







**LAMPIRAN I**  
**HASIL PENGUJIAN KOMPOSISI KIMIA**



TRIAL I

 PT Astra Honda Motor Measurement & Laboratory Section Quality Assurance Support Department																																																			
LAPORAN PENGUJIAN KOMPOSISI KIMIA																																																			
NAMA PART	: SAMPLE MELTING	TGL PENGUJIAN	: 08-Aug-08 13:32:29																																																
NO PART / TYPE	: Sample No. ( 060808 ALTIB M3)	STANDARD UJI	: HES G-101-99																																																
MATERIAL	: AC 4B	MEBIL UJI	: SPECTRO SHIMADZHU																																																
SEKSI / SUB CON	: LPDC	KETERANGAN	: SHIFT 1																																																
TEST KE	: 1																																																		
<table border="1"> <thead> <tr> <th colspan="2">ACTUAL</th> <th colspan="2">STANDARD QA AHM</th> </tr> </thead> <tbody> <tr> <td>SI</td> <td>: 9.056</td> <td>SI</td> <td>: 7.00 ~ 10.00</td> </tr> <tr> <td>CU</td> <td>: 2.914</td> <td>CU</td> <td>: 2.00 ~ 4.00</td> </tr> <tr> <td>MG</td> <td>: 0.272</td> <td>MG</td> <td>: 0.50 MAX</td> </tr> <tr> <td>ZN</td> <td>: 0.532</td> <td>ZN</td> <td>: 1.00 MAX</td> </tr> <tr> <td>FE</td> <td>: 0.432</td> <td>FE</td> <td>: 1.00 MAX</td> </tr> <tr> <td>MN</td> <td>: 0.236</td> <td>MN</td> <td>: 0.50 MAX</td> </tr> <tr> <td>NI</td> <td>: 0.079</td> <td>NI</td> <td>: 0.35 MAX</td> </tr> <tr> <td>TI</td> <td>: 0.067</td> <td>TI</td> <td>: 0.20 MAX</td> </tr> <tr> <td>PB</td> <td>: 0.068</td> <td>PB</td> <td>: 0.20 MAX</td> </tr> <tr> <td>SN</td> <td>: 0.027</td> <td>SN</td> <td>: 0.10 MAX</td> </tr> <tr> <td>CR</td> <td>: 0.015</td> <td>CR</td> <td>: 0.20 MAX</td> </tr> </tbody> </table>		ACTUAL		STANDARD QA AHM		SI	: 9.056	SI	: 7.00 ~ 10.00	CU	: 2.914	CU	: 2.00 ~ 4.00	MG	: 0.272	MG	: 0.50 MAX	ZN	: 0.532	ZN	: 1.00 MAX	FE	: 0.432	FE	: 1.00 MAX	MN	: 0.236	MN	: 0.50 MAX	NI	: 0.079	NI	: 0.35 MAX	TI	: 0.067	TI	: 0.20 MAX	PB	: 0.068	PB	: 0.20 MAX	SN	: 0.027	SN	: 0.10 MAX	CR	: 0.015	CR	: 0.20 MAX		
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			<p>KETERANGAN</p> <div style="border: 1px solid black; padding: 5px; text-align: center; font-size: 24px; font-weight: bold;">OK</div>																																																
			<p>DIBUAT</p> <div style="border: 1px solid black; padding: 5px; text-align: center;">             11/17/08         </div> <p>FAHRURROZI</p>																																																

 PT Astra Honda Motor Measurement & Laboratory Section Quality Assurance Support Department			
LAPORAN PENGUJIAN KOMPOSISI KIMIA			
NAMA PART	: SAMPLE MELTING	TGL. PENGUJIAN	: 06-Aug-08 20:45:04
NO PART / TYPE	: Sample No: ( 06/08/2008 ALTIB M3	STANDARD UJI	: HES C-101-99
MATERIAL	: AC 4B	MESIN UJI	: SPECTRO SHIMADZHU
SEKSI / SUB CON	: LPDC	KETERANGAN	: SHIFT 2
TEST KE	: 1		
<u>ACTUAL</u> SI : 8.997 CU : 2.918 MG : 0.264 ZN : 0.568 FE : 0.460 MN : 0.240 NI : 0.096 TI : 0.081 PB : 0.059 SN : 0.021 CR : 0.016		<u>STANDARD QA AHM</u> SI : 7.00 ~ 10.00 CU : 2.00 ~ 4.00 MG : 0.50 MAX ZN : 1.00 MAX FE : 1.00 MAX MN : 0.50 MAX NI : 0.35 MAX TI : 0.20 MAX PB : 0.20 MAX SN : 0.10 MAX CR : 0.20 MAX	
<u>NOTE</u> - HASIL UKUR YANG BERGARIS BAWAH = NG - LAKUKAN PERBAIKAN BILA HASIL TEST NG			
			KETERANGAN <div style="border: 1px solid black; padding: 5px; text-align: center; width: 80px; margin: 0 auto;">OK</div>
			DIBUAT <div style="text-align: center; margin-top: 10px;">               DIDI S...           </div>





PT Astra Honda Motor  
Measurement & Laboratory Section  
Quality Assurance Support Departement

## LAPORAN PENGUJIAN KOMPOSISI KIMIA

NAMA PART	: SAMPLE MELTING	TGL.PENGUJIAN	: 07-Aug-08 14:38:09
NO PART / TYPE	: Sample No: (ALTIB M3)	STANDARD UJI	: HES C-101-99
MATERIAL	: AC 4B	MESIN UJI	: SPECTRO SHIMADZHU
SEKSI / SUB CON	: LPDC	KETERANGAN	: ALTIB(07/08/08 M3)
TEST KE	: 1		

### ACTUAL

**SI** : 8.731  
**CU** : 3.101  
**MG** : 0.233  
**ZN** : 0.454  
**FE** : 0.513  
**MN** : 0.227  
**NI** : 0.089  
**TI** : 0.115  
**PB** : 0.070  
**SN** : 0.037  
**CR** : 0.020

### STANDARD QA AHM

**SI** : 7.00 ~ 10.00  
**CU** : 2.00 ~ 4.00  
**MG** : 0.50 MAX  
**ZN** : 1.00 MAX  
**FE** : 1.00 MAX  
**MN** : 0.50 MAX  
**NI** : 0.35 MAX  
**TI** : 0.20 MAX  
**PB** : 0.20 MAX  
**SN** : 0.10 MAX  
**CR** : 0.20 MAX

### NOTE

- HASIL UKUR YANG BERGARIS BAWAH = NG
- LAKUKAN PERBAIKAN BILA HASIL TEST NG

### KETERANGAN

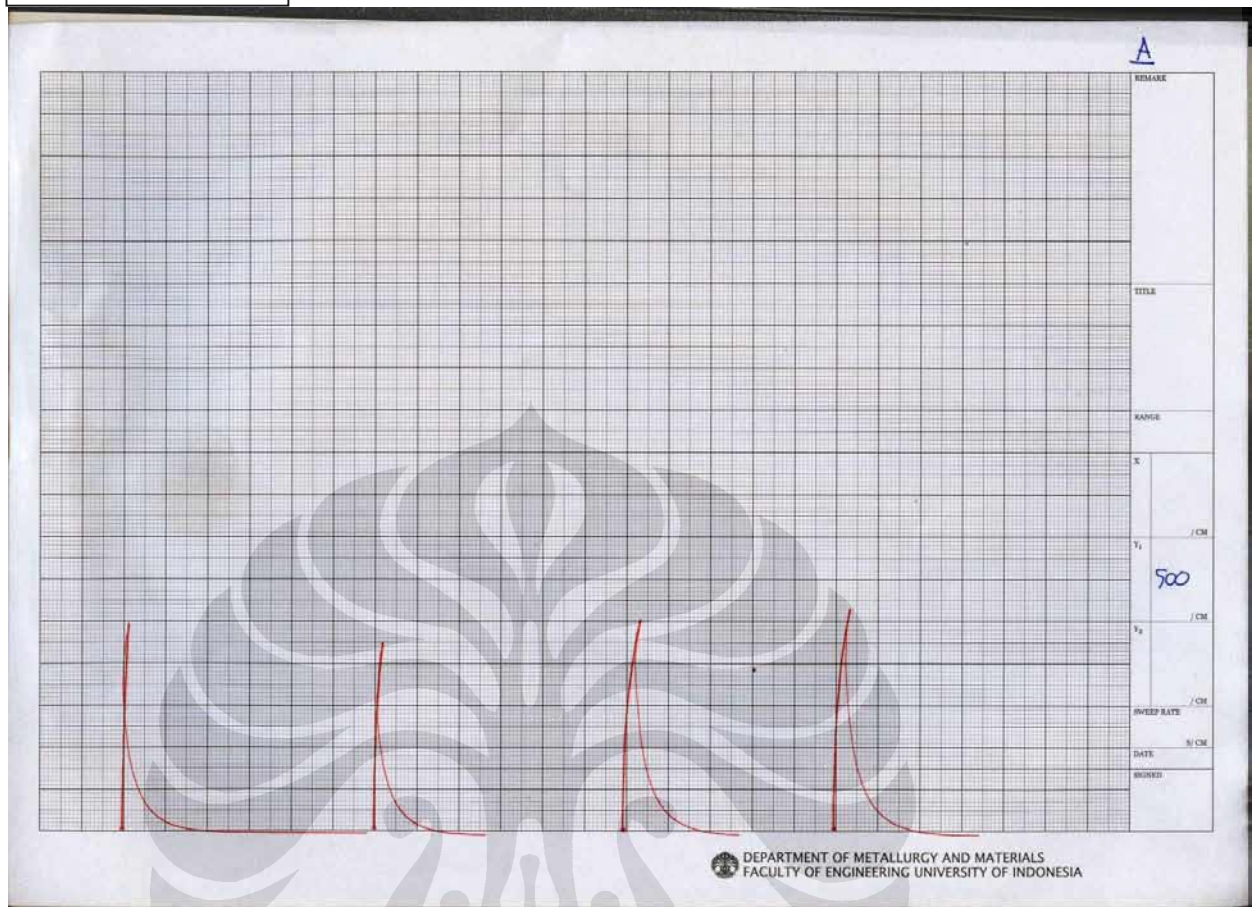
OK

DIBUAT

SALAH MASII

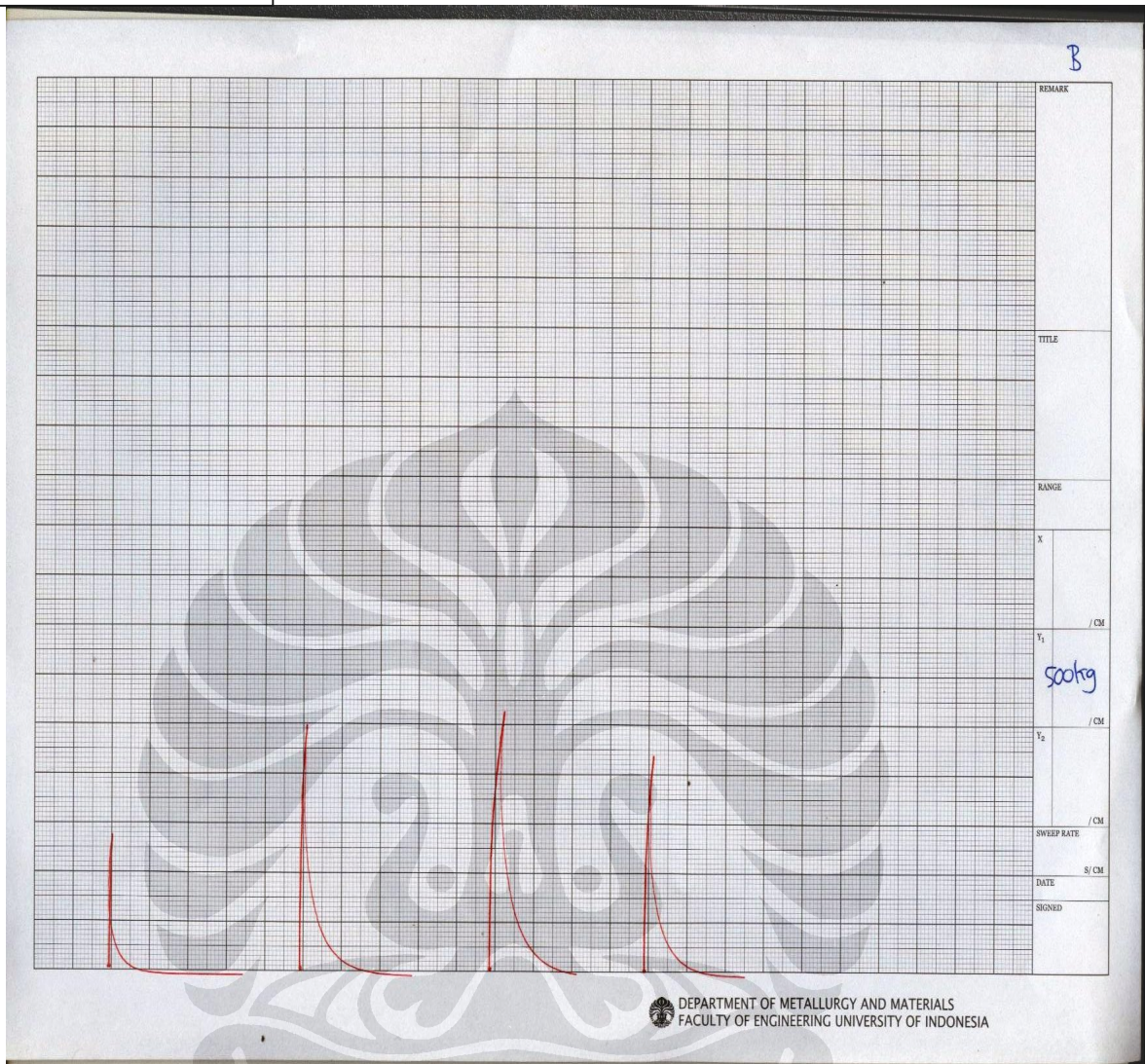


0.067 wt. % Ti

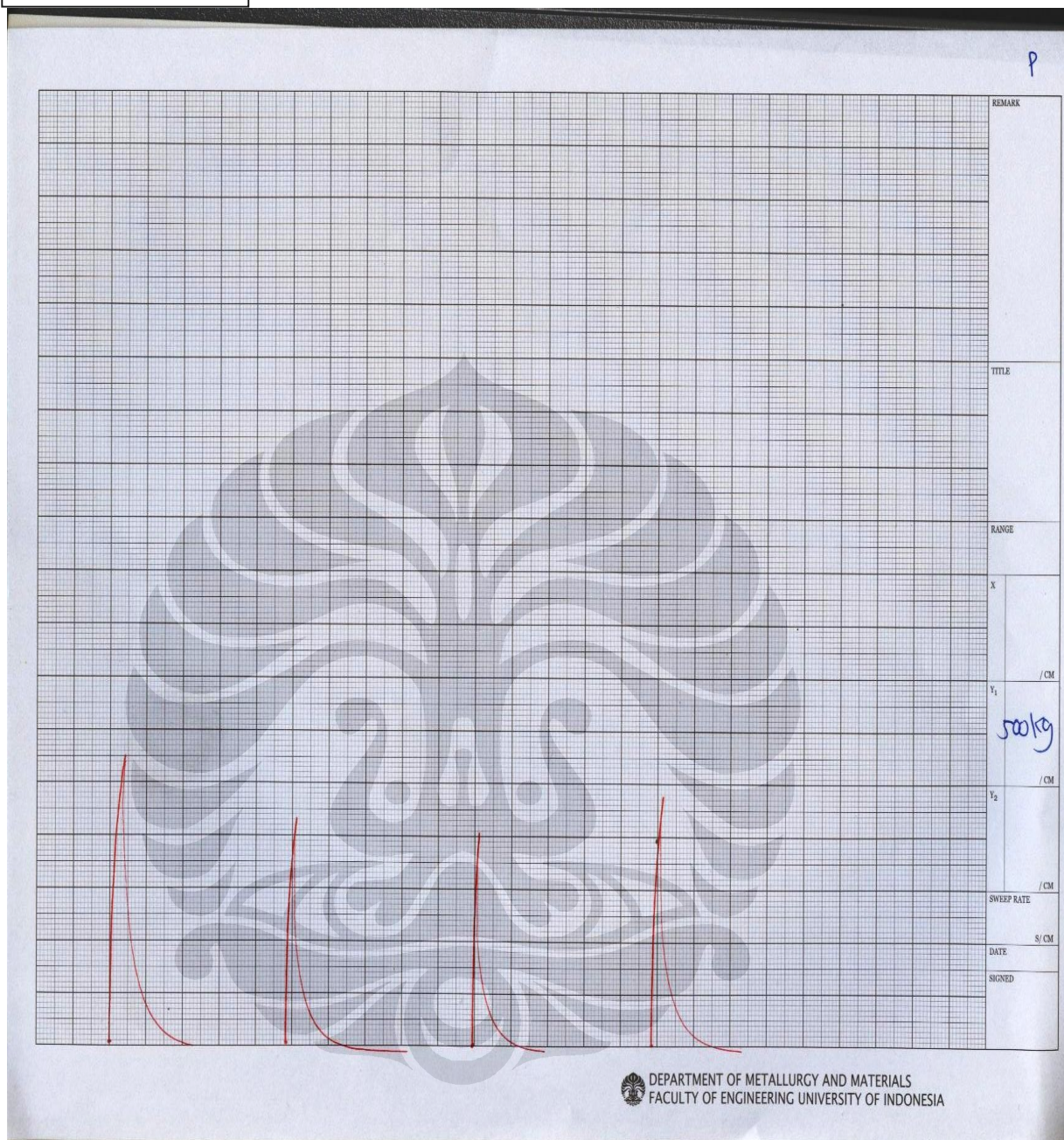




0.081 wt. % Ti



0.115 wt. % Ti



### Lampiran Pengolahan data uji tarik

#### 0.067 wt. % Ti

Sampel ke-	P (Kg)	dL (mm)	$\epsilon$	$\sigma$ (MPa)
A1	0	0	0	0
	2450	0.5	0.01	191.252
A2	0	0	0	0
	1650	0.5	0.01	128.803
	2250	1	0.02	175.64
A3	0	0	0	0
	1700	0.5	0.01	133
	1800	1	0.02	140.512
	2250	1.5	0.03	175.64
A4	250	2	0.04	195.156
	0	0	0	0
	1000	0.5	0.01	76.84
	1750	1	0.02	134.475
	2250	1.5	0.03	172.896
	2650	2	0.04	203.633

#### 0.081 wt. % Ti

Sampel ke -	P (Kg)	dL (mm)	$\epsilon$	$\sigma$ (MPa)
1	0	0	0	0
	1500	0.5	0.01	112.3
	1800	1	0.02	162.643
2	0	0	0	0
	2200	0.5	0.01	157.366
	2450	1	0.02	192.774
3	0	0	0	0
	1750	0.5	0.01	142.172
	2200	1	0.02	178.732
	2500	1.5	0.03	203.104
4	0	0	0	0
	1550	0.5	0.01	130.087
	2000	1	0.02	167.854
	2200	1.5	0.03	184.640

**0.115 wt. % Ti**

<b>Sampel ke-</b>	<b>P (Kg)</b>	<b>dL (mm)</b>	<b><math>\epsilon</math></b>	<b><math>\sigma</math> (MPa)</b>
1	0	0	0	0
	1450	0.5	0.01	112.3
	2100	1	0.02	162.643
	2400	1.5	0.03	185.877
	2750	2	0.04	212.984
2	0	0	0	0
	1000	0.5	0.01	94.46
	1750	1	0.02	165.299
	2150	1.5	0.03	203.079
3	0	0	0	0
	1000	0.5	0.01	86.75
	1800	1	0.02	156.147
	2050	1.5	0.03	177.834
4	0	0	0	0
	1000	0.5	0.01	79.95
	1750	1	0.02	139.907
	2200	1.5	0.03	175.883
	2300	2	0.04	183.878

<b>sampel</b>	<b>UTS</b>	<b>UTS rata-rata</b>
0.067	191.252	191.42025
	175.64	
	195.156	
	203.633	
total	765.681	
0.081	162.643*	193.506
	192.774	
	203.104	
	184.640	
total	743.161	
0.115	212.984	194.44375
	203.079	
	177.834	
	183.878	
total	777.775	

\* tidak dimasukkan ke dalam perhitungan karena sampel mengalami poros pada *gauge length*-nya.



### Lampiran Pengolahan Data Kekerasan (Brinell Hardness)

#### Sampel 0.067 tebal

titik	Nilai Kekerasan
1	78.58283558
2	75.91748847
3	76.68100482
4	76.35241054
5	83.58922446
6	78.58283558
7	80.31899189
total	550.0247913
<b>rata-rata</b>	<b>78.57497019</b>

#### Sampel 0.067 tipis

titik	Nilai Kekerasan
1	75.8093255
2	78.81112061
3	76.68100482
4	80.55472777
5	80.0842684
6	76.57124305
7	80.43673262
total	548.9484228
<b>rata-rata</b>	<b>78.42120325</b>

#### Sampel 0.081 tebal

titik	Nilai Kekerasan
1	78.07255925
2	78.925629
3	79.40184915
4	79.40184915
5	79.39150405
6	79.39150405
7	78.80774612
total	553.3926408
<b>rata-rata</b>	<b>79.05609154</b>

#### Sampel 0.081 tipis

titik	Nilai Kekerasan
1	77.56746943
2	78.69685688
3	79.85055164
4	82.23370245
5	76.02587776
6	79.61783439
7	79.61783439
total	553.6101269
<b>rata-rata</b>	<b>79.08716099</b>

#### Sampel 0.115 tebal

titik	Nilai Kekerasan
1	80.79148011
2	82.23370245
3	81.02925709
4	78.24222344
5	79.96728423
6	78.58283558
7	77.34444901
total	558.1912319
<b>rata-rata</b>	<b>79.74160456</b>

#### Sampel 0.115 tipis

titik	Nilai Kekerasan
1	80.67297642
2	79.15537859
3	77.67933418
4	81.62821572
5	78.925629
6	78.69685688
7	82.11207827
total	558.8704691
<b>rata-rata</b>	<b>79.83863844</b>



**LAMPIRAN IV**  
**HASIL PENGUKURAN *Dendrite Arm Spacing* (DAS)**

## Lampiran Pengolahan Data DAS

sampel	Titik	Panjang <i>Secondary DAS</i> (mm)	sampel	Titik	Panjang <i>Secondary DAS</i> (mm)
0.067 - Tebal	1	0.035	0.067-Tipis	1	0.02
	2	0.04		2	0.03
	3	0.025		3	0.035
	4	0.035		4	0.013
	5	0.03		5	0.02
	6	0.027		6	0.022
	7	0.04		7	0.02
	rerata	<b>0.033</b>		rerata	<b>0.029</b>
0.081 - Tebal	1	0.015	0.081 - Tipis	1	0.011
	2	0.02		2	0.015
	3	0.012		3	0.015
	4	0.015		4	0.01
	5	0.02		5	0.02
	6	0.015		6	0.01
	7	0.04		7	0.012
	rerata	<b>0.019</b>		rerata	<b>0.013</b>
0.115 - Tebal	1	0.02	0.115 -Tipis	1	0.01
	2	0.02		2	0.01
	3	0.025		3	0.01
	4	0.015		4	0.011
	5	0.011		5	0.01
	6	0.01		6	0.013
	7	0.01		7	0.01
	rerata	<b>0.015</b>		rerata	<b>0.01</b>





**LAMPIRAN V**  
**HASIL PERHITUNGAN *YIELD STRESS* (Hall-  
Petch Equation)**

Lampiran Pengolahan Data *Hall-Petch Equation*

wt. % Ti	Dendrite Size ( $10^{-3}$ m)	$\sigma_y$ (using Hall-Petch equation) (MPa)	Mean (MPa)
0.067 - tebal	0.49	131.38	120.393
	0.66	113.51	
	0.7	110.57	
	0.49	131.38	
	0.64	115.125	
0.081 - tebal	0.49	131.38	139.988
	0.45	137.55	
	0.42	142.95	
	0.4	147	
	0.43	141.06	
0.115 - tebal	0.34	162	156.668
	0.35	159.14	
	0.37	153.89	
	0.39	149.17	
	0.35	159.14	
0.067 - tipis	0.62	116.83	124.168
	0.49	131.38	
	0.47	134.34	
	0.59	119.62	
	0.6	118.67	
0.081 - tipis	0.6	118.67	135.56
	0.45	137.56	
	0.43	141.06	
	0.42	142.95	
	0.45	137.56	
0.115 - tipis	0.36	156.44	160.35
	0.34	162	
	0.35	159.14	
	0.33	165.03	
	0.35	159.14	

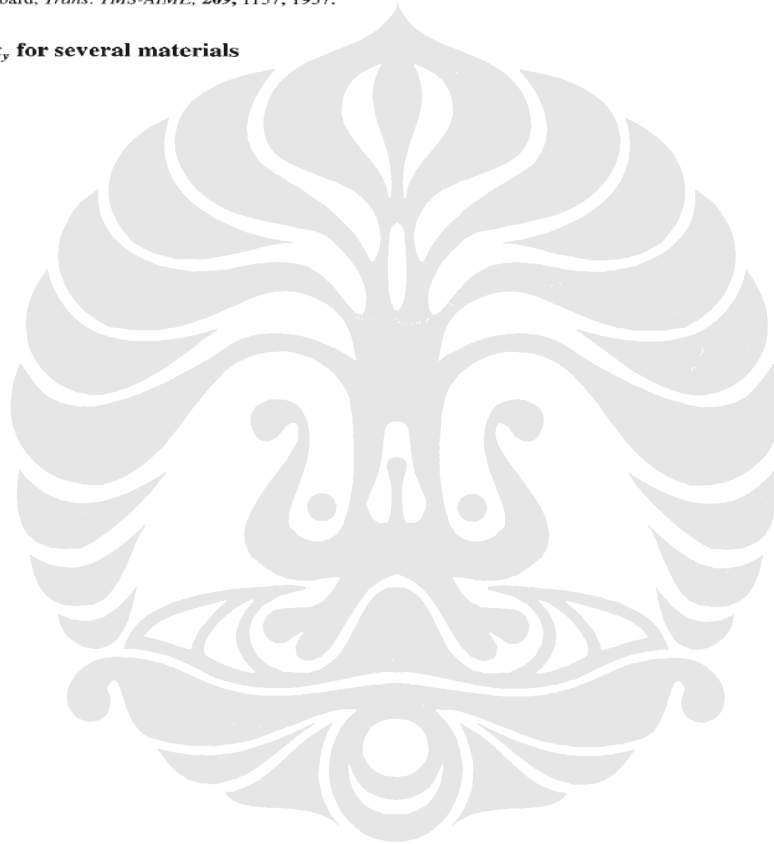
Friction Stress for Aluminum =  $\pm 62$  MPa

Material	Crystal structure	$k_f$ (MN/m <sup>3/2</sup> )
Low-carbon steel	bcc	0.307
Armco iron	bcc	0.583
Molybdenum	bcc	1.768
Zinc	hcp	0.220
Magnesium	hcp	0.279
Titanium	hcp	0.403
Copper	fcc	0.112
Aluminum	fcc	0.068

Source: Adapted from J. D. Embury, *Strengthening Methods in Crystals*, ed. A. Kelly and R. B. Nicholson, Wiley, New York, 1971. Original data from: R. Armstrong et al., *Phil. Mag.*, **7**, 45, 1962; E. Anderson et al., *Trans TMS-AIME*, **242**, 115, 1968; A. A. Johnson, *Phil. Mag.*, **4**, 194, 1959; F. E. Hauser et al., *Trans TMS-AIME*, **206**, 889, 1956; R. W. Guard, *WADC Tech. Report 55-RL-1339*, 1955; F. Feltham and J. E. Meakin, *Phil. Mag.*, **2**, 105, 1959; R. P. Carreker and W. R. Hibbard, *Trans. TMS-AIME*, **209**, 1157, 1957.

[Courtesy]

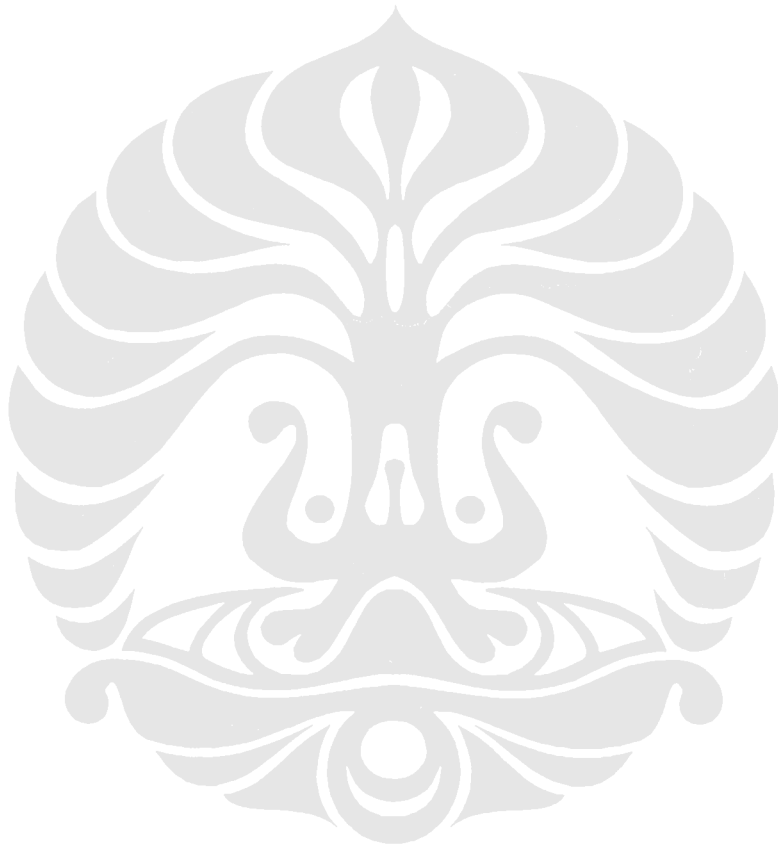
**Table 5.1**  
Values of  $k_f$  for several materials



## LAMPIRAN VI

## HASIL PENGUJIAN KEBOCORAN





Temp. melting : 818 °C  
 Komposisi grain refiner : 0.05 %  
 Temp. penambahan grain refiner : 725 °C  
 Jenis grain refiner : AlTiB (Rod)  
 Waktu GBF : 7 Menit

No Shot	No Dies	Temp. Dies (oC)		Temp. Molten (oC)	Tekanan mesin (kPa)	Jam ke	Marking	Jenis Cacat LPDC	Jenis Cacat Machining	Ket.
		Upper	Lower							
1	Trial									
2	Trial									
3	39	235	364	705	25	0	A1	Misrun (PL)		Remelting
	40	233	341				A2	Misrun (PL)		Remelting
4	39	258	407	710	25	0	A3			Sampel
	40	259	351				A4			Sampel
5	39	263	386	710	25	0	A5	Misrun (PL,IN)		OK
	40	257	294				A6	Misrun (IN,EX), kerospos (chain)		Reject
6	39	272	412	711	25	0	A7	Misrun (IN)		OK
	40	264	360				A8	Misrun (PL)		OK
7	39	262	386	710	25	0	A9	Misrun (IN)		Remelting
	40	259	299				A10	Pasir gugur		Reject
8	39	266	397	711	25	0	A11			OK
	40	261	306				A12			OK
9	39	273	400	713	25	1	A13	Misrun (PL)		OK
	40	267	327				A14		Bocor (emisi)	Reject
10	39	275	422	714	25	1	A15			OK
	40	268	335				A16			OK
11	39	269	402	713	25	1	A17			OK
	40	262	331				A18			OK
12	39	271	396	713	25	1	A19			OK
	40	263	327				A20	Misrun (PL)		OK
13	39	272	398	713	25	1	A21	Misrun (EX)		OK

	40	264	328				A22		Bocor (body)	OK
14	39	274	404	714	25.6	1	A23			OK
	40	266	327				A24	Misrun (PL,EX)	Bocor (emisi)	OK
15	39	275	466	714	25.6	1	A25	Misrun (IN)		OK
	40	268	327				A26	Misrun (IN)		OK
16	39	276	405	712	25.6	1	A27			OK
	40	269	331				A28			OK
17	39	279	403	712	25.6	1	A29			OK
	40	268	332				A30			OK
18	39	280	407	712	25.6	1	A31			OK
	40	270	334				A32			OK
19	39	277	405	711	25.6	1	A33	Misrun (PL,IN)		OK
	40	269	337				A34			OK
20	39	281	400	712	25.6	1	A35	Misrun (PL)		Reject
	40	273	338				A36			OK
21	39	283	398	713	25.6	1	A37	Misrun (PL)		OK
	40	273	337				A38			OK
22	39	283	404	714	25.6	2	A39	Misrun (IN)		Remelting
	40	273	337				A40			OK
23	39	288	405	715	25.6	2	A41			OK
	40	276	341				A42			OK
24	39	285	412	716	25.6	2	A43			OK
	40	275	344				A44			OK
25	39	284	400	710	25.6	2	A45	Misrun (PL)		OK
	40	274	339				A46			OK
Dies seret										
26	39	243	350	714	25.6	2	A47			OK
	40	237	310				A48	Keropos (chain,port)		OK
27	39	257	378	714	25.6	2	A49			OK
	40	249	316				A50	Misrun (IN)		OK
28	39	266	393	712	25.6	2	A51			OK
	40	258	328				A52	Misrun (IN,EX)		OK
29	39	230	399	712	26.2	2	A53			OK
	40	265	337				A54	Misrun (PL)		OK
30	39	277	402	711	26.2	2	A55			OK

	40	268	338				A56	Misrun (PL)		OK
31	39	276	393	711	26.2	2	A57	Misrun (PL)		OK
	40	269	333				A58		OK	
32	39	280	403	711	26.2	3	A59			OK
	40	279	339				A60	Misrun (PL)	OK	
33	39	282	405	713	26.2	3	A61	Misrun (PL,EX)		OK
	40	276	343				A62		OK	
34	39	291	406	712	26.2	3	A63	Misrun (PL,IN)		Remelting
	40	277	342				A64	Misrun (PL)	OK	
35	39	282	394	712	26.2	3	A65			OK
	40	274	333				A66	Misrun (PL)	OK	
36	39	290	429	712	26.2	3	A67	Misrun (IN)		OK
	40	282	346				A68	Misrun (PL)	OK	
37	Trial (Buang Kotoran)									
38	39	276	387	712	26.2	3	A69			Remelting
	40	266	337				A70		OK	
39	39	279	391	712	26.2	3	A71	Misrun (PL), kropos (chain)		OK
	40	270	337				A72	Kropos (port)	OK	
40	39	285	416	712	26.2	3	A73			OK
	40	276	338				A74	Misrun (PL,EX)	Remelting	

Temp. melting : 823 °C



Komposisi grain refiner : 0.08 %  
 Temp. penambahan grain refiner : 763 °C  
 Jenis grain refiner : AITiB (Rod)  
 Waktu GBF : 8 Menit

No Shot	No Dies	Temp. Dies (oC)		Temp. Molten (oC)	Tekanan mesin (kPa)	Jam ke	Marking	Jenis Cacat LPDC	Jenis Cacat Machining	Ket.
		Upper	Lower							
1	Trial									
2	Trial									
3	39	238	341	701	25	0	B1	Misrun (PL,IN), keropos (port)		Sampel
	40	230	275				B2			Reject
4	39	248	357	703	25	0	B3	Misrun (PL)		Remelting
	40	240	288				B4			Sampel
5	39	279	372	705	25	0	B5	Misrun (PL)		OK
	40	247	300				B6			Remelting
6	39	236	371	706	25	0	B7			Remelting
	40	248	302				B8			OK
Rehat 30 menit ganti shift										
7	Trial									
8	Trial									
9	39	249	361	715	25	1	B9			OK
	40	239	293				B10			OK
10	39	260	382	715	25	1	B11	Misrun (PL,IN)		OK
	40	251	304				B12			Sampel
11	39	264	381	714	25	1	B13	Misrun (PL,IN)		OK
	40	256	311				B14			Reject
12	39	267	382	714	25	1	B15			OK
	40	260	322				B16			OK
13	39	269	384	713	25	1	B17	Misrun (PL)		OK
	40	261	318				B18			OK
14	39	274	392	712	25.6	1	B19			OK

	40	266	323				B20		OK
15	39	278	399	712	25.6	1	B21		Sampel
	40	271	330				B22		OK
16	39	279	391	711	25.6	1	B23		OK
	40	271	328				B24	Misrun (PL,IN)	OK
17	39	278	388	711	25.6	1	B25	Misrun (PL,IN)	OK
	40	272	321				B26	Misrun (PL,EX)	OK
18	39	281	398	711	25.6	2	B27		OK
	40	276	334				B28		OK
19	39	283	401	711	25.6	2	B29		Sampel
	40	278	337				B30	Misrun (IN)	OK
20	Trial								
21	39	269	384	712	25.6	2	B31		OK
	40	263	321				B32	Misrun (PL)	OK
22	39	279	395	713	25.6	2	B33	Misrun (PL)	Remelting
	40	270	326				B34		OK
23	39	284	395	715	25.6	2	B35		OK
	40	274	330				B36	Keropos	OK
24	39	287	400	712	25.6	2	B37	Misrun (PL)	OK
	40	278	333				B38		OK
25	39	291	404	712	25.6	2	B39		OK
	40	280	337				B40		OK
26	39	292	406	711	25.6	2	B41		OK
	40	283	340				B42		OK
27	39	292	403	711	26.2	2	B43		OK
	40	285	341				B44	Misrun (IN)	OK
28	39	294	410	711	26.2	2	B45		OK
	40	287	346				B46		Sampel
29	39	298	412	710	26.2	2	B47		OK
	40	289	345				B48		OK
30	39	295	406	710	26.2	2	B49	Misrun (PL)	Remelting
	40	288	343				B50		OK
31	39	294	420	711	26.2	3	B51	Misrun (IN)	OK
	40	284	344				B52		OK

32	39	292	400	710	26.2	3	B53	Misrun (IN)	Bocor (emisi)	OK
	40	284	341				B54			
33	39	291	400	711	26.2	3	B55	Keropos (chain)		Reject
	40	284	340				B56			
34	39	289	411	711	26.2	3	B57	Keropos (chain)		Reject
	40	283	343				B58			
35	39	296	408	710	26.2	3	B59			OK
	40	286	345				B60			
36	39	293	404	710	26.2	3	B61			OK
	40	285	343				B62			
37	39	298	412	710	26.2	3	B63			OK
	40	288	344				B64			
38	39	296	414	710	26.2	3	B65			OK
	40	288	344				B66			
39	39	297	410	711	26.2	3	B67			OK
	40	288	351				B68			
40	39	299	412	711	26.8	3	B69	Misrun (IN)		OK
	40	288	344				B70			
41	39	296	414	710	26.8	3	B71			Sampel
	40	288	345				B72			
42	39	297	417	710	26.8	3	B73			OK
	40	289	347				B74			
43	39	295	415	710	26.8	3	B75			OK
	40	288	347				B76			
44	39	297	416	709	26.8	4	B77			OK
	40	291	346				B78			
45	39	297	417	709	26.8	4	B79			Sampel
	40	294	347				B80			

Temp. melting : 810 °C  
 Komposisi grain refiner : 0.1 %  
 Temp. penambahan grain refiner : 762 °C

Jenis grain refiner : AITiB (Rod)  
 Waktu GBF : 6 Menit

No Shot	No Dies	Temp. Dies (oC)		Temp. Molten (oC)	Tekanan mesin (kPa)	Jam ke	Marking	Jenis Cacat LPDC	Jenis Cacat Machining	Ket.
		Upper	Lower							
1	Trial									
2	Trial									
3	39	248	281	705	25	0	O1	Misrun (IN)	Bocor (body)	OK
	40	241	292				O2	Misrun (IN), keropos (port)		
4	39	254	290	708	25	0	O3	Misrun (IN)		Sampel
	40	248	302				O4	Misrun (PL,IN)		Sampel
5	39	258	296	709	25	0	O5	Misrun (PL)		Reject
	40	252	309				O6	Misrun (EX)		OK
6	Trial									
7	39	261	303	710	25	0	O7	Misrun (PL)		Reject
	40	260	322				O8			OK
8	39	259	370	710	25	0	O9	Misrun (IN)		OK
	40	258	317				O10	Misrun (Gate)		Reject
9	39	265	386	712	25	1	O11	Misrun (Gate)		Reject
	40	261	323				O12	Misrun (PL), keropos (port)		Reject
10	39	270	380	712	25	1	O13	Misrun (Gate)		Reject
	40	262	323				O14	Misrun (EX)		OK
11	39	275	390	712	25	1	O15	Misrun (PL,IN)		Sampel
	40	270	330				O16	Misrun (EX)		OK
12	39	280	366	713	25	1	O17	Misrun (Gate)		Reject
	40	271	334				O18			OK
13	39	284	330	713	25	1	O19			OK
	40	273	335				O20			OK
14	39	287	338	713	25	1	O21	Misrun (PL,IN)		OK
	40	274	339				O22	Misrun (EX)		OK
15	39	296	329	713	25	1	O23	Misrun (IN)		OK
	40	277	328				O24	Misrun (PL)		OK

16	39	289	330	712	25	1	O25		OK
	40	279	343				O26	Misrun (PL)	OK
17	39	292	334	712	25.6	1	O27	Misrun (IN)	OK
	40	279	335				O28	Misrun (IN)	OK
18	39	294	338	713	25.6	1	O29	Misrun (PL)	Sampel
	40	281	352				O30		OK
19	39	289	337	712	25.6	1	O31	Misrun (IN)	OK
	40	279	343				O32	Misrun (IN,EX)	OK
20	39	293	329	713	25.6	1	O33	Misrun (IN)	OK
	40	286	344				O34		OK
Dies bermasalah ( $\pm 30$ menit)									
21	39	203	281	711	25.6	2	O35	Keropos (chain)	OK
	40	197	283				O36	Keropos (chain)	Reject
22	39	227	286	715	25.6	2	O37	Misrun (PL)	OK
	40	216	296				O38	Misrun (PL)	Sampel
23	39	238	292	715	25.6	2	O39	Misrun (IN)	OK
	40	228	306				O40	Misrun (PL), keropos (chain)	Reject
24	39	238	292	715	25.6	2	O41	Misrun (PL), keropos (chain)	Reject
	40	230	309				O42	Misrun (EX), keropos (port)	Reject
25	39	241	296	713	25.6	2	O43	Misrun (IN)	Bocor (emisi)
	40	234	314				O44	Misrun (PL,IN)	Sampel
26	39	249	377	712	26.2	2	O45	Misrun (PL)	OK
	40	242	318				O46	Misrun (EX), keropos (chain)	Reject
27	39	255	385	711	26.2	2	O47	Misrun (IN)	OK
	40	248	323				O48	Misrun (IN)	OK
28	39	261	390	711	26.2	2	O49	Misrun (PL,IN)	OK
	40	253	330				O50	Misrun (PL)	Reject
29	39	263	389	710	26.2	3	O51	Misrun (IN)	Sampel
	40	256	328				O52	Misrun (EX)	OK
30	39	265	392	712	26.2	3	O53	Misrun (PL)	Remelting
	40	260	331				O54	Misrun (EX)	Bocor (body)
31	39	274	393	710	26.2	3	O55		OK
	40	260	329				O56		OK
32	39	275	395	711	26.2	3	O57	Keropos (chain)	Reject
	40	263	330				O58	Misrun (PL)	Sampel

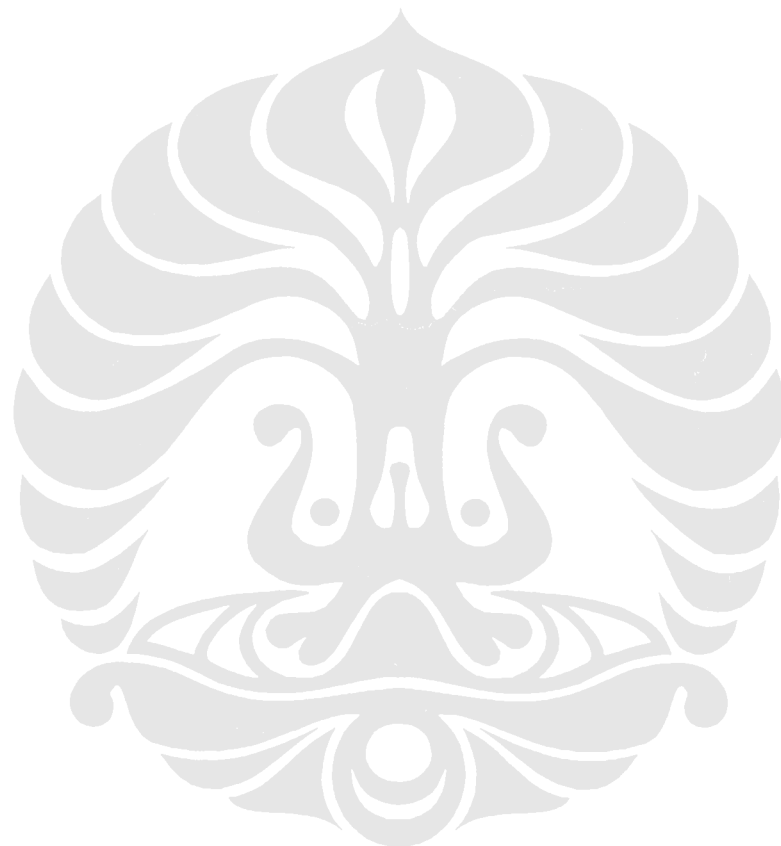
33	39	275	399	711	26.2	3	O59		OK
	40	267	334				O60	Misrun (PL)	Reject
34	39	276	389	710	26.2	3	O61	Misrun (Lower)	Reject
	40	265	328				O62	Misrun (EX), keropos (chain)	Reject
35	39	279	403	711	26.2	3	O63	Misrun (EX)	OK
	40	266	333				O64		OK
36	39	280	399	710	26.2	3	O65		OK
	40	270	333				O66	Misrun (EX)	OK
Rehat 30 menit ganti shift									
37	Trial								
38	39	253	350	715	26.2	4	O67	Keropos (chain)	Reject
	40	246	301				O68	Bocor (body)	OK
39	39	264	372	714	26.2	4	O69	Misrun (PL)	Reject
	40	257	312				O70	Misrun (IN,EX)	Sampel
40	39	271	383	713	26.8	4	O71		OK
	40	264	319				O72		OK
41	39	272	394	712	26.8	4	O73	Misrun (IN)	OK
	40	266	329				O74	Misrun (PL), keropos (chain)	Keropos, Bocor (body)
42	39	282	397	711	26.8	4	O75		OK
	40	272	329				O76		OK
43	39	282	399	711	26.8	4	O77	Misrun (IN)	Sampel
	40	275	333				O78		OK
44	39	287	404	710	26.8	4	O79		OK
	40	277	336				O80		OK
45	39	286	401	710	26.8	4	O81		OK
	40	278	339				O82		OK

Temp. melting : 809 °C  
 Komposisi grain refiner : 0.114 %  
 Temp. penambahan grain refiner : 737 °C  
 Jenis grain refiner : AITiB (Rod)  
 Waktu GBF : 6 Menit

No Shot	No Dies	Temp. Dies (oC)		Temp. Molten (oC)	Tekanan mesin (kPa)	Jam ke	Marking	Jenis Cacat LPDC	Jenis Cacat Machining	Ket.
		Upper	Lower							
1	Trial									
2	Trial									
3	39	288	376	702	25	0	P1	Misrun (PL,IN)		OK
	40	290	300				P2	Misrun (IN)		OK
4	39	282	390	701	25	0	P3	Misrun (PL,IN)		Sampel
	40	285	315				P4	Misrun (PL,IN)		OK
5	39	279	388	702	25	0	P5	Misrun (IN)		OK
	40	282	317				P6	Misrun (PL,IN,EX)		OK
6	39	277	395	704	25	0	P7	Misrun (PL)		OK
	40	278	321				P8	Misrun (PL,EX)		Sampel
7	39	282	406	705	25	0	P9			OK
	40	280	327				P10	Misrun (PL)		OK
8	39	283	409	706	25	1	P11	Pasir gugur		Reject
	40	281	331				P12	Misrun (PL)		OK
9	39	277	406	707	25	1	P13	Misrun (IN)		OK
	40	278	333				P14	Misrun (IN,EX)		OK
10	39	271	387	708	25	1	P15	Misrun (IN)		OK
	40	282	330				P16	Misrun (PL,EX)		OK
11	39	285	415	708	25	1	P17			OK
	40	281	341				P18			OK
12	39	285	415	708	25	1	P19	Misrun (IN)		OK
	40	280	340				P20	Misrun (EX)		OK
13	39	285	392	710	25.6	1	P21			OK
	40	278	330				P22	Misrun (EX)		OK
14	39	284	397	711	25.6	1	P23	Misrun (PL)		OK
	40	279	334				P24	Misrun (EX)		OK
15	39	284	399	711	25.6	1	P25	Misrun (IN)		OK
	40	280	337				P26			OK
16	39	284	399	712	25.6	1	P27	Misrun (PL)		OK
	40	281	342				P28	Misrun (EX)		OK
17	39	285	395	713	25.6	1	P29			OK

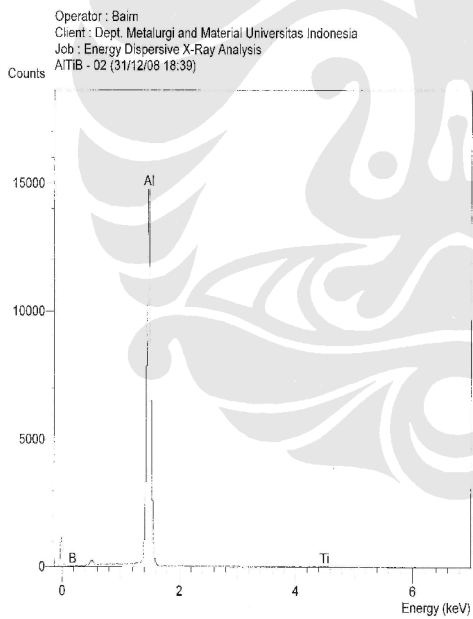
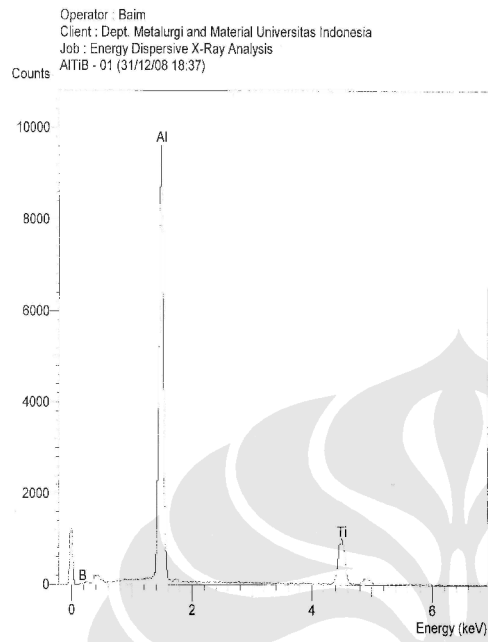
	40	282	343				P30	Misrun (EX)		OK
18	39	290	394	712	25.6	1	P31	Misrun (PL)		OK
	40	282	334				P32		OK	
19	39	291	410	713	25.6	1	P33			OK
	40	284	346				P34		OK	
20	39	296	408	713	25.6	2	P35			OK
	40	286	341				P36		OK	
21	39	294	407	713	25.6	2	P37			OK
	40	287	342				P38		OK	
22	39	292	405	713	25.6	2	P39			OK
	40	288	344				P40	Misrun (EX)		OK
23	39	292	410	713	25.6	2	P41			OK
	40	288	347				P42		OK	
24	39	281	377	712	25.6	2	P43			OK
	40	275	329				P44	Misrun (EX)		OK
25	39	277	378	713	25.6	2	P45			OK
	40	273	329				P46	Misrun (PL,IN,EX)		OK
26	39	282	395	713	25.6	2	P47			OK
	40	278	333				P48		OK	
27	39	290	405	713	262	2	P49			OK
	40	282	337				P50	Misrun (EX)		OK
28	39	294	406	713	262	2	P51			OK
	40	284	340				P52		OK	
29	39	290	408	712	262	2	P53	Misrun (EX)		OK
	40	281	342				P54		OK	
30	39	288	409	712	262	2	P55			OK
	40	282	342				P56	Misrun (EX)		OK
31	39	291	406	712	262	2	P57			OK
	40	286	342				P58	Misrun (EX)		OK
32	39	290	403	712	262	2	P59			OK
	40	286	343				P60		OK	
33	39	290	400	712	262	3	P61			OK
	40	286	343				P62		OK	
34	39	292	406	712	262	3	P63			OK
	40	288	344				P64		OK	







**LAMPIRAN VI**  
**HASIL SEM dan EDS**



SEMQuant results. Listed at 18:40:42 on 31/12/08  
 Operator: Bain  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: AlTiB - 02

System resolution = 60 eV

Quantitative method: ZAF ( 12 iterations).  
 Analysed all elements and normalised results.

1 peak possibly omitted: 0.50 keV

Standards :  
 B K LaB6 03/03/07  
 Al K CeAl2 03/03/07  
 Ti K Titanium Oxide 19/05/06

Elmt	Spect. Type	Element %	Atomic %
B K	ED	63.23	81.17
Al K	ED	36.43	18.74
Ti K	ED	0.34	0.10
Total		100.00	100.00

\* = <2 Sigma

SEMQuant results. Listed at 18:39:30 on 31/12/08  
 Operator: Bain  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: AlTiB - 01

System resolution = 60 eV

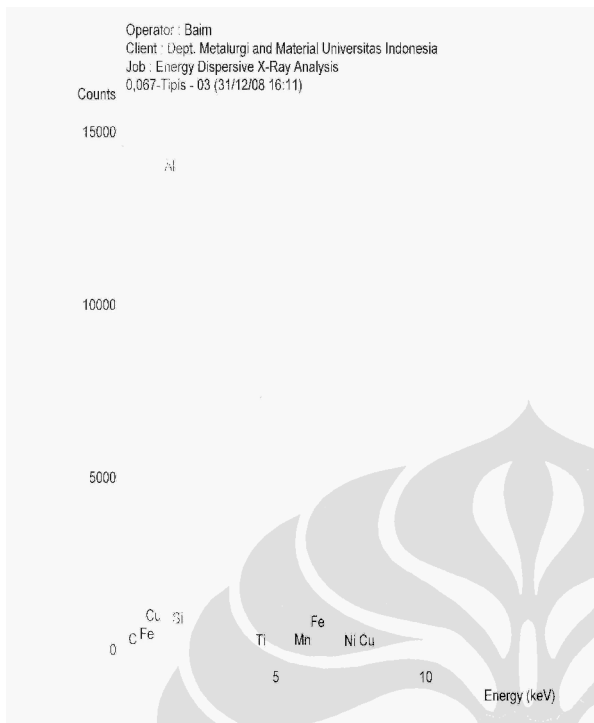
Quantitative method: ZAF ( 6 iterations).  
 Analysed all elements and normalised results.

1 peak possibly omitted: 0.42 keV

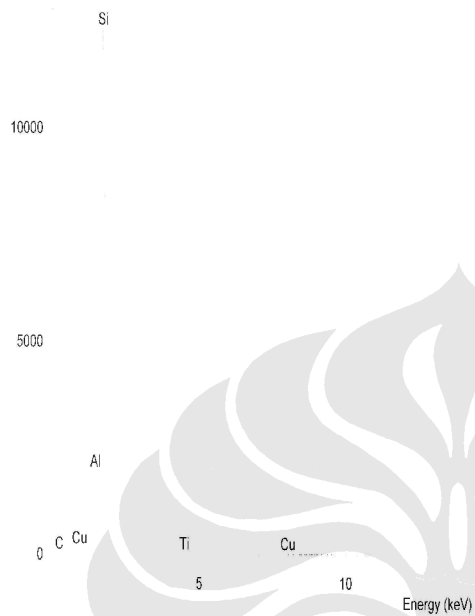
Standards :  
 B K LaB6 03/03/07  
 Al K CeAl2 03/03/07  
 Ti K Titanium Oxide 19/05/06

Elmt	Spect. Type	Element %	Atomic %
B K	ED	53.91	78.37
Al K	ED	25.62	14.92
Ti K	ED	20.47	6.72
Total		100.00	100.00

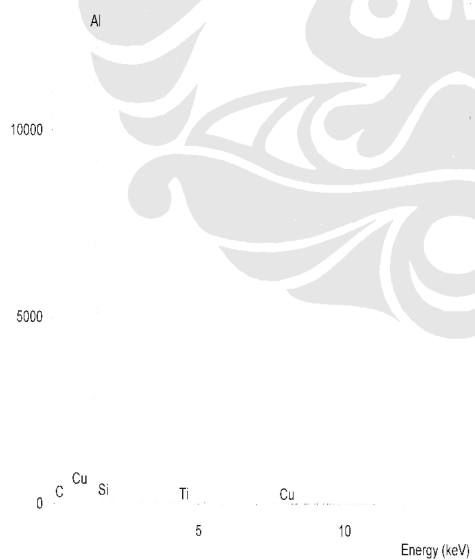
\* = <2 Sigma



Operator : Baim  
Client : Dept. Metalurgi and Material Universitas Indonesia  
Job : Energy Dispersive X-Ray Analysis  
0,081-Tipis - 02 (31/12/08 16:53)



Operator : Baim  
Client : Dept. Metalurgi and Material Universitas Indonesia  
Job : Energy Dispersive X-Ray Analysis  
0,081-Tipis - 03 (31/12/08 16:54)



SEMQuant results. Listed at 17:02:01 on 31/12/08  
 Operator: Beim  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,061-Tipis - 04

System resolution = 50 eV

Quantitative method: ZAF ( 3 iterations)  
 Analysed all elements and normalised results.

1 peak possibly omitted: -0.02 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CuAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/09/06  
 Cu K Copper 22/03/06

Elem	Spect.	Element	Atomic
	Type	%	%
C K	K $\alpha$	1.41	1.24
Al K	ED	15.91	13.66
Si K	ED	63.03	41.92
Ti K	ED	0.24*	0.11*
Cu K	ED	2.41*	1.05*
Total		100.00	100.00

\* = <2 Sigma

SEMQuant results. Listed at 16:15:32 on 31/12/08  
 Operator: Beim  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,061-Tipis - 03

System resolution = 50 eV

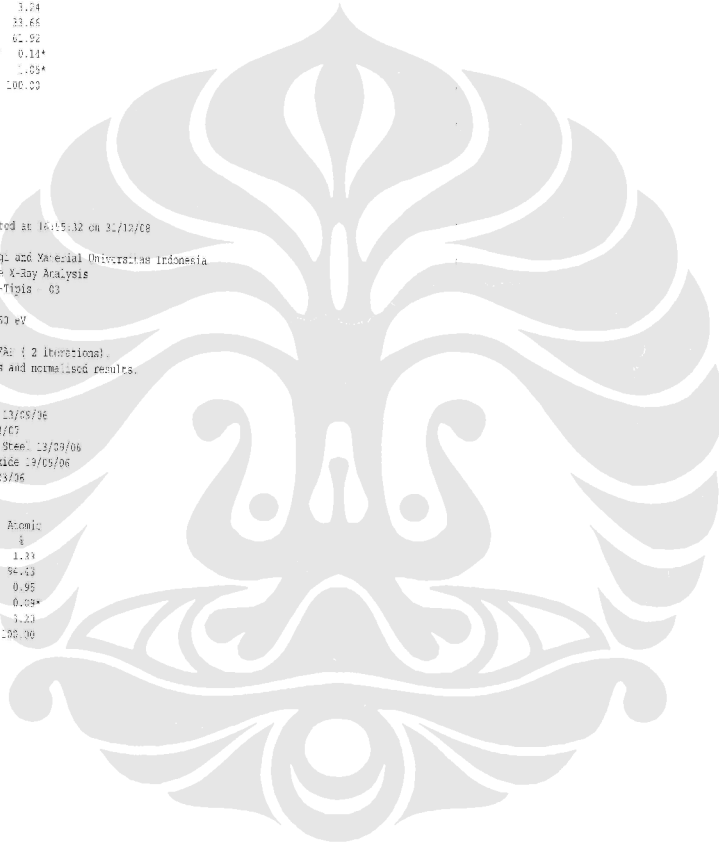
Quantitative method: ZAF ( 2 iterations)  
 Analysed all elements and normalised results.

Standards :

C K Carbon Low 13/09/06  
 Al K CuAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/09/06  
 Cu K Copper 22/03/06

Elem	Spect.	Element	Atomic
	Type	%	%
C K	ED	0.57	1.24
Al K	ED	61.95	54.43
Si K	ED	0.95	0.95
Ti K	ED	0.10*	0.09*
Cu K	ED	7.27	3.23
Total		100.00	100.00

\* = <2 Sigma



SEIQuant results, listed at 17:31:21 on 31/12/06  
 Operator: Bain  
 Client: Dept. Metallurgy and Material, Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum Label: 0.115-Tipis - 02

System resolution = 61 eV

Quantitative method: ZAF : 3 iterations!  
 Analyze all elements and normalized results.

2 peaks possibly identified: 0.02, 2.96 keV

Standards :

C X Carbon Low 13/05/06  
 W X Wagonite 22/03/05  
 Al X AlAl 03/03/07  
 Si X Low Carbon Steel 13/09/06  
 Ti X Titanium Oxide 19/05/06  
 Fe X Fe2 22/03/05  
 Mn X Mncen 22/03/05  
 Cu X Copper 22/03/05

Elem	Specn.	Element	Atomic
	Type	%	%
C	K	ED	0.23 0.74
O	K	ED	3.32 9.82
Al	K	ED	46.33 65.59
Si	K	ED	1.51 2.04
Ti	K	ED	3.54* 0.93*
Fe	K	ED	3.82 9.56
Mn	K	ED	1.41 1.17
Cu	K	ED	48.51 23.95
Total			100.00 100.00

\* = <2 Sigma

SEIQuant results, listed at 17:29:53 on 31/12/06  
 Operator: Bain  
 Client: Dept. Metallurgy and Material, Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum Label: 0.115-Tipis - 01

System resolution = 60 eV

Quantitative method: ZAF : 3 iterations!  
 Analyze all elements and normalized results.

2 peaks possibly identified: 0.02, 2.96 keV

Standards :

C X Carbon Low 13/05/06  
 Al X AlAl 03/03/07  
 Si X Low Carbon Steel 13/09/06  
 Ti X Titanium Oxide 19/05/06  
 Cu X Copper 22/03/05

Elem	Specn.	Element	Atomic
	Type	%	%
C	K	ED	3.15 1.72
Al	K	ED	61.48 94.88
Si	K	ED	1.81 1.57
Ti	K	ED	3.35* 0.13*
Cu	K	ED	3.82* 1.63*
Total			100.00 100.00

\* = <2 Sigma





SEMQuant results. Listed at 17:34:10 on 31/12/08  
 Operator: Baim  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,115-Tipis - 04

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

1 peak possibly omitted: -0.02 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Cu K Copper 22/03/06

Elmt	Spect. Type	Element %	Atomic %
C K	ED	0.27	0.96
Al K	ED	35.06	54.86
Si K	ED	1.47	2.21
Ti K	ED	-0.09*	-0.08*
Cu K	ED	63.29	42.06
Total		100.00	100.00

\* = <2 Sigma

SEMQuant results. Listed at 17:32:46 on 31/12/08  
 Operator: Baim  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,115-Tipis - 03

System resolution = 62 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

1 peak possibly omitted: -0.02 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Mn K Mangan 02 13/09/06  
 Fe K FeS2 22/03/06  
 Cu K Copper 22/03/06

Elmt	Spect. Type	Element %	Atomic %
C K	ED	0.61	1.50
Al K	ED	56.83	66.50
Si K	ED	14.52	16.28
Ti K	ED	-0.31*	-0.20*
Mn K	ED	5.91	3.38
Fe K	ED	22.28	12.56
Cu K	ED	0.15*	0.08*
Total		100.00	100.00

\* = <2 Sigma

SEMQuant results. Listed at 17:06:50 on 31/12/08  
 Operator: Baim  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,081-Tebal - 01

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

2 peaks possibly omitted: -0.02, 2.98 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Cu K Copper 22/03/06

Elmt	Spect. Type	Element %	Atomic %
C K	ED	0.84	1.89
Al K	ED	94.06	94.85
Si K	ED	1.90	1.84
Ti K	ED	0.59*	0.22*
Cu K	ED	2.80*	1.20*
Total		100.00	100.00

\* = <2 Sigma

SEMQuant results. Listed at 16:30:18 on 31/12/08  
 Operator: Baim  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,081-Tebal - 03

System resolution = 62 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

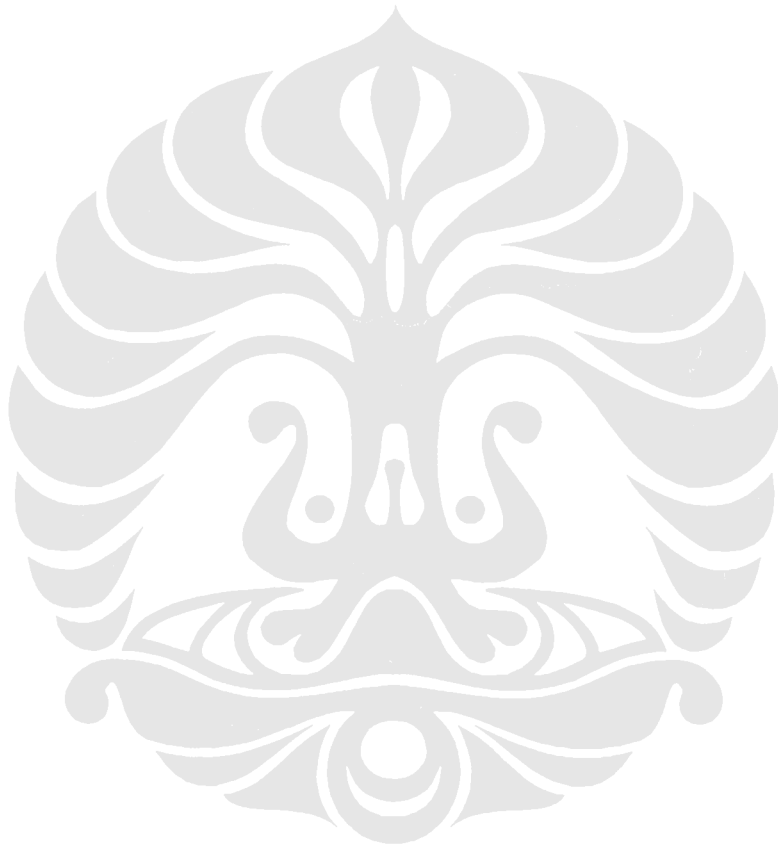
1 peak possibly omitted: -0.02 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Mn K Mangan 02 13/09/06  
 Fe K FeS2 22/03/06  
 Ni K Nickel 22/03/06  
 Cu K Copper 22/03/06

Elmt	Spect. Type	Element %	Atomic %
C K	ED	0.61	1.18
Al K	ED	56.83	65.01
Si K	ED	14.52	11.72
Ti K	ED	-0.31*	-0.20*
Mn K	ED	5.91	3.86
Fe K	ED	22.28	14.72
Ni K	ED	0.15*	1.01
Cu K	ED	0.15*	1.09*
Total		100.00	100.00

\* = <2 Sigma



SEMQuant results. Listed at 17:10:58 on 31/12/08  
 Operator: BaIm  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,081 Tebal - 03

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

1 peak possibly omitted: 3.48 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Cu K Copper 22/03/06

Elm	Spect.	Element	Atomic
	Type	%	%
C K	ED	1.86	4.12
Al K	ED	19.49	19.25
Si K	ED	82.34	78.12
Ti K	ED	0.40*	0.22*
Cu K	ED	-4.09*	-1.72*
Total		100.00	100.00

\* = \*2 Sigma

SEMQuant results. Listed at 17:08:07 on 31/12/08  
 Operator: BaIm  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,081 Tebal - 02

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

Standards :

C K Carbon Low 13/09/06  
 Mg K MgOxide 22/03/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Cu K Copper 22/03/06

Elm	Spect.	Element	Atomic
	Type	%	%
C K	ED	0.81	2.16
Mg K	ED	2.94	2.69
Al K	ED	64.88	77.09
Si K	ED	2.74	3.13
Ti K	ED	0.16*	0.12*
Cu K	ED	29.36	14.82
Total		100.00	100.00

\* = \*2 Sigma

SEMQuant results. Listed at 17:14:33 on 31/12/08  
 Operator: Bain  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,081 Tebal - 03

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

1 peak possibly omitted: 5.90 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Fe K FeS2 22/03/06  
 Cu K Copper 22/03/06

Elem	Spect.	Element	Atomic
	Type	%	%
C K	ED	0.41	1.09
Al K	ED	57.66	69.05
Si K	ED	11.65	13.41
Ti K	ED	0.64	0.43
Fe K	ED	13.46	7.79
Cu K	ED	16.18	8.23
Total		100.00	100.00

\* = ±2 Sigma

SEMQuant results. Listed at 17:12:31 on 31/12/08  
 Operator: Bain  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,081 Tebal - 04

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

1 peak possibly omitted: -0.02 keV

Standards :

C K Carbon Low 13/09/06  
 Mg K MgOxide 22/03/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Cu K Copper 22/03/06

Elem	Spect.	Element	Atomic
	Type	%	%
C K	ED	0.98	2.50
Mg K	ED	5.74	7.25
Al K	ED	64.13	72.98
Si K	ED	5.27	5.76
Ti K	ED	0.17*	-0.11*
Cu K	ED	24.65	11.62
Total		100.00	100.00

\* = ±2 Sigma

SEMQuant results. Listed at 17:40:38 on 31/12/08  
 Operator: Baim  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,115-Tebal - 01

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

2 peaks possibly omitted: -0.02, 2.96 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Cu K Copper 22/03/06

Elmt	Spect.	Element	Atomic
	Type	%	%
C K	ED	0.87	1.94
Al K	ED	96.80	96.02
Si K	ED	1.85	1.77
Ti K	ED	0.55*	0.31*
Cu K	ED	-0.06*	-0.03*
Total		100.00	100.00

\* = ±2 Sigma

SEMQuant results. Listed at 17:45:17 on 31/12/08  
 Operator: Baim  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,115-Tebal - 02

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

2 peaks possibly omitted: -0.02, 2.96 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Cu K Copper 22/03/06

Elmt	Spect.	Element	Atomic
	Type	%	%
C K	ED	0.67	1.62
Al K	ED	84.17	90.12
Si K	ED	2.34	2.41
Ti K	ED	0.16*	0.10*
Cu K	ED	12.66	5.75
Total		100.00	100.00

\* = ±2 Sigma

SEMQuant results. Listed at 17:50:56 on 31/12/08  
 Operator: Bain  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum label: 0,115-Tebal - 04

System resolution = 60 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

2 peaks possibly omitted: -0.02, 3.50 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Cu K Copper 22/03/06

Elm	Spect.	Element	Atomic
	Type	%	%
C K	ED	1.39	3.24
Al K	ED	28.19	29.18
Si K	ED	65.95	65.59
Ti K	ED	0.15*	0.09*
Cu K	ED	4.31*	1.89*
Total		100.00	100.00

\* = <2 Sigma

SEMQuant results. Listed at 17:49:30 on 31/12/08  
 Operator: Bain  
 Client: Dept. Metalurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X Ray Analysis  
 Spectrum label: 0,115-Tebal - 03

System resolution = 62 eV

Quantitative method: ZAF ( 3 iterations).  
 Analysed all elements and normalised results.

1 peak possibly omitted: -0.02 keV

Standards :

C K Carbon Low 13/09/06  
 Al K CeAl2 03/03/07  
 Si K Low Carbon Steel 13/09/06  
 Ti K Titanium Oxide 19/05/06  
 Mn K Mangan 02 13/09/06  
 Fe K FeS2 22/03/06  
 Cu K Copper 22/03/06

Elm	Spect.	Element	Atomic
	Type	%	%
C K	ED	0.40	1.07
Al K	ED	58.46	69.09
Si K	ED	11.30	12.49
Ti K	ED	0.11*	0.07*
Mn K	ED	6.10	3.54
Fe K	ED	24.93	14.23
Cu K	ED	-1.01*	-0.50*
Total		100.00	100.00

\* = <2 Sigma

SEMQuant results, listed at 16:13:02 on 31/12/08  
 Operator: Baim  
 Client: Dept. Metallurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum Label: D\_067-Tipis - 03

System resolution: 0.62 eV

Quantitative method: ZAF (3 iterations).  
 Analysed all elements and normalised results.

1 peak possibly missed: -0.02 keV

Standards:

C K Carbon 13/09/06  
 Al K 99Al2 11/03/07  
 Si K Low Carbon Steel 15/09/06  
 Ti K Titanium oxide 19/05/06  
 Mn K Manganese 11/09/06  
 Fe K FeS2 21/03/06  
 Ni K Nickel 11/03/06  
 Cu K Copper 11/03/06

Elem	Spect	Element	Atomic %
C K	ED	C	2.01
Al K	ED	Al	86.89
Si K	ED	Si	5.02
Ti K	ED	Ti	0.00*
Mn K	ED	Mn	0.01
Fe K	ED	Fe	2.98
Ni K	ED	Ni	0.04
Cu K	ED	Cu	0.06
Total			100.00

\* = 0.000000

SEMQuant results, listed at 16:11:53 on 31/12/08  
 Operator: Baim  
 Client: Dept. Metallurgi and Material Universitas Indonesia  
 Job: Energy Dispersive X-Ray Analysis  
 Spectrum Label: D\_067-Tipis - 02

System resolution: 0.61 eV

Quantitative method: ZAF (3 iterations).  
 Analysed all elements and normalised results.

Standards:

C K Carbon 13/09/06  
 Al K 99Al2 11/03/07  
 Si K Low Carbon Steel 15/09/06  
 Ti K Titanium oxide 19/05/06  
 Ni K Nickel 11/03/06  
 Cu K Copper 11/03/06

Elem	Spect	Element	Atomic %
C K	ED	C	3.04
Al K	ED	Al	51.84
Si K	ED	Si	6.79
Ti K	ED	Ti	0.13*
Ni K	ED	Ni	2.05
Cu K	ED	Cu	44.46
Total			100.00

\* = 0.000000

# HOESCH METALS AND ALLOYS GMBH

**tuv**



ISO 9001:2000

## Product Data Sheet

Product:

### AlTi5B1 (Sticks 500 mm)

Aluminium Titanium Boron Master Alloy with 5 % Titanium and 1 % Boron for the grain refining of aluminium and aluminium alloys

Typical chemical analysis:

Element	Composition [%]
Ti	4.5 - 5.5
B	0.9 - 1.1
Si	≤ 0.30
Fe	≤ 0.30
V	≤ 0.20
Others each	≤ 0.04
Others total	≤ 0.10
Al	Remainder

Specification:

EN AM-92256, EN AM-ATi5B1 (A)

Customer specification will be considered in accordance to requirements

Typical physical data:

Appearance	Dimension	Weight [net]
Sticks	≈ 500 mm, ∅ ≈ 9 mm	≈ 100 g

Application:

Close control of the cast structure is a major requirement of high quality aluminium alloy products. The most effective way to provide a fine and uniform as-cast grain structure is to add nucleating agents to the melt to control crystal formation during solidification.

Grain refiners with a number of different titanium-to-boron ratios are available to accommodate special conditions which may exist in the user's plant. In selecting the correct grain refiner alloy, the user must take into consideration conditions such as the alloy to be treated, the quantity of recycle or secondary aluminium used, the desired grain size in the product, and the melting and casting practice used.

Recommended titanium content: 100 - 250 ppm  
Application temperature: 700 - 750°C

For more information about the application don't hesitate to contact our sales department

Storage:

AlTi5B1 has to be stored in a dry warehouse. Shelf life: 3 - 6 months in tightly closed original packaging

Packaging:

AlTi5B1 sticks are packed in wooden crates of ≈ 1 000 Kg net each. The crates are shrink-wrapped and suitable for forklift-truck handling

Supplier:

HOESCH Metals and Alloys GmbH ☎ + 49 2428 90476-10  
P.O. Box 10 09 43 ☎ + 49 2428 90476-00  
52353 Dueren, Germany E-Mail: Sales@Hoesch-MetalsAlloys.com

Date:

April 4, 2006/ Rev. #1/0US