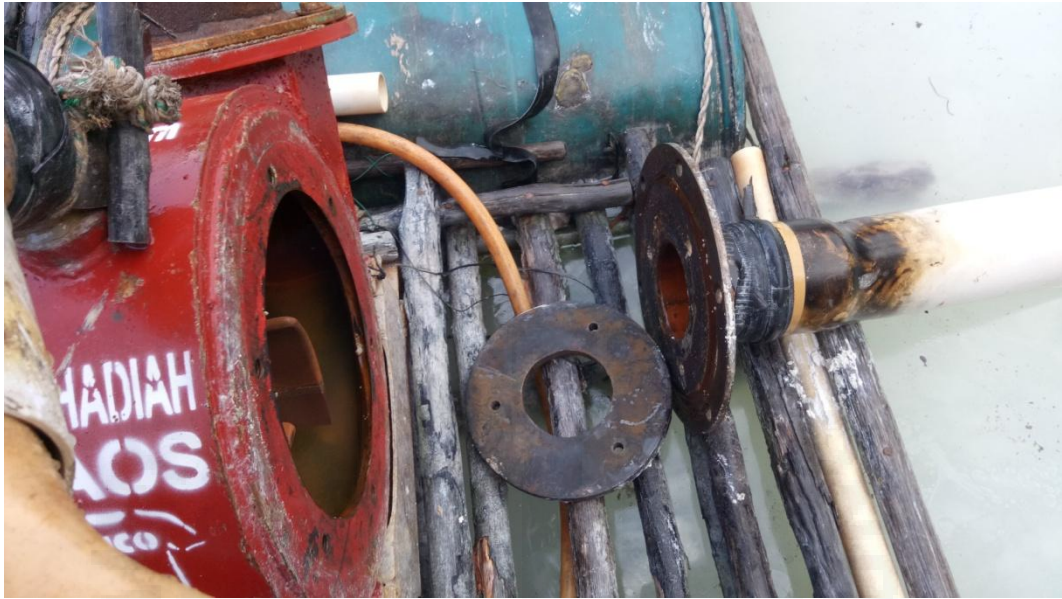


## Lampiran

### Proses pengujian lapangan



Pompa mesin diesel.



Hasil *flange* di lapangan.

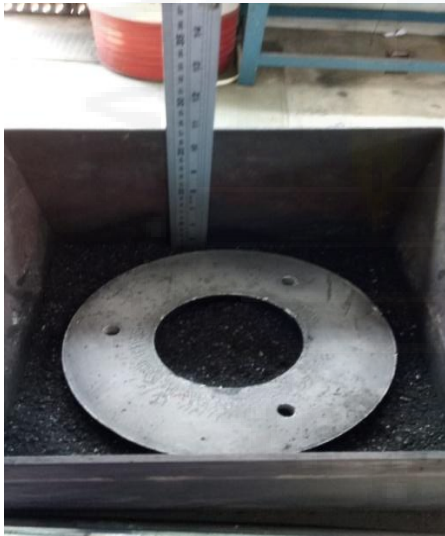


proses pengukuran *flange*.

## Proses *Pack Carburizing*



Tungku listrik.



*Flange/Pump door.*



kotak baja.

## Proses *Case Hardening*



Tungku listrik dan drum



*Flange* di dalam tungku.



Proses pendinginan air.



	Rockwell B Hardness Number, 100 kgf	Vickers Hardness Number	Brinell Hardness Number, 3000 kgf,	Knoop Hardness Number, 500 gf, and Over	Hardness Number		Hardness Number		45
					A Hardness Number, 60 kgf,	F Hardness Number, 60 kgf,	15-T Scale, 15 kgf,	30-T Scale, 30 kgf,	
	(HRB)	(HV)	(HBS)	(HK)	(HRA)	(HRF)	(HR 15-T)	(HR 30-T)	(HR 45-T)
	100	240	240	251	61.5		93.1	83.1	72.1
	99	234	234	246	60.9		92.8	82.5	71.1
	98	228	228	241	60.2		92.5	81.8	70.1
	97	222	222	236	59.5		92.1	81.1	69.1
	96	216	216	231	58.9		91.8	80.4	68.1
	95	210	210	226	58.3		91.5	79.8	67.1
	94	205	205	221	57.6		91.2	79.1	66.1
	93	200	200	216	57.0		90.8	78.4	65.1
	92	195	195	211	56.4		90.5	77.8	64.1
	91	190	190	206	55.8		90.2	77.1	63.1
	90	185	185	201	55.2		89.9	76.4	62.1
	89	180	180	196	54.6		89.5	75.8	61.1
	88	176	176	192	54.0		89.2	75.1	60.1
	87	172	172	188	53.4		88.9	74.4	59.1
	86	169	169	184	52.8		88.6	73.8	58.1
	85	165	165	180	52.3		88.2	73.1	57.1
	84	162	162	176	51.7		87.9	72.4	56.1
	83	159	159	173	51.1		87.6	71.8	55.1
	82	156	156	170	50.6		87.3	71.1	54.1
	81	153	153	167	50.0		86.9	70.4	53.1
	80	150	150	164	49.5		86.6	69.7	52.1
	79	147	147	161	48.9		86.3	69.1	51.1
	78	144	144	158	48.4		86.0	68.4	50.1
	77	141	141	155	47.9		85.6	67.7	49.1
	76	139	139	152	47.3		85.3	67.1	48.1
	75	137	137	150	46.8	99.6	85.0	66.4	47.1
	74	135	135	147	46.3	99.1	84.7	65.7	46.1
	73	132	132	145	45.8	98.5	84.3	65.1	45.1
	72	130	130	143	45.3	98.0	84.0	64.4	44.1
	71	127	127	141	44.8	97.4	83.7	63.7	43.1
	70	125	125	139	44.3	96.8	83.4	63.1	42.1
	69	123	123	137	43.8	96.2	83.0	62.4	41.1
	68	121	121	135	43.3	95.6	82.7	61.7	40.1
	67	119	119	133	42.8	95.1	82.4	61.0	39.1
	66	117	117	131	42.3	94.5	82.1	60.4	38.1
	65	116	116	129	41.8	93.9	81.8	59.7	37.1
	64	114	114	127	41.4	93.4	81.4	59.0	36.1
	63	112	112	125	40.9	92.8	81.1	58.4	35.1
	62	110	110	124	40.4	92.2	80.8	57.7	34.1
	61	108	108	122	40.0	91.7	80.5	57.0	33.1
	60	107	107	120	39.5	91.1	80.1	56.4	32.1
	59	106	106	118	39.0	90.5	79.8	55.7	31.1
	58	104	104	117	38.6	90.0	79.5	55.0	30.1
	57	103	103	115	38.1	89.4	79.2	54.4	29.1
	56	101	101	114	37.7	88.8	78.8	53.7	28.1
	55	100	100	112	37.2	88.2	78.5	53.0	27.1
	54			111	36.8	87.7	78.2	52.4	26.1
	53			110	36.3	87.1	77.9	51.7	25.1
	52			109	35.9	86.5	77.5	51.0	24.1
	51			108	35.5	86.0	77.2	50.3	23.1
	50			107	35.0	85.4	76.9	49.7	22.1
	49			106	34.6	84.8	76.6	49.0	21.1
	48			105	34.1	84.3	76.3	48.3	20.1
	47			104	33.7	83.7	75.9	47.7	19.1
	46			103	33.3	83.1	75.6	47.0	18.1
	45			102	32.9	82.6	75.3	46.3	17.1
	44			101	32.4	82.0	74.9	45.7	16.1
	43			100	32.0	81.4	74.6	45.0	15.1
	42			99	31.6	80.8	74.3	44.3	14.1
	41			98	31.2	80.3	74.0	43.7	13.1
	40			97	30.7	79.7	73.6	43.0	12.1
	39			96	30.3	79.2	73.3	42.3	11.1
	38			95	29.9	78.7	73.0	41.7	10.1
	37			94	29.5	78.2	72.7	41.0	9.1

Tabel (HRB) Standard metode rockwell.

Rockwell C Hardness Number 150 kgf	Vickers Hardness Number	Brinell Hardness Number			Knoop Hardness Number 500 gf and Over	Rockwell Hardness Number		Rockwell Superficial Hardness Number			Sclero- scope Hardness Number
		10-mm Standard Ball, 3000 kgf	10-mm Carbide Ball, 3000 kgf	(HK)		A Scale, 60 kgf	D Scale, 100 kgf	15-N Scale, 15 kgf	30-N Scale, 30 kgf	45-N Scale, 45 kgf	
		(HBS)	(HBW)			(HRA)	(HRD)	(HR 15-N)	(HR 30-N)	(HR 45-N)	
68	940			920	85.6	76.9	93.2	84.4			
67	900			895	85.0	76.1	92.9	83.6	75.4	97.3	
66	865			870	84.5	75.4	92.5	82.8	74.2	95.0	
65	832		(739)	846	83.9	74.5	92.2	81.9	73.3	92.7	
64	800		(722)	822	83.4	73.8	91.8	81.1	72.0	90.6	
63	772		(705)	799	82.8	73.0	91.4	80.1	71.0	88.5	
62	746		(688)	776	82.3	72.2	91.1	79.3	69.9	86.5	
61	720		(670)	754	81.8	71.5	90.7	78.4	68.8	84.5	
60	697		(654)	732	81.2	70.7	90.2	77.5	67.7	82.6	
59	674		634	710	80.7	69.9	89.8	76.6	66.6	80.8	
58	653		615	690	80.1	69.2	89.3	75.7	65.5	79.0	
57	633		595	670	79.6	68.5	88.9	74.8	64.3	77.3	
56	613		577	650	79.0	67.7	88.3	73.9	63.2	75.6	
55	595		560	630	78.5	66.9	87.9	73.0	62.0	74.0	
54	577		543	612	78.0	66.1	87.4	72.0	60.9	72.4	
53	560		525	594	77.4	65.4	86.9	71.2	59.8	70.9	
52	544	(500)	512	576	76.8	64.6	86.4	70.2	58.6	69.4	
51	528	(487)	496	558	76.3	63.8	85.9	69.4	57.4	67.9	
50	513	(475)	481	542	75.9	63.1	85.5	68.5	56.1	66.5	
49	498	(464)	469	526	75.2	62.1	85.0	67.6	55.0	65.1	
48	484	451	455	510	74.7	61.4	84.5	66.7	53.8	63.7	
47	471	442	443	495	74.1	60.8	83.9	65.8	52.5	62.4	
46	458	432	432	480	73.6	60.0	83.5	64.8	51.4	61.1	
45	446	421	421	466	73.1	59.2	83.0	64.0	50.3	59.8	
44	434	409	409	452	72.5	58.5	82.5	63.1	49.0	58.5	
43	423	400	400	438	72.0	57.7	82.0	62.2	47.8	57.3	
42	412	390	390	426	71.5	56.9	81.5	61.3	46.7	56.1	
41	402	381	381	414	70.9	56.2	80.9	60.4	45.5	54.9	
40	392	371	371	402	70.4	55.4	80.4	59.5	44.3	53.7	
39	382	362	362	391	69.9	54.6	79.9	58.6	43.1	52.6	
38	372	353	353	380	69.4	53.8	79.4	57.7	41.9	51.5	
37	363	344	344	370	68.9	53.1	78.8	56.8	40.8	50.4	
36	354	336	336	360	68.4	52.3	78.3	55.9	39.6	49.3	
35	345	327	327	351	67.9	51.5	77.7	55.0	38.4	48.2	
34	336	319	319	342	67.4	50.8	77.2	54.2	37.2	47.1	
33	327	311	311	334	66.8	50.0	76.6	53.3	36.1	46.1	
32	318	301	301	326	66.3	49.2	76.1	52.1	34.9	45.1	
31	310	294	294	318	65.8	48.4	75.6	51.3	33.7	44.1	
30	302	286	286	311	65.3	47.7	75.0	50.4	32.5	43.1	
29	294	279	279	304	64.8	47.0	74.5	49.5	31.3	42.2	
28	286	271	271	297	64.3	46.1	73.9	48.6	30.1	41.3	
27	279	264	264	290	63.8	45.2	73.3	47.7	28.9	40.4	
26	272	258	258	284	63.3	44.6	72.8	46.8	27.8	39.5	
25	266	253	253	278	62.8	43.8	72.2	45.9	26.7	38.7	
24	260	247	247	272	62.4	43.1	71.6	45.0	25.5	37.8	
23	254	243	243	266	62.0	42.1	71.0	44.0	24.3	37.0	
22	248	237	237	261	61.5	41.6	70.5	43.2	23.1	36.3	
21	243	231	231	256	61.0	40.9	69.9	42.3	22.0	35.5	
20	238	226	226	251	60.5	40.1	69.4	41.5	20.7	34.8	
								19.6	34.2		

Tabel (HRC) Standard metode *rockwell*.

Element	Burn 1	Burn 2	Burn 3	Burn 4	Burn 5	Burn 6	Burn 7	Burn 8	Burn 9	Burn 10	Burn 11	Burn 12	Burn 13	Burn 14	Burn 15	Average
Fe %	92.0	91.9	91.3													91.8
C %	0.170	0.159	0.122													0.150
Si %	0.224	0.209	0.214													0.216
Mn %	0.696	0.665	0.668													0.676
P %	> 0.200	> 0.200	> 0.200													> 0.200
S %	> 0.100	> 0.100	> 0.100													> 0.100
Cr %	0.0203	0.0211	0.0211													0.0208
Mo %	0.0010	0.0022	0.0010													0.0014
Ni %	0.0089	0.0065	0.0064													0.0073
Al %	0.0413	0.0480	0.0533													0.0475
Co %	< 0.0010	< 0.0010	< 0.0010													< 0.0010
Cu %	0.0044	0.0049	0.0044													0.0046
Nb %	0.0026	0.0031	0.0030													0.0029
Ti %	0.0011	0.0016	0.0013													0.0013
V %	0.0028	0.0025	0.0026													0.0027
W %	< 0.0050	< 0.0050	< 0.0050													< 0.0050
Pb %	< 0.0010	< 0.0010	< 0.0010													< 0.0010
Sn %	< 0.0010	< 0.0010	< 0.0010													< 0.0010
B %	< 0.0005	< 0.0005	< 0.0005													< 0.0005
Ca %	0.0007	0.0005	0.0006													0.0006
Zr %	0.0056	0.0062	0.0061													0.0060
Zn %	< 0.0005	0.0005	0.0014													0.0006
Bi %	< 0.0015	< 0.0015	< 0.0015													< 0.0015
As %	< 0.0005	< 0.0005	< 0.0005													< 0.0005
Se %	< 0.0010	< 0.0010	< 0.0010													< 0.0010
Sb %	< 0.0050	< 0.0050	< 0.0050													< 0.0050
Ta %	< 0.0050	< 0.0050	< 0.0050													< 0.0050

Gambar Hasil uji komposisi material *flange* sebelum di *pack carburizing*

Element	Burn 1	Burn 2	Burn 3	Burn 4	Burn 5	Burn 6	Burn 7	Burn 8	Burn 9	Burn 10	Burn 11	Burn 12	Burn 13	Burn 14	Burn 15	Average
Fe %	44.1	42.9	44.1													43.7
C %	0.193	0.243	0.209													0.215
Si %	0.281	0.323	0.319													0.308
Mn %	0.989	1.28	1.05													1.10
P %	> 0.200	> 0.200	> 0.200													> 0.200
S %	> 0.100	> 0.100	> 0.100													> 0.100
Cr %	0.0362	0.0365	0.0354													0.0360
Mo %	0.0391	0.0273	0.0339													0.0335
Ni %	0.0078	0.0067	0.0102													0.0082
Al %	0.0555	0.0539	0.0603													0.0566
Co %	< 0.0010	< 0.0010	< 0.0010													< 0.0010
Cu %	0.0168	0.0163	0.0166													0.0165
Nb %	0.0268	0.0195	0.0235													0.0233
Ti %	0.0106	0.0189	0.0123													0.0139
V %	0.0058	0.0065	0.0070													0.0064
W %	0.105	0.0461	0.132													0.0947
Pb %	< 0.0010	< 0.0010	< 0.0010													< 0.0010
Sn %	0.0070	0.0069	0.0083													0.0074
B %	< 0.0005	< 0.0005	< 0.0005													< 0.0005
Ca %	> 0.0080	> 0.0080	> 0.0080													> 0.0080
Zr %	0.0114	0.0086	0.0100													0.0100
Zn %	< 0.0005	< 0.0005	< 0.0005													< 0.0005
Bi %	< 0.0015	< 0.0015	< 0.0015													< 0.0015
As %	0.0066	0.0030	< 0.0005													0.0032
Se %	< 0.0010	< 0.0010	< 0.0010													< 0.0010
Sb %	< 0.0050	< 0.0050	< 0.0050													< 0.0050
Ta %	< 0.0050	< 0.0050	< 0.0050													< 0.0050

Gambar Hasil uji komposisi material *flange* setelah di  
*pack carburizing*