STYRENE PARK OFFSITE

Document Title:

Installation, Operation & Maintenance (Manual)

R0	09-03-2025	IFA	K.BASAMI	J.BEIGLOO	A.GHOLIZADEH
Rev.	**Issued Date**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**

REVISION RECORD SHEET

Page	Revisions								Page	Revisions						
	R0	R1	R2	R3	R4	R5	R6			R0	R1	R2	R3	R4	R5	R6
1	X								41	X						
2	X								42	X						
3	X								43	X						
4	X								44	X						
5	X								45	X						
6	X								46	X						
7	X								47	X						
8	X								48	X						
9	X								49	X						
10	X								50	X						
11	X								51	X						
12	X								52	X						
13	X								53	X						
14	X								54	X						
15	X								55	X						
16	X								56	X						
17	X								57	X						
18	X								58	X						
19	X								59	X						
20	X								60	X						
21	X								61	X						
22	X								62	X						
23	X								63	X						
24	X								64	X						
25	X								65	X						
26	X								66	X						
27	X								67	X						
28	X								68	X						
29	X								69	X						
30	X								70	X						
31	X								71	X						
32	X								72	X						
33	X								73	X						
34	X								74	X						
35	X								75	X						
36	X								76	X						
37	X								77	X						
38	X								…	X						
39	X								93	X						
40	X								94	X						

Table of Contents

1. INTRODUCTION

These instructions have been prepared to facilitate the erection, installation and maintenance of equipment supplied by DTT and offer customers best procurement conditions and delivery time of detail and spare parts requested.

The equipment assembly and erection operation procedures within this document shall be handled by qualified personnel with experience in the field of air-cooler erection in full compliance with API 661.

Erection and commissioning shall be carried out in strict conformity with the instructions of this manual. Any problems regarding the implementation of these instructions shall be filed and reported to DTT in writing (via email or fax) after sale service spec manual, which will answer as soon as possible.

DTT's responsibility cannot be engaged when the clauses of this document are not met, furthermore should any issue arise, please contact DTT.

Damafin Thermal Technology Co. (DTT)

Zamyad Street, Iran-Khodro Blvd., 14th Km Karaj Road, Tehran, Iran

Tel: (98) 21 44922312-14

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Email: sales@damafin.com

DETAIL/SPARE PARTS PROCUREMENT

SPARE PARTS AND SERVICE DEPARTMENT

For procurement of detail and spare parts, please contact DTT Sale Service Department. When ordering, please specify the following information:

DTT job No. (for example: 21105, 23153, 26102…).

DTT serial No. which is stamped on the tube bundle unit nameplate.

Item No. (for example: E601, 172 A01, etc.).

Description and reference No. of part.

MARKING SYSTEM

To facilitate the picking of parts, they are marked in the following pattern:

- 1st group: 3 Number Characters >> DTT's job number (DTT’s job number for this project is 1158)

- 2nd group: 1 Letter following a 2-Digit Number >> DTT's item number (DTT’s Item Code: A, B, C, … following DTT’s Bank Number:01, 02, 03, …)

- 3rd group: Numbering Code for Document (for common parts such as steel structure part number, see general part list)

- 4th group: 2 Number Characters >> Representing Document Series Number

Example: steel structure part of item: Drawing no.: 1158-A01-1100-00

Marking: Column: CL-1 or 1111-00

Note: some of identical parts for all items are not marked, such as

- Tie Rod
- Butt Straps
- Special Washer

2. THERMAL DATASHEET

STYRENE PARK OFFSITE

Document Title:

Air Cooler Thermal Data Sheet

Rev.	Issued Date	DESCRIPTION	PREPARED	CHECKED	APPROVED
R1	1-JUL-2024	IFA	H.Torshizi	H.Torshizi	B.Sheikhbeigi
R0	22-JUN-2024	IFA	H.Torshizi	H.Torshizi	B.Sheikhbeigi

REVISION RECORD SHEET

Page	Revisions								Page	Revisions						
	R0	R1	R2	R3	R4	R5	R6			R0	R1	R2	R3	R4	R5	R6
1	X	X							41							
2	X	X							42							
3	X	X							43							
4	X								44							
5									45							
6									46							
7									47							
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36									76							
37									77							
38									78							
39									79							
40									80							

API 661 Air-Cooled Heat Exchanger - Specification Sheet

Damafin Thermal Technology Co.

Based on GEA Btt-Batignolles Technologies Thermiques FRANCE

Job No.		Item No.	Air Cooler
Page	Page 1 of 2	By	
Date	June 30, 2024	Revision	R1
Proposal No.	02612N	Contract No.	
Inquiry No.		Order No.	
		No. of Item	2

Manufacturer		Damafin Thermal Technology Co.	Heat exchanged	(kW)	257.
Model no.			Surface/Item-Finned tube	(m2)	1579.2
Customer		ENER Teknoloji	Bare tube	(m2)	68.101
Plant location			MTD, Eff.	(Deg. C)	6.8
Service			Transfer rate-Finned	(W/m2-K)	25.561
Type draft		FORCED	Bare tube, service	(W/m2-K)	592.73
Bay size (WxL)	(m)	2.65 x 6.4	Bare tube, clean	(W/m2-K)	679.13
No. of bays/Items		1			

Basic design data

Pressure design code		ASME VIII div 1 + API 661	Structural code		UBC 97
Tube bundle code stamped		No.	Flammable service		Yes.
Heating coil code stamped		No.	Lethal/toxic service		No.

Performance Data - Tube Side

					In		Out	
Fluid name		Propane						
Total fluid entering	(kg/hr)	3015.5	Total flow rate (Liq/Vap)	(kg/hr)	0.0000 /	3015.5	3015.5 /	0.0000
Dew/bubble point	(Deg. C)	/	Water/Steam	(kg/hr)	0.0000 /	0.0000	0.0000 /	0.0000
	(Deg. C)		Noncondensables	(kg/hr)		0.0000		0.0000
Latent heat	(kJ/kg)		Molecular Wt. (Vap/Non-cond)		/		/	
Inlet pressure	(bar)	19.800	Density (Liq/Vap)	(kg/m3)	435.84 /	40.275	435.93 /	46.071
Pressure drop (All/Calc)	(bar)	0.100 / 0.018	Specific heat (Liq/Vap)	(kJ/kg-C)	3.6067 /	2.2738	3.6049 /	2.3920
Velocity (Allow/Calc)	(m/s)	/ 0.85	Thermal cond. (Liq/Vap)	(W/m-C)	0.0764 /	0.0253	0.0764 /	0.0238
Inside fouling resistance (m2-K/W)		0.000170	Viscosity (Liq/Vap)	(cP)	0.0730 /	0.0106	0.0730 /	0.0103
		In / Out						
Temperature	(Deg. C)	73.50 / 56.32						

Performance Data - Air Side

Air inlet temperature	(Deg. C)	48.00	Face velocity	(m/s)	3.15
Air flow rate/item	(m3/s)	45.529	Minimum design ambient temp	(Deg. C)	5.00
Mass velocity	(kg/s-m2)		Altitude	(m)	20.000
Air outlet temperature	(Deg. C)	52.28	Static pressure	(Pa)	102.95
Air flow rate/fan	(m3/s)	26.879			

Design, Material, and Construction

Design pressure	(barG)	22 + F.V	**Heating Coil**		NO.
Test pressure	(barG)		No. of tubes		
Design temperature	(Deg. C)	120.00	Tube outside diameter	(mm)	
Min. design metal temp.	(Deg. C)		Tube material		
Tube bundle			Fin material and type		
Size (WxL)	(m)	2.5 X 6.4	Fin thickness	(mm)	
No./Bay		1	ASME Code, Sec. VIII, Div. 1		
Number of tube rows		4	Heating fluid		
Bundles in parallel		1	Heating fluid flow rate	(kg/hr)	
Bundles in series			Temperature (In/Out)	(Deg. C)	/
Structure mounting		Grade	Inlet pressure	(bar)	
Pipe rack beams			Pressure drop (All/Calc)	(kPa)	/
Ladders, walkways, platforms			Design temperature	(Deg. C)	
Structure surface prep.			Design pressure	(bar)	
Header surface prep.			Inlet/Outlet nozzle		/
Louver		NO.	**Header**		
Material			Type		Plug
Action control			Material		SA-516 Gr70(N)
Action type			Corrosion Allowance	(mm)	3
			No. of passes		4
			Tube / Tubesheet		Strength weld

API 661 Air-Cooled Heat Exchanger - Specification Sheet

Based on GEA Btt-Batignolles Technologies Thermiques FRANCE

Job No.		Item No.	Air Cooler
Page	Page 2 of 2	By	
Date	June 30, 2024	Revision	R1
Proposal No.	02612N	Contract No.	
Inquiry No.		Order No.	

Design, Material, and Construction (continued)

Header (continued)					
Slope / Split	1% on last pass / No				
Plug material	SA 350 LF2 CL.1				
Gasket material	Soft Iron				
Nozzle	No.	Size, (in)	Rating/Facing		
Inlet	1	4	#300		
Outlet	1	2	#300		
Vent					
Drain					
Chemical Cleaning					
Min. Wall Thk.					
Tube					
Material	SA-334 6				
Tube outside diameter	(mm)	25.400			
Min wall thickness	(mm)	1.651			

No./Bundle		140	
Length	(m)	6.096	
Pitch	(mm)	69.850	
Layout		Triangular	
Fin			
Type		Extruded	
Material		Aluminum	
Thickness (Base / Tip)	(mm)	1 / 0.24	
Selection temp.	(C)		
Outside diameter	(mm)	57.150	
Fin density	(fin/meter)	433.1	
ASME Code, Sec. VIII, Div. 1			
Customer Specifications			

Mechanical Equipment

Fan		
Manufacturer	Axial Fans Int Srl (or equivalent)	
No./Bay	2	
RPM	(Revs/min.)	
Diameter	(ft)	7
No. of blades		
Angle	(degrees)	
Pitch adjustment	100% Manual	
Blade material	Aluminium	
Hub material	Manufacturer Standard	
@design temp	(kW)	
@min. ambient temp		
Tip speed		
Driver		
Type	Electrical	
Manufacturer	OME ELECTRIC OR AVL	
No./Bay		
Driver (1)	(kW)	7.5

RPM		1500	
Service factor			
Enclosure		Exec / IP55	
Voltage		400	
Phase		3	
Cycle		50	
Fan noise level	(dB)	max 85	
Speed Reducer			
Type		V- belt	
Manufacturer			
No./Bay		2	
Service factor			
Speed ratio			
Support			
Vib. switch		YES	
Enclosure			

Controls - Air Side

Air recirculation		Louvers	
Degree control of outlet process temp.		Positioner	
(Max. Cooling),+/-	/	Signal air pressure (bar)	
Action on control signal failure		From	To
Fan pitch		From	To
Louvers		Supply air pressure (bar)	
Actuator air supply		From	To
Fan		From	To

Shipping

Plot area (WxL)	(m)	2.65 x 6.4	Total weight, Dry / Wet	(Kg) (Based On HTRI)	11,800 / 12,300
Bundle weight	(kg)		Shipping	(kg)	
Bay	(kg)				

1) STD. nominated power.

3. INSTALLATION AND ERECTION

3.1 DESCRIPTIONS

The following documents should be consulted before undertaking erection:
- This Instruction Manual
- Outline Drawing
- Supporting Steel Structure Erection Diagram
- Fan Drive Machinery Diagram
- Service Walkway Assembly and Installation Diagram
- Parts and Hardware Lists

Erection Sequence:
1 - Anchoring Verification
- Verification of Pieces
- Pipe Rack Level

2 - Main Steel Structure
- Civil Engineering Level
- Assembling

3 - Fan Hoods
- Fan Plenum
- Fan Ring

4 - Fan & Drive
- Bearings
- Speed Reducer (Belt & Pulley)
- Fans
- Motors

5 - Bundles
- Lifting

6 - Louvers
- Assembly
- Adjustment

7 - Finishing
- Guard
- Ladder and Walkway
- Sealing Strips

3.2 ASSEMBLY PROCEDURE OF A FORCED DRAFT AIR-COOLER

Pre-Assembling on the Ground in Modular or Semi-Modular Way

Lifting of The Pre-Assembled Tube Bundle onto The Rack or Platform:
Stage 1 - Front View of a Forced Draft Air-Cooler Unit. (Figure 3-1)

A Column
B Bracing
C Beam
D Tube Bundle
E Louver
F Plenum
G Fan Ring
H Fan Guard
I Support Mechanism

Stage 2 - 3D View of Assembled Steel Structure (Figure 3-2)

Stage 3 - including:
1- Assembly Operation of the Fan Ring and Plenums on the Ground
2- Assembly Operation of the Plenums and Structures (Figure 3-4)

Stage 4 - Assembling the Mechanisms on the Ground on Temporary Irons to be supplied by Company in charge of Assembly Operation (Figure 3-5)

Stage 5 - Fastening of the Mechanisms under the Fan Ring and Plenums of the uneven Modules (Figure 3-6)
The mechanisms of the even units will be lifted onto the platforms to be installed there after the modules and units are lifted. The fans can be installed also on the uneven modules.

Stage 6 - Lifting of the Tube bundles and Louvers (Figure 3-7)

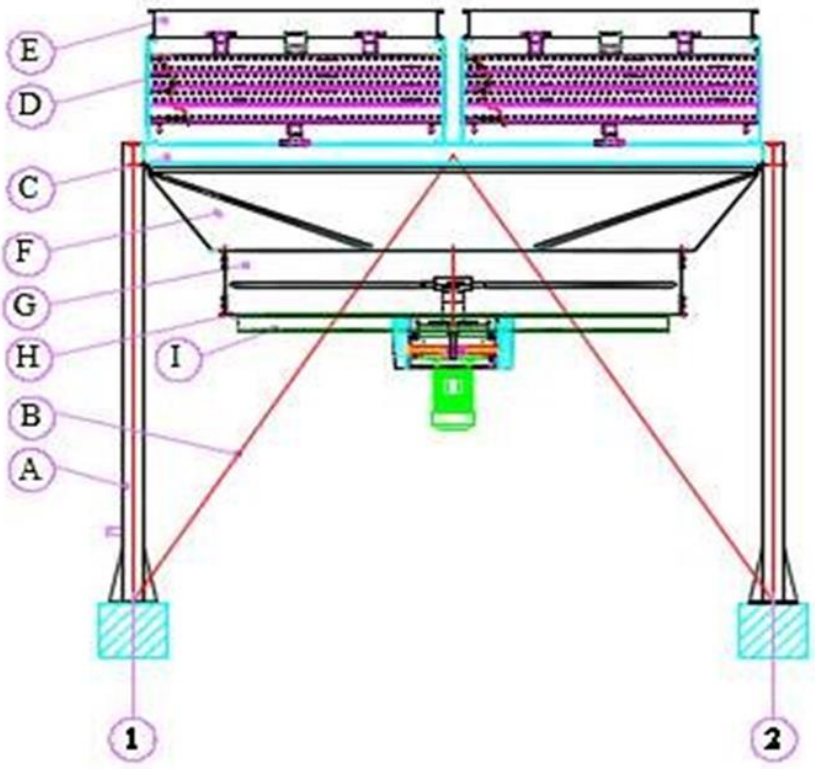


Figure 3-1

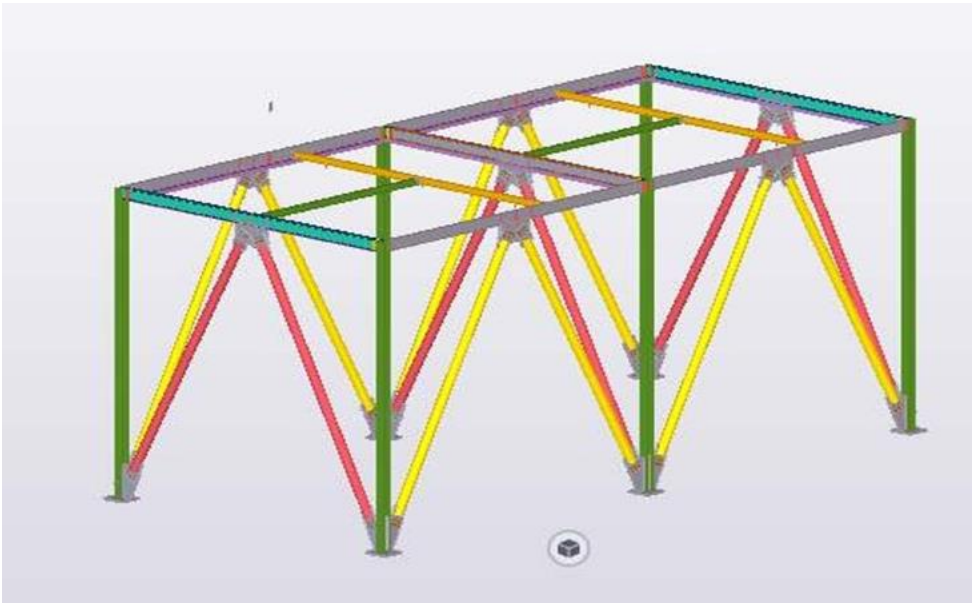


Figure 3-2

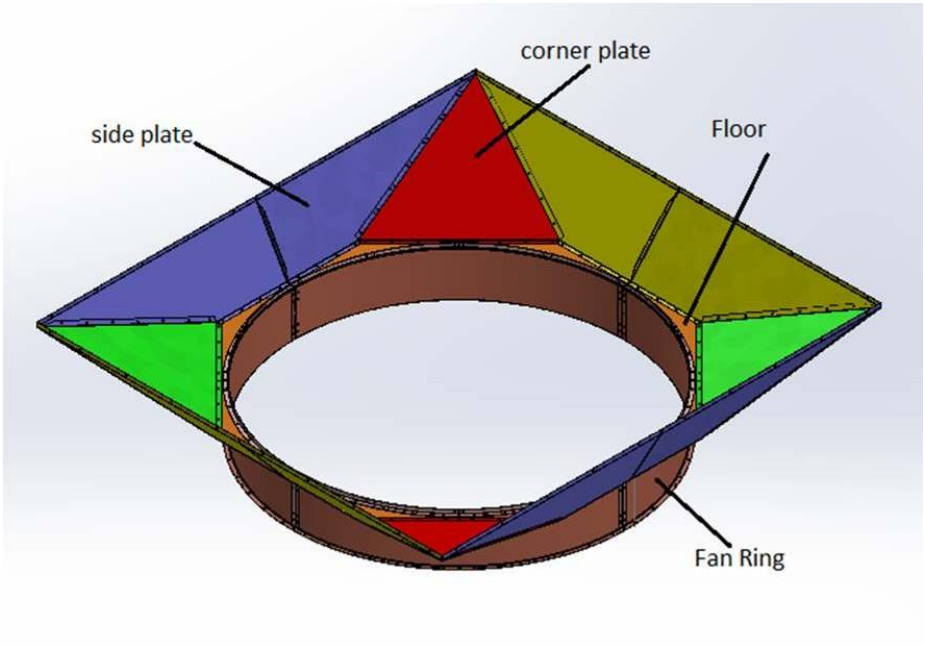


Figure 3-3

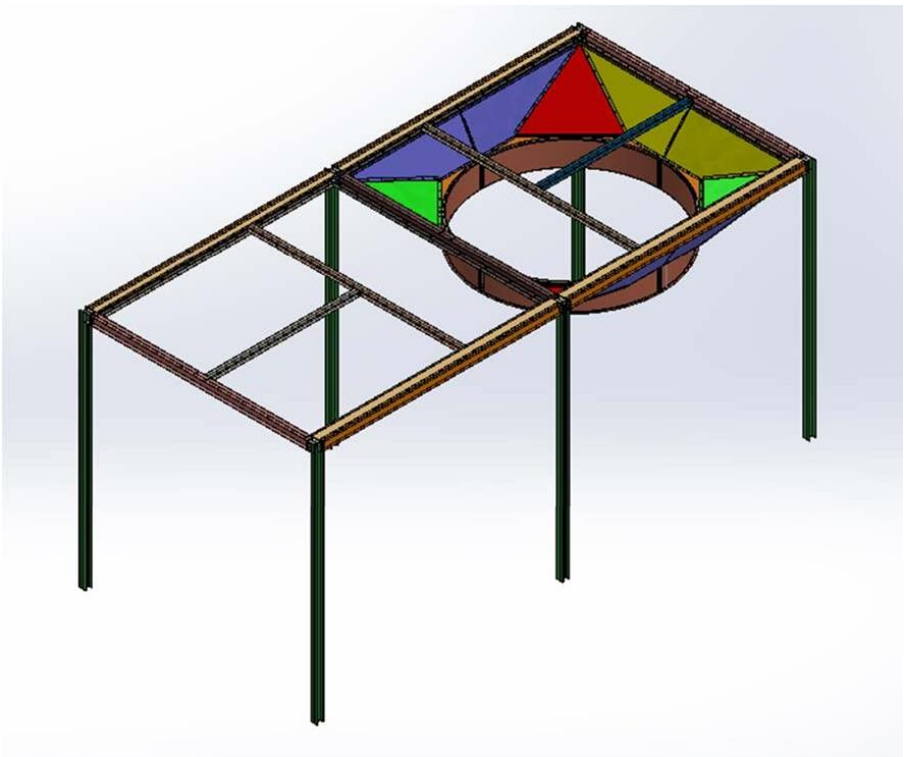


Figure 3-4

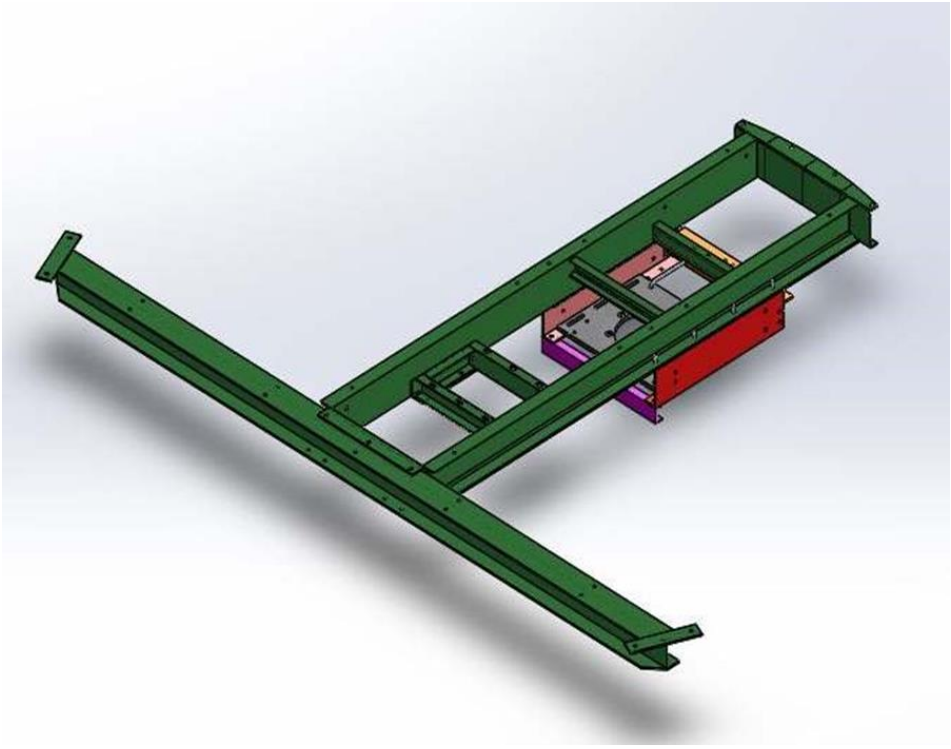


Figure 3-5

Figure 3-6

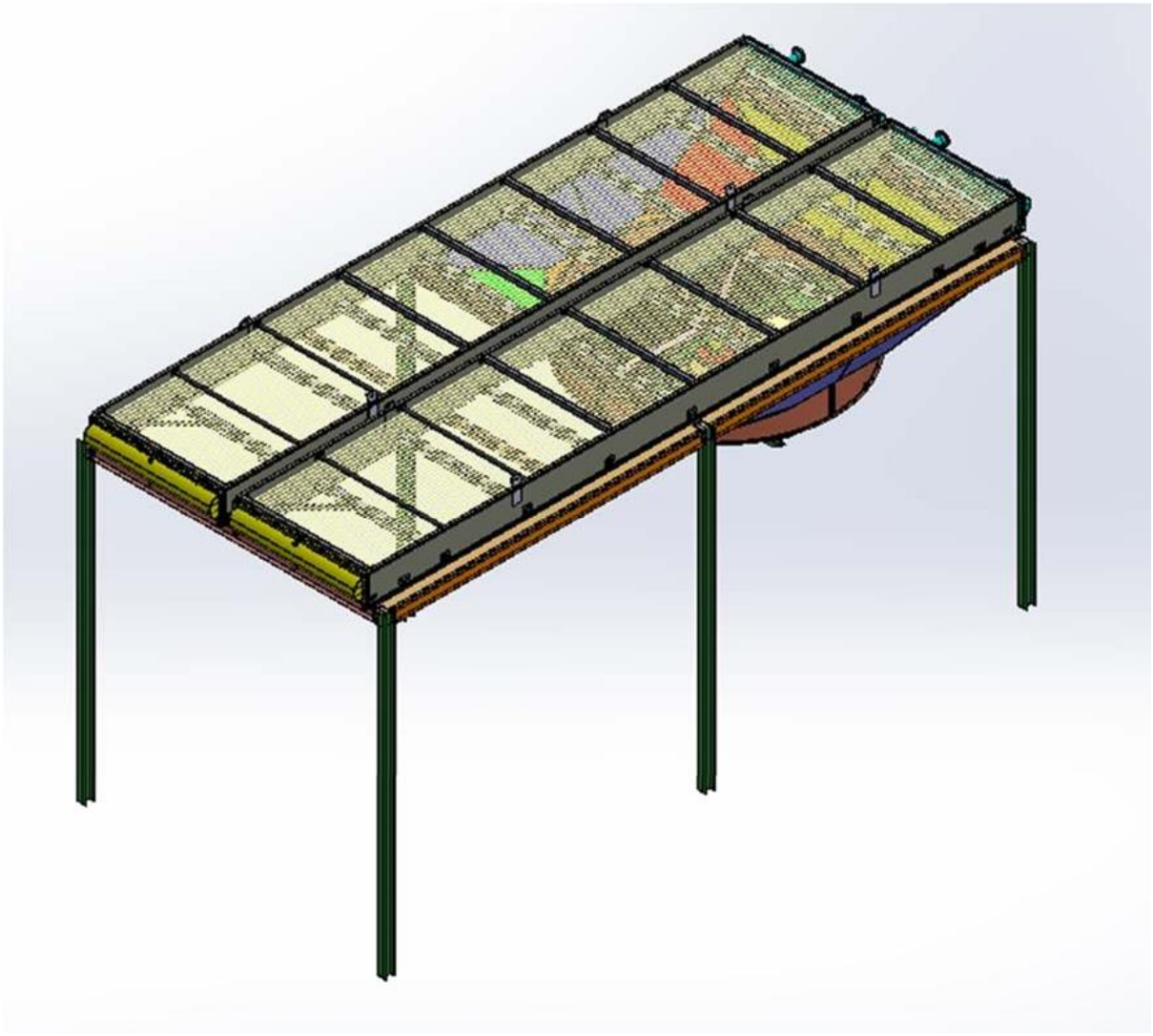


Figure 3-7

3-3 ANCHORING VERIFICATION

The foundations or supports (pipe rack) are to be supplied by the purchaser. They are to be in compliance with the dimensions shown on the DTT drawings as approved by the purchaser.

a) Foundation Case

The top surface of foundation footings/slabs shall be leveled within maximum tolerance of +0mm/-30mm from the elevation as specified by DTT. Anchor bolts must be arranged according to the purchaser (see limit of supply on drawings).

b) Substructure Case

The top surface of substructure which will be used as seating plan for items of equipment, as well as the holes drilled in it for bolts, must exactly comply with the dimensions shown on the DTT drawings approved by the purchaser.

The bolts to secure DTT items of equipment to the substructure top members are supplied by either DTT or the purchaser (see limit of supply on drawing).

IMPORTANT NOTE!

The erector must prior to undertaking erection work ensure that the substructure top surface is true leveled and flat, and they shall provide any shims required to obtain a true level seating plan.

3-4 MAIN STEEL STRUCTURE AND WALKWAY ASSEMBLY

The pieces of steel structure will be uncrated, picked out and verified with marks and quantities in regards to part lists.

The columns should be erected, if necessary, with shims under base plates so as to have their top flanges exactly at the elevation shown on DTT erection diagram. The cross beams, if any, as well as front and rear bracing members should be fitted then bolted. Finally, tighten the nuts of hook anchor bolts when bars have been previously embedded in concrete footings or place and grout the fishtail anchor bolts into concrete footing recesses.

For more information see “Steel Structure Drawing for Air Cooled Heat Exchanger (All Items)”.

WALKWAY ASSEMBLY

Consult DTT outline drawing, Platform installation diagram(s) and part list.

A. Bolt walkway frame brackets to the main steel structure columns or, in some cases, to the tube bundle frame members.

B. Bolt the walkway stringers onto walkway brackets or supports.

C. Place and secure the flooring sections using hardware or screws supplied for that purpose.

NOTE! When flooring consists of dropped-tear or checked/serrated steel plates, they are sometimes shop welded onto walkway supporting structure.

D. Install and secure ladders, after fitting the safety cages, if provided.

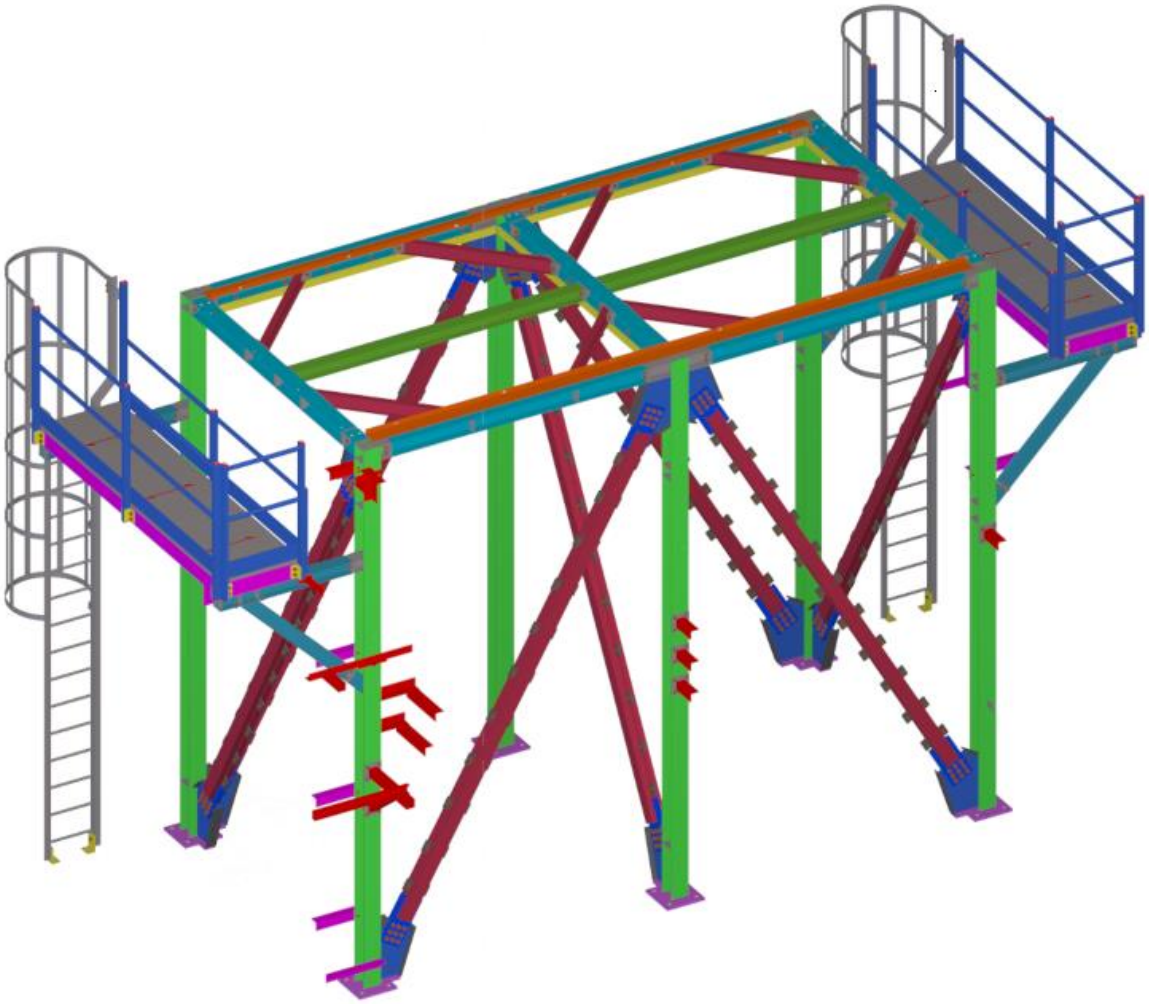
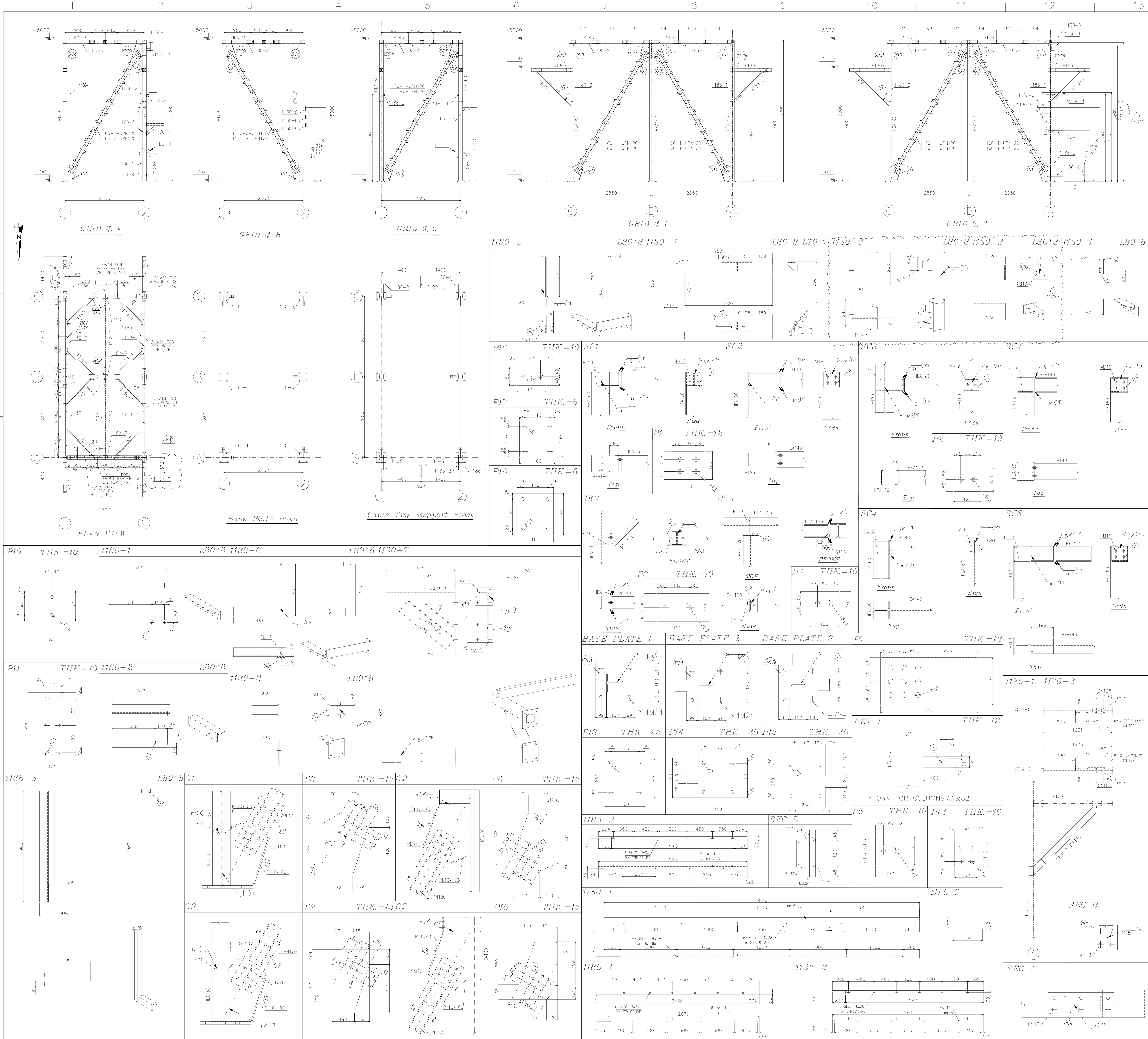


Figure 3-8 Steel Structure of Air Cooler
For Reference See “Steel Structure Drawing”
Document No.: EI027-DMF-VD-ST-DWG-013



TOTAL UNITS =2

PART LIST FOR 1 UNIT

PART NO.	DESCRIPTION	PROFILE	DIMENTION DIA (mm)	LENGTH (mm)	WIDTH (mm)	THK (mm)	MATERIAL	QTY.	UNIT WEIGHT (kg)	TOTAL WEIGHT (kg)	REV.
1110-1	COLUMN ASS.	HEA160		5000	-	-	ST-37(PAINTED.)	1	247.3	247.3	
1110-2	COLUMN ASS.	HEA160		5000	-	-	ST-37(PAINTED.)	1	246.8	246.8	
1110-3	COLUMN ASS.	HEA160		5000	-	-	ST-37(PAINTED.)	1	251.8	251.8	
1110-4	COLUMN ASS.	HEA160		5000	-	-	ST-37(PAINTED.)	1	249.8	249.8	
1110-5	COLUMN ASS.	HEA160		5000	-	-	ST-37(PAINTED.)	1	271.4	271.4	
1110-6	COLUMN ASS.	HEA160		5000	-	-	ST-37(PAINTED.)	1	269.6	269.6	
1130-1	PIPE SUPPORT ASS.	L80*8		257	-	-	ST-37(PAINTED.)	1	2.8	2.8	
1130-2	PIPE SUPPORT ASS.	L80*8		278	-	-	ST-37(PAINTED.)	1	3.4	3.4	
1130-3	PIPE SUPPORT ASS.	L80*8		282	223	-	ST-37(PAINTED.)	1	6.9	6.9	
1130-4	PIPE SUPPORT ASS.	L80*8 , L70*7		957	336	-	ST-37(PAINTED.)	1	11.9	11.9	
1130-5	PIPE SUPPORT ASS.	L80*8		463	362	-	ST-37(PAINTED.)	1	8.7	8.7	
1130-6	PIPE SUPPORT ASS.	L80*8		463	458	-	ST-37(PAINTED.)	1	9.6	9.6	
1130-7	PIPE SUPPORT ASS.	BOX80*80*8, UPN80		800	612	-	ST-37(PAINTED.)	1	25.2	25.2	
1130-8	PIPE SUPPORT ASS.	L80*8		235	-	-	ST-37(PAINTED.)	4	3.4	13.6	
1140-1	HORIZENTAL BRACING ASS.	IPE120		1358	-	-	ST-37(PAINTED.)	8	16.4	131.2	
1150-1	BEAM ASS.	HEA140		2393	-	-	ST-37(PAINTED.)	2	67.5	135	
1150-2	BEAM ASS.	HEA140		2393	-	-	ST-37(PAINTED.)	2	67.5	135	
1150-3	BEAM ASS.	HEA140		2437	-	-	ST-37(PAINTED.)	1	71.1	71.1	
1150-4	BEAM ASS.	HEA140		2437	-	-	ST-37(PAINTED.)	1	71.1	71.1	
1150-5	BEAM ASS.	HEA140		2437	-	-	ST-37(PAINTED.)	1	75.8	75.8	
1160-1	BRACING ASS.	UPN120		4934	-	-	ST-37(PAINTED.)	8	97.2	777.6	
1160-2	BRACING ASS.	UPN120		4914	-	-	ST-37(PAINTED.)	6	96.9	581.4	
1170-1	WALKWAY SUPPORT ASS.	HEA120		1235	-	-	ST-37(PAINTED.)	2	27.9	55.8	
1170-2	WALKWAY SUPPORT ASS.	HEA120		1235	-	-	ST-37(PAINTED.)	2	27.9	55.8	
1170-3	WALKWAY SUPPORT ASS.	IPE120		1439	-	-	ST-37(PAINTED.)	4	17.5	70	
1180-1	SEALING ASS.	PLATE		5570	182	2	ST-37(PAINTED.)	2	15.7	31.4	
1185-1	L SHAPE PLENUM	L70*7		2670	-	-	ST-37(PAINTED.)	2	19.7	39.4	
1185-2	L SHAPE PLENUM	L70*7		2670	-	-	ST-37(PAINTED.)	2	19.7	39.4	
1185-3	L SHAPE PLENUM	L70*7		2628	-	-	ST-37(PAINTED.)	4	19.4	77.6	
1186.1	CABLE TRY SUPPORT ASS.	L80*8		513	-	-	ST-37(PAINTED.)	3	5	15	
1186.1	CABLE TRY SUPPORT ASS.	L80*8		513	-	-	ST-37(PAINTED.)	4	5	20	
1186.1	CABLE TRY SUPPORT ASS.	L80*8		980	446	-	ST-37(PAINTED.)	2	13.7	27.4	
1188-1	TIE ROD BEAM ASS.	HEA120		2690	-	-	ST-37(PAINTED.)	2	55.2	110.4	
							TOTAL WEIGTH (kg)			4139.2	

LIST OF BOLTS & NUTS & WASHERS FOR 1 UNIT

PART NO.	DESCRIPTION	PROFILE	DIMENTION DIA (mm)	LENGTH (mm)	WIDTH (mm)	THK (mm)	MATERIAL	QTY.	UNIT WEIGHT (kg)	TOTAL WEIGHT (kg)	REV.
1190-1	for BEAM ASS.	-	M16	50	-	-	DIN 933-8.8 (DACROMET.)	56	-	-	
1190-2		-	M16		-	-	DIN 934-8 (DACROMET.)	56	-	-	
1190-3		-	A17		-	-	DIN 125A-ST (DACROMET.)	112	-	-	
1190-4	for BRACING ASS.		M20	70			DIN 933-8.8 (DACROMET.)	126			
1190-5			M20				DIN 934-8 (DACROMET.)	126			
1190-6			A21				DIN 125A-ST (DACROMET.)	252			
1190-7		-	M16	45	-	-	DIN 933-8.8 (DACROMET.)	154	-	-	
1190-8		-	M16		-	-	DIN 934-8 (DACROMET.)	154	-	-	
1190-9		-	A17		-	-	DIN 125A-ST (DACROMET.)	308	-	-	
1190-10	for HORIZENTAL BRACING ASS.	-	M16	45	-	-	DIN 933-8.8 (DACROMET.)	32	-	-	
1190-11		-	M16		-	-	DIN 934-8 (DACROMET.)	32	-	-	
1190-12		-	A17		-	-	DIN 125A-ST (DACROMET.)	64	-	-	
1190-13	for WALKWAY SUPPORT ASS.	-	M16	45	-	-	DIN 933-8.8 (DACROMET.)	8	-	-	
1190-14		-	M16		-	-	DIN 934-8 (DACROMET.)	8	-	-	
1190-15		-	A17		-	-	DIN 125A-ST (DACROMET.)	16	-	-	
1190-16		-	M12	40	-	-	DIN 933-8.8 (DACROMET.)	40	-	-	
1190-17		-	M12		-	-	DIN 934-8 (DACROMET.)	40	-	-	
1190-18		-	A13		-	-	DIN 125A-ST (DACROMET.)	80	-	-	
1190-19	for TIE ROD BEAM ASS.	-	M16	45	-	-	DIN 933-8.8 (DACROMET.)	8	-	-	
1190-20		-	M16		-	-	DIN 934-8 (DACROMET.)	8	-	-	
1190-21		-	A17		-	-	DIN 125A-ST (DACROMET.)	16	-	-	
1190-22	for PIPE SUPPORT ASS.	-	M12	40	-	-	DIN 933-8.8 (DACROMET.)	36	-	-	
1190-23		-	M12		-	-	DIN 934-8 (DACROMET.)	36	-	-	
1190-24		-	A13		-	-	DIN 125A-ST (DACROMET.)	72	-	-	
1190-25	for CABLE TRY SUPPORT ASS.	-	M12	40	-	-	DIN 933-8.8 (DACROMET.)	18	-	-	
1190-26		-	M12		-	-	DIN 934-8 (DACROMET.)	18	-	-	
1190-27		-	A13		-	-	DIN 125A-ST (DACROMET.)	36	-	-	
1190-28	for L SHAPE PLENUM ASS.	-	M16	45	-	-	DIN 933-8.8 (DACROMET.)	48	-	-	
1190-29		-	M16		-	-	DIN 934-8 (DACROMET.)	48	-	-	
1190-30		-	A17		-	-	DIN 125A-ST (DACROMET.)	96	-	-	
1190-31	for SEALINGASS.	-	M12	30	-	-	DIN 933-8.8 (DACROMET.)	12	-	-	
1190-32		-	M12		-	-	DIN 934-8 (DACROMET.)	12	-	-	
1190-33		-	A13		-	-	DIN 125A-ST (DACROMET.)	24	-	-	

NOTES:

1- ALL DIMENSIONS ARE IN MILLIMETER .
2-ALL PARTS SHALL PAINTED ACCORDING TO EI027-DMF-VD-QC-PRO-024
3- BOLTS & NUTS & WASHERS SHALL BE DACROMET IN ACCORDANCE WITH ASTM - A153 OR EN ISO 1461
4- WELD: CONTINUOUS WELD.
MIN. HEIGHT OF FILLET WELD =0.7 x MIN. THK.
< MAX. THK. , IF MAX.THK.< 7mm
< MAX. THK.-1.5 , IF MAX.THK.> 7mm

TOLERANCES					
THE FOLLOWING VALUES ARE APPLICABLE TO THE DIMENSIONS THAT ARE NOT PROVIDED WITH TOLERANCES ON DRAWING					
NOMINAL DIMENSIONS PER MILLIMETER STEPS	0 200	201 800	801 2000	2001 5000	5001 & +
TOLERANCES ±	2	3	5	6	7
TOLERANCE ON CENTER DISTANCES ± 1.5					
THE TOLERANCES SHOWN HERE ARE NOT CUMULATIVE					

General Arrangement Drawing	1158-A01-1000-00	EI027-DMF-VD-ME-DWG-003
Bundle Frame Drawing	1158-A01-2400-00	EI027-DMF-VD-ME-DWG-007
Plenum Drawing	1158-A01-5110-00	EI027-DMF-VD-ME-DWG-011
Header Walkway Drawing	1158-A01-1200-00	EI027-DMF-VD-ST-DWG-014
Ladder Drawing	1158-A01-1520-00	EI027-DMF-VD-ST-DWG-015

REV	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	APPROVED BY	FINAL APPROVED BY
R3	12/30/2024	ISSUED FOR APPROVAL	J.M.	J.B.L	J.B.L	A.GHZ
R2	12/28/2024	ISSUED FOR APPROVAL	J.M.	J.B.L	J.B.L	A.GHZ
R1	11/13/2024	ISSUED FOR APPROVAL	J.M.	J.B.L	J.B.L	A.GHZ
R0	09/01/2024	ISSUED FOR APPROVAL	J.M.	J.B.L	J.B.L	A.GHZ

CLIENT: ENER TEKNOLOJI

CONTRACTOR: dtt Damafin thermal technology
Factory : Km 14 special Karaj road

PROJECT : AIR COOLER FOR
Toase-ehe Park Sanati Gohar Ofogh Petrochemical Co.
Steel Structure Drawing
1158-A01-1100-00

DWG. NO. EI027-DMF-VD-ST-DWG-013

SCALE : NTS SIZE : A1 REV. : R3

3-5 FAN HOOD

3-5-1 Fan Ring Assembly

- On the floor, position the 4 quarter sections of fan ring.

- Connect the 4 quarter sections together, using the fixing plates with provided bolts and nuts. (See Fan Ring Drawing)

See Figure 3-9

3-5-2 Plenum Assembly on the Assembled Fan Ring

- Place the 4 quarter sections of floor plate (octagonal plates) on the corresponding side of the assembled fan ring.

- The octagonal plates junction shall be positioned at a 45-degree angle relative to the junction of fan ring sections.

- Install the angle brackets, superimposing them over the quarter floor. Link the angle brackets, quarter floor and ring with the hardware.

- Position the fan hood side sheets (trapezoid plates) to rest over the quarter floor plates. Link them to each other with the inside clamps. Maintain the side sheets at the ends using support parts (wooden blocks).

NOTE! The side sheets are symmetrical.

- Position the corner sheets (triangular plates) to rest over the quarter floor and link with the quarter floor and side sheets. (**WARNING! The corner sheet butt plates are located outside the fan hood**). The corner sheets are symmetrical.

The ring is locked after installation of the blades and adjustment of a correct clearance on the blade tip.

The butt plates enable the ring to be widened.

For storage purpose (according to the fan hood geometry) it is possible to stack 3-4 completely assembled plenums.

The screws are fitted with 2 washers, the nuts are located inside the plenum.

Fit the motors, the bearings, the fan pulleys and hub and accessories onto the machinery mount and assemble the unit according to the space requirement drawing(s).

See Figure 3-10 & 3-11

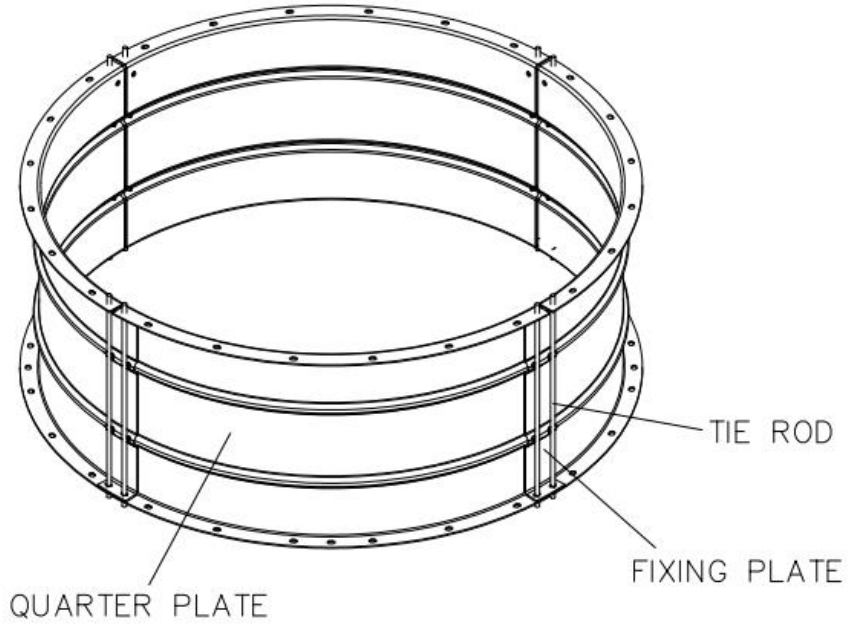
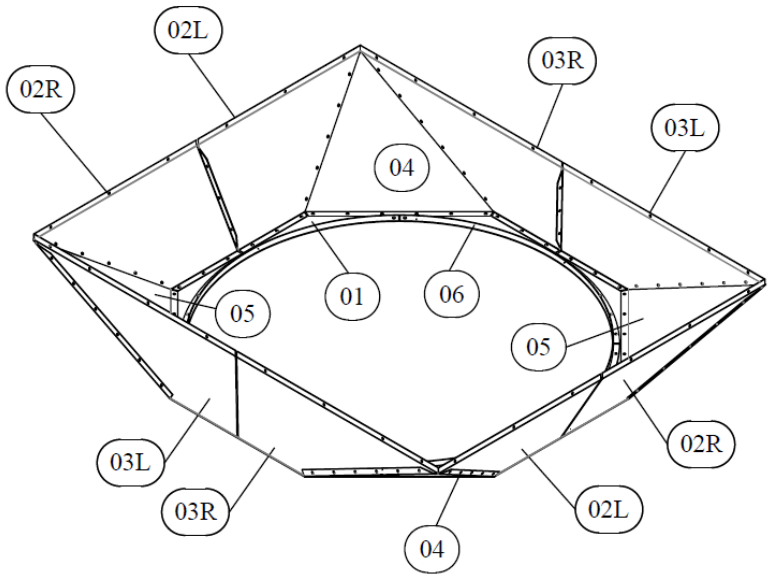


Figure 3-9 Assembled Fan Ring (All Items)



PART NO.	DESCRIPTION
01	Floor Plate (Octagonal Plate)
02R/02L/03R/03L	Side Plate (Trapezoid Plate)
04/05	Corner Plate (Triangular Plate)

Figure 3-10 Double Section Side Plate Plenum (All Items)

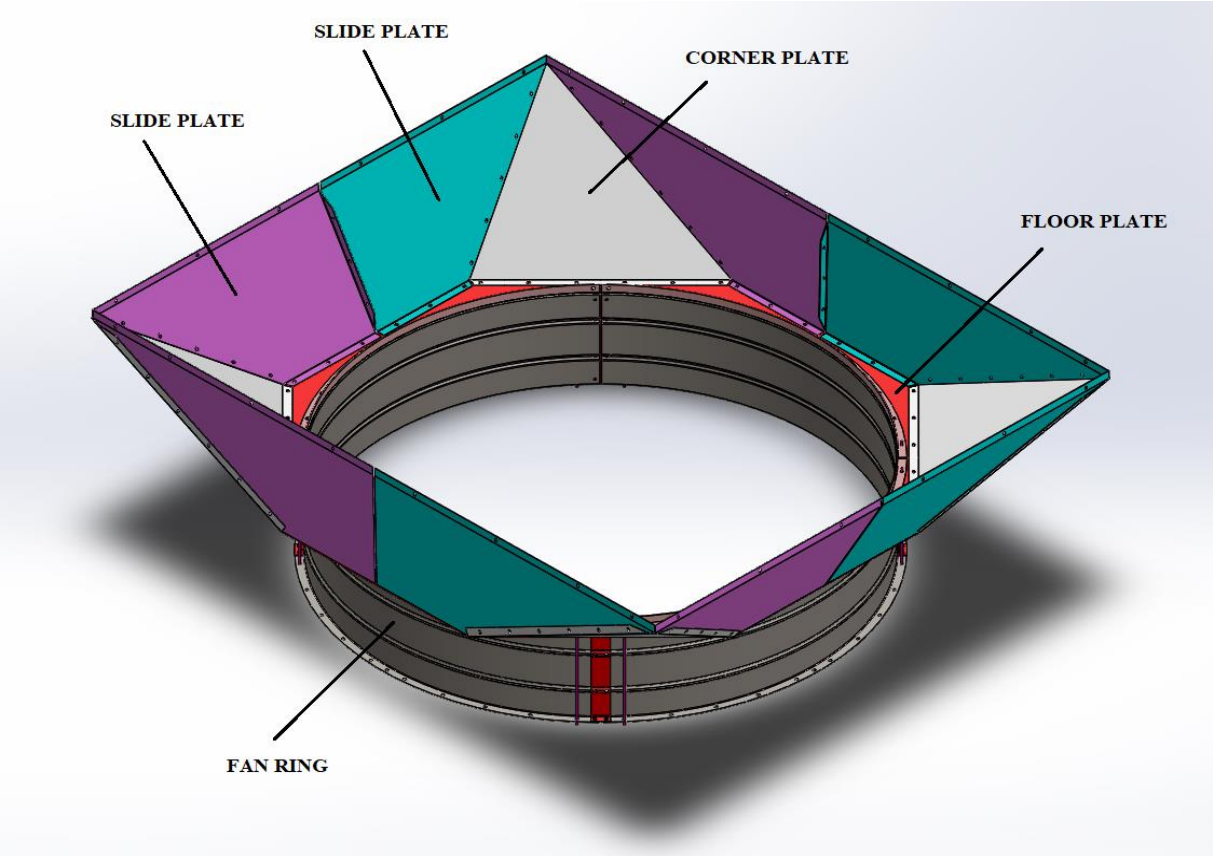


Figure 3-11 Assembled Fan Hood (Plenum + Fan Ring)

3-6 INSTALLATION OF FORCED DRAFT FAN BELT ARRANGMENT

3-6-1 INSTALLATION STEPS

A. Mechanism support, fan ring and plenum are to be assembled on the floor before being lifted and installed on the structure under the bundle frame. (See Figure 3-12)

B. The mechanism support shall be horizontally level by means of tie beams. (See Figure 3-13)

C. After step B, the screws connecting different sections of plenum together and also the screws connecting plenum to fan ring shall be completely tightened.

D. Install complete fan shaft assembly (Shaft+Bearing Blocks) on the mechanism support, but don't tighten the bolts. (See Figure 3-14)

Note! The fan shaft comes pre-assembled to the site.

E. Center the fan shaft with regard to the fan ring and make sure of its vertical alignment. After that, tighten the bolts connecting fan shaft to the mechanism support.

F. Install the driven pulley on the fan shaft.

G. Equip the motor with its motor support plate, the driver pulley and the motor support frame. (See Figure 3-15)

H. Hoist the motor assembly (electric motor + motor plate + motor support frame) and bolt it to mechanism support.

I. Slide the fan propeller hub to let it rest on shaft shoulder. Tighten hub securing bolts, then install the fan blades at angle setting required on project's thermal or fan datasheets. (See Figure 3-16)

(Refer to fan manufacturer's instructions attached in section 5.)

WARNING! Set the fan ring inside diameter to obtain 6-10 mm or 8-15 mm tip clearance for reinforced resin or aluminum blades respectively.

J. Unscrew the grease nipples from the fan shaft bearings to screw them into the lubrication block fitted on the side of the motor supporting frame (See Figure 3-17). Then connect copper (or stainless steel) lubricating lines between the two shaft bearings and the block using the fittings provided for this purpose.

K. Then install the belt of the fan drive systems.

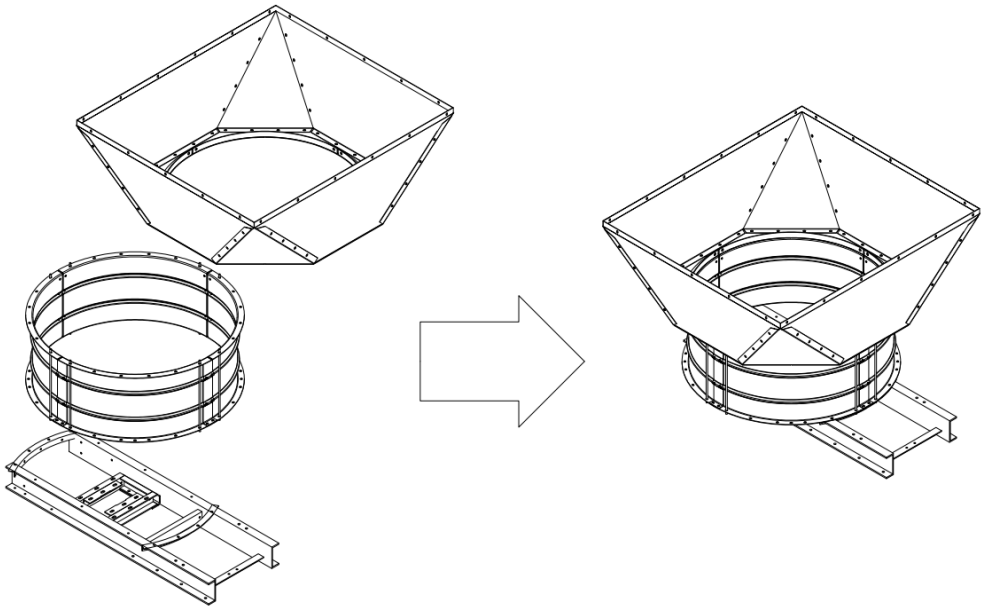


Figure 3-12 Assembly of Mechanism Support, Fan Ring & Plenum on the Floor

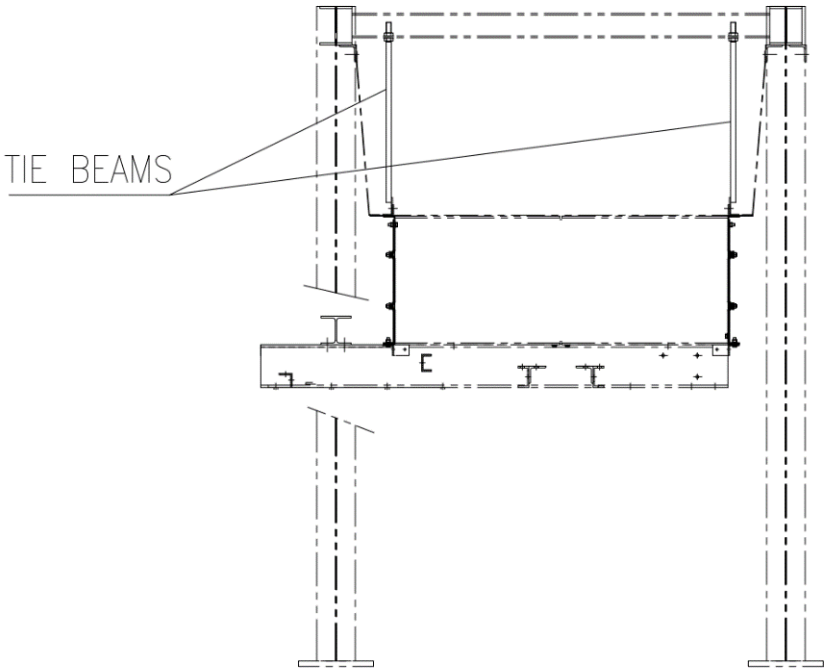


Figure 3-13 Connecting Support Mechanism + Fan Ring + Plenum
to Structure and Leveling by Tie Beams

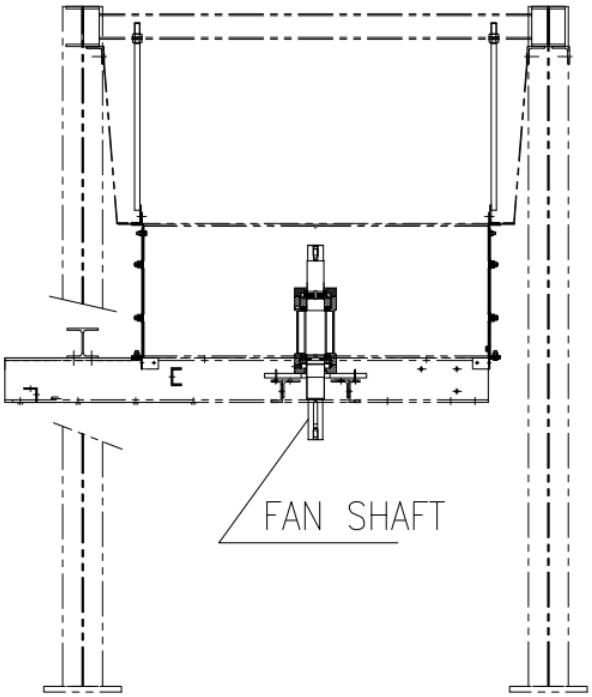


Figure 3-14 Installation of Fan Shaft on Mechanism Support

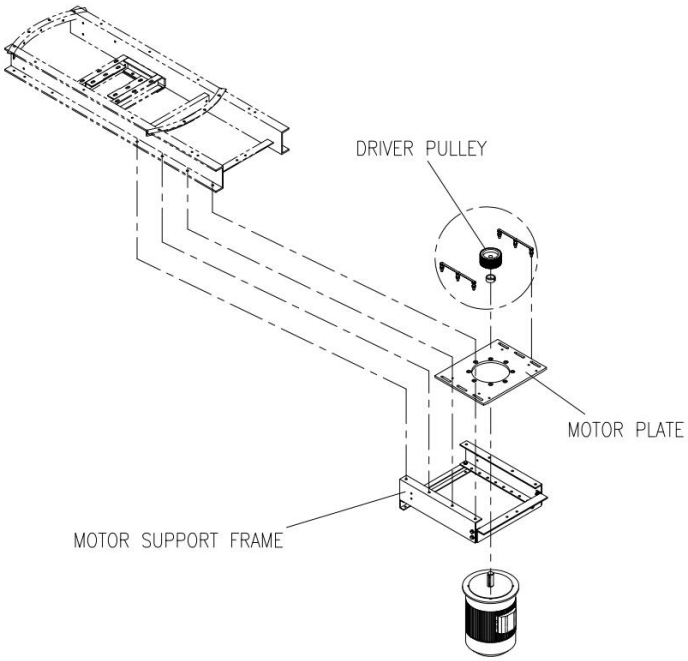


Figure 3-15 Motor Installation on Mechanism Support

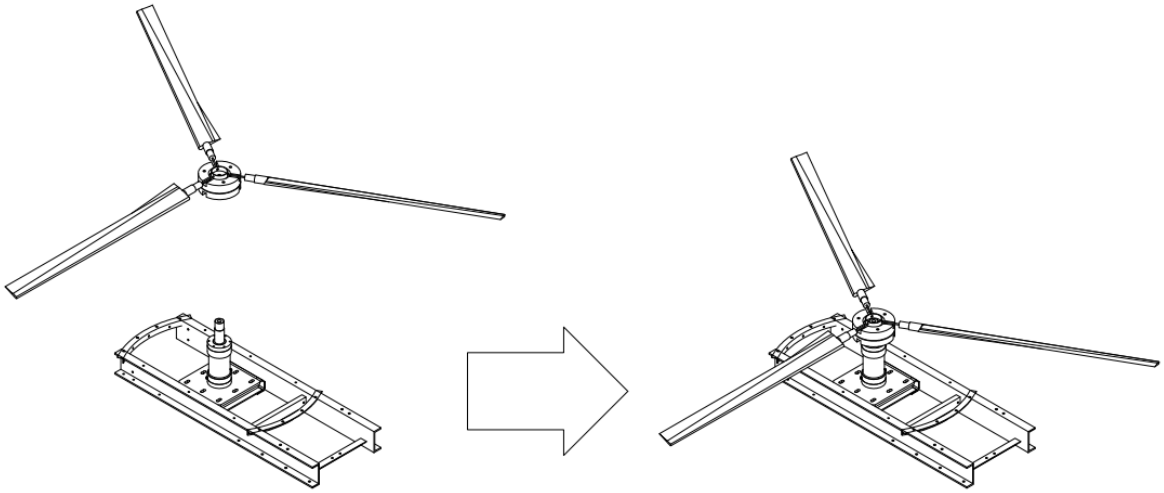


Figure 3-16 Fan Blade Assembly on Shaft Shoulder

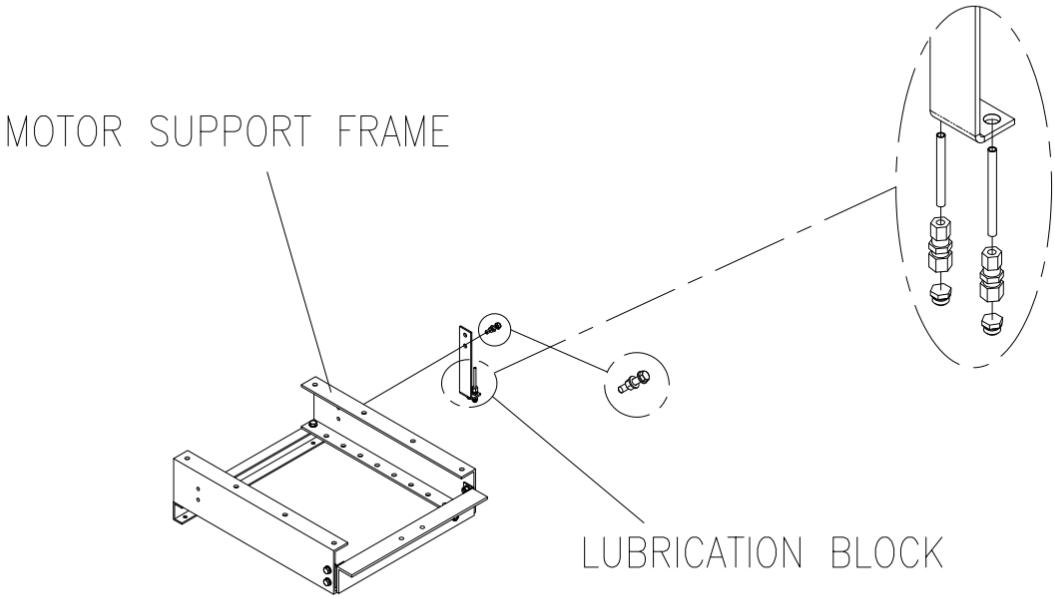


Figure 3-17 Lubrication Block Location

3-7 BELT DRIVE INSTALLATION

a. Paying special attention to the Machinery Diagram, make sure that motor baseplate is properly resting on the supporting slide members.

b. Align the driven pulley on the driving pulley. Both pulleys must be within one horizontal plane (see instruction on the following page).

c. After locking the pulley mounting hub bolts, check alignment again and correct if needed.

d. Loosen the motor securing bolt and slide the motor towards the fan shaft. Place the belts (see instructions on the following page) and tension them by means of the tensioning screws.

e. Turn fan propellers by hand to ensure that they operate freely and there are no obstacles to their starting up. Switch on the motors for an instant to check that the direction of rotation and blade positions are compatible. The leading edge is the thicker edge, which must be downwards. For reverse rotation, the motor supply phases should be reversed.

f. Check the motor power required, which must comply with the data (see the following page). Should power requirements not comply with specifications, adjust the blade angle accordingly.

g. Finally, install the belt guards.

3-7-1 PULLEY ALIGNMENT DIAGRAM

Align the driven pulley on the driving pulley. Both pulleys must be within one horizontal plane. After locking the pulley mounting hub bolts, check alignment again and correct if needed. (See figure 3-18)

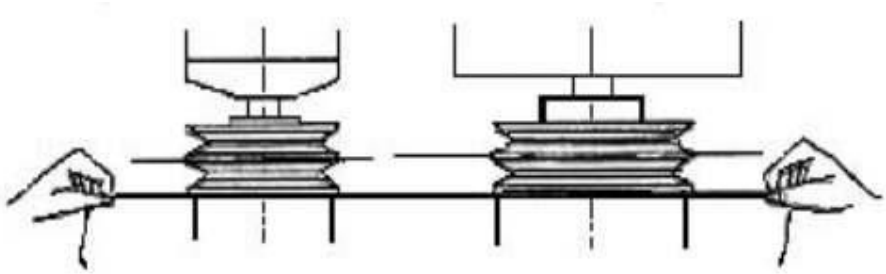


Figure 3-18 Pulley Alignment

3-7-2 INSTALLATION OF BELTS

Belts must be installed without induced forces. Some severe stresses would be placed upon belts if they are forced over the sheave flanges. It can seriously damage the cover fabric and the high quality, low stretch tension members.

3-7-3 BELT TENSIONING

The load C is to be applied at the right angle at the center of the belt span (See Figure 3-19). The drive must be tensioned until the calculated deflection F_a is obtained.

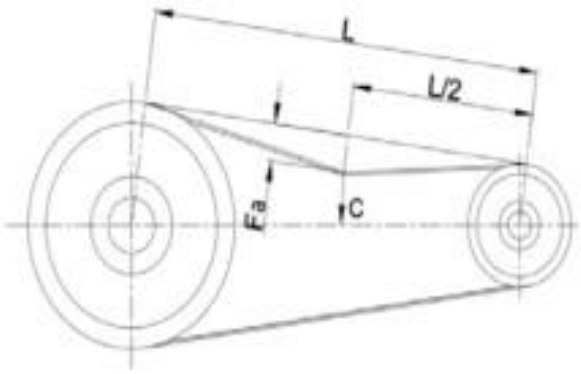


Figure 3-19 Belt Tensioning Load

For a first tension (new belts), take into account C for new belts. See Table 3-1 to check the values required to proceed with the following tensioning procedure:
Place gauge with load hook “A” in the center of the belt span with slider “B” overhanging to next the belt in set as illustrated. (See Figure 3-20)
Apply appropriate load (see Table 3-1) to belt section. At this load upper end of slider “B” should just come into contact with top of next belt in set for deflection F_a.

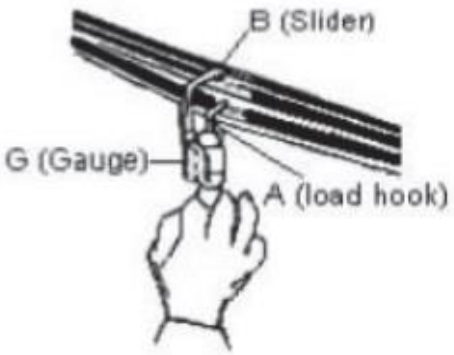


Figure 3-20 Belt Tensioning Procedure

Table 3-1

Item No.	BELT TYPE	TEST LOAD (N)	DEFLECTION (mm)
AIR COOLER	V-Belt Profile: NARROW (SPA)	New: 69 Used: 60	New: 11.6 Used: 11.6

3-7-4 CHECKING THE BELT DRIVES

a. Check the free rotation of fan by turning the fan propeller manually.

b. Check that whether belts are properly tensioned.

c. Switch on the motors for an instant to check if the direction of rotation is consistent with the blade angle and to ensure that there is no excessive vibration and overheating. Also record power requirements (measure current, power, etc.) and check if they comply with specifications.

d. After 5 to 10 hours in operation, take up the belt tension as required.

Procedure to Adjust Electric Fan Drive Motor Current Absorbed with Unit Being Shut-Down

NOTATION

$P = Absorbed\ Fan\ Power\ (kW) - Refer\ to\ Fan\ Datasheet$

$U = Line\ Voltage$

$I = Absorbed\ Current, Measured\ at\ Site\ while\ Fan\ Working$

$I_s = Calculated\ Absorbed\ Current$

$I_r = Absorbed\ Current, Corrected\ for\ Different\ Fan\ Blade\ Pitch\ Angle$

$E_m = Motor\ Efficiency$

$E_d = Drive\ Efficiency$

$PF = Power\ Factor$

$K = Correction\ Factor\ for\ Fan\ Blade\ Pitch\ Angle$

$T_c = Deliver\ Air\ temperature$

$T_a = Fan\ Outlet\ Air\ Temperature, Measure\ at\ Site$

CALCULATING ABSORBED CURRENT UNDER OPERATING CONDITION

- ***Item No.:*** **Air Cooler(@ Min. Temperature)**

- Fan Data
  P (Fan Absorbed Power) = 4.5 kW
  E_d (Drive Efficiency) = 95 % (V- Belt)
- Motor Data
  E_m (Motor Efficiency) = 90.4 %
  PF (Power factor) = 0.84

$$I_s = \frac{1000 \times P}{\sqrt{3} \times U \times PF \times E_d \times E_m}$$

$$I_s = \frac{1000 \times 4.5}{\sqrt{3} \times 400 \times 0.84 \times 0.95 \times 0.904} = 9.2\ A$$

CORRECTING CALCULATED ABSORBED CURRENT FOR FAN PITCH ANGLE

$$I_r = I_s \times K$$

$$K = \frac{273 + T_c}{273 + T_a}$$

For a forced draft unit, T_c equals the inlet air temperature (the lesser of the two specified on fan datasheet). If "I" measured during operation is different from I_r, adjust fan blade pitch so as to achieve I_r.

WARNING!

The "I" measured during operation shall never be exceeding the rated current specified on motor nameplate. If this happens, please inform DTT.

3-8 TUBE-BUNDLE INSTALLATION

When lifting a very large unit, it is recommended to use a 4-leg sling arrangement of sufficient length and place cross-bars between the lifting lugs to prevent any warp to tube-bundle frame (refer to figure 3-21).

Very large tube bundles are supplied by DTT equipped with cross bars between the lifting lugs. When bundles are delivered uncrated two by two, only the upper tube-bundle is equipped with cross bars (those are to be removed for handling the second tube-bundle).

Finally, remove transport temporary clips from tube-bundle frame and protective material from fin-tube layers as well as the cross bars.

IMPORTANT NOTE!

To avoid any damage to fin-tubes, refer to recommendations on diagram.
When the items are equipped with heating bundle, it is necessary to fix them under tube-bundle units; using special hardware components itemized in DTT part lists before lifting them on steel structure.

VERIFICATION OF BUNDLE INSTALLATION

Check that bolts connecting the <u>sliding header</u> to the side frame are removed after installation to allowe the free expansion of the tubes during operation.

Check that the protection material had been removed and do not get in the way of air flow. If required check that the sealing sheets are set between the bundle of the same bay to avoid the bypass of cooling air.

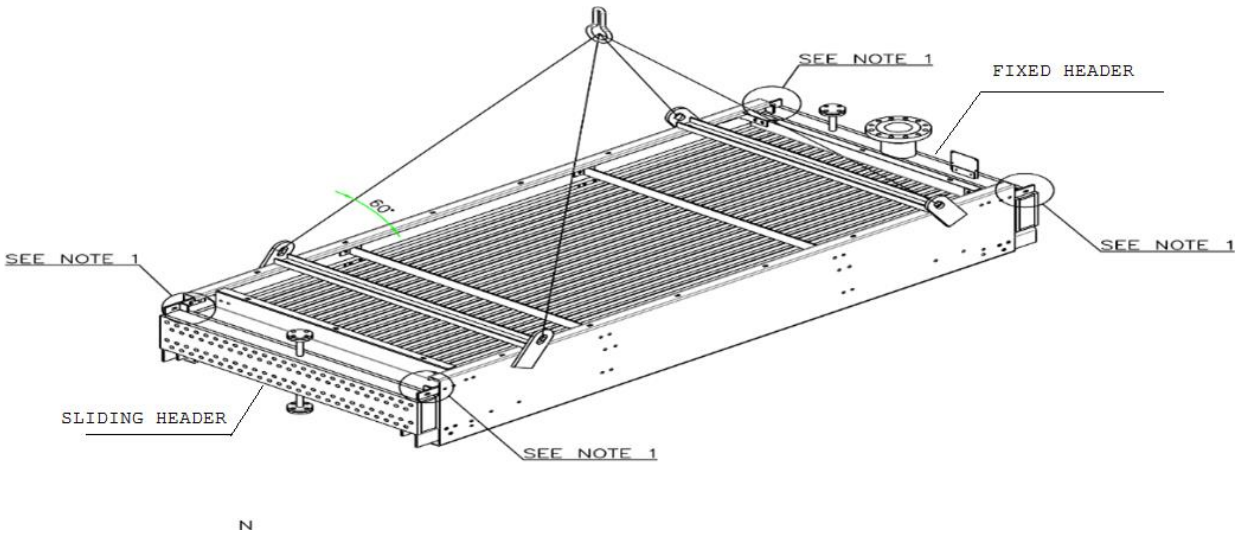


Figure 3-21

Note 1: Bolts which are used for fixing header to side frame should be locked during transportation. But make sure to remove these bolts on the <u>*sliding header*</u> side to allow free expansion of tubes during operation.

Ref : ECA201

ÉLINGUE CÂBLE 2 BRINS BOUCLES COSSÉES MANCHONNÉES ALU

Conforme à la norme EN 13414-1

CROCHETS À LINGUET (Réf. ECA201) / CROCHETS À VERROUILLAGE AUTOMATIQUE (Réf. ECA202)

Ref : ACCOL

Ref : ACCVO

Désignation	Ø câble mm	CMU en kg $0°<\beta\leq45°$ $0°<\alpha\leq90°$ Facteur 1,4	CMU en kg $46°<\beta\leq60°$ $91°<\alpha\leq120°$ Facteur 1	Dimensions maille A x B x Ø d mm	Passage crochets ECA201	Passage crochets ECA202	Longueur / Poids mini réalisable m	Longueur / Poids mini réalisable kg (ECA201)	Longueur / Poids mini réalisable kg (ECA202)	Poids du m + kg
08	8	950	700	120 x 70 x 16	34	33	1	2,10	2,64	0,462
10	10	1 500	1 050	135 x 75 x 18	34	33	1	2,74	3,28	0,722
12	12	2 120	1 550	150 x 90 x 20	40	43	2	5,00	5,82	1,040
14	14	3 000	2 120	150 x 90 x 22	41	47	2	7,50	9,36	1,416
16	16	3 850	2 700	170 x 95 x 25	41	47	2	10,44	12,30	1,848
18	18	4 800	3 400	170 x 95 x 25	52	61	2	12,50	15,60	2,340
20	20	6 000	4 350	200 x 120 x 28	52	61	2	15,60	18,70	2,888
22	22	7 200	5 200	200 x 120 x 30	52	61	2	18,30	21,40	3,494
24	24	8 800	6 300	250 x 150 x 36	60	78	2	25,20	34,20	4,158
26	26	10 000	7 200	250 x 150 x 38	60	78	2	28,60	37,60	4,880
28	28	11 800	8 400	250 x 150 x 38	80	90	3	43,60	49,80	5,660
32	32	15 000	11 400	300 x 200 x 45	80	90	3	57,60	63,80	7,394
36	36	19 000	14 000	300 x 200 x 50	90	102	3	79,00	85,00	9,358

Acier galvanisé - CMU établie sur base âme textile (possiblité âme métallique pour gamme CMU supérieure : nous consulter).

Ref : ECA202

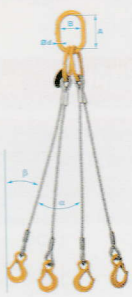
Ref : ECA301

Ref : ECA302

Autres élingues câbles disponibles : ÉLINGUE CÂBLE 3 BRIN - BOUCLES COSSÉES MANCHONNÉES ALU - Conforme à la norme EN 13414-1

CROCHETS À LINGUET (Réf. ECA301) / CROCHETS À VERROUILLAGE AUTOMATIQUE (Réf. ECA302) ..... *Nous consulter*

Ref : ECA401



ÉLINGUE CÂBLE 4 BRINS BOUCLES COSSÉES MANCHONNÉES ALU

Conforme à la norme EN 13414-1

CROCHETS À LINGUET (Réf. ECA401) / CROCHETS À VERROUILLAGE AUTOMATIQUE (Réf. ECA402)

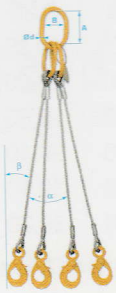
Ref : ACCOL

Ref : ACCVO

Désignation	Ø câble mm	CMU en kg $0°<\beta\leq45°$ $0°<\alpha\leq90°$ Facteur 1,4	CMU en kg $46°<\beta\leq60°$ $91°<\alpha\leq120°$ Facteur 1	Dimensions maille A x B x Ø d mm	Passage crochets ECA301	Passage crochets ECA302	Longueur / Poids mini réalisable m	Longueur / Poids mini réalisable kg (ECA301)	Longueur / Poids mini réalisable kg (ECA302)	Poids du m + kg
08	8	1 500	1 050	120 x 70 x 16	34	33	2	4,70	5,80	0,924
10	10	2 250	1 600	135 x 75 x 18	34	33	2	6,60	7,70	1,444
12	12	3 300	2 300	150 x 90 x 22	40	43	2	10,30	11,90	2,080
14	14	4 350	3 150	150 x 90 x 22	41	47	2	15,30	19,00	2,832
16	16	5 650	4 200	170 x 95 x 25	41	47	2	18,30	22,00	3,696
18	18	7 200	5 200	200 x 120 x 28	52	61	2	25,60	31,80	4,680
20	20	9 000	6 500	200 x 120 x 30	52	61	2	29,40	35,60	5,776
22	22	11 000	7 800	250 x 150 x 36	52	61	3	44,00	50,20	6,988
24	24	13 500	9 400	250 x 150 x 36	60	78	3	54,10	72,10	8,316
26	26	15 000	11 000	250 x 150 x 38	60	78	3	62,60	80,60	9,760
28	28	18 000	12 500	280 x 170 x 44	80	90	3	84,10	96,50	11,320
32	32	23 500	16 500	300 x 200 x 45	80	90	3	100,70	113,10	14,790
36	36	29 000	21 000	300 x 200 x 50	90	102	3	135,00	147,00	18,720

Acier galvanisé - CMU établie sur base âme textile (possiblité âme métallique pour gamme CMU supérieure : nous consulter).

Ref : ECA402



Pour vos commandes et questions techniques, contactez votre conseiller commercial : cliquez ici

MANILLE LYRE HAUTE RÉSISTANCE CE RÉF 5210 et 5211

Réf. Catalogue page 77

Pour définir vos **manilles** indiquer : la **RÉFÉRENCE** et le **CODE**

Acier allié traité haute résistance
Coefficient d'utilisation 1/5
Couleur de l'axe non contractuelle

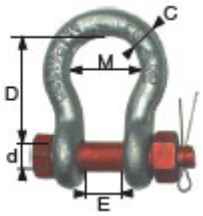
Réf 5210 : axe à oeil

réf 5210 : MANILLE LYRE " AXE À OEIL "

CODE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
CMU en kg	500	750	1000	1500	2000	3250	4750	6500	8500	9500	12000	13500	17000	25000	35000	55000	85000
C en mm	7	8	10	12	13	17	20	23	26	29	33	35	38	45	50	65	75
D en mm	29	31	37	41	46	60	71	83	95	108	119	132	147	178	197	254	330
E en mm	12	13	17	18	21	26	30	38	44	49	54	57	62	74	83	105	127
M en mm	20	21	25	28	32	42	50	57	66	74	80	89	98	126	138	185	-
d en mm	8	10	11	12	16	19	23	25	29	34	36	38	40	50	57	70	80
poids en kg	0,07	0,09	0,14	0,17	0,33	0,62	1,07	1,64	2,28	3,36	4,30	6,14	7,80	14,9	20,6	41	59

Acier allié traité haute résistance
Coefficient d'utilisation 1/5
Couleur de l'axe non contractuelle

Réf 5211 : axe boulonné



réf 5211 : MANILLE LYRE " AXE BOULONNÉ "

CODE	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
CMU en kg	750	1000	1500	2000	3250	4750	6500	8500	9500	12000	13500	17000	25000	35000	55000	85000	120000
C en mm	9	10	11	13,5	16	19	22	25	28	32	35	38	45	50	65	75	90
D en mm	32	36,5	43	51	64	76	83	95	108	115	133	146	178	197	254	330	381
E en mm	13,5	17	18,5	22	27	31	36	43	47	51	57	60	74	83	105	127	146
M en mm	21	26	29	32	43	51	58	68	75	83	92	99	126	138	185	190	238
d en mm	10	11	12	16	19	22	25	28	32	35	38	42	50	57	70	80	95
poids en kg	0,13	0,17	0,25	0,44	0,79	1,26	1,88	2,78	3,87	5,26	6,94	8,79	14,99	20,65	41,05	62,24	110

Alloy Master Links

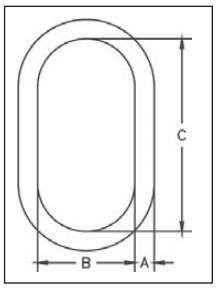
"QT" QUENCHED & TEMPERED | QUIC-CHECK® | Crosby 8/10™

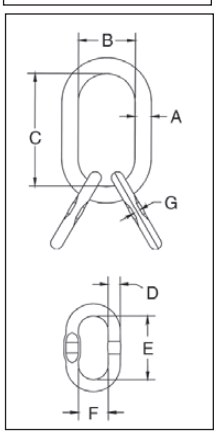
A-342

Ratings below are for use with chain slings fabricated in accordance with ASME B30.9. For other applications, see page 159.

- Alloy Steel – Quenched and Tempered.
- Individually Proof Tested with certification. (See page 159 for Proof Test values.)
- Proof Tested with 60% inside width special fixtures sized to prevent localized point loading per ASTM A-952. Reference page 269.
- Meets or exceeds all requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements. Importantly, these links meet other critical performance requirements including fatigue life, impact properties and material traceability, not addressed by ASME B30.26.
- Forgings have a Product Identification Code (PIC) for material traceability, along with the size, the name Crosby and USA in raised lettering.
- Selected sizes designated with "W" in the size column have enlarged inside dimensions to allow additional room for sling hardware and crane hook.
- Incorporates patented **QUIC-CHECK®** deformation indicators.

A-345





A-342 Alloy Master Links

Size		A-342 Stock No.	Weight Each (lbs.)	Chain Size		Single Leg		Double Leg		Dimensions (in.)			
(in.)	(mm)			(in.)	(mm)	WLL Based on Grade 80 Chain (lbs.)*	WLL Based on Grade 100 Chain (lbs.)*	WLL Based on Grade 80 Chain 60° Sling Angle (lbs.)*	WLL Based on Grade 100 Chain 60° Sling Angle (lbs.)*	A	B	C	Deformation Indicator
1/2W	13W	1014266	1.3	1/4	7	3500	4300	6100	7400	.62	2.80	5.00	3.50
				5/16	8	4500	5700	-	-				
5/8	16	1014280	1.5	5/16	8	4500	5700	7800	-	.62	3.00	6.00	3.50
3/4W	19W	1014285	2.0	5/16	8	4500	5700	-	9900	.73	3.20	6.00	4.00
				3/8	10	7100	8800	12300	-				
7/8W	22W	1014319	3.3	3/8	10	7100	8800	12300	15200	.88	3.75	6.38	4.50
				1/2	13	12000	15000	-	-				
1W	26W	1014331	6.1	1/2	13	12000	15000	20800	26000	1.10	4.30	7.50	5.50
				5/8	16	18100	22600	-	-				
1-1/4W	32W	1014348	12.0	5/8	16	18100	22600	31300	39100	1.33	5.50	9.50	7.00
				3/4	20	28300	35300	-	-				
1-1/2W	38W	1014365	18.6	3/4	20	28300	35300	49000	61100	1.61	5.90	10.50	7.50
				7/8	22	34200	42700	-	-				
1-3/4	44	1014388	25.2	7/8	22	-	-	59200	74000	1.75	6.00	12.00	7.50
				1	26	47700	59700	-	-				
2	51	1014404	37.0	1	26	-	-	82600	103400	2.00	7.00	14.00	9.00
				1-1/4	32	72300	90400	-	-				
2-1/4	57	1014422	54.1	1-1/4	32	-	-	125200	-	2.25	8.00	16.00	10.00
2-1/2	63	1014468	68.5	1-1/4	32	72300	90400	125200	156600	2.5	8.38	16.00	11.00

* Chain slings require that the Minimum Ultimate Load be 4 times the Working Load Limit. Refer to page 159 to determine products actual Ultimate Load. Proof Test Load equals or exceeds the requirement of ASTM A952(8.1) and ASME B30.9-1.4 for the chain size and number of legs. See chart on page 234 for other sling angles.

A-345 Master Link Assembly with Engineered Flat for Use with S-1325A coupler link

Size		A-345 Stock No.	Weight Each (lbs.)	Chain Size		Three and Four Leg Sling		Dimensions (in.)								Engineered Flat for S-1325 (in.) — (mm)
(in.)	(mm)			(in.)	(mm)	WLL Based on Grade 80 Chain 60° Sling Angle (lbs.)*	WLL Based on Grade 100 Chain 60° Sling Angle (lbs.)*	A	B	C	D	E	F	G	Deformation Indicator	
3/4W	19W	1014739	3.5	1/4	7	9100	11200	.73	3.20	6.00	.56	3.35	1.77	.30	4.00	1/4"-5/16", 7-8mm
7/8W	22W	1014742	4.8	5/16	8	11700	14800	.88	3.75	6.38	.56	3.35	1.77	.30	4.50	-
1W	26W	1014766	9.3	3/8	10	18400	22900	1.10	4.30	7.50	.75	3.94	2.36	.33	5.50	3/8", 10mm
1-1/4W	32W	1014779	15.8	1/2	13	31200	39000	1.33	5.50	9.50	1.00	6.30	3.54	.51	7.00	1/2", 13mm
1-1/2W	38W	1014807	34.1	5/8	16	47000	58700	1.61	5.90	10.50	1.25	7.09	3.94	.65	7.50	5/8", 16mm
1-3/4	44	1014810	46.7	3/4	20	73500	91700	1.75	6.00	12.00	1.50	6.00	4.00	-	7.50	No Flat
2-1/4	57	1014845	97	7/8	22	88900	110900	2.25	8.00	16.00	1.88	8.00	5.50	-	10.00	No Flat
				1	26	123900	155100	2.25	8.00	16.00	1.88	8.00	5.50	-	10.00	No Flat
3-1/4	83	1014986	255	1-1/4	32	187800	234900	3.25	10.00	20.00	2.50	11.25	8.00	-	13.50	No Flat

* Chain slings require that the Minimum Ultimate Load be 4 times the Working Load Limit. Refer to page 159 to determine products actual Ultimate Load. Proof Test Load equals or exceeds the requirement of ASTM A952(8.1) and ASME B30.9-1.4 for the chain size and number of legs. **See chart on page 234 for other sling angles.**

3-9 FAN & MECHANISM GAURDS

After complete installation of fan and belt drive system, assemble the guards for each item as shown on diagrams below.

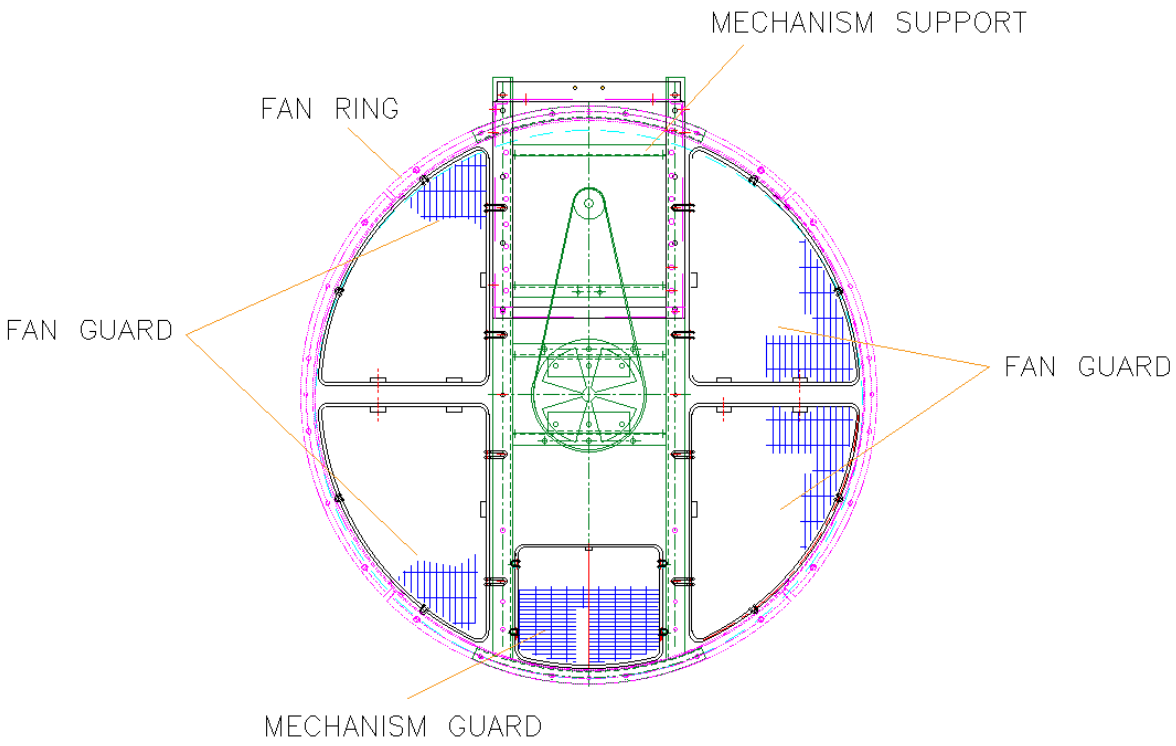


Figure 3-22
For Reference See “Fan Drive Assembly Drawing For Air Cooled Heat Exchangers ”
Document No.: EI027-DMF-VD-ME-DWG-008

3-10 EQUIPOTENTIAL INTERCONNECTION OF METALLIC MASSES

Subsequently to complete assembling of all parts and for safety reasons the equipotential interconnection of metallic masses must be ensured.

For this purpose, all headers and hoods, as well as the 2 columns in the middle of each row, are fitted with an earthing lug (see General Arrangement Drawing). The fitter will have to connect these earthing lugs through some 35 mm2 section stranded copper wire.

The connections of all further bolted metal parts shall be ensured through weld seams or spots protected by paint or varnish compatible with the basic protection coating (see General Arrangement Drawing).

3-11 CLOSURE SHEETS

When several bundles are fitted under a common fan hood it is necessary to equip those with sealing sheets to avoid the "By-pass" of the air.

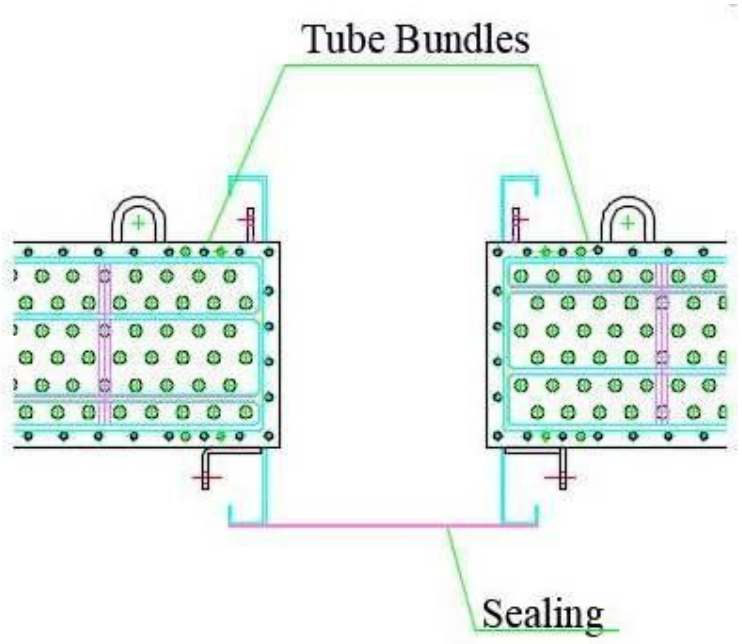


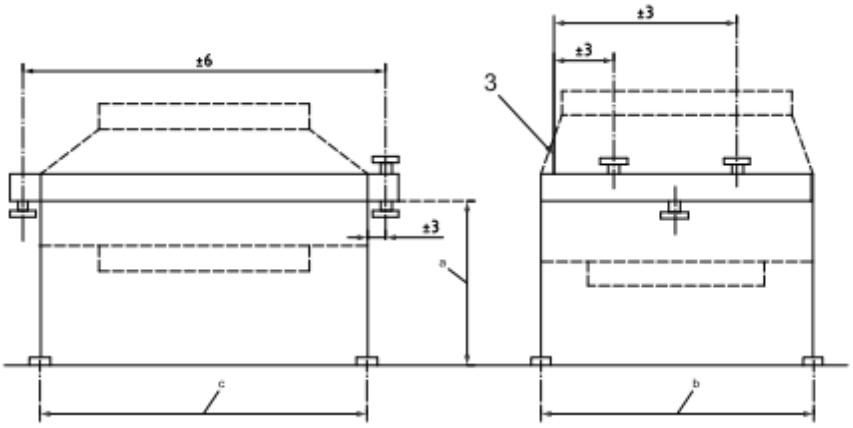
Figure 3-23
For Reference See “General Arrangement Drawing For Air Cooled Heat Exchangers (All Items)”

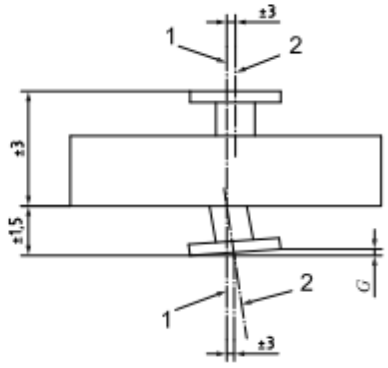
3-12 STANDARD TOLERANCES

3-12-1 Standard Tolerances for The Dimensions of Air-Cooler Tube Bundles

The standard tolerances for assembly dimensions of air-cooler tube-bundles are shown below. Tolerances apply to both forced-draft and induced-draft units.

Tolerances in millimeters (in.)





Key

1 centerline header
2 centerline nozzle
3 reference line
G out-of-plane tolerance, as given below:

Nominal nozzle size DN (NPS)	Maximum out-of-plane tolerance *G* mm (in.)
50 to 100 (2 to 4)	1.6 ($^{1}/_{16}$)
150 to 300 (6 to 12)	2.4 ($^{3}/_{32}$)
> 300 (> 12)	4.8 ($^{3}/_{16}$)
stacked, all	0.8 ($^{1}/_{32}$)

a $^{+1}_{-2}$ per meter.

b ±1 per meter.

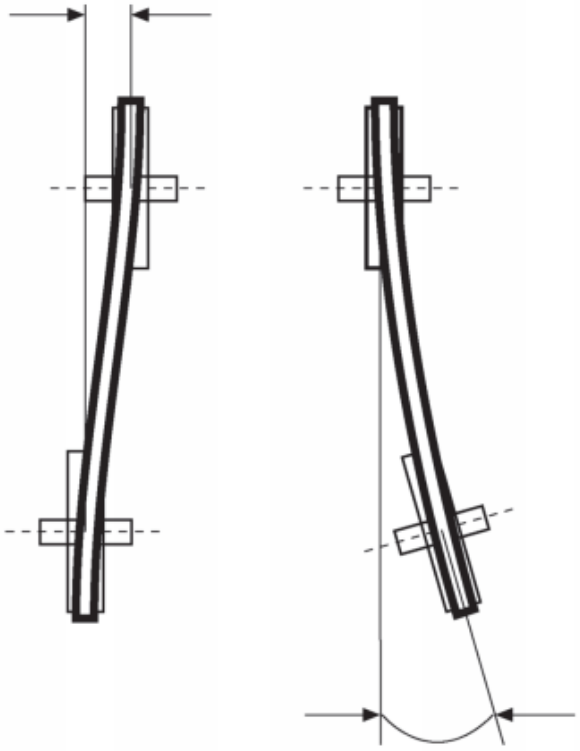
c ±3 (W_p to 3 m; $^{+1}_{-2}$ for each additional meter).

3-12-2 Standard Tolerances for Shaft and Pulley Alignment

Offset and Angular Tolerances are as per figure below:

Axial displacement and angular errors shall be limited as far as possible.

The axial displacement (left) should not exceed 0,5% of the distance between centers.



The angular error (right) should not exceed 0,25°.

4. MAINTENANCE AND OPERATRION

4-1 PROCEDURE FOR INTRODUCTION OF THE PROCESS FLUID

1. During starting up process it is advisable to limit the thermal shock to the tube-bundle and also to avoid a brutal cooling during periods of low ambient temperature and low heat load.

2. It is advisable to take certain special precautions when starting up units intended to release heat from process fluids with the following properties:

   High viscosity fluids; fluids whose pour point is above the ambient air temperature

   In many cases where fluids with these properties are circulating in air-coolers, the units are equipped with one or more of the following systems, aimed at eliminating such problems in starting and during operation: Manually or automatically controlled louvers, steam-coils and auto-variable pitch fan propellers.

   Start-up problems are much reduced with units thus equipped. Before introducing the process fluid, close the louvers, start to circulate steam through the coils and switch off the fans.

   Progressively increase the fluid flow until the normal rate is reached. Then gradually open the louvers, shut off the steam inlet and start the AV fans. Watch carefully the temperature of the output fluid during all this period and, if there is a risk of excessive cooling, run the heating steam.

   For the units without louvers nor steam-coil, the process fluid should be introduced rapidly in order to avoid excessive cooling of the initial charge of fluid in contact with the cold tubes. It is advisable, however, to avoid any fluid pressure surge.

3. In order to release heat from a process fluid having a low viscosity and a very low pour point, the starting procedure will be somewhat simplified. First of all, start up the fans, then admit the process fluid, initially with a low rate of flow, but gradually increase it to the required value.

4-2 REMEDYING LEAKAGE OBSERVED IN TUBE-BUNDLE TEST

Check that assembly bolting is screwed and locked.

Every tube-bundle unit has been subjected to a hydrostatic pressure test in manufacturer's shop. Nevertheless, in order to check that it has not been damaged during transport or erection, it is advisable to subject the tube-bundle and the associated piping, circulating pumps, etc. to further hydraulic proof test, before starting up the plant.

The tube-bundle units will be delivered perfectly leakproof after being subjected to tightness test. However, should any leak be found (which may occur where tube-bundle units have been stored for a period of time) proceed as follows:

A. LEAKAGE AT TUBE SHEET HOLE EXPANDED TUBE JOINT

- Remove cover plates of header.
- Roll in the tube a little further
- Replace the cover plates after changing the gaskets
- Re-pressurize to check the tightness. Repeat this procedure if seal is not perfect.

B. LEAKAGE RESULTING FROM CRACK IN A FAULTY TUBE

In such case, both ends of the faulty tube must be blocked. Proceed as follows:

Remove the cover plates of header

Cut through the faulty tube at one end, a few millimeters from the tube sheet before the start of the finned section of the tube, using an inner tube cutter. - This is a must to prevent the tube acting as a tie-rod between the two box headers.

Using the special mandrel provided by the manufacturer, insert a taper plug into each end of the leaky tube.

Gently hammer in the taper plugs.

Replace the cover plates and new gaskets.

4-3 THE AIR-COOLER SHUTS DOWN UNEXPECTEDLY

In this occasion following steps shall be regarded:

1. Motor power supply line shall be checked.
2. If electrical power line has been disconnected by the vibration switch, check the vibration switch to ensure that it works in proper condition, otherwise, the other vibration possibilities in system shall be checked.
3. Power transmission system included pulleys, belts and fans also inside surface of fan rings shall be checked. Moreover, the bolted connections of motor to motor-support as well as housing to housing-support shall be visually checked in order to distinguishing any vibration.
4. Proper operation of pulleys, belts, motor bearings and housing bearings shall be checked while motor is running.

   Note! Before starting the motor, following steps must be taken:

   - **Rotate the fan by hands in order to ensure that the fan blades have no clash with inside surface of fan ring.**
   - **Start the fan for a moment (ON/OFF) to check if any abnormal vibrations exist.**
5. Any fault in components operation that mentioned above shall be maintained (please contact the producer if required).

4-4 PRE-COMMISSIONING

Document title: Shop run-in test procedure

Checking the tip gap between the end of the blade and the fan ring in accordance with API 661 requirements (Using a ruler).

Fan testing of the machinery by rotation test (Clockwise).

Control of the fan speed according to the specifications of the fan (Using an achy meter).

Record of the absorbed intensity and voltage measurement (using an ammeter).

Power of items plus ambient condition shall be recorded.

Checking of the structure and mechanism vibrations in conformity with the applicable code or the fan supplier´s requirements. Using a vibro-meter and filling up the vibration table (QF-23 as shown at next page).

Point of vibration measuring shall be min 3 points (are shown below), each point related to one direction. For each measuring item, RMS and peak to peak shall be recorded.

Structural members shall be designed to minimize vibration, the maximum amplitude of vibration over the design fan-speed range shall be 0.15mm (0.006 inch) from peak to peak, as measured on primary structural members and machinery mountings (acc. to 7.3.2.1 API 661).

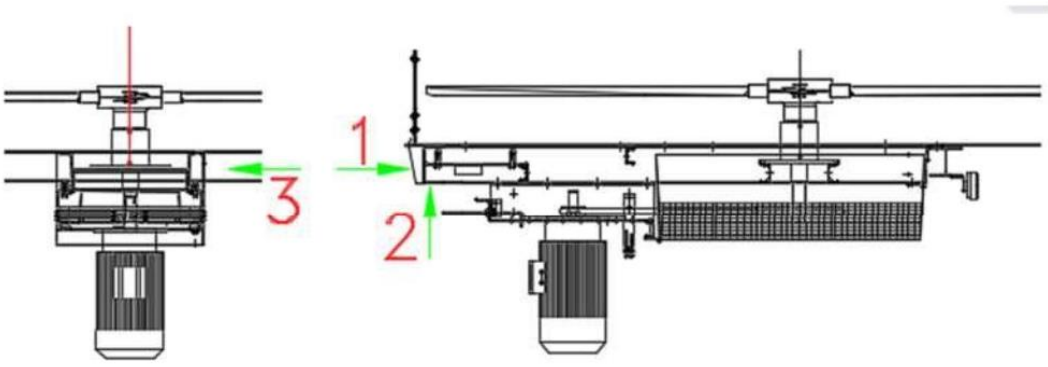
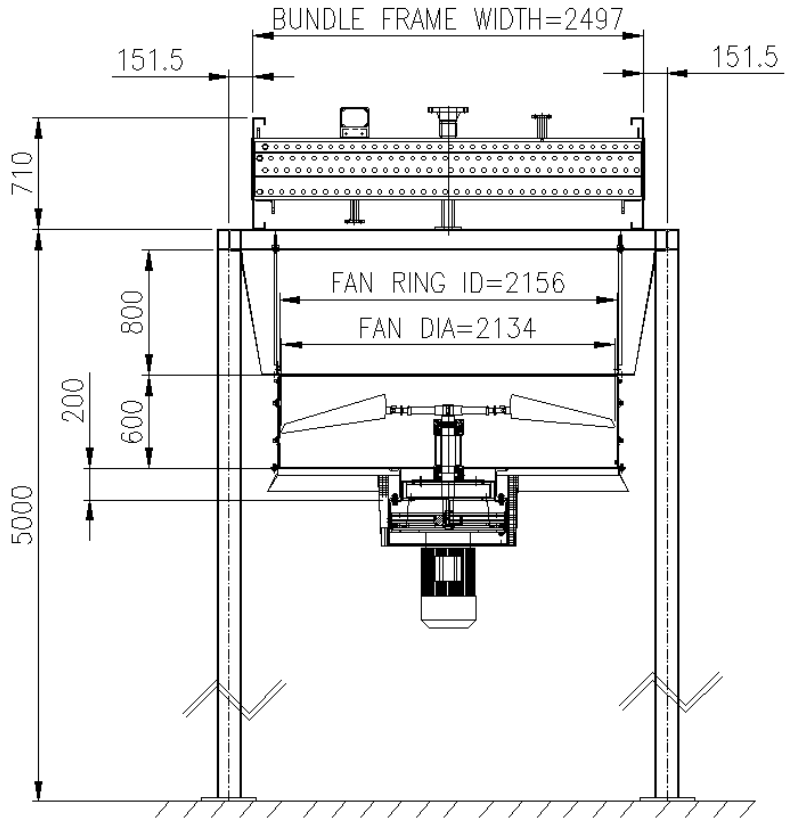


Figure 4-1 Test for Motor and Fan Vibration

Damafin thermal technology	**VIBRATION RECORD RUN-IN TEST**
Report No.:	
Project Name/DTT Job No.:	CONCEPTUAL, BASIC and DETAIL DESIGN ENGINEERING OF STYRENE PARK OFFSITE / 1158
Reference Doc. Name/No.:	
Item No.:	Air Cooler

Sketch:



Measure Point	1	2	3	RPM	
Displacement Speed (mm/s)				Motor	
Displacement (µm)				Fan	

DESCRIPTION:

Vendor	PMC	TPA	OWNER
Name:	Name:	Name:	Name:
Date:	Date:	Date:	Date:
Sign:	Sign:	Sign:	Sign:

4-5 PROCEDURE FOR FIN TUBES MAINTENANCE (Instructions for tube cleaning)

4-5-1 INTERIOR CLEANING OF FIN-TUBES

The methods used for the cleaning of the inside of air-cooler tubes are the same as for conventional shell-and-tube heat-exchangers;

1. Mechanical Cleaning

This method consists of drills or wire brushes fitted to long rods which are rotated by a compressed air motor. This method is normally completed with a water rinse or a blowing out. It is not an advised method for the removal of tarry deposits.

2. Chemical Cleaning

This method consists of circulating a hot chemical solution through the tubes. Such solutions contain inhibitors against tube wall corrosion.

It is recommended to contact a specialist and to supply him with a sample of the fouling deposit, in order to choose the most appropriate chemical solution. Each tube-bundle has to be fitted with inlet and outlet pipe fittings (1 1/2" to 3") to facilitate the passage of the solution. A circulating pump and a topping-up tank should also be available.

This method is becoming more popular in process plants because it reduces downtime and avoids disassembling the unit. It offers no advantage at all with blocked tubes.

3. High-Pressure Hushing Equipment

The use of these units (or "Hydro Jets") has become widespread in the U.S. and Europe during recent years. The tube cleaning can be accomplished by means of a portable HP pump. Generally speaking, such pumps have a capacity of 25 GPM with discharge pressures as high as 62 MPa. The sprinkler head is fitted at the end of a long tube, similar to that used for mechanical cleaning, and it is introduced into each tube individually. The best pressure is found by trial and error. Generally speaking, the softer the deposit, the lower water pressure needs to be. For example, an amine heat-exchanger can be cleaned with a water pressure of around 14 MPa. A scale deposit left by carbonated water requires a higher pressure ranging about 41 to 62 MPa. Here again, it should be emphasized that this is not suitable for blocked tubes. Those have to be mechanically cleaned.

4-5-2 OUTSIDE CLEANING OF FIN-TUBES (General)

The fouling of the extended heat-transfer or fin surfaces depends on the location of the unit, the kind of process, the ground conditions, foliage or other environmental factors, such as presence of other factories in the area.

The most common types of fouling are as follows:

A. Dirt or Dust

It accumulates over fins and between fins.

Sometimes, it collects as a fine powder and after being wetted, it forms a crusty deposit. Or alternatively, with oil, it can produce a mixture having the consistency of putty.

B. Lint, Popular Seeds, Down of Cotton Wool, etc.

C. Insects

D. Mixtures of Dust with Oil and Corrosive Substances

Generally speaking, only the two or three lower fin-tube rows will be found to be fouled. This indicates that the cleaning should be undertaken from the top downwards with the fan at standstill and shut-off valves closed. A preliminary examination should first be made to determine which type of cleaning would be best.

I. Air Nozzle

An air jet from a nozzle under a pressure of 0.22 MPa should normally remove dust powder and dry insects. One should ensure that the air jet is always within the plane of the fins to avoid bending them over. The nozzle usually consists of a 1-inch dia. pipe and 10-inch long, flattened at the end to from a tip about 1 1/4" across. The air is supplied via a hose, a control valve and a pressure gage.

II. Water Nozzle

A cold water-jet under a pressure of 0.22 MPa normally allows the removal of agglomerated dust and other impurities.

A fire hose with a 1" round-nosed jet should be satisfactory. As above, the jet should always he within the fin plane, to avoid bending them over.

III. Hot Water or Steam Jet

If the consistency of the fouling is such as to resist both the cold water and the air jet, an atomized spray of hot water or steam should be sufficient to clean the fins.

The steam nozzle can be made in the same manner as the air nozzle. How water can be obtained by means of a proportioning/mixing device fitted at the inlet of the steam nozzle.

IV. Chemical Cleaning

Normally, in 75% of cases, methods A, B and C will be sufficient to clean the fins. Nevertheless, there are times when the composition of the fouling is either chemical or organic. It is then necessary to consult a specialized chemical cleaning firm. With regard to chemical cleaning, great care must be taken. The cleaning fluid should be consistent with the fin material. The chemical cleaning specialist is familiar with these problems and is capable of supplying the proper cleaning solution.

4-6 PROTECTION OF TUBE-BUNDLE UNITS

4-6-1 EXTERNAL PROTECTION OF TUBE-BUNDLE UNITS

Where the unit is not equipped with control louvers, a canvas or plastic cover should be laid all over the top side of the tube-bundle to prevent the fins from becoming fouled by sand or dust deposits due to wind and/or natural air draft.

Where the unit is equipped with control louvers, the blades should be kept in closed position.

4-6-2 INTERNAL PROTECTION OF TUBE-BUNDLE UNIT

All of the inlet and outlet nozzle and connections should be shut off with blind flanges, one of which per tube-bundle on the side should be fitted with a valve, pressure gauge and blocking plug.

Then connect a nitrogen supply line to the blind flange with valve. Loosen the bolts at one of the inlet nozzle blind flanges to let air escape. Inject gas into tube-bundle so as to effective nitrogen flushing for about 10 minutes and thus to expel all of the air out of the unit.

Finally, re-tighten the inlet nozzle blind flange bolts and let nitrogen pressure build up to 300-500 Pascals so as to get tube-bundle pressurized.

Disconnect the nitrogen line and screw in the blocking plug to avoid any pressure drop in case of valve leak.

4-7 MACHINERY COMPONENTS

First, all drive motors should be taken down to be stored indoors. Then, every month, turn motor shafts by hand to distribute lubricant all over bearing parts.

DRIVE BELTS

General Storage Conditions

The physical properties of correctly stored belts will not change over a period of many years. In poor storage conditions and with incorrect handling, rubber products are, however, subject to changes in their physical properties. These changes can for example, be caused by effects of oxygen, ozone, extreme temperature, light, moisture and solvents.

The storage area should be dried, dust-free and reasonably well ventilated. Belts must not be stored close to chemicals, solvents, fuels, lubricants and acid.

Storage Temperature

The storage temperature should be between +59˚ F (+15˚ C) and +77˚ F (25˚ C). Normally, lower temperatures are not detrimental to Belts. However, since they become very stiff at low temperatures, they should be warmed to a temperature of approximately +68˚ F (20˚ C) before fitting to avoid ruptures and cracks.

Radiators and their supply lines should be guarded. The distance between a radiator and the stored Belts must be at least three feet.

Storage Lighting Conditions

Belts should be protected against light, especially direct sunlight and high ultra violet content (ozone formation) such as naked fluorescent tubes. Illumination utilizing conventional light bulbs is advisable.

Where possible, windows should be painted a red or orange protective paint. Under no circumstances should blue be used.

Ozone

In order to counteract the harmful effects of ozone, warehouses should not contain any ozone producing appliances, for example fluorescent lights, mercury vapor lights or high voltage electrical equipment. Combustion gases and vapors which may lead to the formation of ozone by photo chemical processes must be avoided or eliminated.

Moisture

Damp store rooms are unsuitable. Care must be taken to ensure that condensation does not occur. The most favorable relative air humidity is below 65%.

Storage Position

Because stresses can prompt both permanent deformation and the formation of cracks, care must be taken to ensure that Belts are stored without stress, i.e., without tension, pressure or any other form of deformation.

If Belts are stored horizontally and stacked upon each other, it is recommended that the stack height does not exceed 12 inches to avoid deformation. If to save space, belts are hung, the diameter of the cylinder on which the belts rest should be at least ten times the height of the belt section.

Cleaning

Contaminated belts can be cleaned using a 10:1 glycerin-spirit mixture. Benzene, benzol, and turpentine amongst others must not be used.

In addition, sharp edged objects, wire brushes, emery paper, etc. must not be used under any circumstances. Such action will seriously damage the belts.

PULLEY

Thoroughly clean all the pulley grooves, then coat spray anti-rust compound all over the groove sides.

FAN and DRIVE SHAFT

Clean all machined or exposed surfaces, then coat spray anti-rust compound all over.

BALL/ROLLER BEARING

Every month, turn the fan propelled and shafting by hand to distribute grease evenly all over the bearing parts. Then, every three months, inject grease to prevent any blocking of the lubrication lines possibly due to grease hardening.

Whenever the fan propeller and shafting have been turned, it is a must to secure them at standstill.

FAN UNIT

Fixed Blade Propeller: no particular care is required for bladesSelf-Adjustable Pitch Angle Blade Propeller: every month operate pneumatic control system to actuate blade control linkage so as to prevent hub internals from sticking.

FAN PITCH CONTROL SYSTEM

The pneumatic control system should be supplied with nitrogen and not with air, which even with a very low moisture content, can be detrimental to servo-actuators and controllers.

NOTE!
For protection of equipment, when not operated for long periods of time, the grease used must be a long-time non oxidizing preservation grease.

4-8 FAN SHAFT BEARINGS LUBRICATION

A. 1st FILLING

Fan Shaft Upper Bearing

Fan Shaft Lower Bearing

Bearing Block Grease Capability: Around 0.5 kg

The lubrication lines must be filled with lubricant as well, which requires loosening line fittings at bearing housing. Then, using a grease gun, inject lubricant at the lubrication block nipples so that grease will flow out of the other end of line. Now loosen bearing housing fittings and inject again so that grease flows out at the bearings.

B. PROCEDURE PRIOR TO STARTING-UP

Check that fan shaft bearings for grease packing are correct, and make up lubricant if required. Check that greasing for mechanical equipment is correct, and make up lubricant if required. See supplier's instructions.

C. LUBRICATION OF FAN SHAFT BEARINGS

Lube each 20,000 hours with Athesia EP2 or equivalent. (See Table 4-1)

4-9 LUBRICATION OF FAN DRIVE ELECTRIC MOTORS

Motor bearings are packed with grease before leaving manufacturer's factory. When changing over to a new grade/brand of lubricant, it is necessary to take down the bearing, remove the old grease and clean thoroughly before repackaging with new grease.

WARNING!An excess of grease will be detrimental to bearing life.FITTING OF FAN SHAFT BEARING

Lubrication for Forced Draft Units

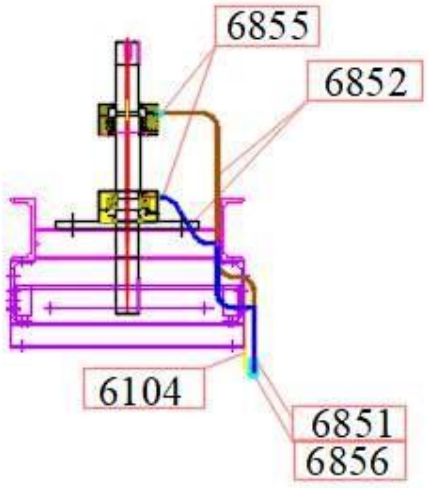


Figure 4-2 Fan Shaft Bearin Block

6851: Union Female Connector (1/8” NPT-8 mm (Tube))

6852: Tube (OD=8 mm, ID=6 mm)

6855: Union Male Connector (1/4” NPT-8 mm (TUBE))

6856: Grease Nipple (1/8” NPT)

6104: Lubrication Piping Support

LUBRICATION SCHEDULE (DS21-6701-01)

Table 4-1

	Equipment	Bearing type	Lubrication Method	Oil Reservoir	Lubricant	Recommended Brand			Initial Charge (1 Set)		Maintenance Frequency			Annual Consumption (for 4 Sets)
						Shell	Total	Domestic Brands	Quantity	Break-in Period	Inspection	Replace	Refill	
1	FAN BEARING	BEARING: (set)	INJECTION	-	GREASE	See below table			0.5 kg	20000 h	-	-	0.5	2 kg

Lubricant chart. (Standard)
SHELL ALVANIA G2 OR G3
TOTAL MULTIS 2 OR 3
ایرانول لیما EP2 یا EP3
بهران یاقوت EP2 یا EP3
نفت پارس، پارس لیتیوم (ماهان سابق) EP2 یا EP3

Note! All of these lubricant types are recommended based on related temperature range.

4-10 UTILITY CONSUMPTION

Table 4

No.	Item No.	Power/Motor (kW)	QTY.	Total Consumption (kW)
1	AIR COOLER	7.5	4	30
		TOTAL		**30**

4-11 BOLT AND PLUG TORQUE

BOLT TORQUE

Size	8.8				10.9			
	ضریب اصطکاکی 0.1		ضریب اصطکاکی 0.14		ضریب اصطکاکی 0.1		ضریب اصطکاکی 0.14	
	PV[N.M]	MA[N]	PV[N.M]	MA[N]	PV[N.M]	MA[N]	PV[N.M]	MA[N]
M8	20	17900	25	16500	28	25100	35	23200
M10	40	28400	49	26200	56	40000	69	36900
M12	69	41500	86	38300	98	58500	120	54000
M14	110	56500	135	52500	155	80000	190	74000
M16	170	78500	210	73000	240	110000	295	102000
M18	235	95000	290	88000	330	134000	405	124000
M20	330	122000	410	114000	465	172000	580	160000
M22	445	152000	550	141000	620	214000	780	199000
M24	570	176000	710	164000	800	248000	1000	230000

PLUG TORQUE

Stainless steel Plugs	90 mkg
Carbon Steel Plugs	80 mkg

5. APPENDICES

(Datasheet of Components and Sub-Supliers Manual)

5.1 Axial Fan Datasheet

STYRENE PARK OFFSITE

Document Title:

Axial Fan Data Sheet

Rev.	Issued Date	DESCRIPTION	PREPARED	CHECKED	APPROVED
R2	18-08-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R1	06-08-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R0	22-06-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh

REVISION RECORD SHEET

Page Page	Revisions								Page	Revisions						
	R0	R1	R2	R3	R4	R5	R6			R0	R1	R2	R3	R4	R5	R6
1	X	X	X						41							
2	X	X	X						42							
3	X	X							43							
4	X	X	X						44							
5	X	X							45							
6	X	X	X						46							
7	X	X							47							
8	X	X							48							
9	X	X							49							
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40									80							

AXIAL FAN DATA SHEET (PROJECT 1158) Qty = 4				
BASIC DATA				
1	Item No.		Air Cooler	
2	Quantity	Manual Adjustable Pitch	100%	
		Automatic Adjustable Pitch	-	
3	Positioner		NO	
4	BEARING BLOCK		YES	
5	Blade Material	Aluminum (ASTM,B-179)	YES	
		Fiber glass	NO	
6	Type of Air cooler/ Inlet		FORCED / CONICAL L/D=0.05	
7	Fan Diameter		7/ 2134	(ft /mm)
8	Fan Ring Diameter		2156	(mm)
9	Fan Ring Height		600	(mm)
10	Altitude		20	(m)
11	Relative Humidity		65	(%)
12	Temperature inlet /outlet		48 /52.28	(° C)
13	Actual flow		26.879	(m3/s)
14	Actual static pressure		102.95	(Pa)
15	Fan RPM		382	(rpm)
16	Tip speed		42.7	(m/s)
17	Motor power rating		7.5	(KW)
18	Noise level (at one meter)		85	(db)
19	Min Temperature		5	° C

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Customer Name	Job Reference
Job Name	
Item Number	Date **8/6/2024**

CHARACTERISTICS

Required Volume	**26.87**	m³/sec	Required Static Pressure	**102.95**	Pa
Pressure recovery	**0.00**	Pa	Fan static pressure	**102.95**	Pa
Velocity pressure	**28.98**	Pa	Total pressure	**131.93**	Pa
Air Temperature	**48.0**	°C	Site Elevation	**20.0**	m
Inlet Air Humidity (%)	**65.0**		Inlet Air Density	**1.068**	kg/m³
Fan diameter	**2134**	mm	Fan ring diameter	**2156**	mm
Blade Airfoil	**24L**	ALU	Rotor hub type	**B3**	
Speed	**382.0**	RPM	Blade Tip Speed	**42.68**	m/sec
N° blades	**4**		Blade Operating Freq. +/-5%	**722**	cpm
Static efficiency	**61.4**	%	Total efficiency	**78.7**	%
Blade pitch angle	**8.5**	(°)	Rotor shaft power	**4.5**	kW
Min. Ambient Temperature	**5.0**	°C	Rotor shaft power @ 5.0 °C	**5.3**	kW
			Rotor shaft power @ API point	**6.0**	kW
Pressure Margin (%)	**65** [1] / **95** [2]		Volume Margin (%)	**28** [1]	
Tip Clearance/D	**0.005**		Inlet	**Conical L/D=0.05**	
Diffuser angle (°)			Diffuser:Length/D		
Inlet Obstacle a/A			Inlet Obstacle x/D		
Outlet Obstacle a/A			Outlet Obstacle x/D		
Installation Type	**Forced**		Aerod axial force	**472**	N
Rotor total weight	**52**	kg			
Rotor inertia PD²	**35**	kg x m²			
Max residual unbalance	**13.1**	N			
Blade Failure Load	**3847**	N			
2 Blades Failure Load	**5441**	N			
Xs Static deflection	**55**	mm	Xr Running deflection	**43**	mm

[1] according to API [2] at Design Pitch Angle

NOISE CHARACTERISTICS

Tolerance on sound values +/- 2 dB(A)

PWL (± 2)	SPL @	Inlet / outlet (± 2)	Side (± 2)
86 dB(A)	**1.0** m From Fan	**78** dB(A)	**65.8** dB(A)

Octave [Hz]	31.5	63	125	250	500	1000	2000	4000	8000

ROTOR MODEL 2134- 4-24L/B3T **PAC**

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Customer Name	Job Reference
Job Name	
Item Number	Date **8/6/2024**

PWL [dB]	89.0	91.0	91.0	87.0	84.0	81.0	73.0	69.0	65.0
Inlet/Outlet SPL [dB]	81.0	83.0	83.0	79.0	76.0	73.0	65.0	61.0	57.0
Side SPL [dB]	68.8	70.8	70.8	66.8	63.8	60.8	52.8	48.8	44.8
Tolerance +/-	5.0	5.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0

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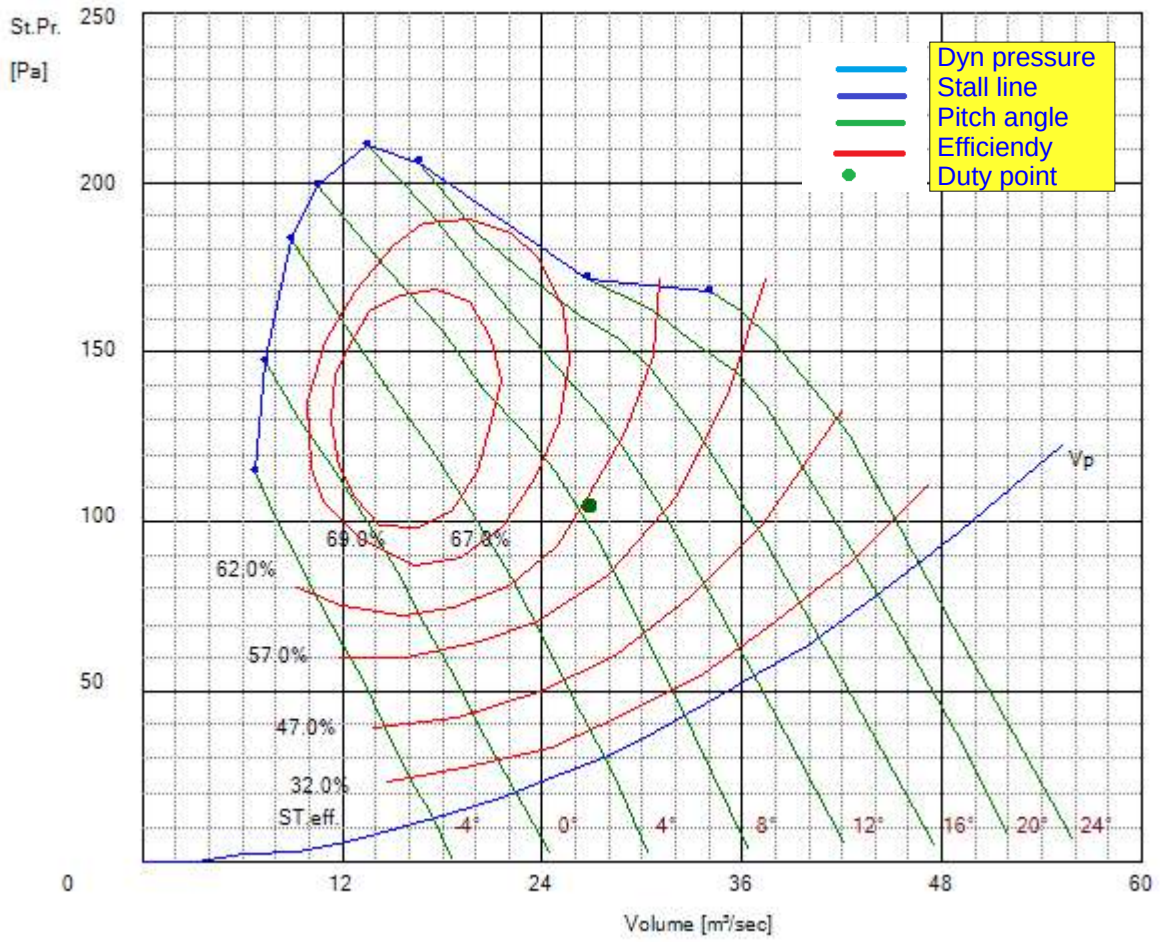
Customer Name	Job Reference
Job Name	
Item Number	Date **8/6/2024**

STATIC PRESSURE vs VOLUME CURVE



Inlet Air Density 1.068 kg/m³
382 RPM = 42.68 m/sec
Pressure recovery 0.00 Pa
Rotor shaft power 4.5 kW
PWL (± 2) 86 dB(A)

ROTOR MODEL 2134- 4-24L/B3T **PAC**

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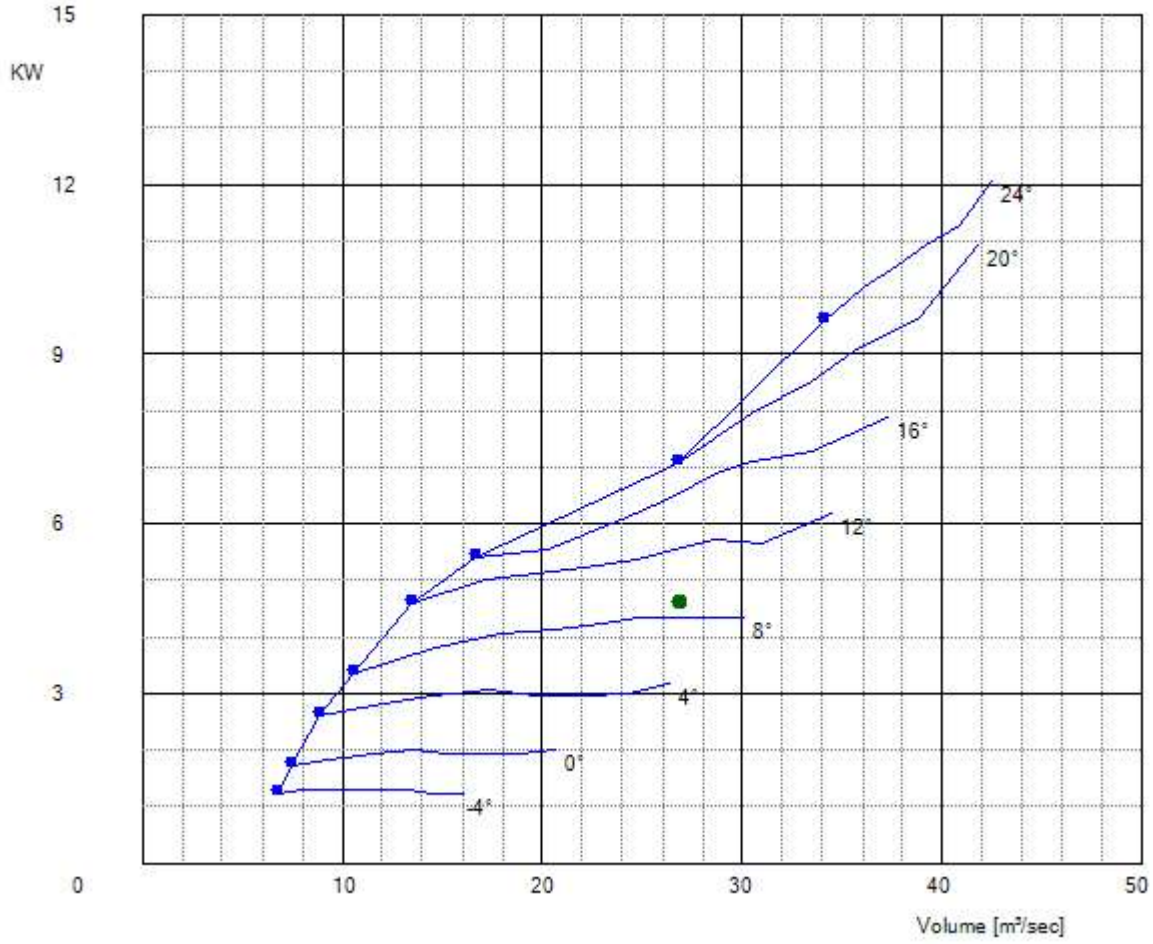
Customer Name	Job Reference
Job Name	
Item Number	Date **8/6/2024**

FAN POWER vs VOLUME CURVE



Inlet Air Density 1.068 kg/m³
382 RPM = 42.68 m/sec
Pressure recovery 0.00 Pa
Rotor shaft power 4.5 kW

ROTOR MODEL 2134- 4-24L/B3T **PAC**

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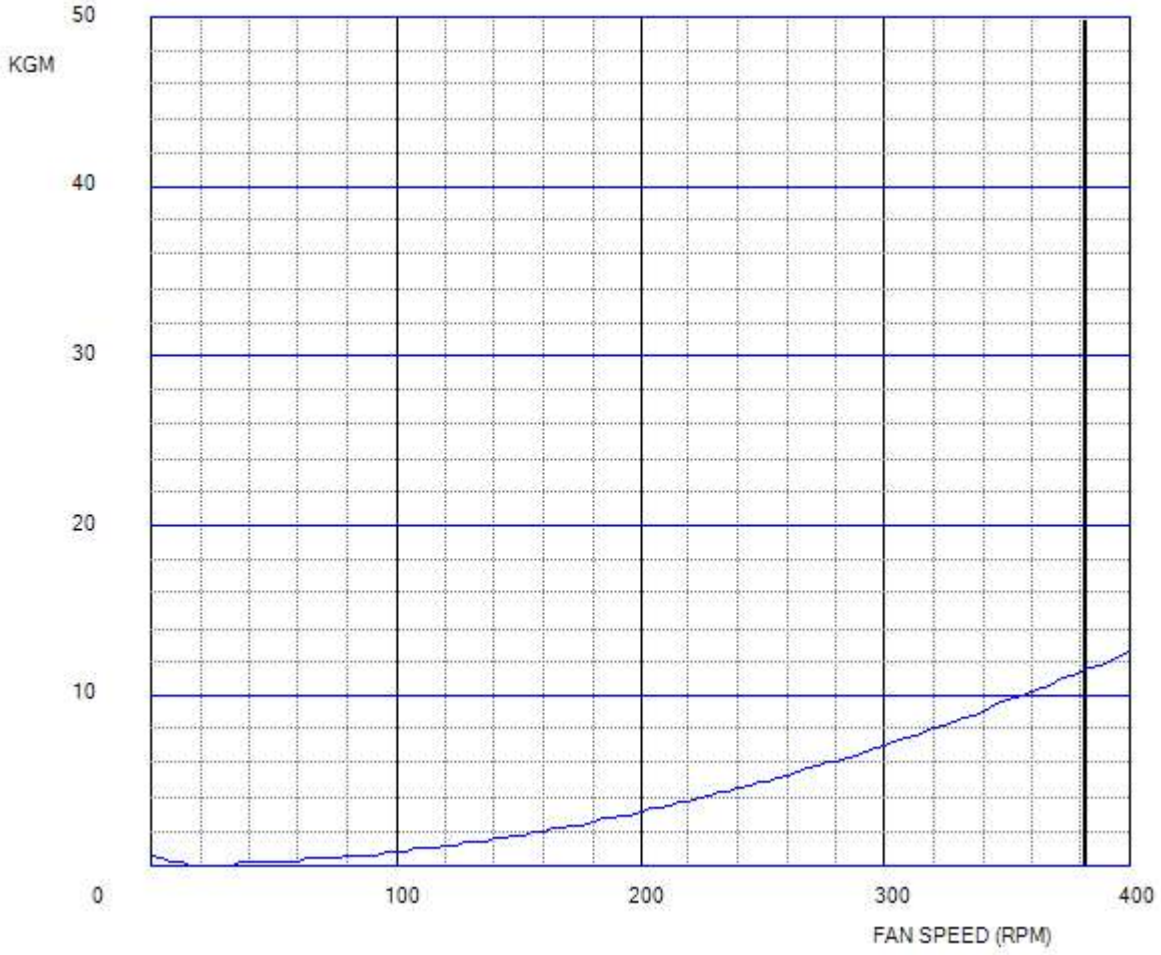
Customer Name	Job Reference
Job Name	
Item Number	Date **8/6/2024**

TORQUE CURVE



Rotor shaft power 4.5 kW
RPM = 382.0
Torque @ 382.0 rpm = 11.5 kgm

ROTOR MODEL 2134- 4-24L/B3T **PAC**

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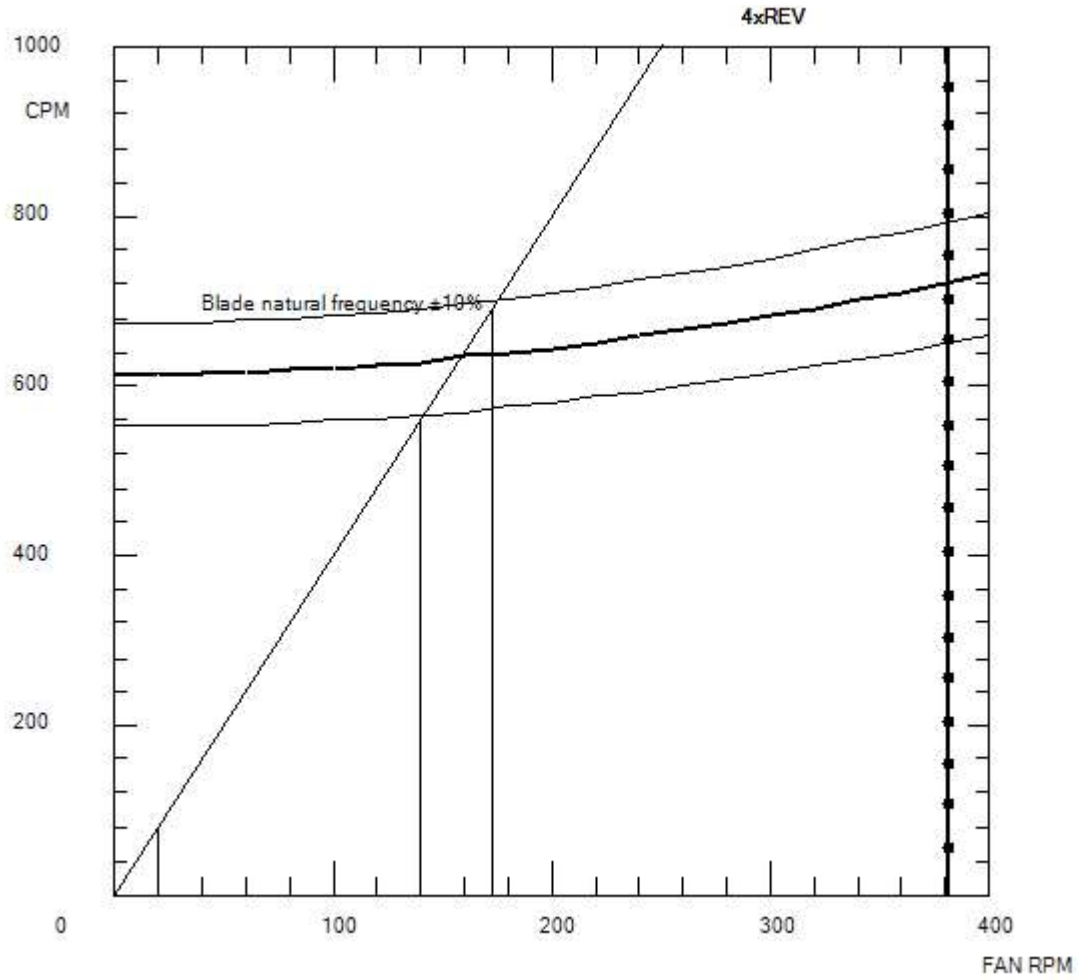
Customer Name	Job Reference
Job Name	
Item Number	Date **8/6/2024**

CAMPBELL DIAGRAM



N° blades 4

382 RPM = 42.68 m/sec

ROTOR MODEL 2134- 4-24L/B3T **PAC**

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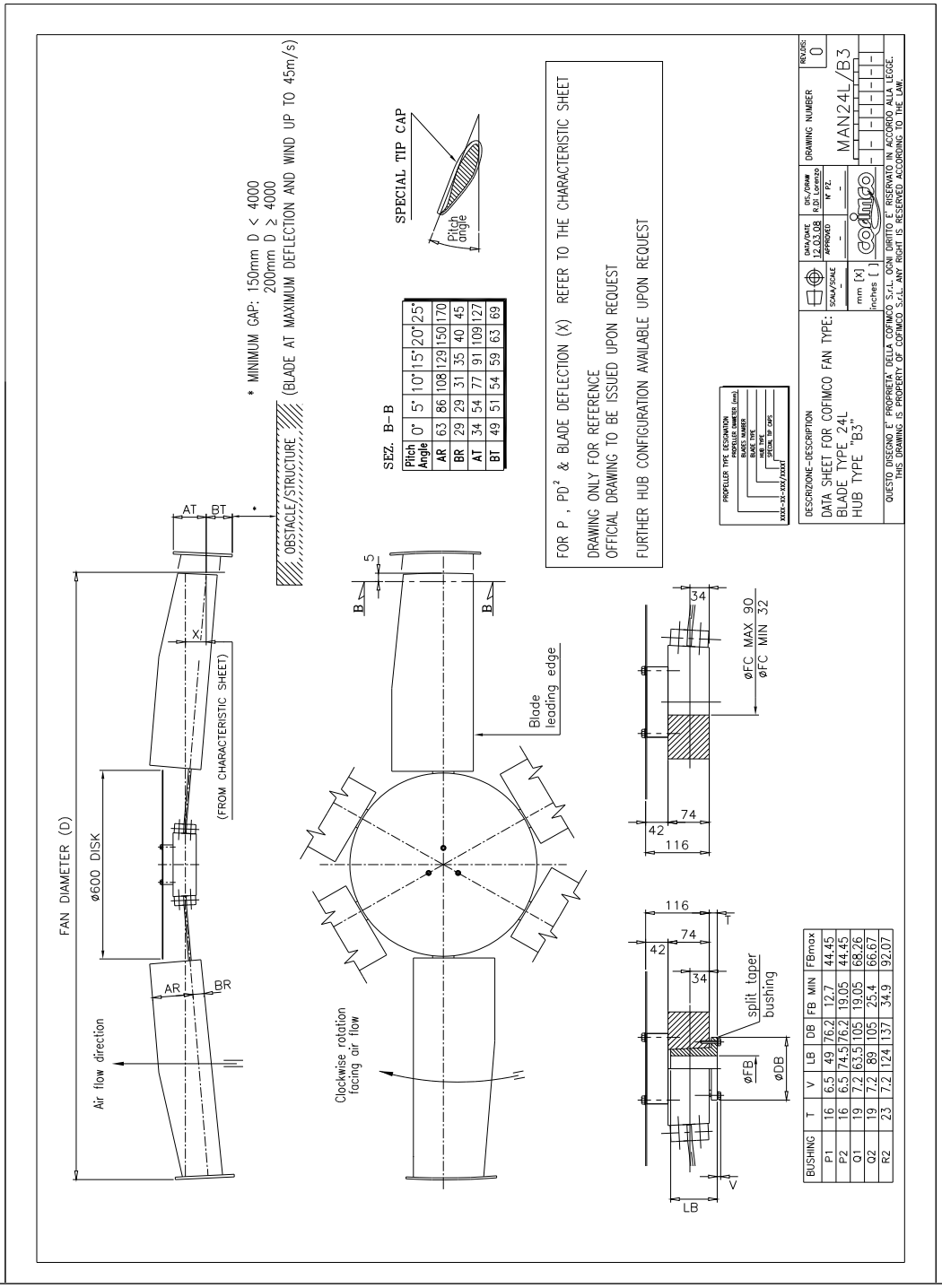

Pitch Angle	0°	5°	10°	15°	20°	25°
AR	63	86	108	129	150	170
BR	29	29	31	35	40	45
AT	34	54	77	91	109	127
BT	49	51	54	59	63	69

BUSHING	T	V	LB	DB	FB MIN	FBmax
P1	16	6.5	49	76.2	12.7	44.45
P2	16	6.5	74.5	76.2	19.05	44.45
Q1	19	7.2	63.5	105	19.05	68.26
Q2	19	7.2	89	105	25.4	66.67
R2	23	7.2	124	137	34.9	92.07

ROTOR MODEL 2134- 4-24L/B3T **PAC**

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5.2 Electric Motor Datasheet

STYRENE PARK OFFSITE

Document Title:

Electrical Motor Data Sheet

Rev.	Issued Date	DESCRIPTION	PREPARED	CHECKED	APPROVED
R4	24-11-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R3	06-11-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R2	06-10-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R1	11-08-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R0	22-06-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh

REVISION RECORD SHEET

Page Page	Revisions								Page	Revisions						
	R0	R1	R2	R3	R4	R5	R6			R0	R1	R2	R3	R4	R5	R6
1	X	X	X	X	X				41							
2	X	X	X	X	X				42							
3	X	X	X	X	X				43							
4		X	X						44							
5		X	X						45							
6		X	X						46							
7		X	X						47							
8		X	X						48							
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MOTOR BASIC DATA (1158)		
INSTALLATION SITE		
QUANTITY/ Tag number		4/ RU0001A-M-02, RU0001A-M-03, RU0001B-M-02, RU0001B-M-03
BRAND-MODEL		Marathon- E3ABL
RATED POWER		7.5 kw
SUPPLY VOLTS		400±5%
FREQUENCY		50±2%
NUMBER OF POLE		4
WINDING CONNECTIONS/ROTATION		Delta
COUPLING TYPE		V-Belt(Belt & Pulley)
NOMIAL SPEED		1500 rpm
DUTY CATEGORY		S1
INVERTER DUTY		YES
ALTITUDE		20 m
AMBIENT TEMPRATURE MIN/MAX		5/48 C
RELATIVE HUMIDITY (RH)		65%
STARTING METHOD		2-DOL /2-VFD
CABLE GLAND SUPLIED		YES
DIRECTION OR ROTATION		Both
ISULATION CLASS/TEMP. RISE		F/B
COOLING		(IC 411)
AREA CLASSIFICATION		Ex db IIB T4
WINDING TEMPERATURE . DETECTORS (PTC RELAY)		N.A
ANTI-CONDANATION HEATER (SPACE HEATER)		N.A
MOUNTING (TYPE OF INSTALATION)		IMV3
PROTECTION DEGREE FOR MOTOR/FOR TERMINAL BOX		IP55//IP55
ROTOR CAGE MATERIAL (AL)		CAST IRON
PAINT SYSTEM		STANDARD COLOR-RAL (5015)
CABLE TYPE AND SIZE (FEEDER CABLE BY CLIENT)	MAIN	18~21 mm
	HEATER	N.A
	PTC	N.A
THERED (GLAND) ENTRY	MAIN	2XM32
	HEATER	N.A
	PTC	N.A
EARTH TERMINALS		IN & EXT
MAX NOISE LEVEL (AT ONE METER)		< 85
LIFTING DEVICE		YES
DRAIN PLUGS		NO
NO OF PHASE		3
IE (EFFICIENCY CLASS)		IE=3
PF (COS &)		0.84
TYPE TEST		NO
MOTOR SUITABLE FOR VCDS (Y/N)		NO
CURVE & OUTLINE & COMPLETE CATALOUGE (Y/N)		YES

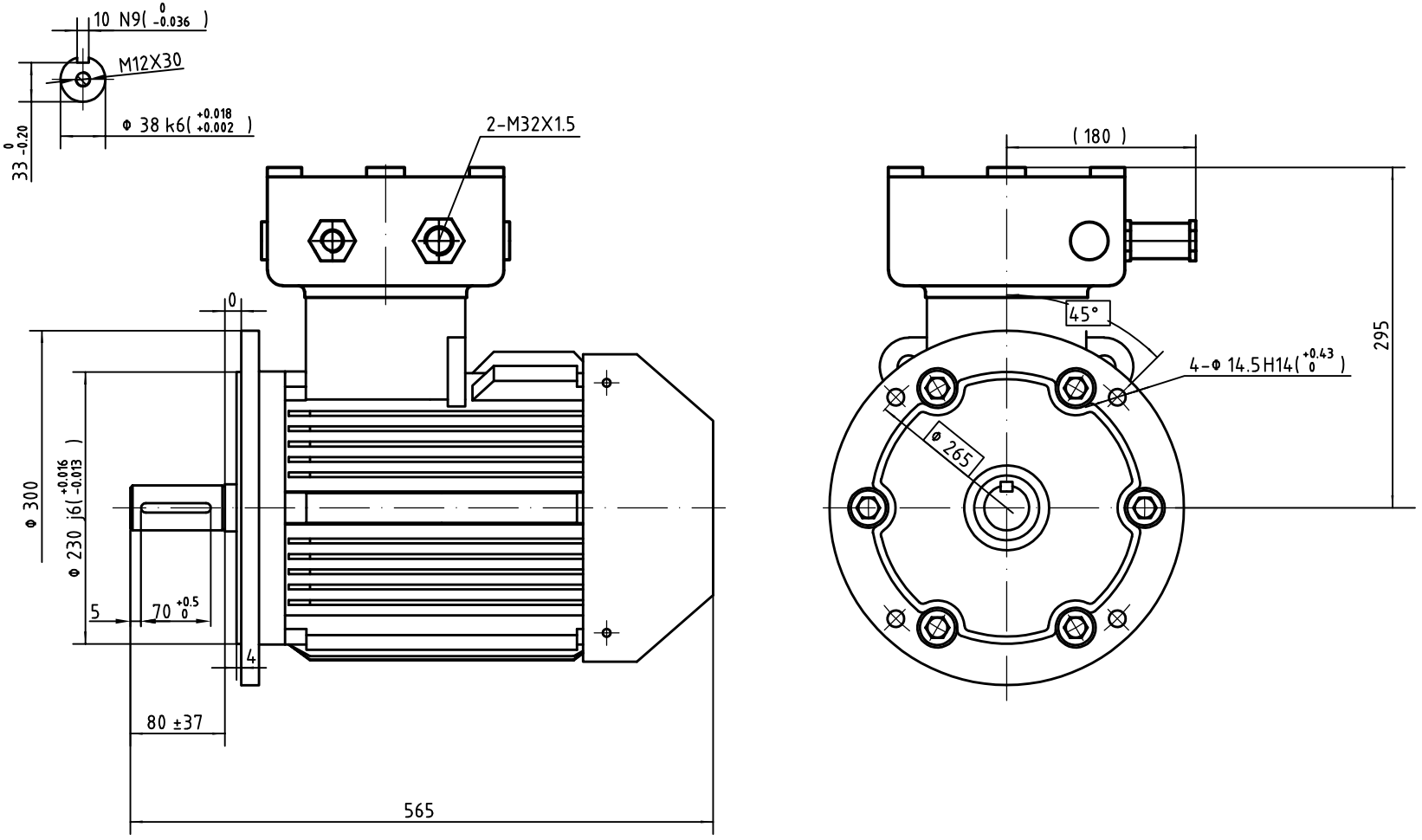
marathon® Motors

Squirrel Cage Induction Motor Data Sheet

Accreditation (National)	IEC 60079
Hazardous Classification	Ex db IIB T4
Series Model Type	E3ABL
Frame Size	132M
Rated Output Power	7.5 kW
Rated Speed	1465 r/min
Number of Poles	4 Pole
Number of Phases	3 Phase
Voltage	400 V
Frequency	50 Hz
Duty Cycle	S1
Service Factor	1.00
Operating Altitude	1000 masl
Insulation Class	F (155°C)
Temperature Rise	80K (B class)
Ambient Temperature	-15°C ~ 50°C
Method of Cooling	IC411 (TEFC - Totally Enclosed Fan Cooled)
Degree of Protection (Ingress Level)	IP55
Material of Construction	Cast Iron
Connection	△/Y
Full Load Current [I_N]	14.43
Locked Rotor Current [I_L / I_N]	7.50
Full Load Torque [T_N]	48.89 Nm
Locked Rotor Torque [T_L / T_N]	2.0
Breakdown Torque [T_B / T_N]	2.3
Efficiency Class	**IE3**

Load	**100% load**	**75% load**	**50% load**
Efficiency	90.4%	90.3%	89.7%
Power Factor (cos φ)	0.84	0.79	0.69

Bearing Configuration (DE / NDE)	Ball Bearing / Ball Bearing
Bearing Series Type	**DE:** 6208-2Z/C3 **NDE:** 6208-2Z/C3
Bearing Lubrication Type	Grease - ESSO UNIREX N2
Vibration	1.6 mm/sec
Moment of inertia (kg.m²)	0.0488
Direction of Rotation	CW or CCW
Sound Pressure Level	75 dB(A)
Final Colour	RAL 5010
Paint Specification	2 Pack Epoxy
Mounting Options	B5 /V3
Terminal Box Position	Top Terminal Box



Note: Cable Gland not Included

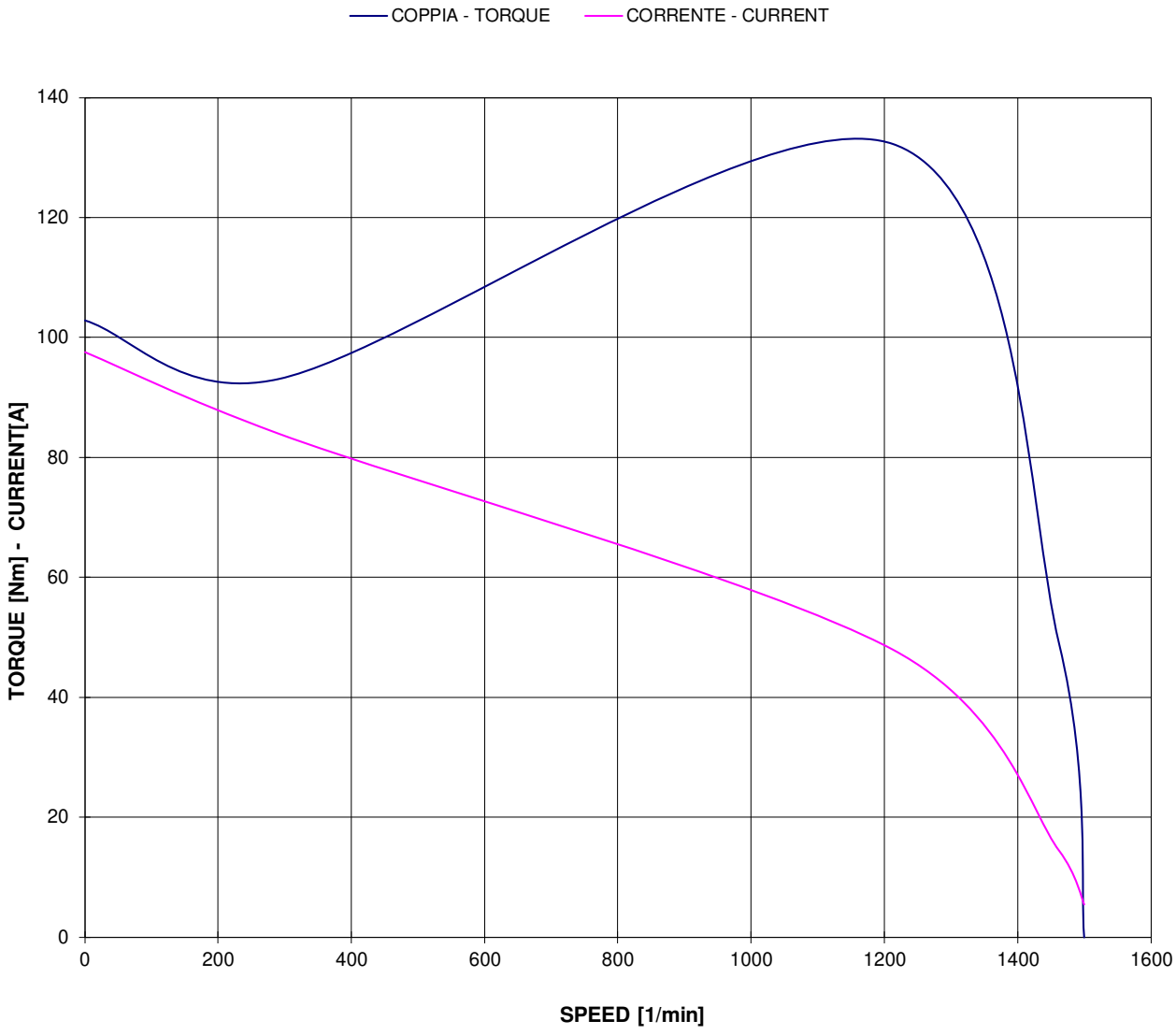
DRAWING REVISION	REVISION BY	DATE
ECO	APPROVED BY	DATE
ECO DESCRIPTION		

DRAWN BY	marathon™ Motors
DATE	
APPROVED BY	DESCRIPTION: E3ABL 132M B5
DATE	
REFERENCE	MATERIAL / PROCESS/FINISH
FIRST ANGLE PROJECTION	SIZE B / DRAWING NUMBER / SHEET

marathon Motors

TORQUE/CURRENT-SPEED DIAGRAM

Motore / Motor	**E3ABL 132M 4**	
Potenza nominale / Rated power	7.50	kW
Poli / Pole	4	
Tensione - Frequenza / Voltage - Frequency	400 - 50	V - Hz
Corrente / Rated current	14.43	A
Velocità / Speed	1462	rpm
Coppia / Torque	48.99	Nm

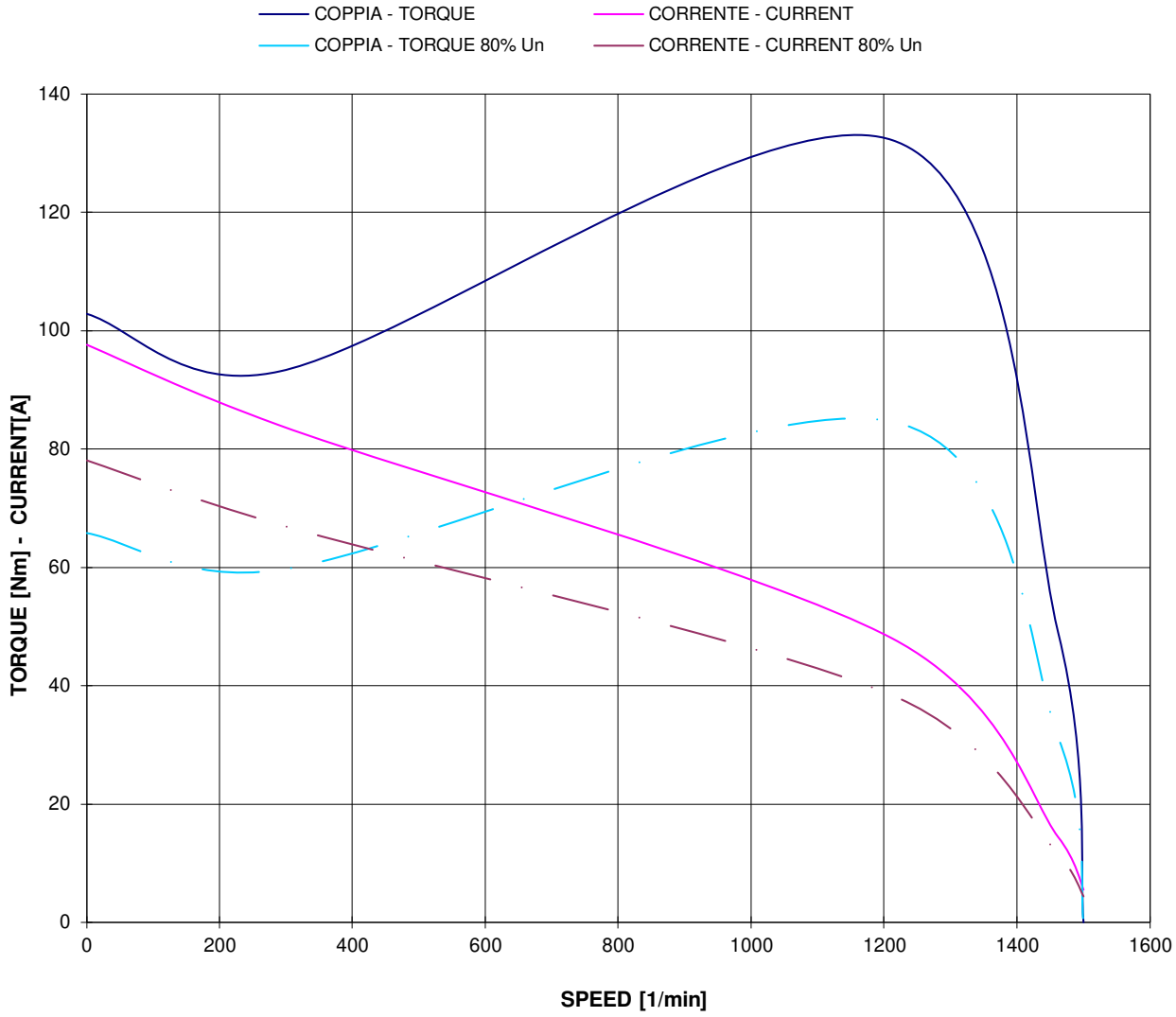


Data obtained by calculation method

marathon Motors

TORQUE/CURRENT-SPEED DIAGRAM (Reduced voltage)

Motore / Motor	**E3ABL 132M 4**	
Potenza nominale / Rated power	7.50	kW
Poli / Pole	4	
Tensione - Frequenza / Voltage - Frequency	400 - 50	V - Hz
Corrente / Rated current	14.43	A
Velocità / Speed	1462	rpm
Coppia / Torque	48.99	Nm

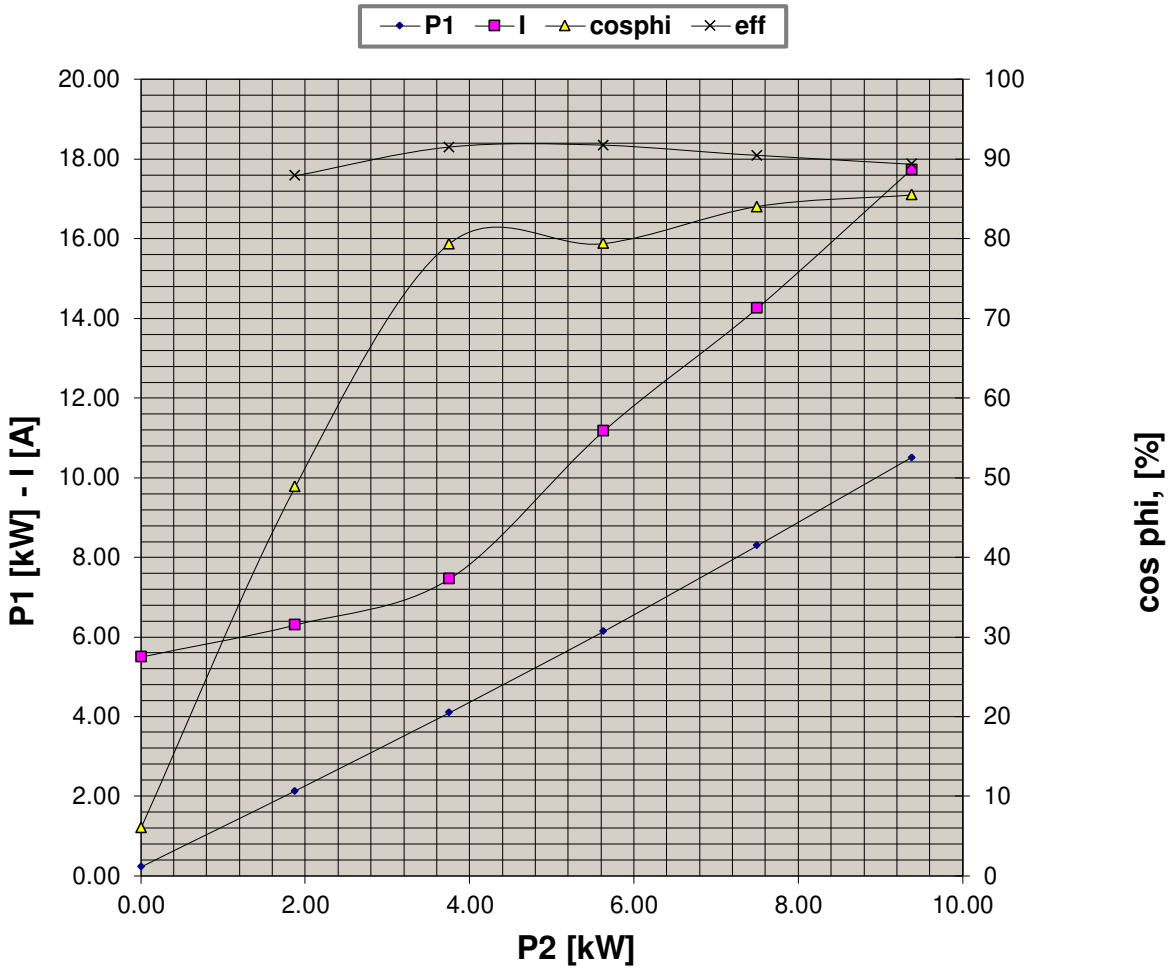


Data obtained by calculation method

marathon Motors

PERFORMANCE CURVES

Motore / Motor	**E3ABL 132M 4**	
Potenza nominale / Rated power	7.50	kW
Poli / Pole	4	
Tensione - Frequenza / Voltage - Frequency	400 - 50	V - Hz
Corrente / Rated current	14.43	A
Velocità / Speed	1462	rpm
Coppia / Torque	48.99	Nm

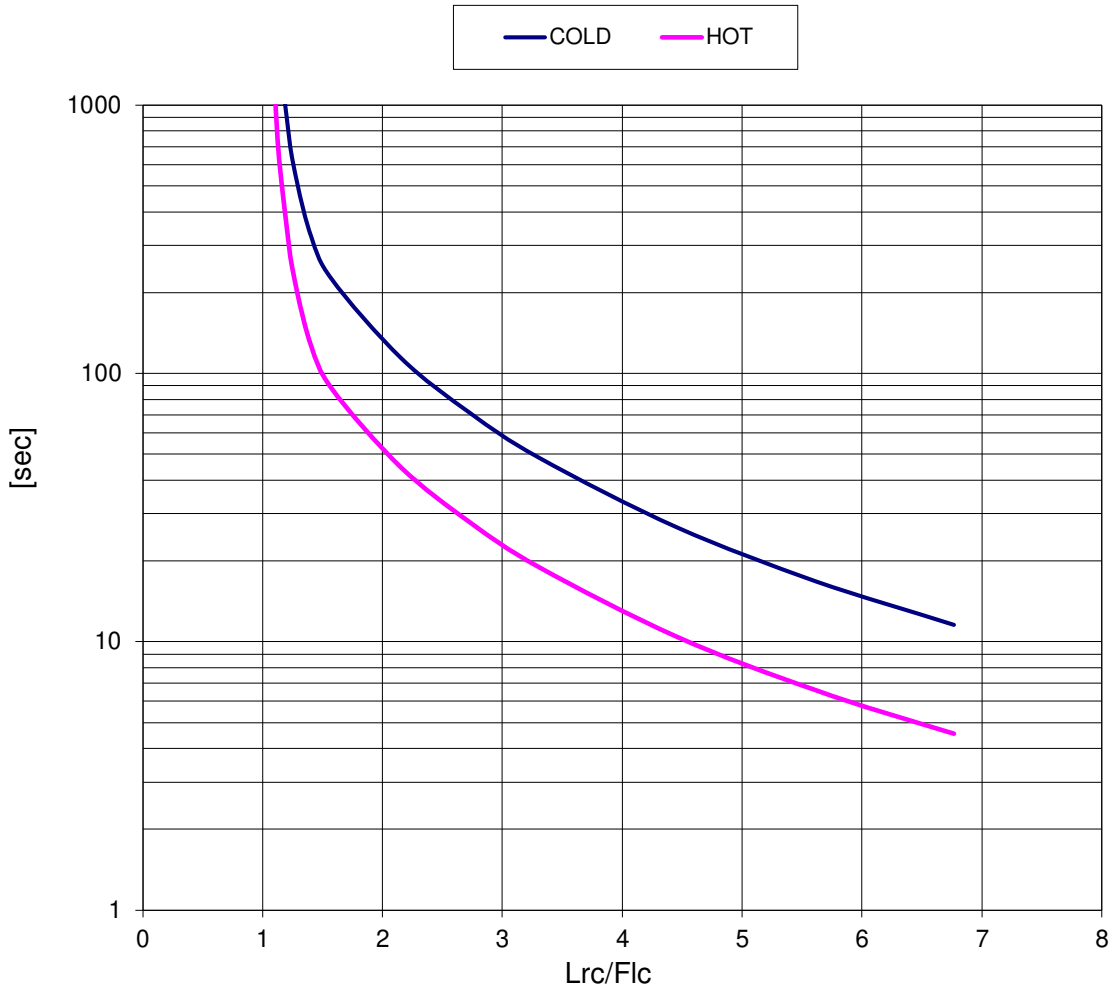


Data obtained by calculation method

marathon Motors

THERMAL WITHSTAND CURVE

Cliente / Customer	0	
Impianto / Plant	-	
ITEM	**-**	
Numero d'offerta / Offer Number	2024	
	-	
Motore / Motor	**E3ABL 132M 4**	
Potenza nominale / Rated power	7.50	kW
Poli / Pole	4	
Tensione - Frequenza / Voltage - Frequency	400 - 50	V - Hz
Corrente / Rated current	14.43	A
Velocità / Speed	1462	rpm
Coppia / Torque	48.99	Nm

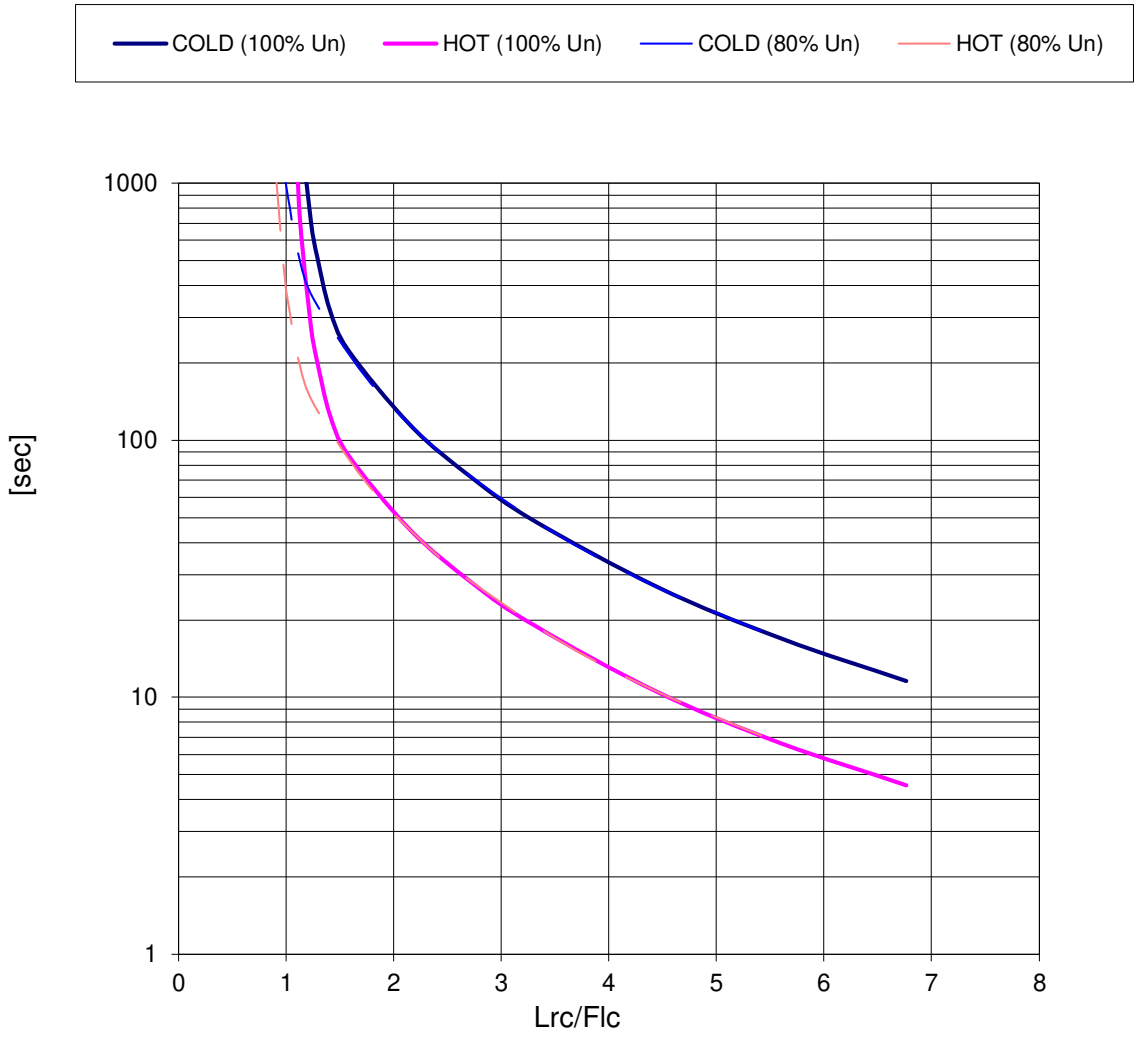


Data obtained by calculation method

marathon® Motors

THERMAL WITHSTAND CURVE (Reduced voltage)

Motore / Motor	**E3ABL 132M 4**	
Potenza nominale / Rated power	7.50	kW
Poli / Pole	4	
Tensione - Frequenza / Voltage - Frequency	400 - 50	V - Hz
Corrente / Rated current	14.43	A
Velocità / Speed	1462	rpm
Coppia / Torque	48.99	Nm



Data obtained by calculation method

5.3 Belt and Pulley Datasheet

STYRENE PARK OFFSITE

Document Title:

Belt & Pulley Data Sheet

Rev.	Issued Date	DESCRIPTION	PREPARED	CHECKED	APPROVED
R2	06-10-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R1	31-08-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R0	22-06-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh

REVISION RECORD SHEET

Page Page	Revisions								Page	Revisions						
	R0	R1	R2	R3	R4	R5	R6			R0	R1	R2	R3	R4	R5	R6
1	X	X	X						41							
2	X	X	X						42							
3	X	X	X						43							
4	X	X	X						44							
5			X						45							
6									46							
7									47							
8									48							
9									49							
10									50							
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37									77							
38									78							
39									79							
40									80							

DATA SHEET FOR PULLEY BELT TRANSMISSION				
BASIC DATA FOR TRANSMISSIONS				
1	Customer items/DTT items	AIR COOLER		
2	Belt type	V-Belt		
3	Total quantity of belt			2Set
4	Motor power	(KW)		7.5
5	Motor frame size			-
6	Speed motor	(rpm)		1440
7	Speed fan	(rpm)		382
8	Speed ratio			3.76
9	Minimum service factor			1.4
10	Real service factor			1.8
11	Min. Max. Center Distance	(mm)		835 ±85
12	Center distance	(mm)		754.3
13	Belt width<QTY	(mm)		-- /2Set
14	Belt order info			CAPXPA2332
15	Belt drive life	(Hours)		V- belt estimated life~20000
16	Transmitted power	(kW)		13.75
17	Driver	QTY		2
		code		PBT106SPA2
		Pitch Dia	(mm)	106
		Pitch of Groove	(mm)	-
		Number of Grooves		2
		Width		-
		Bush no		1610
		Bore	(mm)	-
		Material/Weight		GG20 /-
18	Driven	QTY		2
		code		PBT400SPA2
		Pitch Dia	(mm)	400
		Pitch of Groove	(mm)	-
		Number of Grooves		2
		Width		-
		Bush no		2517
		Bore	(mm)	-
		Material/Weight		GG 20 /-
19	Deflection force	(N)		-
20	Deflection	(mm)		-
21	Maximum tension	(N)		561
22	Noise	dB(A)		85

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+39 02 89144 1
www.sitspa.it
info@sitspa.it - export@sitspa.it

INPUT DATA

Transmission type	2 Pulleys power transmission
Product family	NEXT®
Type	Narrow Raw Edge (XPZ,XPA,XPB,XPC)
Section	XPA

Power [kW]	7.50
Speed [RPM]	1440.0
Torque [Nm]	49.7
Required service factor	1.4

BELT

Code	CAPXPA2332
Length [mm]	2332.00
Number of belts / ribs [-]	2

RESULT

Resulting service factor	1.8
Transmissible power [kW]	13.75
Linear speed [m/s]	8.0
Center-to-center [mm]	754.3

PULLEYS

	Solid hub pulley code	Taper bushing code	External	Number of ribs	Pulley diameter [mm]	X [mm]	Y [mm]
Driver	PT106SPA2	PBT106SPA2	No	2	106.00	0	0
Driven	PT400SPA2	PBT400SPA2	No	2	400.00	754.26	0

	Transmission ratio	Speed [RPM]	Wrap angle [°]	Power [kW]	Torque [Nm]	Static shaft load [N]
Driver	--	1440.0	157.5	7.50	49.7	1693.3
Driven	0.26	381.6	202.5	7.50	187.7	1693.3

TENSIONING

Maximum tension [N]	561	**Minimum tension [N]**	432

		Vibration frequency method	
	Free segment length [mm]	**New belt frequency [Hz]**	**Run-in belt frequency [Hz]**
Driver-Driven	739.8	52 ± 2%	46 ± 2%

06 October, 2024

MESSRS: Damafin Thermal Technology Co.
Iran - Tehran - 14th km of Tehran-Karaj special road –
Iran Khodro South Boulevard - Zamyad Street - No 4

Letter of conformity & Declaration of anti-static properties

Ref. order: PAE03029, 1158

Here enclosed we testify that the below mentioned belts:

Item code	Description	Quantity
CAPXPA2332	SIT NEXT® MC NARROW V-BELT Section XPA, Datum length Ld (mm) 2332	8

Are conform to Standards ISO 13050, and are antistatic according to ISO 9563 (Timing belts) and BS3790-1995, ISO 1813: 1998 (E) (V-Belts).

All belts have been inspected according SIT Spa ISO 9001 quality procedure.

Yours Faithfully,

Emiliano Dalla Nave
Sales Export Manager

SIT S.p.A.
Viale A.Volta, 2
20047 Cusago (MI)
ITALY
address

Tel. +39 02 89144.1
Fax +39 02 89144.291
www.sitspa.it
info@sitspa.it - export@sitspa.it
contacts

Via G. Carminati, 15
24012 Val Brembilla (BG)
Tel. 034598131
Fax 034599374
factory

5.4 Vibration Switch Datasheet

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STYRENE PARK OFFSITE

Document Title:

Vibration Switch Data Sheet

Rev.	Issued Date	DESCRIPTION	PREPARED	CHECKED	APPROVED
R4	01-05-2025	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R3	02-11-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R2	06-10-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R1	17-09-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh
R0	22-06-2024	IFA	F.Aghaienezhad	J.Beigloo	A.Gholizadeh

REVISION RECORD SHEET

Page	Revisions								Page	Revisions						
Page	R0	R1	R2	R3	R4	R5	R6			R0	R1	R2	R3	R4	R5	R6
1	X	X	X	X	X				41							
2	X	X	X	X	X				42							
3	X	X	X	X	X				43							
4		X	X	X	X				44							
5		X	X	X	X				45							
6		X	X	X	X				46							
7		X	X	X	X				47							
8		X	X	X	X				48							
9		X							49							
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37									77							
38									78							
39									79							
40									80							

Vibration Switch Data sheet

Basic Data								Manufacturer Data						
1	PROJECT- Customer item		1158					1	Manufacturer / Origin	SAMI/ WIKA/Italy				
2	Quantity		4					2	Type - Model	VBS SPDT without M20*2.5				
3	Tag No.		VS-RU0001A-01A VS-RU0001A-01B VS-RU0001B-01A VS-RU0001B-01B					3	Enclosure material	Cast aluminum painted				
4	Area classification	IEC	Yes					4	Certification	According to 2014/34/EU ATEX Exd IIC T5				
5		NEMA	Yes					5	Working	HORIZENTAL	Yes	VERTICAL	Yes	
6	Enclosure		Exd					6	Wiring entry(type-size)	M20				
7	Reset		Electric	NO	Manual	YES		7	CABLE GLAND	M20*1.5				
8	Switch contacts		SPDT	YES	DPDT	NO		8	RANGE	0-5g				
9	Protection		IP 65					9	TEMP CLASS	T5				
10	Zone - Gas group		2					10	Normal Operation Temp	(-20, 55) ℃				
11	RANGE - SET POINT		(0- 5 g)											
12	Temperature class		IIB-T3					11	Set point adjust	2g				
13	Ambient temp. min/max		(5 To 48) ℃					12	RESET	MANUAL				
14	Humidity (RH) (%)		80%					13	PROTECTION	IP65				
15	Altitude (m)		20					14	Installation	With fixing base or bracket. The vibration sensitive axle is perpendicular or axial to the switch fixing base				
16	Contact rating		24VDC, 1A					15						
17	Start-up delay		N.A					16						
18	MOUNTING		Yes					17						
19	Housing		CAST ALOMINIUM					18						
20	Thered size - TYPE		M20 @ 1.5					19						

Compact vibration switch, flameproof enclosure Ex D
Model VBS

for further approvals see page 4

Applications

- Monitor excess of vibrations in machinery equipments
- Safety-critical applications in chemical and petrochemical industries, oil and gas, power generation, including nuclear power plants, water/wastewater, mining
- Ventilation / Air conditioning
- Pumps & compressors, turbines
- Engines, motors & generators

Model VBS

Special features

- Robust switch enclosure from aluminium alloy
- Frequency sensitivity up to 60 Hz (< 3600 RPM)
- SPDT or DPDT contacts, up to AC 380 Vac, 15 A
- Calibration: up to 5 g with outer calibration screw

Description

The Vibration switches have been developed to protect the rotating equipments against increase in vibration due to operating anomalies or failures that could damage the entire machinery.
The high quality of the products and manufacturing in accordance with ISO 9001 ensure reliable monitoring of your machine. During the production phase the switches are 100% calibrated and tested.

The switches are of mechanical type. The robust switch enclosure from aluminium alloy can withstand the rough and corrosive operating conditions of the process industry.

To adjust the set point simply open the access cover plate. The access to the terminal block for the electrical connection is protected by a screw-on lid, which is secured with a screw-type lock against unauthorised intervention.
The vibration switches have a fequence sensitivity up to 60Hz and can be calibrated up to 5g acceleration directly in field.

Vibrations Switches contain a spring inside the body.
The excessive vibration, beyond a defined range, causes the movement of the spring, which consequently activates the switch through magnetic attraction.
The position of the magnet in relation to the spring can be changed to match the desired threshold value.
Disengaging the magnet from the spring will reset the Vibration Switch.

In order to ensure operation as flexible as possible, the Vibration switches are fitted with micro switches which enable the switching of an electrical load of up to AC 380V 15A directly.

Data sheets showing similar products and accessories:

Battery-operated signal converter; model FLC-406; see data sheet FL 20.08
Signal converter; model FLC-608; see data sheet FL 20.05
Flow meter; model FLC-2300; see data sheet FL 20.06

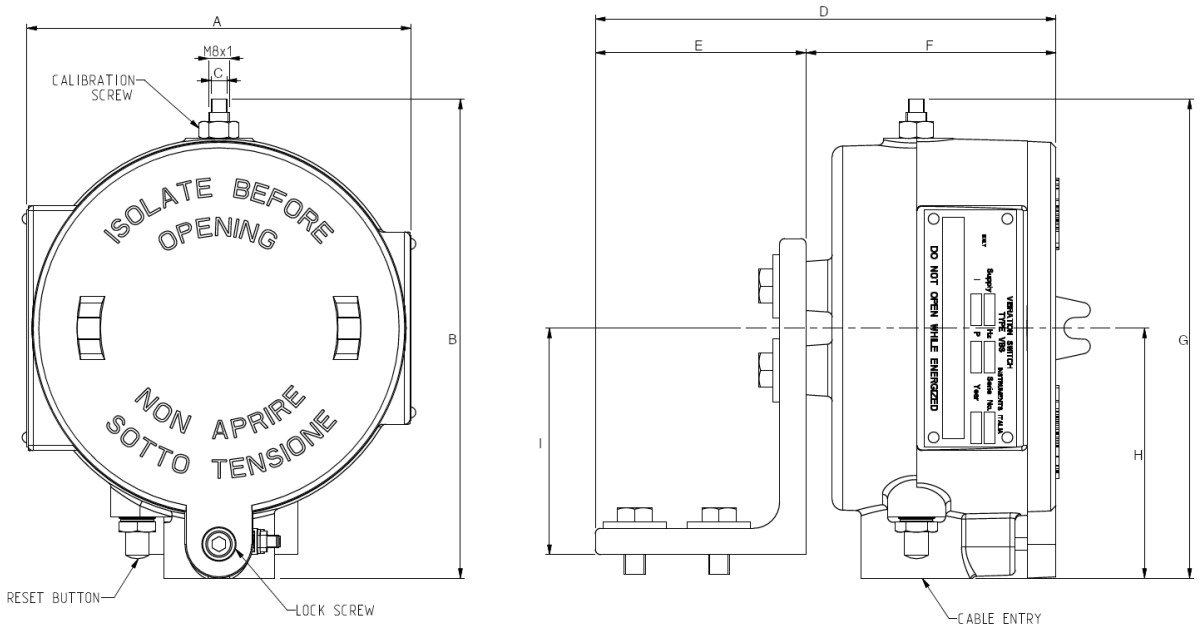
Specifications

Specifications	
Enclosure material	High resistance aluminium alloy. Max copper content: 1%
Ignition protection	CESI Flameproof, Ex d IIC T6 or T5 Gb
Switch enclosure	Epoxy resin coated and tamper-proof junction box and terminal box provided together with the equipment
Peak vibration range	5 g
Calibration	0 to 5g with outer calibration screw [1]
Frequency sensitivity	0 to 60 Hz (0 ÷ 3600 RPM)
Mechanical protection	IP 65 & CE mark
Working axes	2 Axis only (A-B see picture)
Ambient Temperature	■ -20°C +40°C for temperature class T6 ■ -20°C +55°C for temperature class T5
Capacity of contacts	■ SPDT 15A @ 0÷380 Vac ■ DPDT 10A @ 0÷250 Vac
Start-up delay	Optional reset coil required [2]
Reset	■ Local reset is provided as standard ■ Electrical Remote Reset can be supplied as optional
Weight	3 kg (including bracket and fixing screws)
Earth screws	Internal and external
Terminal box	Suitable for cable up to 2,5 mm^2
Installation	With fixing base or bracket. The vibration sensitive axle is perpendicular or axial to the switch fixing base
Label	Laser-engraved stainless steel nameplate fixed to the body, containing the following information: ■ Manufacturer name ■ Model ■ Serial Number ■ Range ■ Purchase Order number ■ Tag number
Reset coil	■ None ■ 115/120 Vac ■ 220/230 Vac ■ 24 Vdc
Electrical connection	■ M20 X 1,5 ■ ¾" NPT-F ■ 1/2" NPT-F
Switch contacts	■ SPDT ■ DPDT

[1] The vibration switches are provided with a standard pre-set factory set-point. The set-point of the instrument strongly depends on the intensity of the natural vibration produced by the equipment during the normal operation. The final calibration of the vibration switch must be done on field according to the peculiarity of machinery on which the device is installed. For this reasons, due to the huge variables that depend on the equipment and application, WIKA does not provide any customized set-point or any calibration certificate of the instrument.

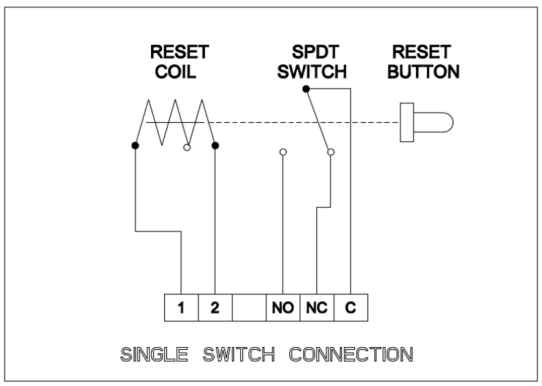
[2] Apply voltage to the reset coil to stop bounces for at least 20 seconds after the machine has started

Dimensions

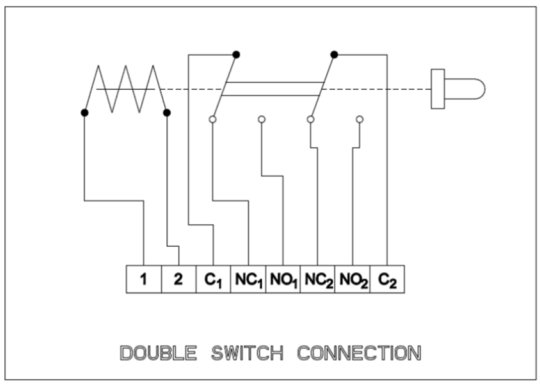


Dimensions in mm [in]								
A	B	C	D	E	F	G	H	I
146 [5.75]	182 [7.16]	6 [0.24]	175 [6.89]	80 [3.15]	95 [3.74]	182 [7.16]	95 [3.74]	86 [3.38]

Single Switch Connection Electrical Diagram



Double Switch Connection Electrical Diagram



Ordering Information

Item Number	Reset coil	Switch contacts	Electrical connections
81647076	24 VDC	DPDT	¾“ NPT-F + ½“ NPF-F adapter
81647079	24 VDC	DPDT	3/4" NPT-F direct
81647080	24 VDC	DPDT	M20x1,5 + Cable gland 11-18mm adapter
81647083	24 VDC	DPDT	M20x1,5 direct
81647077	24 VDC	SPDT	¾“ NPT-F + ½“ NPF-F adapter
81647078	24 VDC	SPDT	3/4" NPT-F direct
81647081	24 VDC	SPDT	M20x1,5 + Cable gland 11-18mm adapter
81647082	24 VDC	SPDT	M20x1,5 direct
81647168	110 VAC	DPDT	¾“ NPT-F + ½“ NPF-F adapter
81647165	110 VAC	DPDT	3/4" NPT-F direct
81647087	110 VAC	DPDT	M20x1,5 + Cable gland 11-18mm adapter
81647084	110 VAC	DPDT	M20x1,5 direct
81647167	110 VAC	SPDT	¾“ NPT-F + ½“ NPF-F adapter
81647166	110 VAC	SPDT	3/4" NPT-F direct
81647086	110 VAC	SPDT	M20x1,5 + Cable gland 11-18mm adapter
81647085	110 VAC	SPDT	M20x1,5 direct
81647170	220 VAC	DPDT	¾“ NPT-F + ½“ NPF-F adapter
81647173	220 VAC	DPDT	3/4" NPT-F direct
81647174	220 VAC	DPDT	M20x1,5 + Cable gland 11-18mm adapter
81647177	220 VAC	DPDT	M20x1,5 direct
81647171	220 VAC	SPDT	¾“ NPT-F + ½“ NPF-F adapter
81647172	220 VAC	SPDT	3/4" NPT-F direct
81647175	220 VAC	SPDT	M20x1,5 + Cable gland 11-18mm adapter
81647176	220 VAC	SPDT	M20x1,5 direct
81647072	Without	DPDT	¾“ NPT-F + ½“ NPF-F adapter
81647068	Without	DPDT	3/4" NPT-F direct
81647074	Without	DPDT	M20x1,5 + Cable gland 11-18mm adapter
81647071	Without	DPDT	M20x1,5 direct
81647073	Without	SPDT	¾“ NPT-F + ½“ NPF-F adapter
81647069	Without	SPDT	3/4" NPT-F direct
81647075	Without	SPDT	M20x1,5 + Cable gland 11-18mm adapter
81647070	Without	SPDT	M20x1,5 direct

Approvals

Logo	Description	Country
CE	**- EU Declaration of conformity** **- RoHS directive** **- ATEX directive** **- II 2G**	European Union

Approvals and certificates, see website

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