
Literature Package Field BOM

Order No. 10047627 Matl No. 2251658 Description MODEL N
Serial Number NC-10047627-A1
Sub-Matl No. 2019445 Drawing 09-
Description FAN GUARD-GALV-PAC NC8402&3

Find #	Item Number	Qty Per	Total Qty	UM	Description
F F D32	044081X	1	1	EA	ASSEMBLY HDG

Figure 3

MATCHING UP THE DRAWINGS

4. Each individual item listed on the **Master Bill of Materials** has a reference to a **drawing number.** For example, figure 4 pinpoints the galvanized fan guard along with its **drawing number, 09-1252.**

5. Use the **drawing number** referenced as in Figure 4 to find the corresponding **drawing** in the **"Install Manuals and Drawings"** tab of the binder.

6. As you can see, Figure 5 shows how to locate the correct **drawing** by locating the **drawing reference number** at the bottom of the page.

7. The **drawing** will provide installation instructions for each individual option piece that has come with your tower.

TOWER A, CELL 1 COOLING — Lit Pac Indicator F

Qty	UM	Description	Drawing / Rev
	EA	FAN GUARD-GALV-PAC NC8402GG	▶09-1252 B
			SEE TWR MANUAL
	EA	KIT FSTN FIELD INSTALL NC8401-3-SCB S3	FSTN KIT
	EA	SUMP S300 08DIA FOR SHIPMENT	09-1259 B
			SEE TWR MANUAL

Figure 4

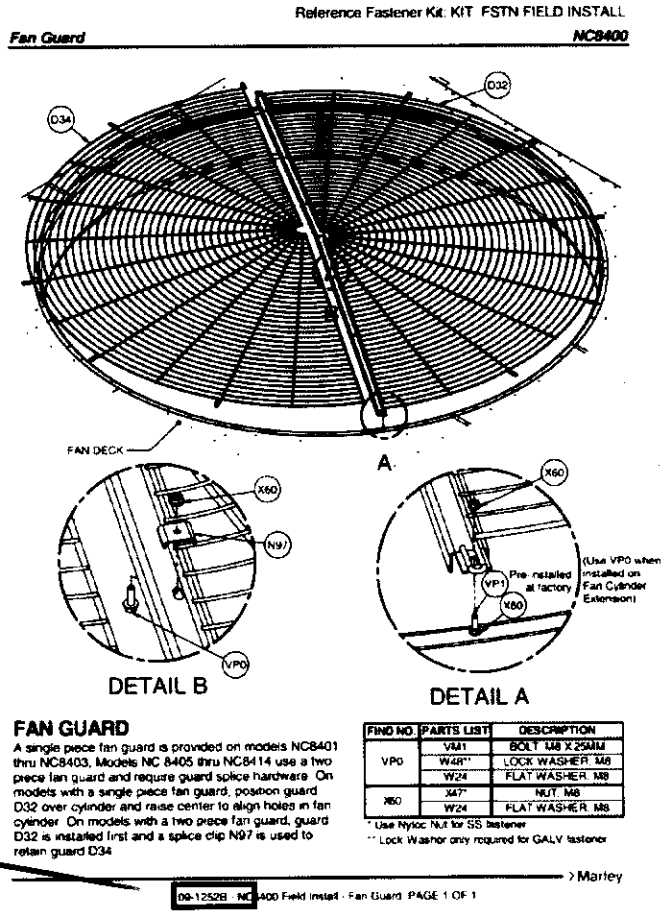
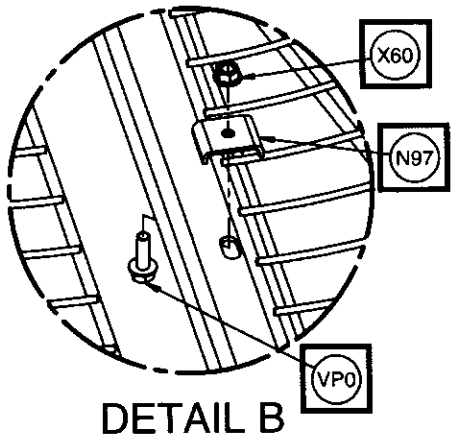


Figure 5

MATCHING UP THE DRAWINGS

8. Notice that on the **drawing** (Figure 6), each install item and accompanying piece of hardware has an individual **find number**. These numbers are generally three characters long and begin with a letter. Refer to the closeup shown below.



9. Figure 7 shows the **find number, X60**. You can see that **X60** is pointing to the flanged nut. This means that to complete this particular installation, you will need to retrieve a nut from the bag labeled **X60.**

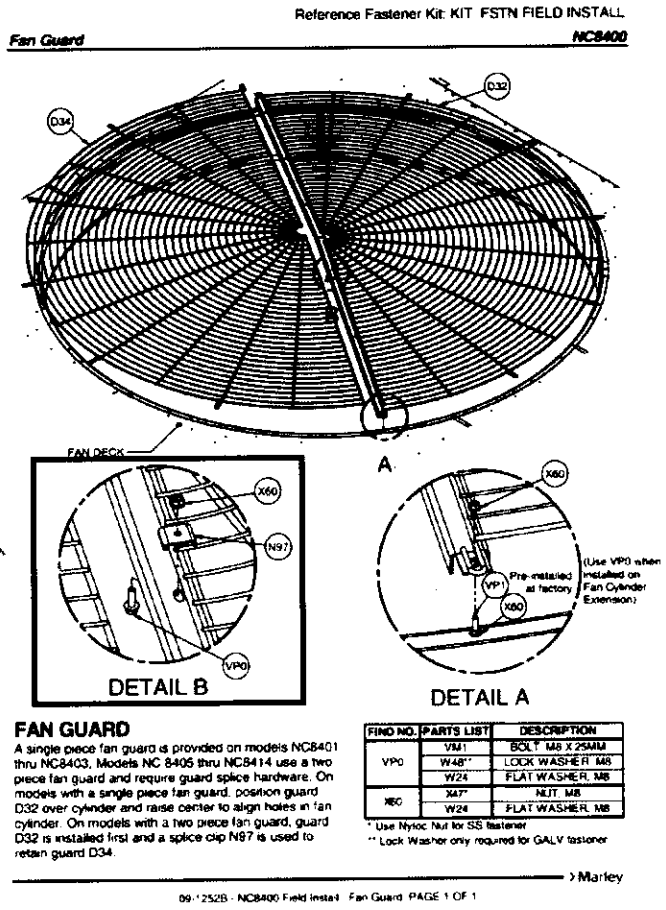


Figure 6

10. Locate the correct hardware bag, which can be found in the blue Marley tub that came with the tower, by matching the **find number** on the **drawing** to the bag with the same **find number.**

Refer to Figure 8. The **find number** on the bag will be a sticker label with the three characters of the **find number**.

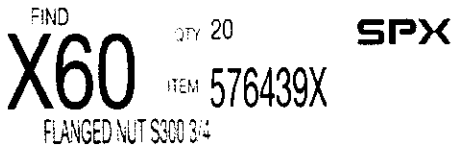


Figure 8

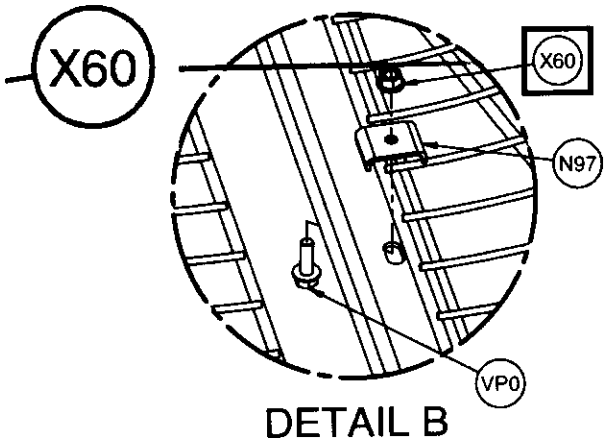


Figure 7

[redacted]

SPX®

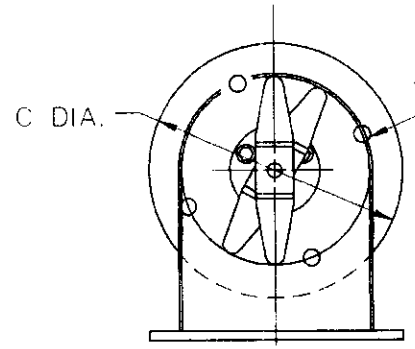
quick start guide

AN INTRODUCTORY TUTORIAL
FOR NAVIGATING YOUR MARLEY
INSTALLATION MANUAL

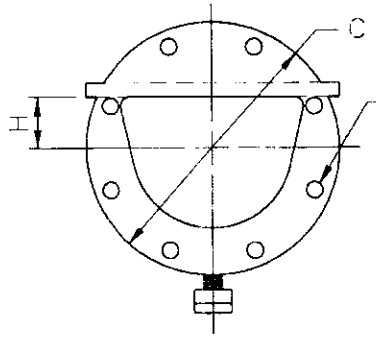
SPX COOLING TECHNOLOGIES, INC.
7401 W 129 STREET
OVERLAND PARK, KANSAS USA
P: 913 664 7400
F: 913 664 7439
spxcooling@spx.com
spxcooling.com

ISSUED 8/2012 M2012-1555

A	B	C	D	F	G	H	J	K
6" [152]	8" [203]	11" [279]	9 1/2" [241]	16 1/2" [419]	10 3/4" [273]	2 5/8" [67]	3 7/16" [87]	13 1/2" [343]
8" [203]	9" [229]	13 1/2" [343]	11 3/4" [298]	16 1/4" [413]	10 5/8" [270]	2 3/4" [70]	3 1/2" [89]	15 3/4" [400]
10" [254]	11" [279]	16" [406]	14 1/4" [362]	22 1/16" [560]	16 1/16" [408]	3 3/8" [86]	4 1/4" [108]	19" [483]

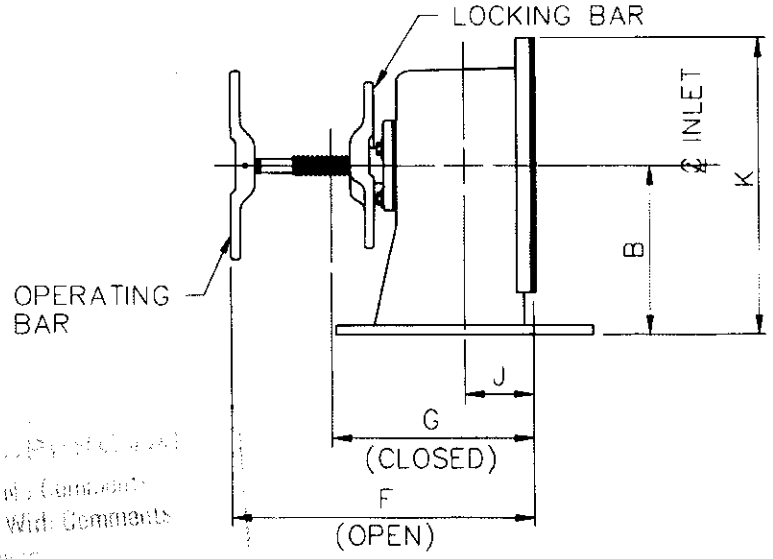


FOR 6" & 8" DIA. VALVES:
(2) 7/8" [22] DIA. HOLES
AND (2) 3/4" [19] DIA. UNC TAPPED
HOLES ON "D" DIA.
FOR 10" DIA. VALVE:
(3) 1" [24] DIA. HOLES AND
(3) 7/8" [22] DIA UNC TAPPED



FOR 6" & 8" DIA. VALVES:
7/8" [22] DIA, 8 HOLES
ON "D" DIA. B.C.
FOR 10" DIA. VALVE:
1" [24] DIA, 12 HOLES
ON "D" DIA. B.C.

VALVE SIZE "A"



Approved as Corrected
Approved, With Comments
Not Approved
7/20/2010
SIGNATURE

GENERAL NOTES

1. VALVE FLANGE DIAMETERS & BOLT CIRCLES CONFORM TO AMERICAN STD. CLASS 125# CAST IRON SPEC. ANSI B16.1.
2. ORIENTATION OF HOLE PATTERN CONFORMS TO ANSI B16.1. HALF THE STD. NO. OF BOLT HOLES ARE PROVIDED FOR CUSTOMER ATTACHMENT.
3. ALL DIMENSIONS SHOWN INSIDE OF BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

I-P [SI] UNITS

SHOP FABRICATION TOLERANCE
UNLESS OTHERWISE NOTED

COMMON FRACTIONS MAY VARY	+ or - 1/16" [2]
XX.XX DECIMALS MAY VARY	+ or - .030" [.8]
XX.XXX DECIMALS MAY VARY	+ or - .010" [.3]
ANGLES MAY VARY	+ or - 1/2°
WELD SIZE	+ 1/16" [2] -0

ECO NUMBER	REV. BY	CHECKED
	AJH	OCY

H.C. VALVE DIMENSIONAL DATA

SPX. COOLING TECHNOLOGIES

REV. DATE	DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
01/08/13	R.L. FUNK	10/25/89				1=8	89-1237	B

SPECIFIED TORQUE
ALL MECHANICAL EQUIPMENT HOLD-DOWN FASTENERS

BOLT THREAD SIZE	FASTENER TORQUE Ft-Lbs (N-m)		
	GALVANIZED UNLUBRICATED	STAINLESS STEEL UNLUBRICATED	STAINLESS STEEL LUBRICATED
1/4-20 UNC-2A	6 (8.1)	6 (8.1)	4 (5.4)
5/16-18 UNC-2A	18-20 (24.4-27.1)	18-20 (24.4-27.1)	10-12 (13.6-16.3)
3/8-16 UNC-2A	30-32 (40.7-43.4)	34-36 (46.1-48.8)	18-20 (24.4-27.1)
1/2-13 UNC-2A	64-66 (87-90)	85-90 (115-122)	40-45 (54-61)
5/8-11 UNC-2A	135-140 (183-190)	125-130 (169-176)	65-70 (88-95)
3/4-10 UNC-2A	220-230 (298-312)	195-205 (264-278)	110-120 (149-163)
7/8-9 UNC-2A	295-305 (400-414)	270-280 (366-380)	140-150 (190-203)
1-8 UNC-2A	395-405 (535-549)	350-360 (475-488)	180-190 (244-258)
1 1/8-8 UNC-2A	495-505 (671-685)	445-455 (603-617)	230-240 (312-325)

NOTE:
UNLUBRICATED STAINLESS STEEL FASTENERS ARE PRONE TO GALLING. BE ALERT TO A SUDDEN RISE IN NUT TURNING RESISTANCE BEFORE PARTS ARE PROPERLY CLAMPED. THIS SIGNIFIES GALLING. REMOVE NUT AND BOLT AND REPLACE WITH NEW ONES UNTIL A SATISIFACTORY JOINT IS MADE.

THREAD LOCKING COMPOUND: USAGE RATE

(B)

SIZE (in)	1/4	5/16	3/8	1/2	5/8	3/4	7/8	1	1 1/8
SIZE (mm)	6	8	10	12	16	20	22	24	27
CC/100 NUTS	6	6	10	18	30	46	54	100	125
DROPS/NUTS	1	1	1	2	3	4	6	8	10

APPROVED COMPOUND: 609 BY LOCTITE CORPORATION
ERECTOR TO CHECK DRIVESHAFT ALIGNMENT, SECURITY AND TIGHTNESS OF ALL BOLTED JOINTS ON SHOP ASSEMBLED COMPONENTS AFTER INSTALLATION ON TOWER. ALIGN AND RETIGHTEN AS NECESSARY.

MECHANICAL EQUIPMENT HOLD-DOWN FASTENER
INSTALLATION PROCEDURE:
FOR ALL FACTORY ASSEMBLED PRODUCTS, AND K/D TOWERS

NOTE:
FOR GALVANIZED HARDWARE NOTES 1,2,3 AND 4 APPLY: FOR STAINLESS STEEL HARDWARE NOTES 2,3 AND 5.

1. ALL HOLD-DOWN BOLTS SHALL BE CLEAN AND FREE OF LUBRICANT. NUTS, BOLTS AND WASHERS WITH DIRT, SAND, OIL, WATER DROPS ETC. SHOULD BE WIPED WITH A DRY, CLEAN CLOTH BEFORE INSTALLATION.
2. A FLAT WASHER SHALL BE USED UNDER THE NUT AND BOLT HEAD IF SEATED OVER A SLOT. FLAT WASHERS SHALL BE USED WHERE A HOLE IS MORE THAN 1/16" (2mm) GREATER IN DIAMETER FOR 1/2" (12mm) AND SMALLER BOLTS OR WHERE THE HOLE IS 1/8" (3mm) GREATER FOR BOLTS LARGER THAN 1/2" (12mm) DIAMETER. FLAT WASHER SHALL BE OF THE SAME MATERIAL AS THE NUT AND BOLT AND OF SUFFICIENT THICKNESS AND DIAMETER TO PREVENT CUPPING.
3. TIGHTEN EACH NUT 5 (7 N-m) TO 10 (13 N-m) ft. lbs. LESS THAN SPECIFIED TORQUE WHILE HOLDING BOLT HEAD. RETIGHTEN NUTS TO SPECIFIED TORQUE. BOLT HEAD MAY BE TIGHTENED WHILE HOLDING NUT IF NUT IS NOT ACCESSIBLE WITH TORQUE WRENCH.
4. APPLY THREAD LOCKING COMPOUND AROUND THREADED END AT THE TOP OF TIGHTENED NUT. THE COMPOUND WILL "WICK" INTO THE THREADS WITH THREADED END UP OR HORIZONTAL. FOR HOLD-DOWN BOLTS WITH THREADED END DOWN; BEFORE INSTALLING NUT APPLY THREAD LOCKING COMPOUND COMPLETELY AROUND NUT THREADS AND TIGHTEN PER NOTE THREE (3) ABOVE. THREAD LOCKING COMPOUND IS USED WITH UNLUBRICATED BOLTS ONLY. STAINLESS STEEL BOLTS USE SELF-LOCKING NUTS.
5. FOR STAINLESS STEEL HOLD-DOWN BOLTS LUBRICANT IS REQUIRED TO PREVENT GALLING. IN THIS APPLICATION LUBRICATE BOLT THREADS WITH THREAD LUBRICANT PER ES 47406. LUBRICATED HOLD-DOWN BOLTS SHALL BE FASTENED WITH SELF-LOCKING NUTS PER ES 48004 INSTEAD OF A STANDARD NUT AND LOCKWASHER. TIGHTEN SELF-LOCKING NUT TO THE SPECIFIED TORQUE FOR LUBRICATED STAINLESS STEEL HOLD-DOWN FASTENERS. (NO THREAD LOCKING COMPOUND IS USED WITH LUBRICATED STAINLESS STEEL BOLTS.

Approved, No Comments
Approved, With Comments
Not Approved
Mail
SIGNATURE
7/20/2015
DATE

MECHANICAL EQUIPMENT HOLD-DOWN FASTENER INSTALLATION FOR FIELD ERECTED TOWERS AND SHOP ASSEMBLED POWER PACKS

ERECTOR TO FOLLOW SAME PROCEDURES AS DESCRIBED FOR SHOP ASSEMBLY OF COMPONENTS. DO NOT APPLY THREAD LOCKING COMPOUND AFTER TIGHTENING TO THE SPECIFIED TORQUE. SELF-LOCKING NUTS NOT REQUIRED FOR POWER PACKS.

ECO NUMBER		MECHANICAL EQUIPMENT HOLD-DOWN FASTENER INSTALLATION				SPX COOLING TECHNOLOGIES			
9906									
REV. BY	CHECKED								
EW	RWP								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
7-8-08		WOLFE	02-13-91	LB	DMS		1=1	91-398	B

SERVICE

SPX COOLING TECHNOLOGIES

White Rust and Water Treatment

About Your Galvanized Cooling Tower

Your new cooling tower is constructed of sheet steel casing and structural components protected with "heavy mill galvanizing" (HMG). This protective zinc coating is fused to the sheet steel at the steel mill in a continuous hot-dip process. The zinc coating in Marley towers conforms to the industry standard coating class G-235, which means the weight of zinc coating averages 2.35 ounces per square foot of steel sheet. All of the HMG steel sheet used in our towers is treated after galvanizing with a chromate rinse to passivate the zinc coating. This important step helps prevent the formation of "white rust" on the surface of galvanized steel sheet during storage, fabrication, and initial tower operation.

What is "White Rust" — Can it Harm My Tower?

HMG steel provides excellent corrosion resistance in cooling towers and many other applications exposed to natural outdoor environments. Zinc protects the base steel sheet by galvanic action. To get the best life from your galvanized tower, it must have proper water treatment. Initially, the zinc coating must be allowed to develop a natural nonporous surface of "basic zinc carbonate". This natural chemical barrier prevents further rapid corrosion of the zinc coating from the environment as well as normal cooling tower operation. The basic zinc carbonate barrier will form on galvanized surfaces within eight weeks of tower operation with water of neutral pH (6.5 - 8.0), calcium hardness of 100 - 300 ppm (as $CaCO_3$), and alkalinity of 100 - 300 ppm (as $CaCO_3$). It is very important for the protective basic zinc carbonate barrier to form on galvanized tower surfaces to resist further corrosion. The initial operation of your cooling tower will ***significantly*** affect its service life.

Based on our experience, a very small percentage of galvanized towers incur a damaging type of corrosion which is commonly called ***"white rust"***. White rust appears as a white, waxy or fluffy adherent deposit on surfaces. If it occurs unchecked, the galvanized steel coating will continue to corrode, eventually leading to an early failure of the galvanization in your cooling tower. White rust is actually another form of zinc carbonate which has a different porous structure from the protective "basic zinc carbonate barrier" that naturally protects galvanized surfaces. White rust can form if your new cooling tower is operated with water of pH greater than 8.0 for an extended time period before the basic zinc carbonate barrier can form. There is also evidence that some types of film-forming inhibitor water treatments can promote the formation of white rust if used excessively. If start-up water treatment of the cooling system does not allow for initial passivation of your cooling tower's galvanized surfaces, you may face expensive corrective repairs and water treatment to cure the resulting white rust.

Why is a Knowledgeable Water Treater Important for My Cooling Tower?

The best cure for white rust is an ounce of prevention when you begin operating your tower. Consult with your water treatment specialist and ask about his program for initial system operation and passivation of your galvanized steel cooling tower. We encourage early operation with near neutral pH water and use of only reasonable levels of film-forming inhibitors. Many water treaters suggest corrosion inhibitor treatments of the Phosphate/Polymer/Phosphonate type, which have not promoted white rust in galvanized steel. ***Ideally—initially operate your cooling tower with water of pH between 6.5 and 8.0, and with hardness and alkalinity values between 100 - 300 ppm for at least 8 weeks,*** which should be enough time for the protective "basic zinc carbonate" layer to form. As an alternative, other acceptable water pretreatment methods such as inorganic phosphate passivation may be considered. Be certain your water treatment company is recommending a program suitable for your galvanized steel cooling tower before you start it up!

SPX COOLING TECHNOLOGIES

spxcooling.com

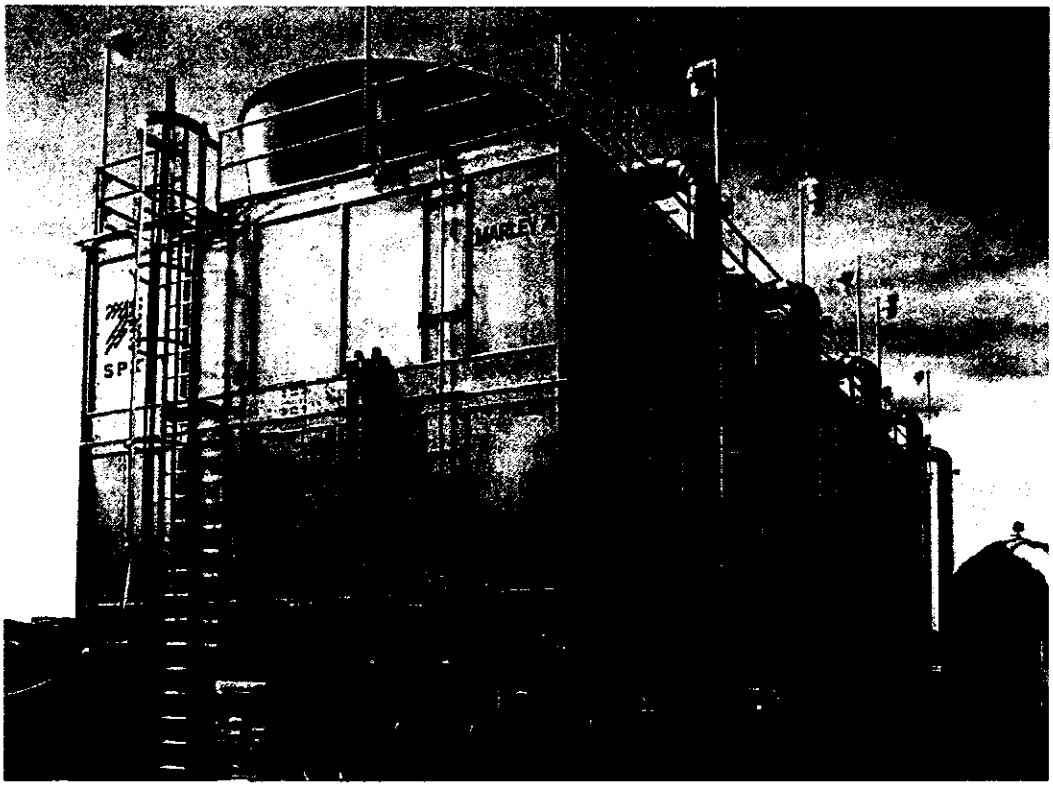
MARLEY®

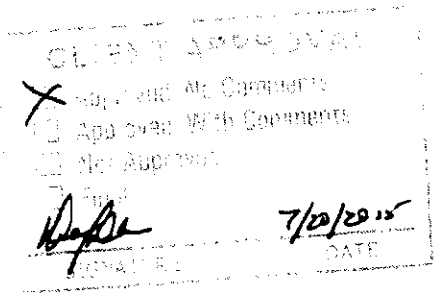
user manual

cooling tower **Downtime Instructions**

Z0238848, B ISSUED 06/2016

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT





/ Marley Cooling Tower Downtime Instructions /

Manual 92-1308A

SPX
COOLING TECHNOLOGIES

Instructions for Downtime

Mechanical Draft Cooling Towers

Preface

Proper preventive maintenance of equipment during downtime will assure trouble-free start-up. This manual gives suggested procedures for protection of tower mechanical equipment for downtime ranging from seasonal to extended downtime in two different periods. The periods increase in length and in extent of protection.

SPX Cooling Technologies offers these suggestions as being representative of good practice. Warranty of condition after downtime and or amendment to specific contract warranties is not intended.

⚠ Warning

Never start motor on fan drive without first making sure that there will be no interference with free rotation of the fan, drive shaft, or V-belt.

Seasonal Downtime

Fans, Drive Shafts, and V-belts

Maintain freedom for fan rotation. Do not operate if snow, ice or other obstruction will interfere with rotation.

Geareducers

Note

With the introduction of the 10.1, 20.1, and 22.3 Geareducer® models, oil changes in these models have been reduced to 5-year intervals. To maintain five-year change intervals, use only oil designed specifically for these Geareducer models. Proceed to step 2 below. If, after five years, turbine-type mineral oil is used, then proceed starting with step 1. Refer to Geareducer Service Manual for oil recommendations and further instructions.

1. At start of down-time period, operate Geareducer until oil is warm (120° F) and change the oil. See Lubrication section of the Geareducer Service Manual for instructions on changing oil. Allow freedom for fan to windmill.
2. Each month, drain any water condensate from the lowest point of the Geareducer and its oil system. Check the oil level and add oil if necessary. Operate the Geareducer a minimum of 20 minutes to recoat the interior surfaces with oil.
3. To return to operation, drain off any condensate, check oil level and add oil as necessary to establish required oil level. Change oil at normal recommended interval, accounting for downtime as operating time.

Bearing Housing, Oil Lubricated Type

1. At start of downtime period, operate bearing housing until oil is warm (95° F) and change the oil. See the Lubrication section of the Bearing Housing Service Manual for instructions on changing oil. Allow fan freedom to windmill.
2. Each month drain any water condensate from the lowest point of the bearing housing. Add oil if necessary to maintain oil level.
3. To return to operation, drain any water condensate, check oil level and add oil as necessary to establish required level. Change oil at normal recommended interval, accounting for downtime as operating time.

Electric Motors

1. At start of shutdown, clean all air passages and lubricate bearings. See the motor manufacturer's instructions.
2. Each month, run motor until it has reached operating temperature. Space heaters are recommended. If heaters are used, motors need be run only 20 minutes minimum.

Note

Higher density of cold air at fan increases motor horsepower. If motor overloads will not allow fan motor operation at high speed in forward direction, one of the following might be done:

- If overloads are adjustable, set at a higher value (+ 15%) for cold weather operation.
- Operate motor (fan) in reverse (reverse any 2 leads).
- Operate two speed motor at low speed.

3. Enclose motors or cover them to protect from wet-down of a fire protection system or rainfall.
4. To return into operation, clean all air passages, remove temporary vented cover and lubricate bearings.

Drive Train Backstop

Fill to normal level with oil recommended in Drive Train Backstop Service Manual.

Extended Downtime (beyond 3 months)

Fans and Drive Shafts

Maintain freedom of rotation. Do not operate if snow, ice or other obstructions will interfere with rotation.

V-Belt Drives

1. At start of down time, remove and store belts in a cool, dry, dark room. Clean and coat sheave grooves with rust preventative, lacquer or paint.
2. Remove rust preventative from sheaves before reinstalling belts.

Geareducers with External Gauge and Drain Lines

At Start of Downtime Period:

1. Operate Geareducer until oil is warm (120° F) and drain the oil. Completely replacing the oil may only be required for Geareducers using mineral oil. See Geareducer note on Page 2 for further information.

2. Fabricate and install an expansion chamber on the sight glass riser; see Figure 1. The figure shows the proportions of the expansion chamber and its relationship in elevation to the oil level. The purpose is to allow for expansion of the oil due to temperature change from that at the time of filling without causing it to overflow at the fan shaft closure. Smaller chambers may satisfy smaller Geareducer applications, but the 4″ depth and elevation relationships should be maintained.

   Expansion volumes required by Geareducers most likely to require this type of storage are listed by basic Series number:

   Models 34, 36 and 38 _____ 1.5 gallons (5.68 liters)
   Models 3600 and 4000 _____ 1.5 gallons (5.68 liters)
   Models 27 and 32 _____ 1.0 gallons (3.79 liters)
   Models 22, 2200 and 2400 ___ .75 gallons (2.84 liters)

   The vent may be removed from the top of the oil level gauge to be used as a vent for the expansion chamber. The chamber must be vented.
3. Remove the vent or vent line from the Geareducer.
4. Fill the Geareducer with oil until it rises just to the bottom of the vent hole in the top (cover) of the Geareducer. Use one of the oils listed in the appropriate Geareducer Manual.
5. Smaller Geareducers than listed may be stored this way, provided the basic requirement of submerging the top-most bearing in oil and the requirements above are satisfied.
6. Plug the vent on the Geareducer with a 1/2" pipe plug. The Series 22 requires a 1/4" plug.

7. Open the disconnect switch to the fan motor, and tag it to prevent running the Geareducer while it is full of oil. Allow Geareducer freedom to windmill. (See note on page 6.)
8. Quarterly, drain water condensate at lowest point of oil system, at drain in expansion chamber, check and make up oil level and rotate input shaft at least 15 revolutions. Allow to windmill.

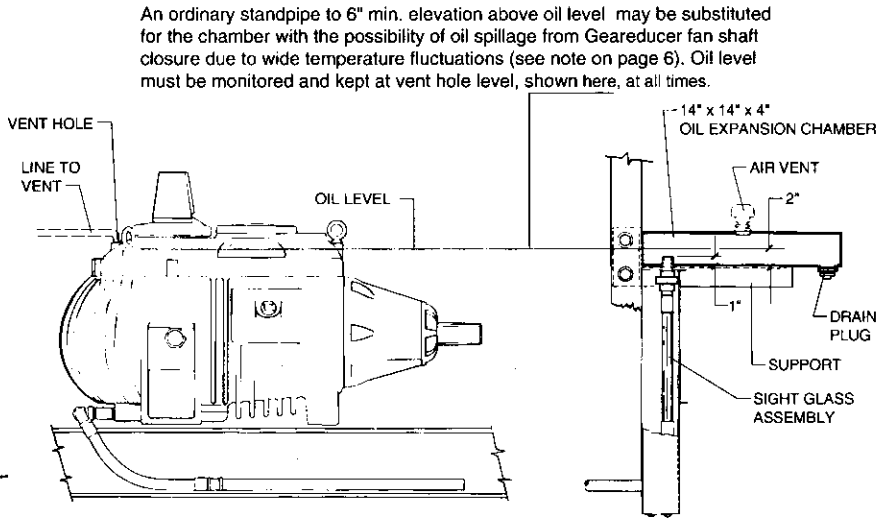


Figure 1

At End of Downtime Period

1. Drain oil to operating level.
2. Remove the pipe plug from the Geareducer vent hole and reinstall the vent fitting or line.
3. Remove the tag and close the disconnect switch to the fan motor. The expansion chamber may be removed .
4. If downtime was 6 months or longer, check to be sure there is no obstruction to rotation and run Geareducer until oil is warm (120° F). Stop the Geareducer and change the oil. Changing oil may only be required for Geareducers using mineral oil. See Geareducer note on page 2 for further information.

Geareducers without External Gauge and Drain Lines

Use the same procedure as outlined for Geareducer with external gauge and drain lines. It will be necessary to install an external gauge and drain line or pipe and a riser which would permit mounting the expansion chamber outside the fan cylinder, see Figure 1.

Bearing Housings, Oil Lubricated

1. At the start of the downtime period, operate bearing housing until oil is warm (95° F), then change the oil. See the Lubrication section of the Bearing Housing Service Manual for instructions.
2. Each quarter, drain any water condensate from the lowest point of the bearing housing. Add oil as necessary to maintain level. Allow to windmill. (See note below.) Rotate 15 revolutions.
3. To return to operation, bring up to operating temperature and change the oil.

Electric Motors

1. At start of downtime period, lubricate bearings. See motor manufacturer's instructions on lubrication.
2. Keep the motor temperature 5° F to 10° F above ambient temperature with the aid of space heaters or reduced voltage winding heating. Allow freedom to windmill.
3. Once each quarter, rotate motor shaft 15 revolutions.
4. Once each year, remove grease fill and relief plugs and lubricate motor bearings. ***Do not*** operate motor. Replace plugs.
5. Enclose motors or cover them to protect from wet-down of a fire protection system or rainfall.
6. To return to operation, remove temporary covers and clean air passages. Remove grease fill and relief plugs and lubricate bearings. Operate the motor to purge excess grease and replace the plugs. See motor manufacturer's instructions on lubrication.

Note

The frequency of maintenance operations required by these instructions assumes sufficient wind velocity to cause some fan rotary motion (not necessarily fan spinning) at least once per month. This motion is required to reposition bearing, shaft and gear elements with respect to each other to allow the lubricant the greatest opportunity to protect these vital parts from corrosion. Any time a period of one month passes without wind-caused fan rotary motion, maintenance personnel should be alert to this fact and provide manual rotation of the drive line. At least 15 revolutions of the motor shaft is recommended.

Drive Train Backstop

Fill to top with oil recommended in the Drive Train Backstop Service Manual. Drain and refill to top each two-year period. To start up, drain oil to operating level.

General

Fire Protection—Protect dry wood towers against fire. Any flammable debris should be removed weekly. Wood towers may be wetted for fire protection. This may be done by providing some form of sprinkler system to wet the entire top of the tower. This should include the top structure inside the fan cylinder. Sprinkling should be avoided in freezing weather.

The sprinkler system must be designed in order not to cause direct water impingement on Geareducer shaft closures, the Geareducer vent, the Geareducer external oil system vent, and the electric motor shaft closures, air openings, vents and drains.

The electric motor(s) must be covered with a vented enclosure to avoid moisture entrapment. This is necessary to avoid excessively high humidity around the motors, and to avoid wide fluctuation in motor temperature that sprinkling would cause. The enclosure should cover any back stop or brake assembly mounted on, or connected to any part of the motor.

During Freezing Weather—Drain tower basins and all exposed piping including risers. Leave the drain and overflow valves open to prevent accumulation of rain water, snow or melted snow and ice.

During Non-Freezing Weather—It may be more convenient to keep normal water level in wood basins for short downtime periods to keep basins tight. Wood basins (over longer periods) and concrete and steel basins should be drained.

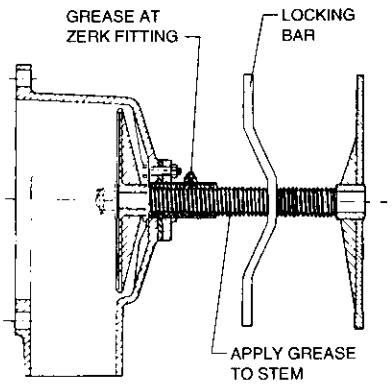


Figure 2

Flow Control Valves are to be left full open with locking bar locked. Apply grease through the zerk fitting to the stem-guide interface and coat the entire exposed stem with grease. NLGI #2 Lithium base grease is suggested. See Figure 2.

Start-Up Preparation of a wood tower after a long dry shut-down should include thorough wetting before full operation.

SPX

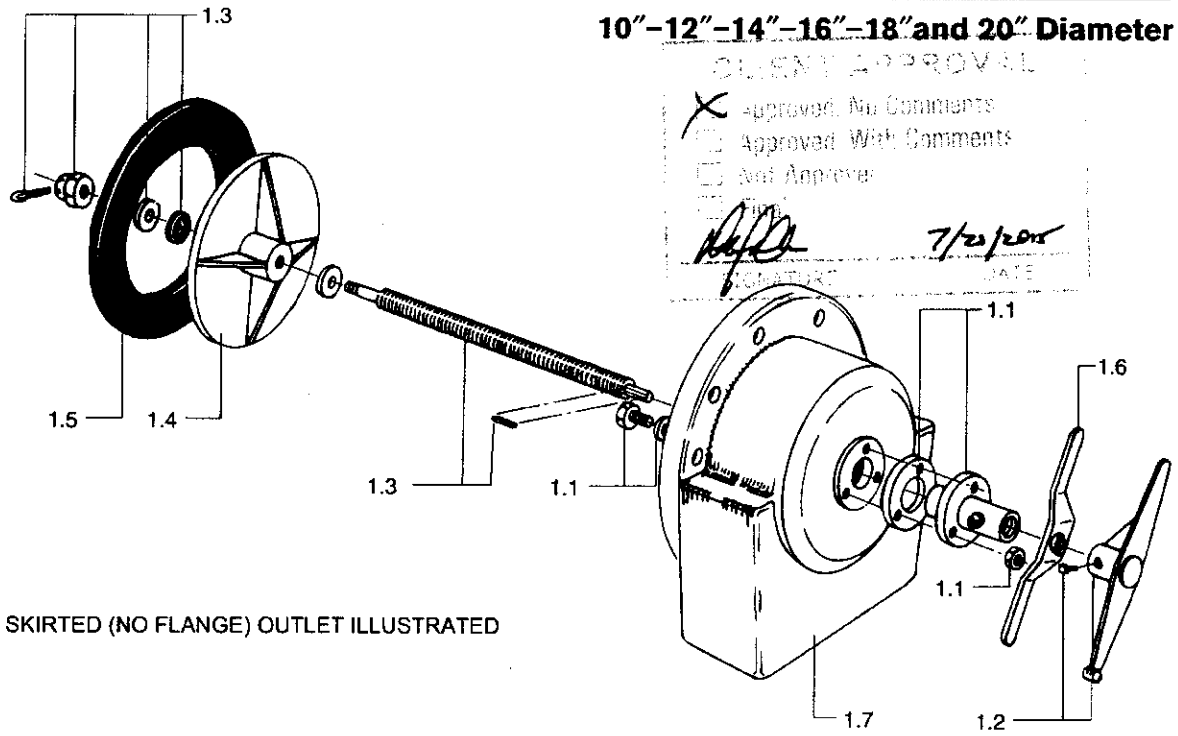
COOLING TECHNOLOGIES

spxcooling.com

1308-

Marley Horizontal Flow Control Valve

10"–12"–14"–16"–18" and 20" Diameter



SKIRTED (NO FLANGE) OUTLET ILLUSTRATED

Replacement Parts

1.0 Complete Valve Assembly

1.1 Valve stem guide with grease fitting, gasket, and attaching hardware.

1.2 Operating handle with set screw.

1.3 Valve stem with key, washers, resilient washer, castle nut and cotterpin.

1.4 Valve disc.

1.5 Valve body gasket.

1.6 Locking bar.

1.7 Valve body.

When ordering parts, always provide original Marley order number and tower serial number. Contact the Marley sales office or Marley representative in your area for assistance.

Assembly Sequence

1–Attach valve stem guide and gasket to valve body.

2–Place valve disc and washers on valve stem. Install castle nut and tighten to compress resilient washer to ⅛" to 3⁄16" thick. Install cotter pin.

3–Install valve stem and disc subassembly through valve stem guide. Center valve disc in valve inlet opening by differential tightening of the three valve stem guide machine bolts.

4–Install locking bar on valve stem.

5–Insert key in valve stem keyway and install operating handle. Tighten set screw against key.

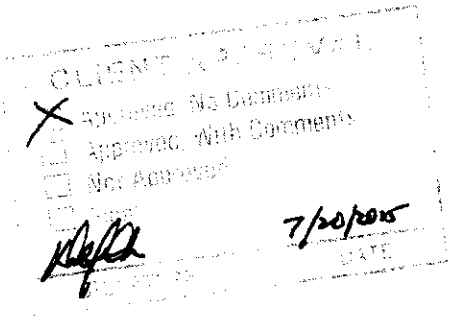
6–Grease valve stem threads at grease fitting using rust inhibiting lithium base grease of NLGI No. 2 consistency. Coat exposed valve stem threads with grease.

7–After adjusting the flow, set the locking bar in the locked position to stabilize the stem and disc.

SPX

COOLING TECHNOLOGIES

7401 WEST 129 STREET | OVERLAND PARK, KANSAS 66213 | UNITED STATES | 913 664 7400 | spxcooling@spx.com | **spxcooling.com**



/ Cooling Tower Motor /

User Manual 92-1475A

SPX
COOLING TECHNOLOGIES

Installation, Operation and Maintenance

of

Electric Motors

on Cooling Towers

RECEIVING AND STORING MOTORS

A motor should be inspected on receipt to make sure it was not damaged during shipment. Turn the shaft by hand to see that it turns freely. Check motor nameplate for correct horsepower, voltage, phase and speed.

If a motor is stored before installation, place it in a building in which air is kept reasonably dry and with a minimum of temperature fluctuation to prevent moisture condensing in the motor. Do not store directly on the floor, always block up.

Windings should be meggered at the time the motors are put in storage.

If motors have space heaters, the heaters should be energized when the motors are placed in storage.

NOTE: Remove units from containers when heaters are energized. Reprotect if necessary.

If outdoor storage is necessary, protection should include a vapor barrier beneath the motor. The motor should be blocked up to prevent flooding. All external parts such as shafts, machined surfaces, and threaded holes should be protected with a rust inhibitor coating.

Rotate motor shaft monthly to insure that the bearing surfaces are protected with lubricant.

When a motor is removed from storage, the insulation and rotor movement should be checked. The insulation should be checked by applying the potential from a 500 volt megohmmeter between the windings and grounded frame for 10 minutes. Resistance readings should be taken at 1 and 10 minutes. Correct the readings to 40°C as discussed on page 6 of this manual. Calculate the winding polarization index by dividing the 10 minute reading by the one minute reading. The recommended minimum value of polarization index for alternating current machine is:

Class A insulation 1.5

Class B insulation 2.0

Class F insulation 2.0

A low polarization index indicates the insulation should be cleaned and dried before the motor is placed in operation. It is possible to operate a motor with a polarization value less than the minimum listed above but this is not considered good practice.

The rotor movement is checked by rotating the shaft by hand. If shaft is not free, contact the motor manufacturer's authorized repair shop. Grease in the motor bearings should be purged at the time of removal from storage. Refer to LUBRICATION on pages 5 and 6.

INSTALLATION

Check to see that the motor nameplate data agrees with the voltage and frequency of the power supply provided for the motor. All induction motors will operate successfully when the frequency is not more than five percent above or below the nameplate rating, the voltage is not more than ten percent above or below the nameplate rating, and the combined variation in voltage and frequency is not more than ten percent above or below the nameplate rating.

The power supply line for the motor should be of sufficient capacity to carry 125 percent of the motor's full load current with a maximum voltage drop of three percent on the line.

The power supply MUST conform with motor nameplate voltage. Motors rated 200 volts are for a 208 volt system. Motors rated 230/460 volts are for a 240 or 480 volt system. Do not use a 230 or 230/460 volt motor on a 208 volt system.

Unbalanced voltages in the power supply will greatly increase the internal losses of the motor, reducing the safe load the motor can carry. Have the power company correct any unbalanced voltage.

When motor power is supplied by overhead conductors, it is advisable to provide a lightning arrestor on each ungrounded line.

Wire the motor to the power supply through a disconnect switch, short-circuit protection, and suitable magnetic starter with overload protection. All wiring and fusing should be in accordance with the National Electrical Code and local requirements. All motors should be connected as shown on the nameplate diagram.

The National Electrical Code requires a motor to be in sight of the controller unless the disconnecting means can be locked open or unless there is a manually operated switch in sight of the motor which will disconnect the motor from its electrical supply.

Overload protection should be installed in all three lines. Size overload heaters in starters for nameplate service factor and amps. Overloads for 1.15 service factor motors must kick out at no more than 125% of nameplate current. Overloads for 1.0 service factor motors must kick out at no more than 115% of nameplate current.

Overloads should be at the same ambient temperature as motor. Do not use ambient compensated overloads.

If a two-speed motor is used, be sure control characteristics are compatible with the motor. A two-speed single-winding motor requires a different starter than a two-speed two-winding motor. Starters for two-speed motors must include a minimum time delay of 20 seconds when switching from high to low speed.

When a disconnect switch is installed between motor and starter for two speed or part winding start single- speed motor, a 6-pole disconnect must be used.

SAFETY NOTE: Use of two 3-pole disconnects can result in one disconnect not being off and unexpected starts or motor damage.

If reverse operation of mechanical equipment is required, provide minimum time delay of two minutes before energizing motor when changing direction of rotation.

Check the wiring system for grounds and check the resistance between all leads for open, bad or incorrect connections before operating the motor.

The conduit system should be arranged so that trapped water will collect in a sump equipped with suitable drain and will not go into the motor terminal box.

When the motor must be moved for coupling removal or belt adjustment, a short section of flexible, watertight metallic conduit should be used in place of rigid conduit to protect the leads to the motor.

Remove all water drain plugs from totally-enclosed motors. These plugs will be located in the lowest part of the installed motor. Because of inaccessability of drain plugs with motor installed on supports, it is sometimes necessary to remove plugs before the motor is bolted in place.

The drain plugs on explosion-proof motors are automatic and must not be removed.

NOTE: After motor is installed, it should be run for three hours at least once a month, even if the tower is not in operation. This serves to dry out windings and relubricate bearing surfaces. If motors are purchased with space heaters, they should be energized as soon as possible. Use an auxiliary contact on the starter to turn heater off when motor is running.

OPERATION

Sleeve bearing motors are usually shipped without oil and must be oiled before operation. Ball bearing motors are lubricated for the initial operation by the motor manufacturer; however, it is recommended that the grease and relief plugs be removed and the motor bearing housing be examined for presence of adequate grease before motor is placed in operation. Add grease if necessary. See instructions on pages 5 and 6 for lubricating ball bearing or sleeve bearing motors.

Turn the rotor by hand to see that it rotates freely. Motor shaft should be parallel to driven shaft so that there are no stresses in motor frame.

INITIAL STARTING: The motor should bring the fan up to speed in less than 15 seconds. If it does not, check connections, fuses, overloads and voltage at motor terminals during start-up period. Run the motor to check the connections and direction of rotation. If the rotation is incorrect, change any two of the three motor leads for a three phase motor or interchange the connections of either the main or start windings for single phase capacitor start motor.

CAUTION: Excessive fan cycling may shorten the motor's expected service life. On fans 20 feet (6 meter) diameter and smaller allow for 4 to 5 starts per hour. On larger fans, 2 or 3 starts per hour may be the limit. On two speed motors each low speed start and each high speed start count as one start.

If a two-speed motor is used, allow a time delay of a minimum of 20 seconds after de-energizing the high speed winding and before energizing the low speed winding. Tremendous strains are placed on driven machinery and motor unless the motor is allowed to slow to low speed rpm or less before the low speed winding is energized.

When changing fan direction of rotation, allow a minimum of two minutes time delay before energizing the fan motor.

DETERMINE LOAD AT MOTOR: With design water rate and design heat load on the tower, test motor hp as follows:

1. Run motor for 30 minutes. Record motor name plate data.
2. Measure voltage between all lines at motor terminals.
3. Measure amps in all three lines.
4. Average the measured volts and amps and calculate test horsepower using the following equation:
5. For a given fan pitch setting and RPM, horsepower will

$$hp\ (test) = \frac{Volts \times Amps\ (average)}{Volts \times Amps\ (nameplate)} \times hp\ (nameplate)$$

vary directly with the air density which is a function of temperature and barometric pressure. Because fans are generally pitched for summer weather horsepower, it is expected that the motor nameplate horsepower will be exceeded during winter operation. Assuming 100% heat load, the temperature rise in the motor will be greater at the higher horsepower, but the operating temperature of the motor will actually be lower due to the drop in ambient temperature. Under these conditions, the higher horsepower should not be detrimental to the motor.

If the horsepower measurement is taken during cold weather conditions, the predicted horsepower which will result during summer operation may be determined by applying the Factor from Figure 1. For a given location, the barometric pressure will not normally vary enough to cause significant error and for this reason, has not been included in the Factors.

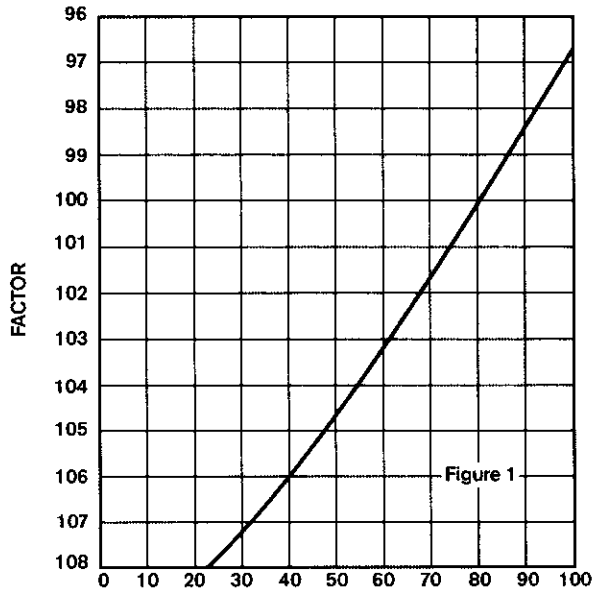


Figure 1

Example: The horsepower on an induced draft cooling tower is 7.8 hp on a 40°F ambient wet-bulb day. What is the predicted hp on a 75°F ambient wet-bulb day?*

$$hp_{(75°F)} = hp_{(40°F)} \times \frac{Factor\ (75°F)}{Factor\ (40°F)} = 7.8 \times \frac{100.8}{105.9} = 7.43$$

If it is desired to correct for high or low test barometric pressure, multiply the predicted horsepower by standard station barometric pressure and divide by test station barometric pressure.

*Use ambient dry-bulb temperatures if checking a forced draft cooling tower.

Fan motor overloads sized for summer weather will handle the higher winter horsepower without adjustment providing they are at the same ambient temperature as the motor and there is ample heat load on tower.

NORMAL OPERATION: Class B insulated motors are rated at a maximum total operating temperature of 130°C (266°F). A thermometer in contact with the winding may indicate a temperature up to 100°C (212°F). on a protected motor or up to 115°C (239°F) on a totally enclosed motor without the motor being too hot. Therefore, a motor that appears to be hot is not necessarily overloaded. Check with thermometers.

CAUTION: Normal operating temperatures of electric motors can be hot enough to cause burns. Avoid any unprotected contact with the surface of an operating motor.

MAINTENANCE

SAFETY NOTE: When working on the fan or fan drive, make sure the electric motor cannot be started. See "Installation" section.

To obtain maximum motor life, establish a schedule of maintenance based on the particular application of the motor and observe the following procedures and precautions:

CLEANING: Remove any oil, dust or scale deposits from the motor. They can cause excessive insulation temperatures.

LUBRICATION:

Ball Bearing Motors: The following table may be used as a guide in determining greasing periods for motors:

Duty	1 - 30 hp	40 - 250 hp
Intermittent	12 months	12 months
8 to 16 hours per day	12 months	6 months
Continuous	8 months	4 months

All greases will deteriorate in time depending upon bearing size, speed and temperature. The grease used should be recommended by the motor manufacturer. See instructions attached to motor for recommended lubricant. If these instructions have been lost or misplaced, obtain information on lubricant to use and local supply source from motor manufacturer's nearest authorized service facility or from the motor manufacturer. Give complete motor nameplate data and state clearly that the motor is used on a water cooling tower. Chevron SRI-2 is recognized by many motor manufacturers as a suitable grease for ball bearing motors for cooling tower service. In general, a polyurethane or lithium base grease with rust and oxidation inhibitors is recommended. Use a grease of NLGI No. 2 consistency. Do not mix greases which are of different types or specifications. If a change is desired, the motor bearing housing grease reservoir should be completely cleaned of old grease before repacking with new grease.

The relief method of greasing motors tends to purge the bearing housing reservoir of used grease by forcing out old grease with new grease. Use a plunger type grease gun which will not fit the bearing grease fill hole too tightly.

Either an excess or insufficient amount of lubricant in the bearings can cause overheating. To prevent this occurrence, use the following greasing procedure:

1. Stop motor.
2. Wipe grease plugs, outside of bearing housing, and relief plug, clean.
3. Remove grease and relief plugs and free relief hole of any hardened grease. Use a thin piece of wire in opening.
4. Add grease with a hand operated pressure gun until new grease appears at the relief hole. Take special care when greasing the fan end bearing of TEFC motors. The long relief might be too small for the bearing to relieve properly.
5. Run the motor for approximately one hour after greasing to permit rotating parts of the bearing to expel excess grease. Take out some of the excess grease with a thin piece of wire.
6. Replace plugs and wipe the outside of the bearing housing clean.

Every few years the motor end brackets should be removed and the grease reservoirs cleaned and repacked full with approved ball bearing grease. Open bearings should be cleaned and repacked.

Bearings should be checked for "roughness" by turning the outer race slowly with the fingers while holding the inner race. If the bearing feels rough or binds in spots, it should be replaced.

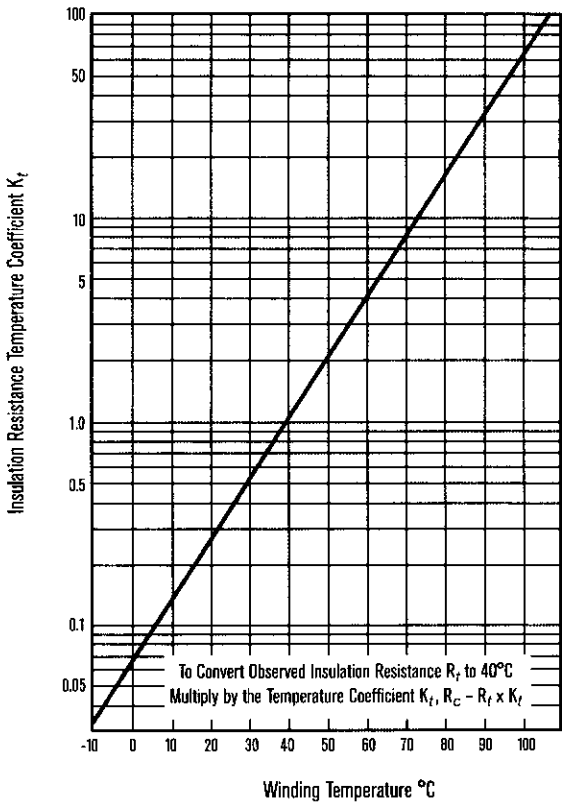
Sleeve Bearing Motors: Check oil in sleeve bearings at least every three months. When journal size is less than two inches, stop the motor to check the oil level. Old oil should be drained and replaced at least every year. Clean out oil well if there is evidence of dirt and sludge.

Motor shaft must be stopped when motor is oiled. The oil used should be a good grade of mineral oil of light or medium viscosity (such as SAE No. 10). Turbine oil rather than automotive crankcase oil is recommended.

Check bearing wear yearly by measuring the air gap with a feeler gauge. Measure gap in at least four equally spaced positions at each end of the motor with two of the places being the lowest point and the point subject to the load pull.

INSULATION: Check insulation resistance with a megohmmeter at the end of each shutdown period. Apply the megohmmeter potential to the winding for one minute before taking a reading. Correct the reading to 40°C by using the equation:

$R_{40°C} = K_t \times R_t$ and the curve below



Approximate Insulation Resistance Variation with Temperature for Rotating machines.

A record of these corrected readings will show a trend in the insulation condition. It is considered good practice to recondition a winding if the resistance, having been high on previous readings, drops to near the recommended minimum value as calculated by:

$$\text{Megaohms} = \frac{1000 + \text{Rated Voltage of Machine}}{1000}$$

Motors in continuous operation will stay at a temperature sufficiently above ambient temperature to prevent condensation of moisture on and about the windings, even if the location is very humid. Idle motors, however, accumulate moisture readily which causes gradual deterioration of insulation. Where motors are idle for a long time, single-phase heating or space heaters may be required to prevent water condensation.

Check insulation resistance at least once a year with the motor at normal operating temperature. Comparison with several previous readings will give an indication of improvement or deterioration of insulating value. Readings, to have comparison value, should be taken under the same conditions (temperature, operating time since last shutdown, etc.).

Low or falling resistance readings indicate the need for maintenance. Contact the nearest repair facility authorized by the motor manufacturer for repair service.

VIBRATION: If vibration occurs, it should be corrected without delay. Use the following procedure to determine source of trouble:

1. Check motor mounting to see that fasteners are tight.
2. Disconnect motor from load and run motor separately. If motor still vibrates, rebalance rotor.
3. If vibration is in mechanical equipment*, check:
   a. Alignment of motor with mechanical equipment.
   b. Tightness of Geareducer, or belt driven components, mounting bolts.
   c. Unbalance in drive shaft or fan.

*Refer to service manuals for operating and maintenance recommendations.

SEASONAL SHUTDOWN

If a motor is used only seasonally, it should be cleaned and lubricated at the close of each season. Refer to motor manufacturer's recommendations for lubrication and maintenance instructions. At start of new season, make sure bearings are adequately lubricated before returning motor to operation. *When tower is not in operation, the motor should be run for three hours at least once a month. This serves to dry out windings and relubricate bearing surfaces.*

Do not start motor without determining that there will be no interference with free rotation of the fan drive.

MOTOR WARRANTY

Motor manufacturers' warranties run for 12 months in service but not to exceed 18 months from date of manufacture. Motor manufacturers warrant their products to be of the type and quality described, suitable for the service for which they are supplied, and free of defects in materials and workmanship. Failures from causes external to the motor (e.g., single phasing, operation under prolonged or extensive overload, damage from handling, improper maintenance, use on other than the service for which supplied, defect in wiring to power supply, or deficiency or defect in controls) are not covered by the motor manufacturers' warranties.

If a motor failure occurs within the warranty period because of defect in material or workmanship, the motor manufacturer is liable and has the right to remedy the failure by adjustment, repair, or supplying a replacement motor F.O.B. his factory or authorized repair facility. In such event, the motor must be delivered to the nearest repair facility authorized by the motor manufacturer with notification that the motor is from a Marley product and that warranty consideration is requested. Prompt notification of such failure should be directed to a Marley sales representative.

Motor manufacturers will not accept warranty obligation for repair of motors by other than their authorized repair facility nor warranty obligation for materials or workmanship employed in making repairs. Repair shops, including authorized repair facilities, generally warrant their material and workmanship for a period of 12 months.

Motor manufacturers' warranties do not cover cost of dismounting, transportation to and from repair facilities, or remounting motors.

MOTOR OPERATION NOTE:

Higher density of cold air at fan increases motor horsepower. If motor overloads will not allow fan motor operation at high speed in forward direction, one of the following might be done:

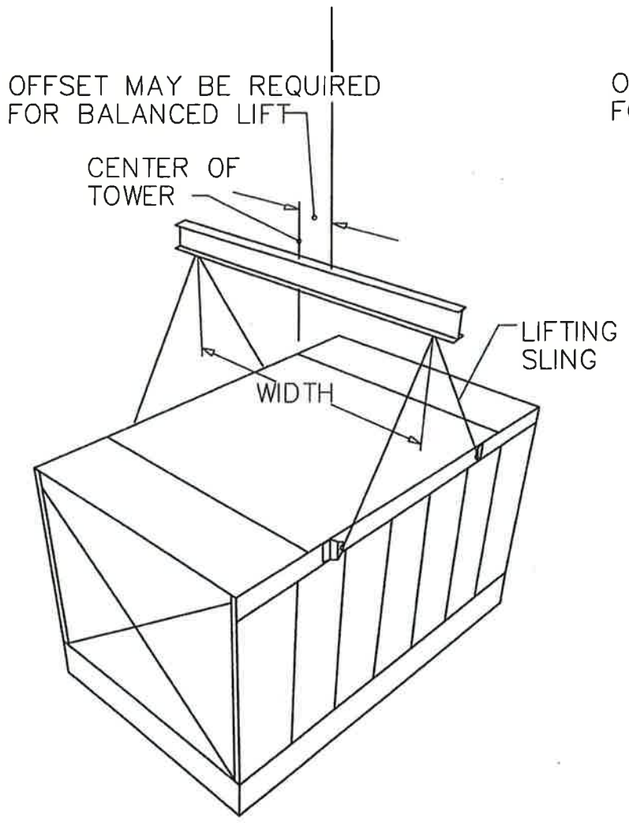
1. If overloads are adjustable, set at a higher value (+15%) for cold weather operation. Readjust for summer operation.
2. Operate motor (fan) in reverse (reverse 2 loads).
3. Operate 2-speed motor at low speed.

SPX

COOLING TECHNOLOGIES

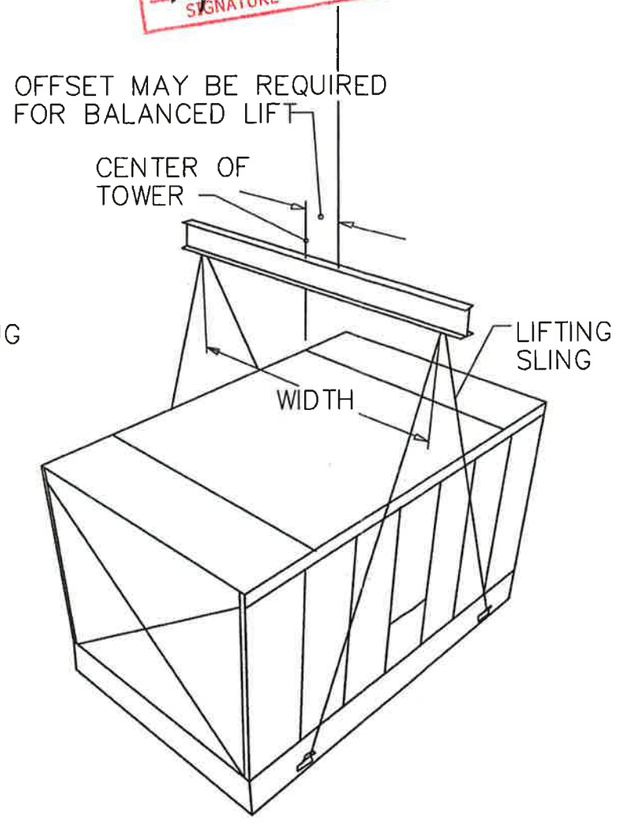
spxcooling.com

CLIENT APPROVAL
☒ Approved, No Comments
☐ Approved, With Comments
☐ Not Approved
☐ Other
SIGNATURE 3/15/2010 DATE



TOWER UNITS WITH
HOISTING CLIPS AT THE TOP

8401 THRU 8407
TOP MODULE OF 8411, 8412, 8413 & 8414



TOWER UNITS WITH
HOISTING CLIPS AT THE BOTTOM

8409
BOTTOM MODULE OF 8411, 8412, 8413 & 8414

TOWER MODEL	TOWER WIDTH	MINIMUM SLING LENGTH
8401	6'-7" [2007]	5'-6" [1676]
8402	8'-6" [2591]	6'-0" [1829]
8403	8'-6" [2591]	8'-0" [2438]
8405	10'-0" [3048]	8'-0" [2438]
8407	12'-0" [3658]	8'-6" [2591]
8409	14'-0" [4267]	17'-6" [5334]
8411 TOP	12'-0" [3658]	9'-0" [2743]
8411 BOTTOM	12'-0" [3658]	16'-6" [5029]
8412 TOP	14'-0" [4267]	9'-0" [2743]
8412 BOTTOM	14'-0" [4267]	16'-6" [5029]
8413 TOP	12'-0" [3658]	9'-0" [2743]
8413 BOTTOM	12'-0" [3658]	16'-6" [5029]
8414 TOP	14'-0" [4267]	9'-0" [2743]
8414 BOTTOM	14'-0" [4267]	16'-6" [5029]

NOTES:
1. ALL HOISTING CLIP HOLES ARE 1 1/4" [32].
2. OVERALL LENGTH OF SHACKLE PIN SHOULD NOT EXCEED 5 1/4" [133].
3. FOR OVERHEAD LIFTS OR WHERE ADDITIONAL SAFETY IS REQUIRED, ADD SLINGS BENEATH THE TOWER UNIT.
4. ALL DIMENSIONS SHOWN INSIDE OF BRACKETS[ ] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

I-P [SI] Units

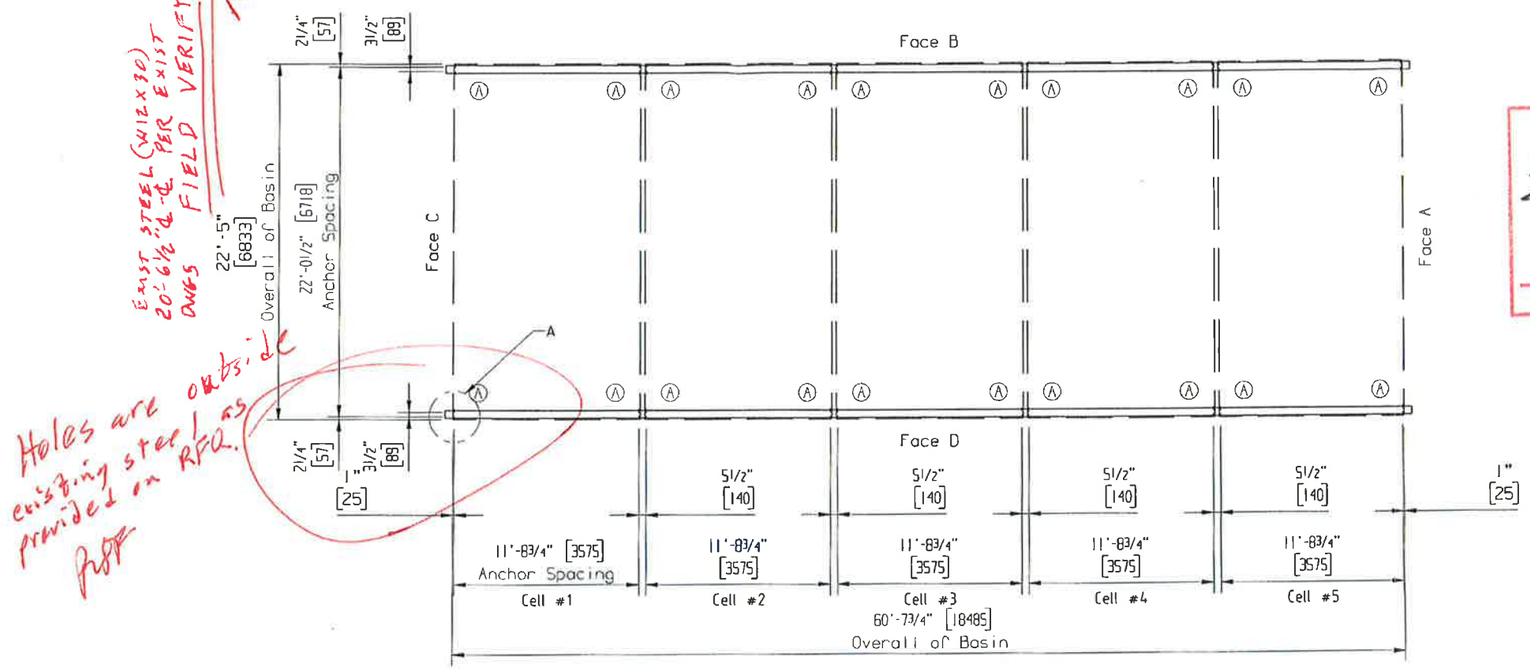
ECO NUMBER		HOISTING DETAILS 8401 THRU 8414 TOWERS				SPX. COOLING TECHNOLOGIES			
REV. BY	CHECKED								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
		B. GOODING	01/23/2009		MN		1=1	09-136	

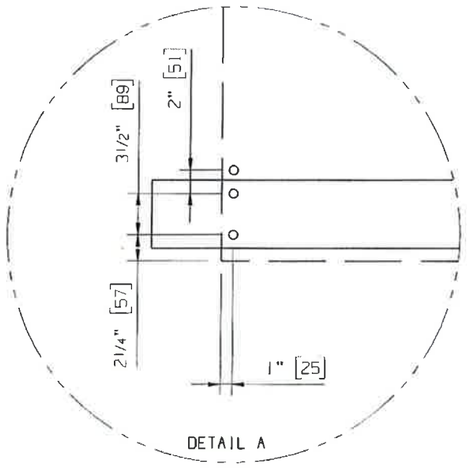
Shipping Weight		Design Operating Loads			Wind Load		Seismic Load	
per Tower	Heaviest Lift	per Tower	per Cell	at A	Vert. Reaction at A	Horiz. Reaction at A	Vert. Reaction at A	Horiz. Reaction at A
111739 lb (50684 kg)	12990 lb (5892 kg)	223569 lb (101409 kg)	44714 lb (20282 kg)	12296 lb (5577 kg)	261.85 x P lb (24.33 x P kgf)	130.63 x P lb (12.14 x P kgf)	23544 x G lb (10679 x G kgf)	11672 x G lb (5294 x G kgf)

(8) 3/4" ASTM A307 or M20 Grade 4.6 anchor bolts are required per cell. These anchor bolts are capable of resisting 34 psf (1628 N/m²) wind load or a factored 0.38 G seismic load applied to the tower. Determination of the site specific design wind and seismic loads are by others.

EXIST STEEL (W12x30) 20'-6½" c-c PER EXIST DWGS FIELD VERIFY

Holes are outside existing steel as provided on RFQ.





DETAIL A

The first anchor bolt hole is the closest to the end of the cold water basin flange. The second anchor bolt should use the hole that matches the gauge of the beam.

NOTES

1. SUPPORTING STEEL: The supporting steel is to be designed, constructed and furnished by the customer. It shall include customer supplied anchor bolts to suit the general dimensions of this drawing and of the Outlet Piping Plan drawing. The top surface of the supporting steel must be framed flush and level. The maximum beam deflection shall be limited to 1/360 of span, not to exceed 1/2" (13 mm) at the anchor bolts in order to assure that the cooling tower is level and plumb.
2. DESIGN OPERATING LOADS: The design operating loads shown in the above table are based upon the volume of water in the collection basin at shutdown. The shutdown water level has been sized to accommodate the maximum allowable flow rates. The design loads are shown for your use as a quick reference. The actual operating load is variable, and dependent upon the design flow rate per cell. Design loads are all based upon the recommended operating water level. Operating levels in excess of that recommended will result in loads exceeding the values stated. Consult a SPX CT representative for greater detail on this or any other subject.
3. WIND & SEISMIC LOADS: Reactions shown are the result of the wind/seismic load being applied perpendicular to the face of the tower structure. Loads are additive to the operating loads. Wind reactions can be calculated by multiplying by P, which is the wind pressure in psf for Imperial units and kgf/m² for metric units. Seismic reactions can be calculated by design G.
4. SHIPPING WEIGHTS AND MAXIMUM OPERATING LOADS: Values shown in table include the optional equipment weights.
5. NON-STANDARD ANCHORAGE LOCATION: The anchor bolt dimension shown can be varied upon request. Consult a SPX CT representative for specifics and to insure that the appropriate modifications are added to the structure.
6. PIER SUPPORTS: The tower may be supported from piers at each anchor bolt location as an alternate. A pier should be at least 6" (152 mm) x 6" (152 mm).
7. VIBRATION ISOLATORS: The towers may be supported on vibration isolators. The isolators must be placed UNDER the supporting steel beams and not between the support beams and the tower.
8. The tower assembly tolerance applicable to all dimensions is + or - 1/8" (3 mm). Consult suppliers of supporting structure for construction tolerances.
9. The units of measure are in IP (SI) units unless otherwise noted.

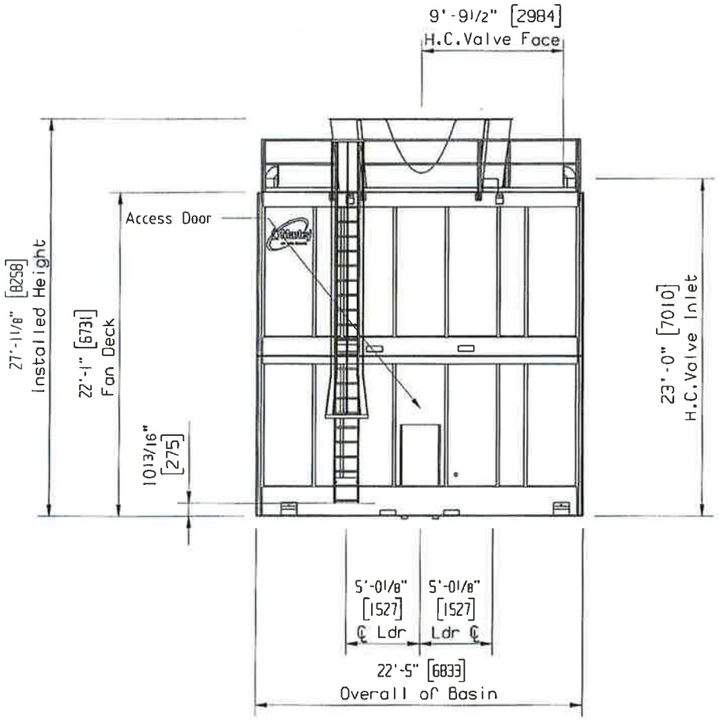
EXISTING STRUCTURE. lgw

EXISTING STRUCTURE. lgw

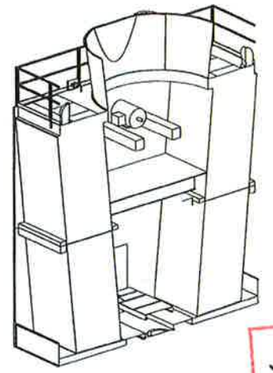
CLIENT APPROVAL
☐ Approved, No Comments
☒ Approved, With Comments
☐ Not Approved
☐ Final
SIGNATURE 3/15/2015 DATE

NOTE: VENDOR IS RESP. TO VERIFY THAT NEW COOLING TOWER WILL FIT & MOUNT TO EXISTING STRUCTURAL FRAMEWORK. lgw

ECO NUMBER		NC8413XAS5GGF - Supporting Steel Plan and Details Juniper Rfq for Lake Charles Westlake, LA, United States						
REV. BY	CHECKED							
REV. DATE	DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
	RICKY WILSON_141119_124418252 V1	02/19/15	QTC	SYS	10100890	1=1	RW552853G	



Cased Face C



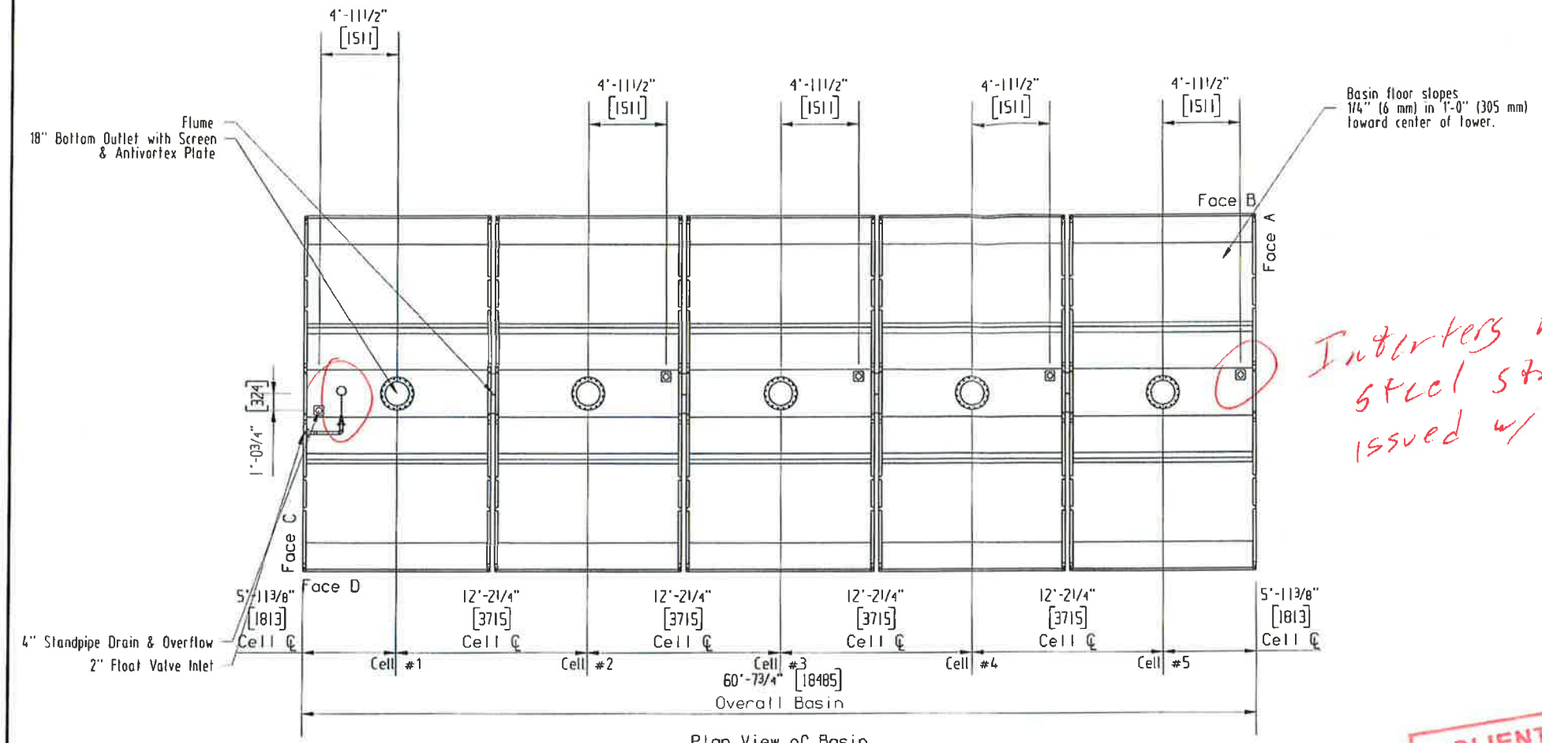
Interior View

CLIENT APPROVAL
☒ Approved, No Comments
☐ Approved, With Comments
☐ Not Approved
☐ Final
SIGNATURE
3/16/2015
DATE

NOTES

1. The fan motor must be locked out and inoperable before entering the tower. This warning has been placed on the access door.
2. Flanged connections conform to class 125 of the ANSI B16.1 specification. The bolt holes straddle the centerlines.
3. Horizontal Control (HC) valves can withstand a maximum static shutoff pressure of 25 psi (172 kPa)
4. Full flat face flange gaskets are supplied by SPX CT.
5. An incoming riser and manifold must allow clearance for entry to the tower access doors. 4'-2" (1270 mm) is the minimum clearance needed to clear the optional access door or motor access platform.
6. To insure maximum thermal performance the cooling tower must be installed level and plumb. Both of the air inlet faces must have adequate air supply. If obstructions exist, consult your SPX CT representative.
7. Hoisting clips are provided for ease of unloading and positioning. For overhead lifts or where additional safety precautions are prudent, add slings beneath the tower. Adequate space has been provided for removal of the shackles and the 5 1/4" (133 mm) long pins from the hoist clips between the cells of a multi-cell tower. If the pin used is longer than 5 1/4" (133 mm), the cell may be slid into it's final position by using come-alongs at the base of the unit, after removal of shackle pins. See Hoisting Details drawing.
8. The vertical weight of the piping illustrated within the tower perimeter may be supported by the tower structure. All other piping shall be supported independent of the tower (see section A-A for specific details). The piping, their supports, the design of both piping and supports, and the lateral restraint of piping loads shall be supplied by others.
9. Construction of the ladder and guardrail: The guardrail is fabricated from galvanized structural tubing. Top rail, middle rail and posts are 1 1/2" (38 mm) square tube 1/8" (3 mm) thick. Toeboards are 12 gauge heavy mill galvanized steel. The ladder is aluminum 3" (76 mm) x 1 1/8" (29 mm) I-beam side rails and 1 1/4" (32 mm) serrated rungs.
10. The ladder and guardrail are field installed by others. The tower is shop modified to accept this option. The clips and hardware are provided by SPX CT for the field installation. The installation detail drawings are included in the literature package shipped with the tower.
11. O.S.H.A. standards recommend the use of a Safety Cage when the length of a single ladder exceeds 20'-0" (6096 mm).
12. The Plenum Walkway consists of 11 gauge steel supports and 16 gauge steel walkway panels. The elevation of the Plenum Walkway is above the overflow water level of the collection basin. The distance from the top of the Plenum Walkway to the fan is 18'-4 7/8" (5610 mm).
13. The Interior Mechanical Equipment Platform consists of the Plenum Walkway plus an elevated platform for access to the mechanical equipment. A ladder is provided from the Plenum Walkway to the elevated platform along with a handrail system for the elevated platform.
14. The distance from the elevated platform to the fan exceeds 7'-0 13/16" (2154 mm).
15. The tower assembly tolerance applicable to all dimensions is + or - 1/8" (3 mm). Consult suppliers of supporting structure for construction tolerances.
16. The units of measure are in IP (SI) units unless otherwise noted.

ECO NUMBER		NC8413XAS5GGF - Schematic Cased Elevation and Notes Juniper Rfq for Lake Charles Westlake, LA, United States							
REV. BY	CHECKED								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
		RICKY WILSON_141119_124418252 V1	02/19/15	QTC	SYS	10100890	1=1	RW552853M	



Plan View of Basin

Interfaces with existing steel structure as issued w/ Bid documents

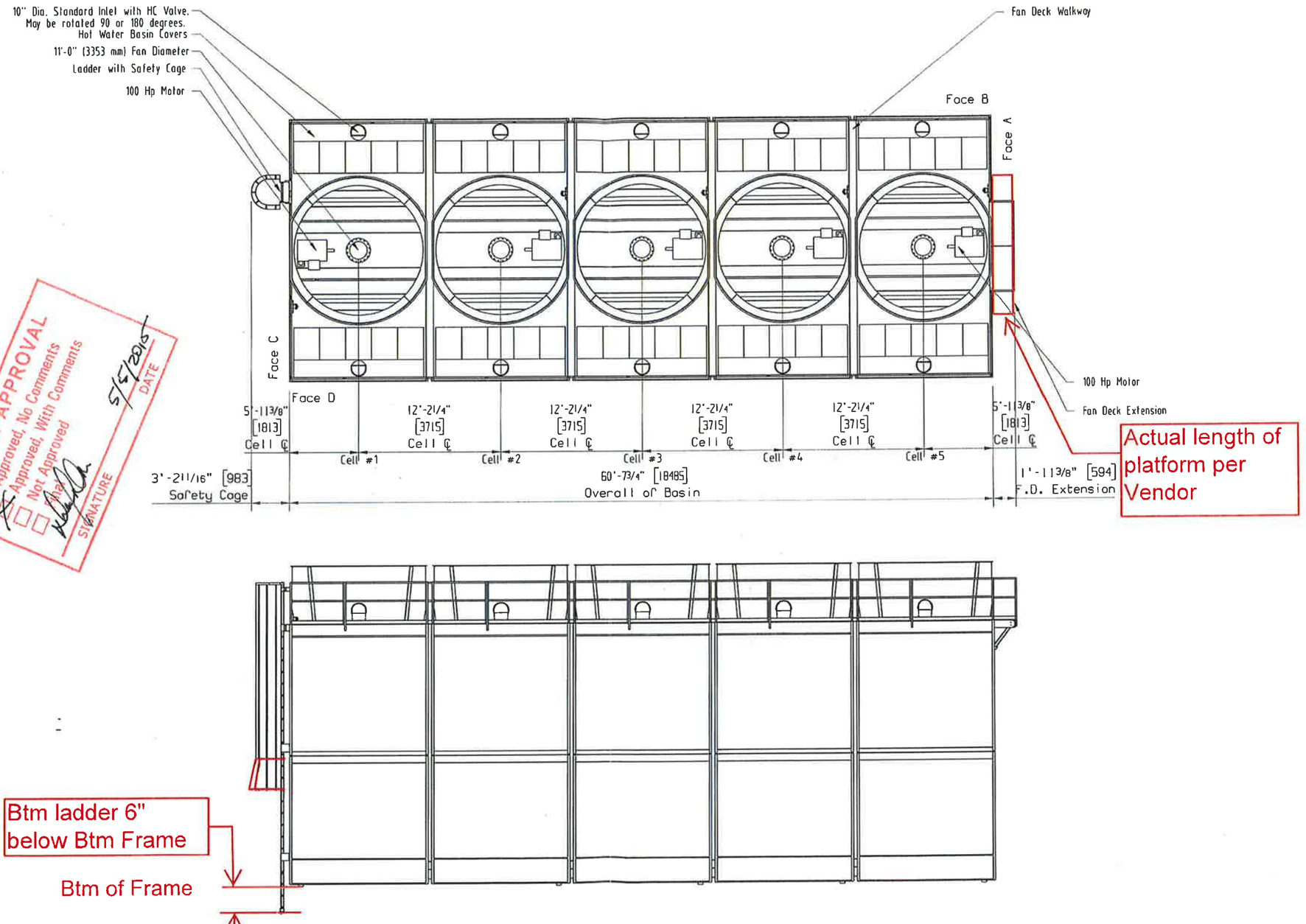
RTF

CLIENT APPROVAL
☐ Approved, No Comments
☒ Approved, With Comments
☐ Not Approved
☐ Final
SIGNATURE
3/18/2015
DATE

NOTES

1. All piping supports are by others. Do NOT support outlet piping from the tower.
2. The collection basin piping accessories shown on this drawing are furnished by SPX CT. This includes a full faced gasket. Flat faced flange, fasteners and seal washers attachment to the outlet are supplied by others. The use of a flange other than a flat faced flange will damage the collection basin floor.
3. The standpipe overflow is to be field installed by others.
4. The design operating loads shown in the table on the Grillage Details drawing are based upon the volume of water in the collection basin at shutdown. The shutdown water level has been sized to accommodate the maximum allowable flow rates. The actual operating load is variable, and is dependent upon the design flow rate per cell. Design loads are all based upon the recommended operating water level. Operating levels in excess of that recommended can result in loads exceeding values stated. Consult a SPX CT representative for greater detail on this or any other subject.
5. Basin flumes are shipped inside the tower and are to be field installed by others. The connecting collars are shop installed.
6. The tower assembly tolerance applicable to all dimensions is + or - 1/8" (3 mm). Consult suppliers of supporting structure for construction tolerances.
7. The units of measure are in IP (SI) units unless otherwise noted.

ECO NUMBER		NC8413XAS5GGF - Piping Plan Juniper Rfq for Lake Charles Westlake, LA, United States							
REV. BY	CHECKED								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
		RICKY WILSON_141119_124418252 V1	02/19/15	QTC	SYS	10100890	1=1	RW552853P	



CLIENT APPROVAL
☐ Approved, No Comments
☐ Approved, With Comments
☐ Not Approved
SIGNATURE
5/5/2015
DATE

NOTES

1. The tower assembly tolerance applicable to all dimensions + or - 1/8" (3 mm). Consult suppliers of supporting structure for construction tolerances.
2. The units of measure are in IP (SI) units unless otherwise noted.
3. See Schematic Cased Elevation and Notes drawing for additional notes.

ECO NUMBER		NC8413XAS5GGF - Schematic Plan and Louver Elevation Juniper Rfq for Lake Charles Westlake, LA, United States					Marley AN SPX BRAND		
REV. BY	CHECKED								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
		RICKY WILSON_141119_124418252 V2	03/13/15	QTC	SYS	10100890 C01	1=1	RW555028S	

Shipping Weight		Design Operating Loads			Wind Load		Seismic Load	
per Tower	Heaviest Lift	per Tower	per Cell	at A	Vert. Reaction at A	Horiz. Reaction at A	Vert. Reaction at A	Horiz. Reaction at A
111949 lb (50779 kg)	12990 lb (5892 kg)	223779 lb (101504 kg)	44756 lb (20301 kg)	12308 lb (5583 kg)	261.85 x P lb (24.33 x P kgf)	130.63 x P lb (12.14 x P kgf)	23544 x G lb (10679 x G kgf)	11672 x G lb (5294 x G kgf)

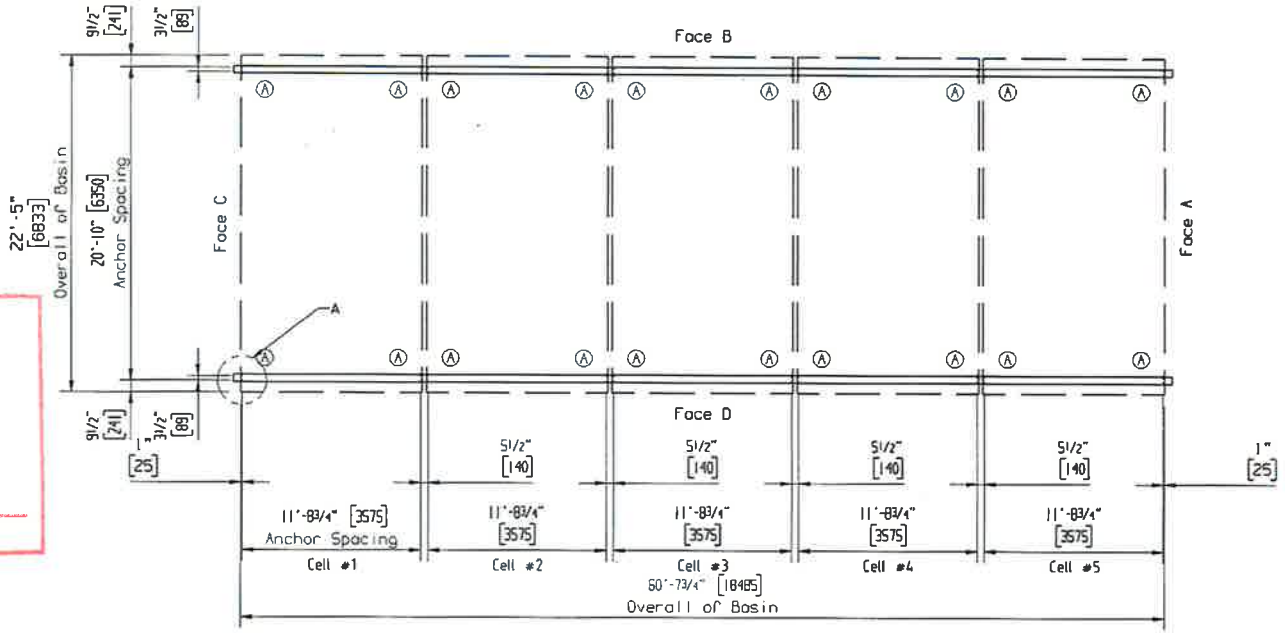
(8) 3/4" ASTM A307 or M20 Grade 4.6 anchor bolts are required per cell. These anchor bolts are capable of resisting 56 psf (2681 N/m²) wind load or a factored 0.77 G seismic load applied to the tower. NoValue Determination of the site specific design wind and seismic loads are by others.

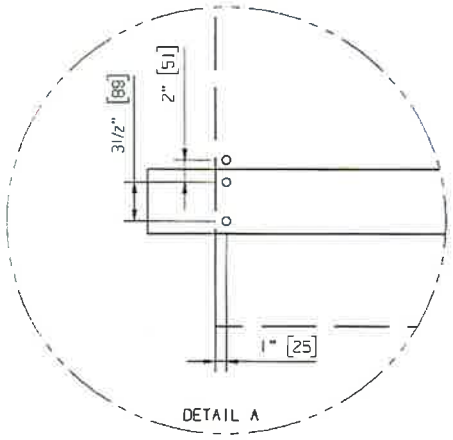
CLIENT APPROVAL

- ☐ Approved, No Comments
- ☐ Approved, With Comments
- ☐ Not Approved
- ☒ Final

Richard Pfaff 7/20/15

SIGNATURE DATE





DETAIL A

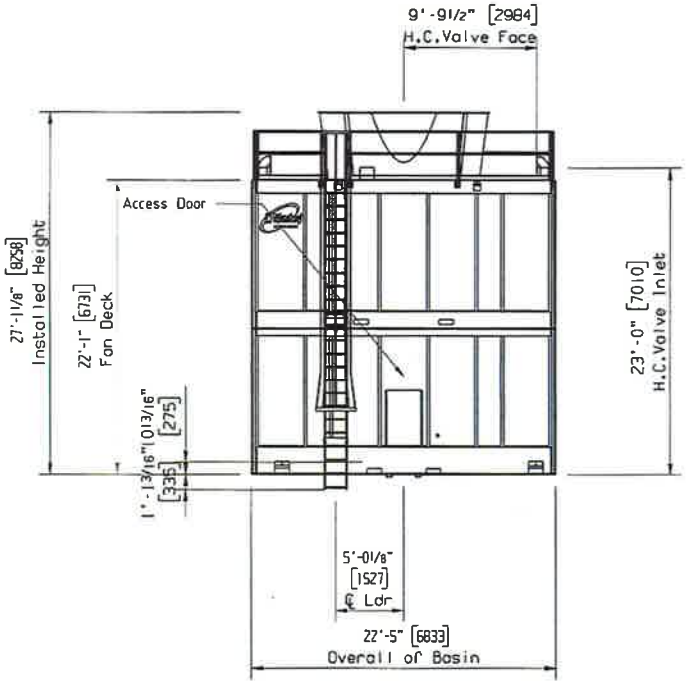
The first anchor bolt hole is the closest to the end of the cold water basin flange. The second anchor bolt should use the hole that matches the gauge of the beam.

NOTES

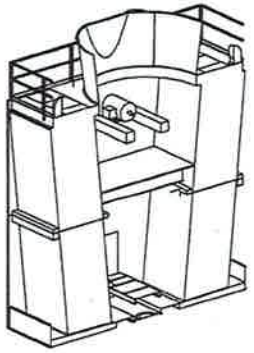
1. SUPPORTING STEEL: The supporting steel is to be designed, constructed and furnished by the customer. It shall include customer supplied anchor bolts to suit the general dimensions of this drawing and of the Outlet Piping Plan drawing. The top surface of the supporting steel must be framed flush and level. The maximum beam deflection shall be limited to 1/360 of span, not to exceed 1/2" (13 mm) at the anchor bolts in order to assure that the cooling tower is level and plumb.
2. DESIGN OPERATING LOADS: The design operating loads shown in the above table are based upon the volume of water in the collection basin at shutdown. The shutdown water level has been sized to accommodate the maximum allowable flow rates. The design loads are shown for your use as a quick reference. The actual operating load is variable, and dependent upon the design flow rate per cell. Design loads are all based upon the recommended operating water level. Operating levels in excess of that recommended will result in loads exceeding the values stated. Consult a SPX CT representative for greater detail on this or any other subject.
3. WIND & SEISMIC LOADS: Reactions shown are the result of the wind/seismic load being applied perpendicular to the face of the tower structure. Loads are additive to the operating loads. Wind reactions can be calculated by multiplying by P, which is the wind pressure in psf for imperial units and kgf/m² for metric units. Seismic reactions can be calculated by design G.
4. SHIPPING WEIGHTS AND MAXIMUM OPERATING LOADS: Values shown in table include the optional equipment weights.
5. NON-STANDARD ANCHORAGE LOCATION: The anchor bolt dimension shown can be varied upon request. Consult a SPX CT representative for specifics and to insure that the appropriate modifications are added to the structure.
6. PIER SUPPORTS: The tower may be supported from piers at each anchor bolt location as an alternate. A pier should be at least 6" (152 mm) x 6" (152 mm).
7. VIBRATION ISOLATORS: The towers may be supported on vibration isolators. The isolators must be placed UNDER the supporting steel beams and not between the support beams and the tower.
8. The tower assembly tolerance applicable to all dimensions is + or - 1/8" (3 mm). Consult suppliers of supporting structure for construction tolerances.
9. The units of measure are in IP (SI) units unless otherwise noted.

ECO NUMBER		NC8413XAS5GGF - Supporting Steel Plan and Details Juniper Rfq for Lake Charles Westlake, LA, United States							
REV. BY	CHECKED								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
		RICKY WILSON_141119_124418252 V2	05/12/15	QTC	SYS	10100890 C01	1=1	RW561065G	

Marley AN SPX BRAND



Cosed Face C



Interior View

NOTES

1. The fan motor must be locked out and inoperable before entering the tower. This warning has been placed on the access door.
2. Horizontal Control (HC) valves can withstand a maximum static shutoff pressure of 25 psi (172 kPa)
3. Full flat face flange gaskets are supplied by SPX CT.
4. An incoming riser and manifold must allow clearance for entry to the tower access doors. 4'-2" (1270 mm) is the minimum clearance needed to clear the optional access door or motor access platform.
5. To insure maximum thermal performance the cooling tower must be installed level and plumb. Both of the air inlet faces must have adequate air supply. If obstructions exist, consult your SPX CT representative.
6. Hoisting clips are provided for ease of unloading and positioning. For overhead lifts or where additional safety precautions are prudent, add slings beneath the tower. Adequate space has been provided for removal of the shackles and the 5 1/4" (133 mm) long pins from the hoist clips between the cells of a multi-cell tower. If the pin used is longer than 5 1/4" (133 mm), the cell may be slid into it's final position by using come-alongs at the base of the unit, after removal of shackle pins. See Hoisting Details drawing.
7. The vertical weight of the piping illustrated within the tower perimeter may be supported by the tower structure. All other piping shall be supported independent of the tower (see section A-A for specific details). The piping, their supports, the design of both piping and supports, and the lateral restraint of piping loads shall be supplied by others.
8. Flanged connections conform to Class 125 ANSI B16.1 specification. The bolt holes straddle the centerlines.
9. Construction of the ladder and guardrail: The guardrail is fabricated from galvanized structural tubing. Top rail, middle rail and posts are 1 1/2" (38 mm) square tube 1/8" (3 mm) thick. Toeboards are 12 gauge heavy mill galvanized steel. The ladder is aluminum 3" (76 mm) x 1 1/8" (29 mm) I-beam side rails and 1 1/4" (32 mm) serrated rungs.
10. The ladder and guardrail are field installed by others. The tower is shop modified to accept this option. The clips and hardware are provided by SPX CT for the field installation. The installation detail drawings are included in the literature package shipped with the tower.
11. Ladder extensions are provided in nominal lengths of 5' (1524mm) and 11' (4572mm) only. Field modification by others is required for extensions of different lengths. Anchorage of the bottom of the ladder extension for proper stability is by others.
12. O.S.H.A. standards recommend the use of a Safety Cage when the length of a single ladder exceeds 20'-0" (6096 mm).
13. The Fan Deck Extension is field assembled by others. The tower is shop modified and all attaching clips and fasteners are provided by SPX CT. Assembly details are included in the Literature Package shipped with the tower.
14. The Plenum Walkway consists of 11 gauge steel supports and 16 gauge steel walkway panels. The elevation of the Plenum Walkway is above the overflow water level of the collection basin. The distance from the top of the Plenum Walkway to the fan is 18'-4 7/8" (5610 mm).
15. The Interior Mechanical Equipment Platform consists of the Plenum Walkway plus an elevated platform for access to the mechanical equipment. A ladder is provided from the Plenum Walkway to the elevated platform along with a handrail system for the elevated platform.
16. The distance from the elevated platform to the fan exceeds 7'-0 13/16" (2154 mm).
17. O.S.H.A. standards recommend the use of an Access Door Platform if the door is 4'-0" (1219 mm) or higher above grade.
18. The tower assembly tolerance applicable to all dimensions is + or - 1/8" (3 mm). Consult suppliers of supporting structure for construction tolerances.
19. The units of measure are in IP (SI) units unless otherwise noted.

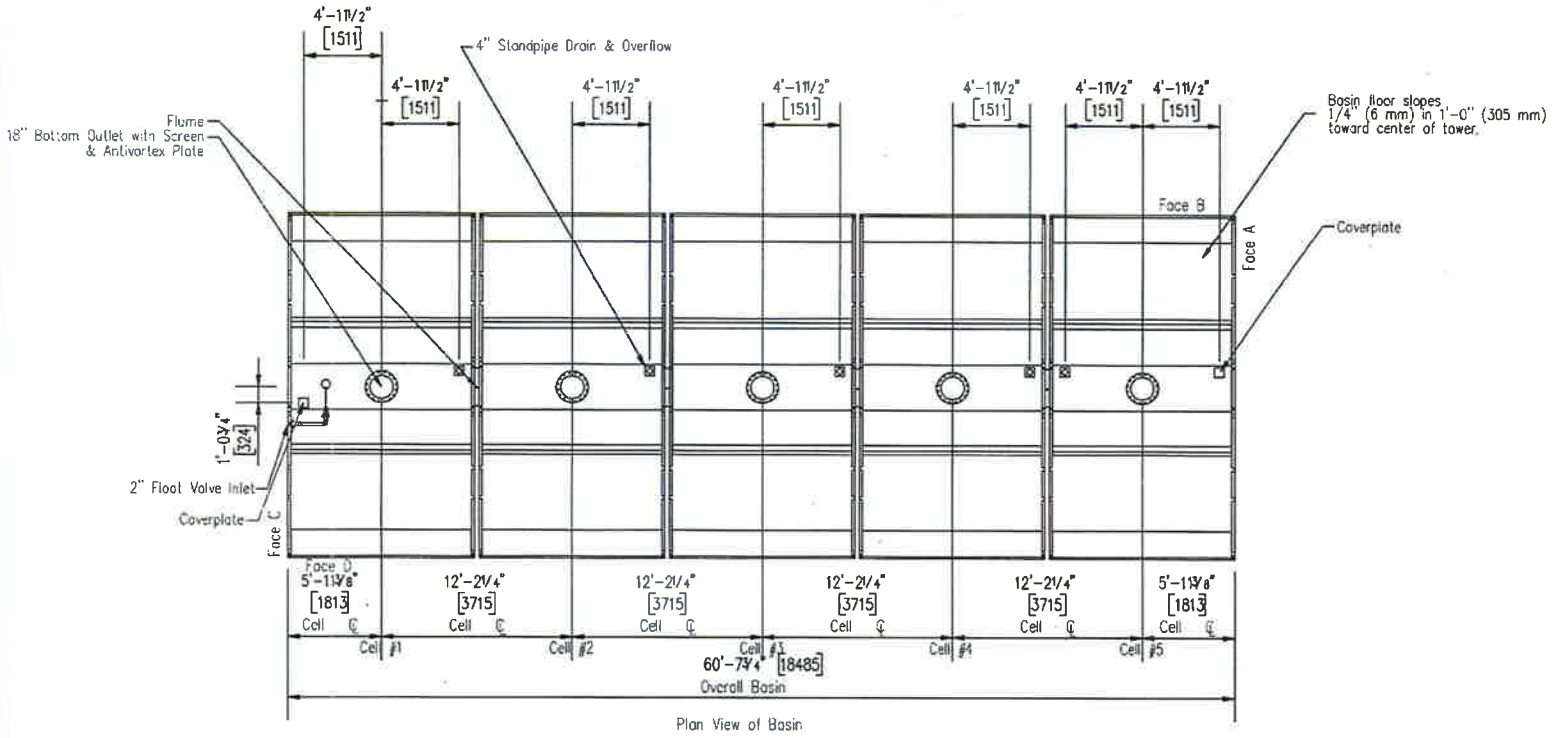
CLIENT APPROVAL

- ☐ Approved, No Comments
- ☐ Approved, With Comments
- ☐ Not Approved
- ☒ Final

Richard Frost 7/20/15

SIGNATURE DATE

ECO NUMBER		NC8413XAS5GGF - Schematic Cased Elevation and Notes Juniper Rfq for Lake Charles Westlake, LA, United States							
REV. BY	CHECKED								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
		RICKY WILSON_141119_124418252 V2	05/12/15	CTC	SYS	10100890 C01	1=1	RW561065M	



CLIENT APPROVAL

- ☐ Approved, No Comments
- ☐ Approved, With Comments
- ☐ Not Approved
- ☒ Final

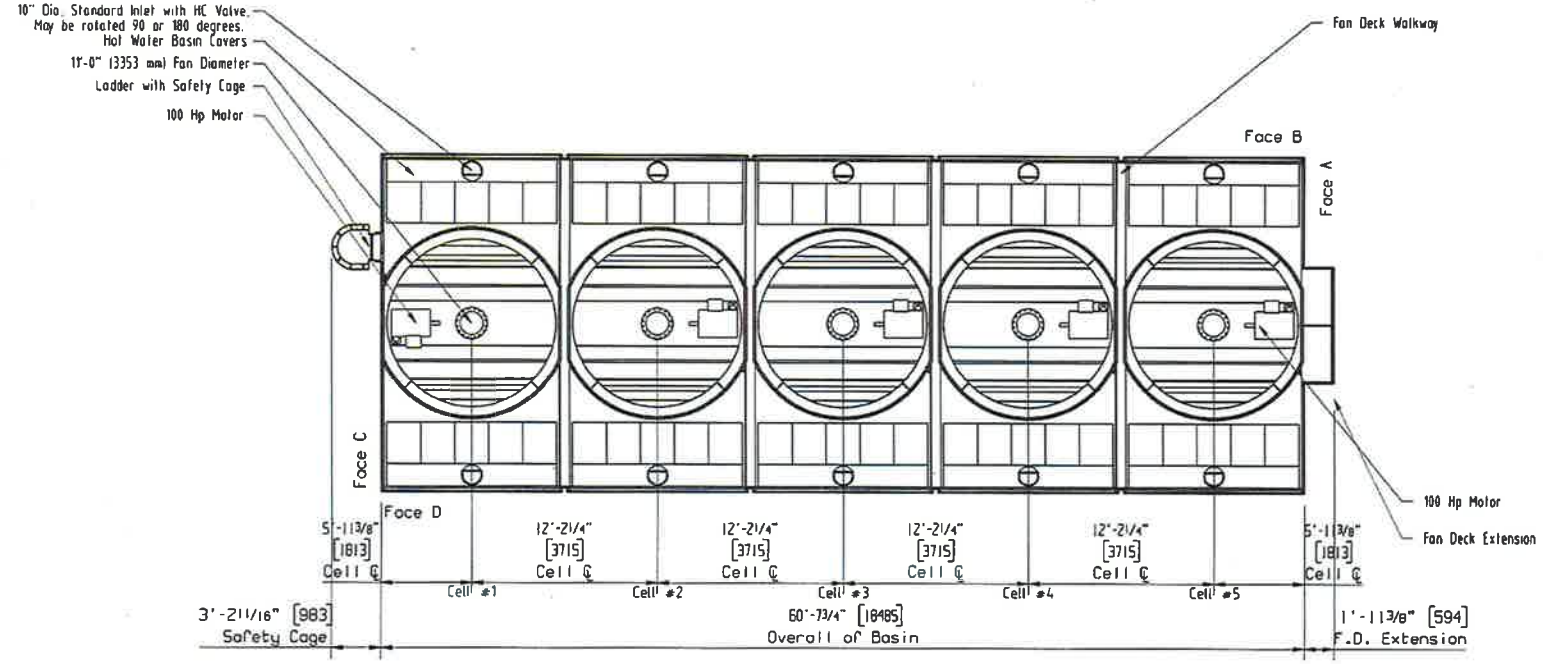
Richard D Fort 7/20/15

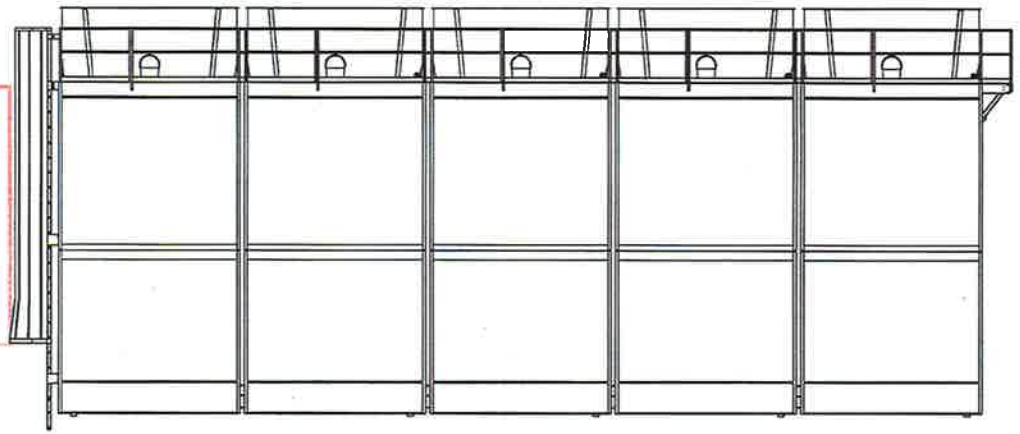
SIGNATURE DATE

NOTES

1. All piping supports are by others. Do NOT support outlet piping from the tower.
2. The collection basin piping accessories shown on this drawing are furnished by SPX CT. This includes a full faced gasket. Flat faced flange, fasteners and seal washers attachment to the outlet are supplied by others. The use of a flange other than a flat faced flange will damage the collection basin floor.
3. The standpipe overflow is to be field installed by others.
4. The design operating loads shown in the table on the Grillage Details drawing are based upon the volume of water in the collection basin at shutdown. The shutdown water level has been sized to accommodate the maximum allowable flow rates. The actual operating load is variable, and is dependent upon the design flow rate per cell. Design loads are all based upon the recommended operating water level. Operating levels in excess of that recommended can result in loads exceeding values stated. Consult a SPX CT representative for greater detail on this or any other subject.
5. Basin flumes are shipped inside the tower and are to be field installed by others. The connecting collars are shop installed.
6. The tower assembly tolerance applicable to all dimensions is + or – 1/8" (3 mm). Consult suppliers of supporting structure for construction tolerances.
7. The units of measure are in IP (SI) units unless otherwise noted.

ECO NUMBER	REV. BY	CHECKED	NC8413XAS5GGF – Piping Plan Juniper Rfq for Lake Charles Westlake, LA, United States								
	JGH										
REV. DATE	DRAWN BY		DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.		
05/15/15	RICKY WILSON_141119_124418252 V2		05/12/15	QTC	SYS	10100890 C01	1=1	RW561065P	A		





CLIENT APPROVAL

- ☐ Approved, No Comments
- ☐ Approved, With Comments
- ☐ Not Approved
- ☒ Final

Richard D Frost 7/20/16

SIGNATURE DATE

NOTES

1. The tower assembly tolerance applicable to all dimensions is + or - 1/8" (3 mm). Consult suppliers of supporting structure for construction tolerances.
2. The units of measure are in IP (SI) units unless otherwise noted.
3. See Schematic Cased Elevation and Notes drawing for additional notes.

ECO NUMBER		NC8413XAS5GGF - Schematic Plan and Louver Elevation Juniper Rfq for Lake Charles Westlake, LA, United States							
REV. BY	CHECKED								
REV. DATE		DRAWN BY	DATE	CHECKED	APPROVED	ORDER NUMBER	PLOT	DRAWING NUMBER	REV.
		RICKY WILSON_141119_124418252 V2	05/12/15	QTC	SYS	10100890 C01	1=1	RW561065S	