MBV ENGINEERING, INC.
MOIA BOWLES VILLAMIZAR & ASSOCIATES
www.mbveng.com CA #3728

LIFT STATION CALCULATIONS

for

FIRE STATION #7

City of Fellsmere, Florida

September 2022
Revised May 2023

Prepared by: MBV Engineering, Inc.
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Certificate of Authorization #: 3728

Engineer's Project Number: 22-0492
Designed by: TJH

AARON G. STANTON LICENSE No. 72460 STATE OF FLORIDA PROFESSIONAL ENGINEER

5/11/23

Aaron G. Stanton, P.E. FL PE# 72460

Lift Station Design Summary Sheet

- **Fiberglass Wet Well**
  Diameter = 6.0 ft
  Depth = 7.7 ft

- **Concrete Anti-flotation Ballast:**
  Volume = 0.0 Cu.Yd.

- **Discharge Line**
  4.00 in DIA PVC Force Main

- **Design Operating Points:**
  Flow = 78.3 gpm
  TDH = 82.8 ft

Operating Points:
Flow = 92.0 gpm
TDH = 89.8 ft

- **Pump Selection:**
  Two - Sulzer PIR - PE45/2C
  6.7 hp
  230V 3P 60Hz
  3525 RPM
  6.3 inch Impeller

- **For Details of System Head curve generation, buoyancy calculation and pump selection, please reference the attached calculations, head curves, and pump data sheet.**

1. PURPOSE

The purpose of this report is to provide the local Utility Department and the Florida Department of Environmental Protection (FDEP) with documentation and calculations in order to construct a proposed lift station and force main to the existing system. The calculations contained in this report demonstrate the system is designed to meet the requirements of FDEP and the local Utility Department.

2. DESIGN FLOW DETERMINATION

FLOW SOURCE	TYPE	NUMBER	UNIT FLOW (gpd)	UNITS	TOTAL FLOW (gpd)
Fire Station	Institutional	3	250	per ERU	750
					0
					0
					0
					0
					0
TOTAL					750

HOURS OF OPERATION: 24.0 HRS (Average)
TOTAL (gpd/gpm): 750 / 0.5
POPULATION EQUIVALENT (000'S): 0.0
PEAKING FACTOR: 4.00
PEAK FLOW (gpm): 2.1

3. TRIBUTARY FLOW FROM OTHER LIFT STATIONS

Station Number	Design Flow (gpm)
1	0
2	0
3	0

TOTAL DESIGN FLOW THIS STATION (GPM): 6.00 (6 gpm minimum)

4. WET WELL SIZING CALCULATIONS

ENTER MINIMUM CYCLE TIME (min):	15.00
DESIGN OUT FLOW (gpm):	6.00
MINIMUM WET WELL STORAGE (gal) = Cylcle Time * Design Out Flow / Peak Factor	22.50
MINIMUM PUMPING TIME AT 0 INFLOW (min):	5.00
WET WELL DIAMETER (ft):	6.00
REQUIRED OPERATING RANGE (ft):	0.11

5. DETERMINE CONTROL ELEVATIONS

TOP OF LIFT STATION ELEVATION:				25.50
LOWEST GRAVITY INLET INVERT ELEVATION:				20.99
ALARM INTERVAL / ELEVATION:		0.50	/	20.49
LAG PUMP INTERVAL / ELEVATION:		0.50	/	19.99
LEAD PUMP INTERVAL / ELEVATION:		0.50	/	19.49
SHUTOFF INTERVAL / ELEVATION:	= 0.11, Use:	0.14	/	19.35
BOTTOM OF LIFT STATION ELEVATION:				17.85

6. TOTAL DESIGN HEAD CALCULATION

MINOR LOSSES COEFFICIENT DETERMINATION

Pipe Size (in) = 4.0

TYPE	Eq. Length (Based on pipe size)	DISCHARGE Number	DISCHARGE Eq. Length Total	COMMON #1 Number	COMMON #1 Eq. Length Total
1. 90 Bend	10.0	8	80	0	0
2. 45 Bend	5.0	8	40	0	0
3. Long Sweep Bend	7.0	2	14	0	0
4. Close Return Bend	24.0	0	0	0	0
5. Tee Straight Run	0.0	0	0	0	0
6. Tee - Side Inlet of Outlet	22.0	3	66	0	0
7. Globe Valve - Open	110.0	0	0	0	0
8. Angle Valve - Open	58.0	0	0	0	0
9. Gate Valve - Fully Open	2.3	3	6.9	0	0
10. Check Valve (Swing)	26.0	2	52	0	0
11. Check Valve (Spring)	43.0	0	0	0	0
	Total Equivalent Length (ft) =		258.9		0

Equivalent Length Chart for various pipe sizes

TYPE	2"	2-1/2"	3"	4"	6"	8"
1. 90 Bend	5.5	6.5	8.0	10.0	15.0	20.0
2. 45 Bend	2.5	3.0	3.8	5.0	7.1	9.4
3. Long Sweep Bend	3.5	4.2	5.2	7.0	11.0	14.0
4. Close Return Bend	13.0	15.0	18.0	24.0	37.0	39.0
5. Tee Straight Run	4.0	5.0				
6. Tee - Side Inlet of Outlet	12.0	14.0	17.0	22.0	31.0	40.0
7. Globe Valve - Open	55.0	67.0	82.0	110.0	160.0	220.0
8. Angle Valve - Open	28.0	33.0	42.0	58.0	83.0	110.0
9. Gate Valve - Fully Open	1.2	1.4	1.7	2.3	3.5	4.5
10. Check Valve (Swing)	13.0	16.0	20.0	26.0	39.0	52.0
11. Check Valve (Spring)	19.0	23.0	32.0	43.0		

7. HEAD LOSS DETERMINATION

PIPE:	DISCHARGE	COMMON #1
Design Flow (gpm) :	2.1	0
Pipe Diameter (inches):	4.00	8
Minimum Velocity (fps):	2.00	0
Minimum Required Flow at Min. Velocity (gpm):	78.3	
Minimum Flow required for this project (gpm):	**78.3**	
Resulting Head from Minimum Flow (ft):	82.8	
Actual Pipe Length (ft):	3409	
Equivalent Pipe Length from above (ft):	258.9	
TOTAL PIPE LENGTH (ft):	3668	0
Hazen-Williams Coefficient (Chw):	120	120
Maximum Field Pressure (PSI):	25.0	*PSI PROVIDED BY Jesse Roland - 5/13/2022
HEAD @ POINT OF CONNECTION	57.75	
HIGH POINT ELEVATION:	24.00	
LOW WET WELL ELEVATION:	19.35	
AVE. STATIC HEAD:	62.40	

8. SYSTEM HEAD CURVE GENERATION

SET INITIAL FLOW (gpm): 0
SET INCREMENTAL FLOW (gpm): 10
PUMP SELECTION: Two - Sulzer PIR - PE45/2C
6.7 hp
230V 3P 60Hz
3525 RPM
6.3 inch Impeller

Flow (gpm)	Velocity (fps)	Friction	Static	Total Design Head
0	0.0	0.000	62.400	62.4
10	0.3	0.452	62.400	62.9
20	0.5	1.629	62.400	64.0
30	0.8	3.449	62.400	65.8
40	1.0	5.872	62.400	68.3
50	1.3	8.873	62.400	71.3
60	1.5	12.432	62.400	74.8
70	1.8	16.535	62.400	78.9
80	2.0	21.168	62.400	83.6
90	2.3	26.321	62.400	88.7
100	2.6	31.986	62.400	94.4
110	2.8	38.154	62.400	100.6
120	3.1	44.817	62.400	107.2
130	3.3	51.971	62.400	114.4
140	3.6	59.607	62.400	122.0
Operating Point = 92	2.3	27.414	62.400	89.8

9. ACTUAL CYCLE TIME:

T= VOL [1/Qin + (1/ (Qout - Qin)]:

Average, T= 20.06 min
Peak, T= 5.28 min

lume (on to off)= 29.59 gal
Q average = 1.50 gpm
Q peak = 6.00 gpm

10. FDEP PUMP STATION DATA

TYPE OF UNIT	# of UNITS	POPULATION PER UNIT	TOTAL POPULATION	PER CAPITAL FLOW	TOTAL AVERAGE DAILY FLOW	PEAK HR FLOW
Single-Family Home			0		0.0 GPD	
Mobile Home			0		0.0 GPD	
Apartment			0		0.0 GPD	
Commercial, Institutional or Industrial facility			0		0.0 GPD	
TOTAL					0.0 GPD	

LOCATION	TYPE	MAXIMUM	AVERAGE	MINIMUM	OPERATING CONDITIONS
TOTAL					

11. BOUYANCY CALCULATIONS

ENTER TYPE OF WELL: C (F=FIBERGLASS, C=CONCRETE)

VOLUME:

WELL DEPTH:	7.7	ft (Depth)
WELL DIAMETER:	6.0	ft (D)
WELL VOLUME:	216	ft^3
WALL THICKNESS:	8	inches
BASE THICKNESS:	18	inches
BASE WIDTH:	10	ft

FORCE OF BOUYANCY (F_b):

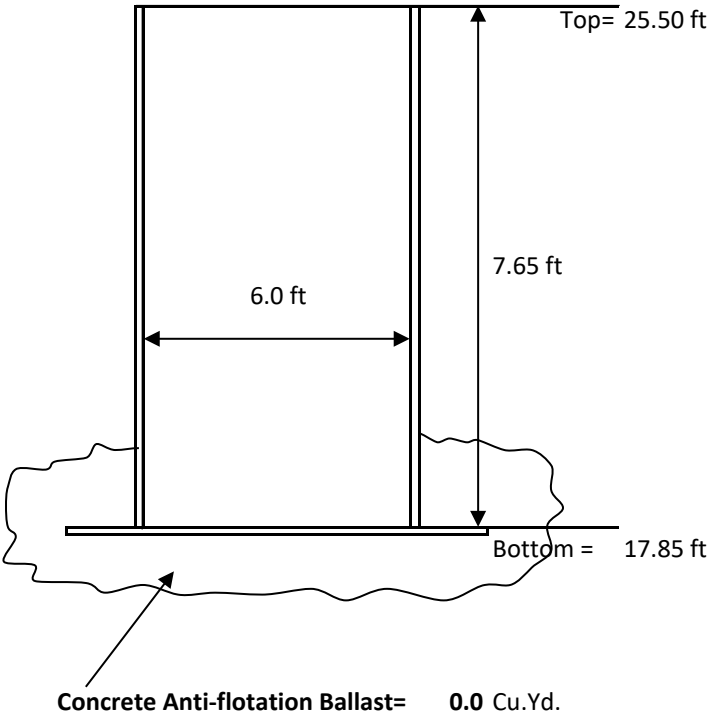
DENSITY:	62.4	lbs/ft^3 (WATER)
F_b:	13,490	lbs = volume of wet well x density of water = (3.14xD^2 /4) x Depth x 62.4

WET WELL WEIGHT (See Sketch next page)

DENSITY:	150	lbs/ft^3 (CONCRETE)	
WALLS:	16,014	lbs = volume of walls x density of walls (based on conc. or fiberglass) *	
BASE:	17,663	lbs = volume of base x density of base (based on conc. or fiberglass) **	
TOTAL:	33,677	lbs = weight of walls plus weight of base	
BALLAST:	-	lbs	0.00 cy conc
TOTAL WEIGHT:	33,677	lbs	
Wet Well Weight - Bouyancy Force =	20,186	lbs =	2.5 factor of safety

* = [(3.14 x (D+2W)^2)/4 - (3.14 x (D^2)/4)] x Well Depth x Density
** = [(3.14 x Base Width^2)/4] x Base Thickness x Density

CONCRETE WET WELL



Concrete Anti-flotation Ballast= 0.0 Cu.Yd.

Product description

SULZER

Pos.no	Description	Item no.	Quant.
	PIR PE1 60 HZ		
	Centrifugal pump: PIR PE45/2-C-60HZ PIR PE1		1

Submersible grinder pump type ABS Piranha with shredding action used for reliable and economical discharge of effluent under pressure, using small diameter discharge lines in communal schemes.
For effluent removal from houses in rural areas where high ground must be overcome, or where only small diameter pipework can be laid, and for example removal from motorway service stations and camp sites, large construction sites, urban renewal and renovation of buildings.
Pumped medium: sewage and other heavily polluted waste water.

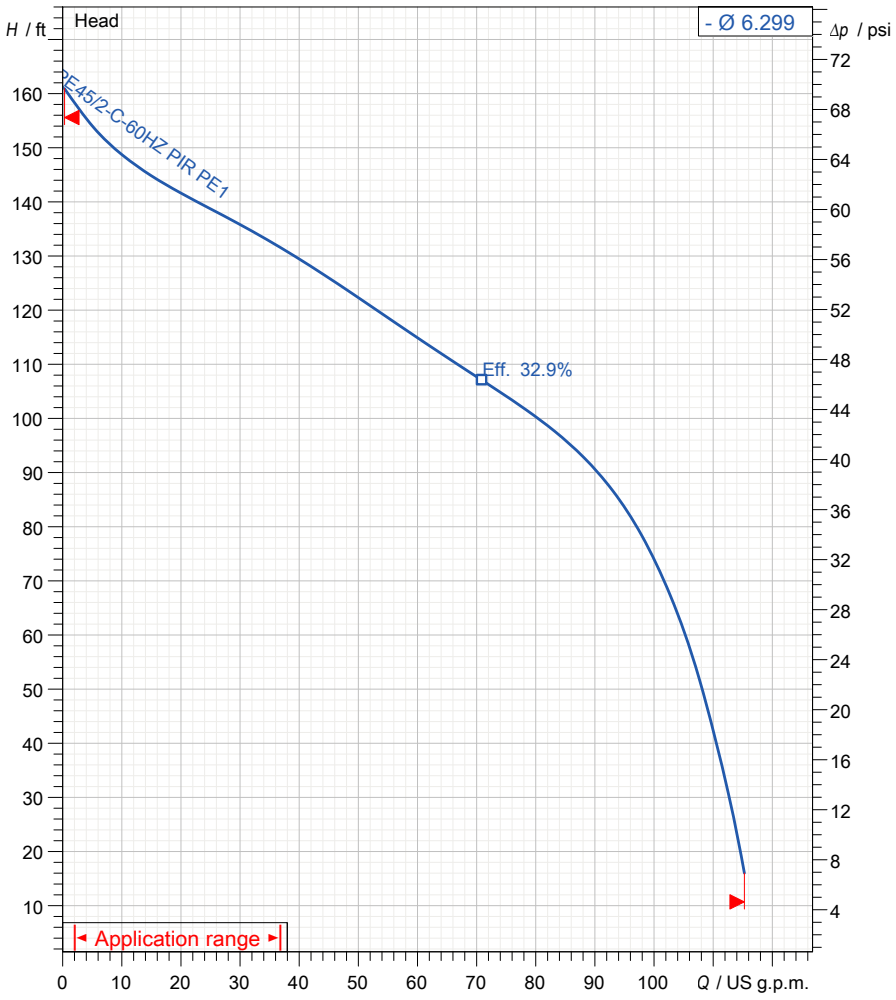
Pumps of the Piranha-PE series have been designed for continuous operation S1 when either submerged or dry-installed.
Piranha-S has been designed for intermittent use only (S3, 25%) when dry installed

Capacity up to	30 m3/h
Head, max.	75 m

Type: PIR PE45/2-C-60HZ PIR PE1

Technical data	
Delivery rate	:
Delivery head	:
Hydr. efficiency	:
Shaft power	:
Speed	: 3525 rpm
Impeller type	: Macerator
Motor output	: 6.705 hp
Voltage	: 230 V
Frequency	: 60 Hz
Discharge outlet	: DN32

PIR PE1 60 HZ



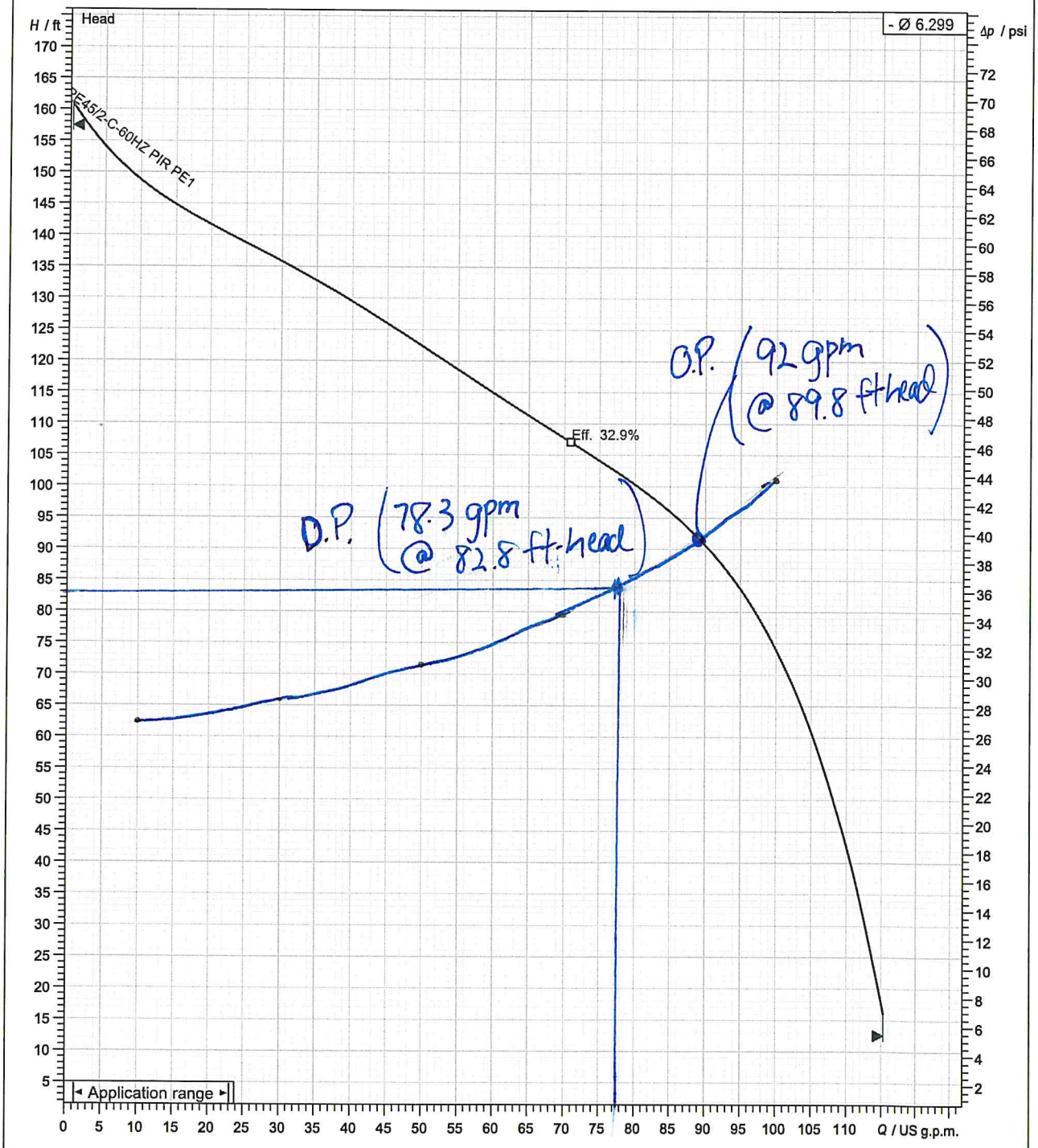
Testnorm
ISO 9906: 2012, HI 11.6/14.6 ≤10kW

2022-02-09

Operating data specification		Power input	
Flow		Head	
Efficiency		Rated power	
NPSH		Fluid	Water
Temperature	68 °F	Nature of system	Single head pump
No. of pumps	1		
Pump data			
Type	PIR PE1 60 HZ	Make	SULZER
Series	PIRANHA & PIRANHA PE	Impeller	Macerator
N° of vanes	5	Impeller size	6.3 inch
Free passage		Suction flange	
Discharge flange	DN32	Type of installation	
Moment of inertia	0.0807 lb ft²		Installation wet well
Motor data			
Rated voltage	230 V	Frequency	60 Hz
Rated power P2	6.71 hp	Nominal Speed	3500 rpm
Number of poles	2	Efficiency	89.1 %
Power factor	0.882	Rated current	16 A
Starting current	120 A	Rated torque	10.1 lbf ft
Starting torque		Degree of protection	IP 68
Insulation class	H	No. starts per hour	15

Curve number	Pump performance curves	SULZER
Reference curve PIR-PE-C-60HZ	PIR PE1 60 HZ	

			Discharge DN32	Frequency 60 Hz
Density 62.32 lb/ft³	Viscosity 1.005 mm²/s	Testnorm ISO 9906: 2012, HI 11.6/14.6 ≤10	Rated speed 3525 rpm	Date 2022-02-09
Flow	Head	Rated power Power input	Hydraulic efficiency	NPSH



Impeller size 6.3 inch	N° of vanes 5	Impeller Macerator	Solid size	Revision

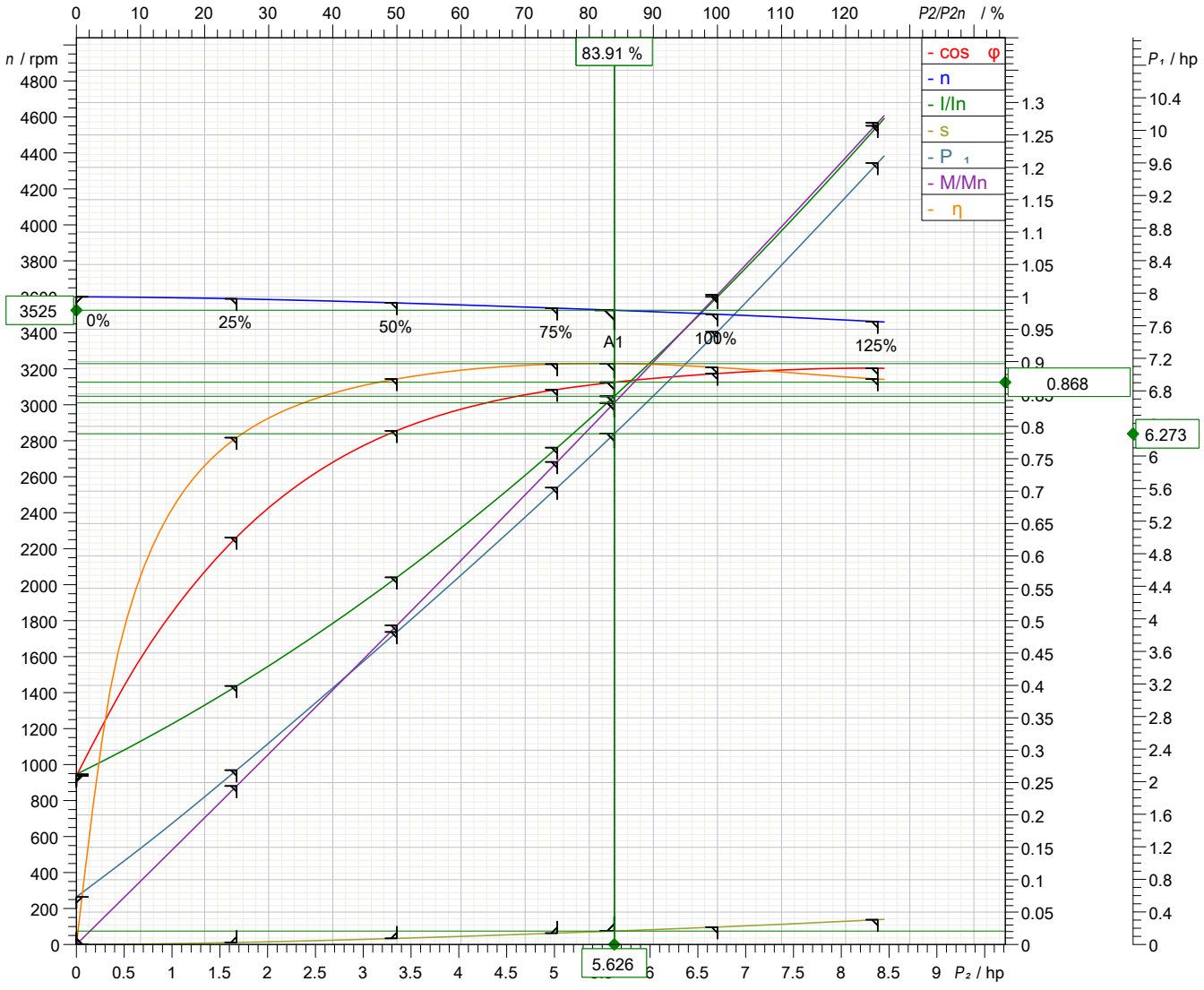
Frequency	PE1
60 Hz	

Motor performance curve

PE45/2-C-60HZ PIR PE1

SULZER

Rated power	Service factor	Nominal Speed	Number of poles	Rated voltage	Date
6.71 hp	1.3	3510 rpm	2	230 V	2022-02-09



Symbol	No load	25 %	50 %	75 %	100 %	125 %
P₂ / hp	0	1.676	3.353	5.029	6.705	8.381
P₁ / hp	0.584	2.142	3.839	5.612	7.526	9.6
η / %	0	78.26	87.33	89.61	89.09	87.3
n / rpm	3600	3589	3566	3537	3503	3462
cos φ	0.2603	0.6284	0.7932	0.8568	0.8816	0.8897
I / A	4.2	6.38	9.06	12.26	15.98	20.2
s / %	0	0.3066	0.9422	1.752	2.693	3.834

Tolerance according toVDE 0530 T1 12.84for rated power

Starting current	Starting torque	Moment of inertia	No. starts per hour
120 A		0.119 lb ft²	15

Spaix® 4, Version 4.3.11 - 2019/01/16 (Build 240)
Data version Jan 2019