

## DAFTAR PUSTAKA

Andrew, J., N. (2016), Jurnal Teknik ITS Vol. 5 No. 2. Diakses pada tanggal 20 Mei 2020, jam 22.00 WIB dari: <https://media.neliti.com>

ASME B31, (2014). *Process Piping Guide*. The American Society of Mechanical Engineers. New York. Section D20-B31.3-G. Diakses pada tanggal 14 Mei 2020 dari:

[https://engstandards.lanl.gov/esm/pressure\\_safety/process\\_piping\\_guide\\_R2.pdf](https://engstandards.lanl.gov/esm/pressure_safety/process_piping_guide_R2.pdf)

ASTM A36 Steel Pipe. (2016 Januari 29). *Carbon&HSLA: Plate*. Diambil Kembali dari Oneal The Metal Company Website:

<http://www.onealsteel.com/carbon-steel-plate-a36>

Frank M. White,(1986). *Mekanika Fluida Jilid I*. Penerbit Erlangga, Jakarta.

Giancoli, Douglas C. (2014). *Fisika:Prinsip dan Aplikasi*. Edisi ke 7 Jilid 1. Jakarta: Erlangga.

Handika. Arief Angga. (2020), *Analisa Pengaruh Variasi Suhu Fluida Yang Mengalir Melalui Return Bends Pipe 180° Terhadap Head Losses Pada Aliran Pipa*. <http://eprints.ummetro.ac.id/63/2/Abstrak.pdf>.

[https://www.academia.edu/8627092/Macam\\_macam\\_Valve\\_dan\\_Fungsinya](https://www.academia.edu/8627092/Macam_macam_Valve_dan_Fungsinya).

Diakses pada 16 Mei 2020, pukul 20.19 WIB.

Jurnal LJTMU: Vol. 03, No. 01, April 2016. Diakses tanggal 25 Juni 2020, jam 23.00 WIB dari: <https://www.neliti.com/id/publications/146661/analisa-beda-tinggi-katup-dan-variiasi-diameter-pipa-inlet-terhadap-unjuk-kerja-p>

Kanginan, Marthen, (2006). *Fisika 2B untuk SMA kelas XI semester 2*, Jakarta: Erlangga.

Liu, Henry. (2005), *Pipeline Engineering*, Lewis Publishers, Florida. Diakses dari: <http://repository.its.ac.id/2816/7/2112100097-Undergraduate-Theses.pdf> pada 01 Juni 2020 jam 21.00 WIB.

Natrium Hidroksida (NaOH). [https://id.wikipedia.org/wiki/Natrium\\_hidroksida](https://id.wikipedia.org/wiki/Natrium_hidroksida). Diakses pada tanggal 30 Mei 2020, jam 23.00 WIB.

Parisher, R.A., dan Robert A. R. (2002), *Pipe Drafting and Design*, Butterworth-Heinemann.

Puja, Wiratmaja. (2011), *Perancangan & Konstruksi Sistem Perpipaan*, ITB.

Rachmat, Subagyo. (Juli 2009), *Analisis Koefisien Kerugian Pada Percabangan Pipa*. Volume 10 No.1. Diakses tanggal 19 Mei 2020, jam 23.00 WIB dari: <https://mesin.ulm.ac.id/assets/dist/penelitian/1761-3644-1-SM.pdf>

Raswari. (1986), *Teknologi dan Perencanaan Perpipaan*, Jakarta: Penerbit Universitas Indonesia.

Raymond A, Serway, John W. Jewett, Jr. (2010), *Fisika Untuk sains dan Teknik*, Jakarta: Salemba Teknik.

Schedule Pipa Dan Fitting., Diambil dari: <http://www.idpipe.com/2014/10/tabel-nominal-pipe-size-dan-pipe-schedule.html>. Diakses pada 25 Juni 2020, jam 14.00 WIB.

Smith, Paul R. et al. (1987), *Piping and Pipe Support Systems*, McGraw-Hill. Diunduh ulang dari: Jurnal: <http://repository.unib.ac.id> pada 25 Juni 2020, jam 13.05 WIB.

Sularso. (2000), *Pompa dan Kompresor*, PT Pradnya Paramita: Jakarta.

Sularso, MSME & Prof. Dr. Haruo Tahara. (1983) *Pompa dan Kompresor*, PT Pradnya Paramita, Jakarta.





## Lampiran 4: Spesifikasi Pipa PS-101

Piping Specification 101	Date: March 16, 2009	Revision: 0	Page 1 of 1
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### DESIGN PARAMETERS

P-Spec	PS-101(A, B, C, D)						
Design Pressure (psig)	285	260	230	200	170	140	125
Design Temperature (°F)	100	200	300	400	500	300	650
Minimum Temperature (°F)	-20	-20	-20	-20	-20	-20	-20
Minimum Test Pressure (psig)	430	390	345	300	270	245	220
Maximum Test Pressure (psig)	320						

Calculation Reference:	00-00-CALC-M-0004-R0
Code of Reference:	B31.3 - 2002
Fluid Service:	Normal
Material:	Carbon Steel
Pressure Rating:	Class 150
External Pressure Rating:	15 psi

### GENERAL NOTES

Refer to General Notes 1-12.

### ALLOWABLE PIPE MATERIALS

Component	Size	Rating	Standard	Material	Material Grade	Additional Requirements
Piping	¼ - 24	Schedule Tables	ASME B38.10M	ASTMA53	B	ERW – Type E/Seamless
Piping	¼ - 24	Schedule Tables	ASME B38.10	ASTMA106	B	Seamless

### REQUIRED SCHEDULES FOR NON-THREADED PIPE

P-Spec	Corrosion Allowance	Pipe Size	¼	½	¾	1	1 ½	2	2 ½	3	4	6	8	10	12	14	16	18	20	24	
A	0.000	Schedule	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
B	0.031	Schedule	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
C	0.063	Schedule	80	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD
D	0.125	Schedule	-	XXS	160	160	160	80	80	80	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD	STD

### REQUIRED SCHEDULES FOR THREADED PIPE

P-Spec	Corrosion Allowance	Pipe Size	¼	½	¾	1	1 ½	2	2 ½	3	4	6
A	0.000	Schedule	80	80	80	80	80	STD	STD	STD	STD	STD
B	0.031	Schedule	80	80	80	80	80	STD	STD	STD	STD	STD
C	0.063	Schedule	-	80	80	80	80	80	80	80	STD	STD
D	0.125	Schedule	-	XXS	160	160	160	160	160	80	80	80

LANL Engineering Standards Manual PD342

Chapter 17 Pressure Safety

Section D20-B31.3-G, ASME B31.3 Process Piping Guide, App B

Rev. 2, 3/10/09

Fluid Service: Caustic Soda (0 – 50% NaOH)	Page 1 of 1	Revision: 0	Date: 3/16/09
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### GENERAL INFORMATION

Material	P-Spec	Corrosion Allowance (in)	Max Pressure (psi)	Max Temperature (°F)	Additional Requirements
Carbon Steel Pipe	PS-101B	0.031	200	200	

### GASKETS

Material	Flange Face Finish	Additional Requirements
NBR Bonded	125-250	May be used with Flat Face Flanges



## VALVES

The valve ID numbering system is defined in Appendix D.

	Feature	Feature Specifications
Required Specification Features	1) Acceptable Standard	CV Code Valve
	2) Material	4-Carbon Steel (1), 5-Stainless Steel 304(L) (2), 6-Stainless Steel 316(L) (3), 7-Monel
	3) Pressure Class	1-150, P-Pressure Rated
	4) End Connection	1-Flanged, 3-Butt Weld
	5) Type of Valve	BL-Ball, CL-Lift Check, CT-Tilting Disk Check, GW-Solid Wedge Gate
Optional Specification Features	6) Valve Size	Specified as shown in the Example Valve ID Number by NPS
	7) Disc Material	A-Chromium (11-13%) (5), D-Stainless Steel, E-Monel
	8) Seat Material	A-Chromium (11-13%) (5), D-Stainless Steel, E-Monel, J-Teflon, P-EPDM
	9) Stem Material	A-Chromium (11-13%) (5), D-Stainless Steel, E-Monel
	10) Packing Material	A-Graphite, B-Teflon, H-EPDM
	11) Body Gasket	A-Graphite, B-Teflon, H-EPDM

### NOTES

- 1) ASTM A216WCB or A105
- 2) CF3, CF8, F304, or F304L
- 3) CF3M, CF8M, F316, F316L
- 4) Non-welded-end stainless steel valves pressure rating is based on the high carbon (non L) grade.
- 5) Limit Chromium (11 – 13%) to 100° F.

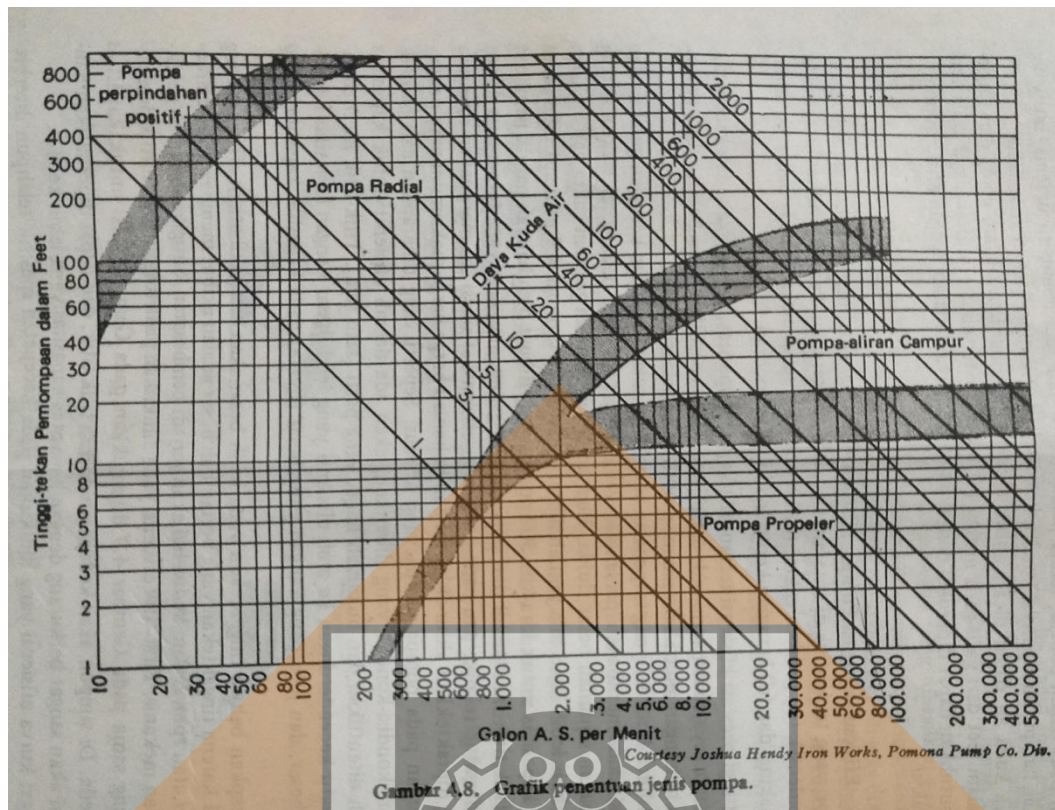
## Lampiran 5: Faktor-faktor Koreksi Motor

Daya yang akan ditransmisikan	$f_c$
Daya rata-rata yang diperlukan	1,2 – 2,0
Daya maksimum yang diperlukan	0,8 – 1,2
Daya normal	1,0 – 1,5

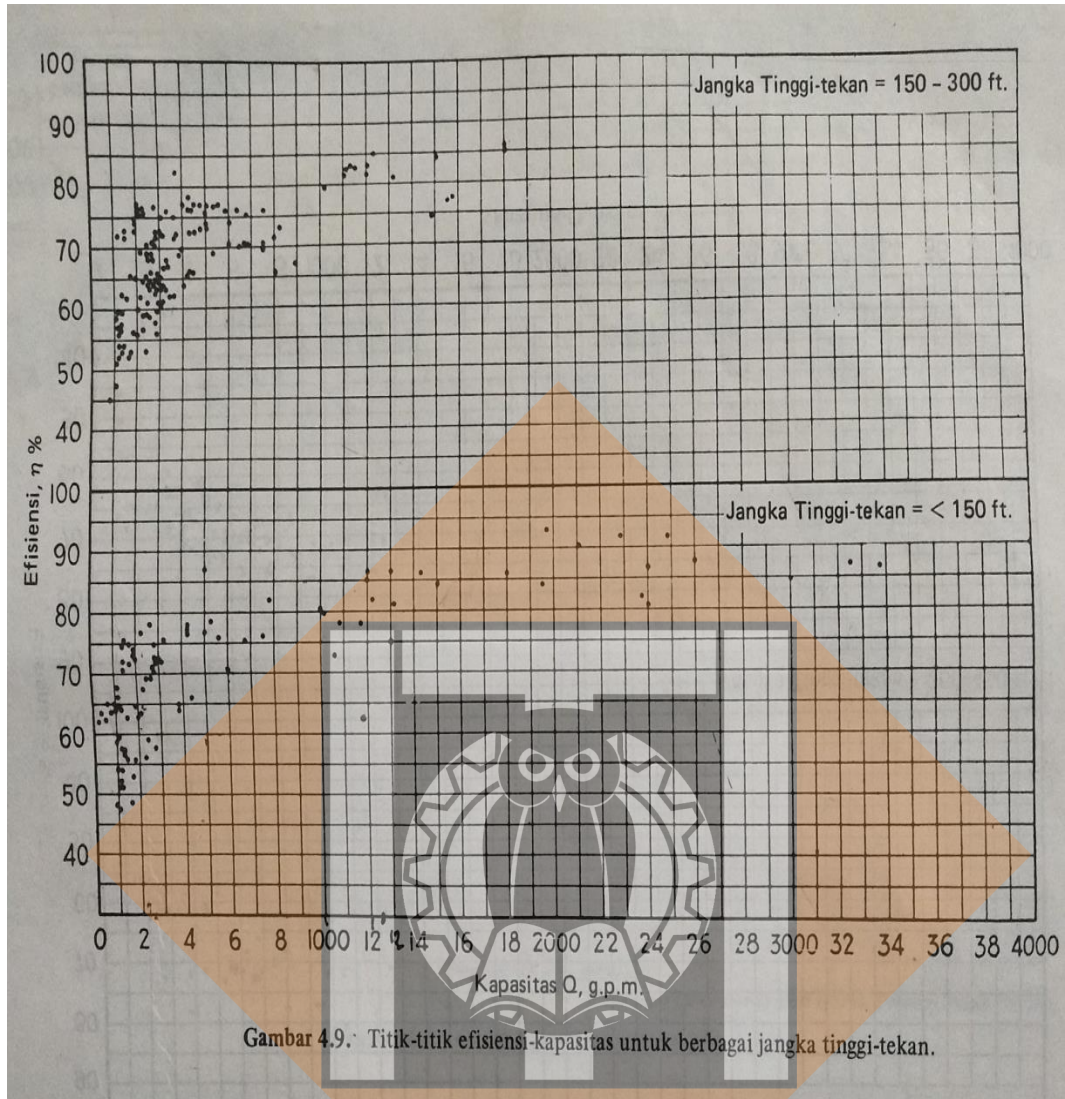
## Lampiran 6: Efisiensi Transmisi

Jenis Transmisi		$\eta_t$
Sabuk rata		0,9-0,93
Sabuk -V		0,95
Roda gigi	roda gigi lurus satu tingkat	0,92-0,95
	roda gigi miring satu tingkat	0,95-0,98
	roda gigi kerucut satu tingkat	0,92-0,96
	roda gigi planiter satu tingkat	0,95-0,98
Kopling hidrolis		0,95-0,97

## Lampiran 7: Grafik Menentukan Jenis Pompa

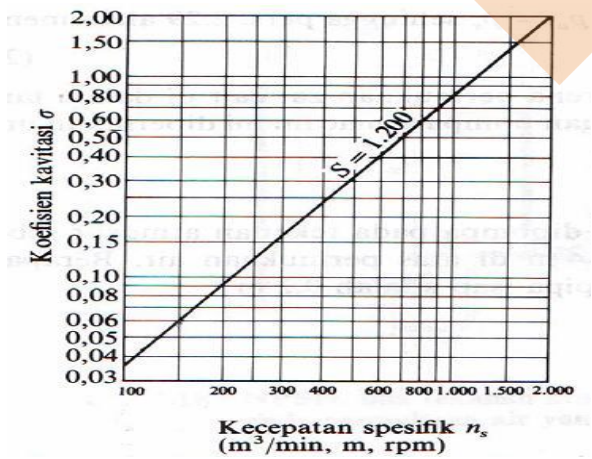


### Lampiran 8: Grafik Efisiensi Pompa



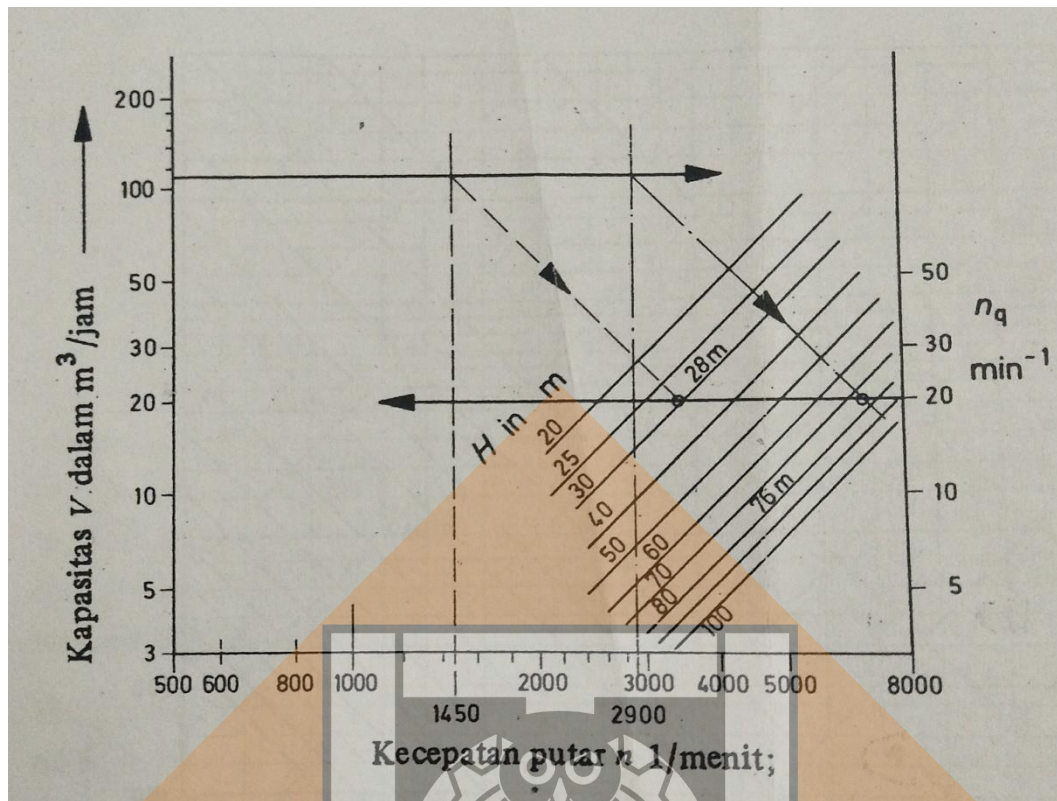
Gambar 4.9. Titik-titik efisiensi-kapasitas untuk berbagai jangka tinggi-tekan.

### Lampiran 9: Faktor Kavitasi pada Pompa Sentrifugal





**Lampiran 10: Grafik Menentukan Tingkatan Pompa**



**Lampiran 11: Densitas Material ASTM A106 Gr. B**

**Table S301.3.1 Generic Pipe Stress Model Input**

Term	Value
<b>Operating conditions:</b>	
internal pressure, $P_1$	3 450 kPa (500 psi)
maximum metal temp., $T_1$	260°C (500°F)
minimum metal temp., $T_2$	-1°C (30°F)
installation temperature	21°C (70°F)
Line size	DN 400 (NPS 16)
Pipe	Schedule 30/STD, 9.53 mm (0.375 in.)
Mechanical allowance, $c$	1.59 mm (0.063 in.)
Mill tolerance	12.5%
Elbows	Long radius
Fluid specific gravity	1.0
Insulation thickness	127 mm (5 in.)
Insulation density	176 kg/m <sup>3</sup> (11.0 lbm/ft <sup>3</sup> )
Pipe material	ASTM A106 Grade B
Pipe density	7 833.4 kg/m <sup>3</sup> (0.283 lbm/in. <sup>3</sup> )
Total weight	7 439 kg (16,400 lbm)
Unit weight	248.3 kg/m (166.9 lbm/ft)

## Lampiran 12: Allowable Stress A106 Grade B

**Table A-1M Basic Allowable Stresses in Tension for Metals (Metric) (Cont'd)**  
Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Line No.	Nominal Composition	Product Form	Spec. No.	Type/ Grade	Class/ Cond./ UNS No.	Temper	Size, mm	P-No. (5)	Notes	Min. Temp., °C (6)	Min. Tensile	Min. Yield	Max. Use
											Str., MPa	Str., MPa	Temp., °C
30	Carbon steel	Pipe & tube	A53	B	K03005	...	...	1	(2)(57)(59)	B	414	241	593
31	Carbon steel	Pipe & tube	A106	B	K03006	...	...	1	(2)(57)	B	414	241	593
32	Carbon steel	Pipe & tube	A333	6	K03006	...	...	1	(2)(57)	-45	414	241	593
33	Carbon steel	Pipe & tube	A334	6	K03006	...	...	1	(2)(57)	-45	414	241	593
34	Carbon steel	Pipe & tube	A369	FPB	K03006	...	...	1	(2)(57)	-30	414	241	593
35	Carbon steel	Pipe & tube	A381	Y35	...	...	...	1	(2)	A	414	241	593
36	Carbon steel	Pipe & tube	API 5L	B	...	...	...	1	(2)(57)(59)(77)	B	414	241	593
37	Carbon steel	Pipe & tube	A139	C	K03004	...	...	1	(2)(8b)	A	414	290	149
38	Carbon steel	Pipe & tube	A139	D	K03010	...	...	1	(2)(8b)	A	414	317	149
39	Carbon steel	Pipe & tube	API 5L	X42	...	...	...	1	(2)(55)(77)	A	414	290	204
40	Carbon steel	Pipe & tube	A381	Y42	...	...	...	1	(2)	A	414	290	204

## Lampiran 13: Table Apendiks A ASME B31.1

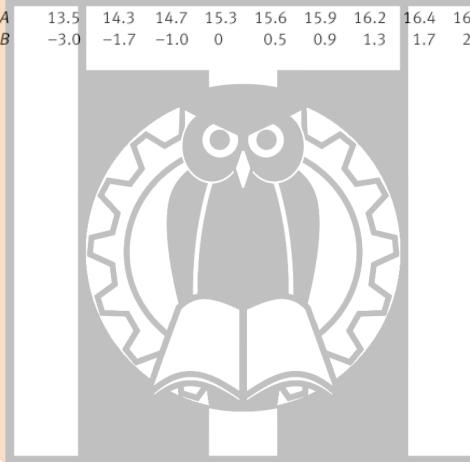
**Table A-1 Basic Allowable Stresses in Tension for Metals (Cont'd)**  
Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	Type/ Grade	UNS No.	Class/ Condition/ Temper	Size, in.	P-No. (5)	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi				
									Tensile	Yield to 100	Min. Temp. 200 300		
<b>Carbon Steel Pipes and Tubes (2)</b>													
A285 Gr. A	A134	...	...	...	...	1	(8b)(57)	B	45	24	15.0	14.7	14.2
A285 Gr. A	A672	A45	K01700	...	...	1	(57)(59)(67)	B	45	24	15.0	14.7	14.2
Butt weld Smls & ERW	API 5L	A25	...	...	...	1	(8a)(77)	-20	45	25	15.0	15.0	14.7
	API 5L	A25	...	...	...	1	(57)(59)(77)	B	45	25	15.0	15.0	14.7
...	A179	...	K01200	...	...	1	(57)(59)	-20	47	26	15.7	15.7	15.3
Type F	A53	A	K02504	...	...	1	(8a)	20	48	30	16.0	16.0	16.0
...	A139	A	...	...	...	1	(8b)	A	48	30	16.0	16.0	16.0
...	A587	...	K11500	...	...	1	(57)(59)	-20	48	30	16.0	16.0	16.0
...	A53	A	K02504	...	...	1	(57)(59)	B	48	30	16.0	16.0	16.0
...	A106	A	K02501	...	...	1	(57)	B	48	30	16.0	16.0	16.0
...	A135	A	...	...	...	1	(57)(59)	B	48	30	16.0	16.0	16.0

## Lampiran 14: Table Ekspansi Material

**Table C-2 Thermal Expansion Data (SI Units)**

Material	Coef- ficient	Temperature Range 20°C to													
		-200	-100	-50	20	50	75	100	125	150	175	200	225	250	275
Group 1 carbon and low alloy steels [Note (2)]	A	9.9	10.7	11.1	11.5	11.8	11.9	12.1	12.3	12.4	12.6	12.7	12.9	13.0	13.2
	B	-2.2	-1.3	-0.8	0	0.4	0.7	1.0	1.3	1.6	2.0	2.3	2.6	3.0	3.4
Group 2 low alloy steels [Note (3)]	A	10.8	11.7	12.0	12.6	12.8	13.0	13.1	13.2	13.4	13.5	13.6	13.7	13.8	13.9
	B	-2.4	-1.4	-0.8	0	0.4	0.7	1.0	1.4	1.7	2.1	2.4	2.8	3.2	3.6
5Cr-1Mo steels	A	10.1	10.8	11.2	11.5	11.8	12.0	12.1	12.3	12.4	12.5	12.6	12.6	12.7	12.8
	B	-2.2	-1.3	-0.8	0	0.4	0.7	1.0	1.3	1.6	1.9	2.3	2.6	2.9	3.3
9Cr-1Mo steels	A	9.0	9.8	10.1	10.5	10.6	10.7	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6
	B	-2.0	-1.2	-0.7	0	0.3	0.6	0.9	1.2	1.4	1.7	2.0	2.3	2.6	3.0
Straight chromium stainless steels 12Cr to 13Cr steels	A	9.1	9.9	10.2	10.6	10.9	11.0	11.1	11.3	11.4	11.4	11.5	11.6	11.6	11.7
	B	-2.0	-1.2	-0.7	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
15Cr to 17Cr steels	A	8.1	8.8	9.1	9.6	9.7	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7
	B	-1.8	-1.1	-0.6	0	0.3	0.5	0.8	1.1	1.3	1.6	1.9	2.2	2.4	2.7
27Cr steels	A	7.7	8.5	8.7	9.0	9.2	9.2	9.3	9.4	9.4	9.5	9.5	9.6	9.6	9.7
	B	-1.7	-1.0	-0.6	0	0.3	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.2	2.5
Austenitic stainless steels (304, 305, 316, 317, 321, 347, 348)	A	13.5	14.3	14.7	15.3	15.6	15.9	16.2	16.4	16.6	16.8	17.0	17.2	17.4	17.5
	B	-3.0	-1.7	-1.0	0	0.5	0.9	1.3	1.7	2.2	2.6	3.1	3.5	4.0	4.5



**Lampiran 15:** Table perubahan Tegangan Ijin ASTM A106 Gr.B akibat perubahan Temperatur

**Table K-1 Allowable Stresses in Tension for Metals for Chapter IX**  
Numbers in Parentheses Refer to Notes for Appendix K Table; Specifications Are ASTM Unless Otherwise Indicated

Allowable Stress, ksi (Multiply by 1000 to Obtain psi), for Metal Temperature, °F, Not Exceeding [Notes (2)–(4)]											
Min. Temp. to 100	150	200	250	300	400	500	600	650	700	Type or Grade	Spec. No.
Carbon Steel Pipes and Tubes (5)											
23.3	...	21.3	...	20.7	20.0	18.9	17.3	16.9	16.8	B	A53
23.3	...	21.3	...	20.7	20.0	18.9	17.3	16.9	16.8	B	A106
23.3	...	21.3	...	20.7	20.0	18.9	17.3	16.9	16.8	6	A333
23.3	...	21.3	...	20.7	20.0	18.9	17.3	16.9	16.8	6	A334
23.3	...	21.3	...	20.7	20.0	18.9	17.3	16.9	16.8	B	API 5L
24.7	...	22.5	...	21.9	21.1	20.0	18.3	17.9	17.8	A-1	A210
26.7	...	24.3	...	22.9	23.7	21.6	19.7	19.4	19.2	C	A106
26.7	...	24.3	...	22.9	23.7	21.6	19.7	19.4	19.2	C	A210
28.0	...	...	...	...	...	...	...	...	...	X42	API 5L
30.7	...	...	...	...	...	...	...	...	...	X46	API 5L
34.7	...	...	...	...	...	...	...	...	...	X52	API 5L
37.3	...	...	...	...	...	...	...	...	...	X56	API 5L
40.0	...	...	...	...	...	...	...	...	...	X60	API 5L

**Lampiran 16:** Faktor Siklus Pemakaian Pipa

Siklus (N)	f
7.000 kurang	1,0
7.000 - 14.000	0,9
14.000 - 22.000	0,8
22.000 - 45.000	0,7
45.000 - 100.000	0,6
100.000 keatas	0,5



## Lampiran 17: Spesifikasi Pompa Sentrifugal 5,5 Kw

Merk : **Pedrollo**



Code : -

Type : **2CP 40/180B**

Category : **Pompa Sentrifugal 3 Phase**

Berat : **60 Kg**

### Spesifikasi produk

<b>Daya Listrik</b>	5500 Watt (7.5HP)
<b>Daya Start Listrik</b>	
<b>Daya Hisap</b>	7 Meter (Max)
<b>Daya Dorong</b>	76 Meter (Max)
<b>Debit Air</b>	400 Liter/Menit (Max)
<b>Pressure</b>	7.6 bar (Max)
<b>Inlet</b>	2 inch
<b>Outlet</b>	1 1/2 inch
<b>Otomatis</b>	NO