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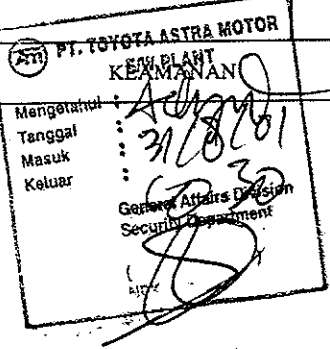
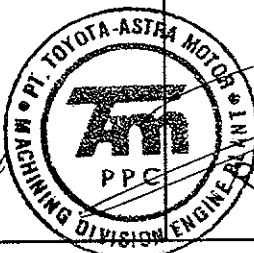
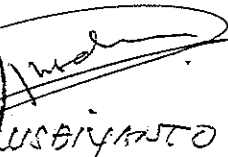

**Pengaruh Suhu Pelarutan Dan Penuaan Terhadap Struktrur Mikro Dan Kekerasan Paduan AC8P**  
Wildan Novianto , Dr. Ir. Viktor Malau, DEA.

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## **LAMPIRAN**



# SURAT JALAN

NAMA BARANG	JUMLAH	DENGAN HURUF	KETERANGAN
STON BLANK ING DEFECT	3 pcs	TIGA (PLR)	UNTUK PENELITIAN AGING PROSES
MENGELUARKAN	MENGETAHUI		YANG MENERIMA
			 WILDAN N (SEK. PUS TPM - UTILI PAD)

PISTON-A ST-No.:ACSP

INSPECTOR : OEDIN WHITE SHIFT I

AN= 93 IAN= 93 08-22-01 13:48












Al	Si	Cu	Pengaruh Suhu Pelarutan Dan Penuaan Terhadap Struktur Mikro Dan Kekerasan Paduan AC8P			
86.032	9.999	2.699	0.008	0.014	0.476	0.000
85.494	10.362	2.787	0.300	0.012	0.508	0.510
85.763	10.181	2.713	0.307	0.010R	0.512	0.493



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Cr	Pb	Sn	Ti	STD
0.008	0.000	0.000	0.008	
0.009	0.000	0.000	0.018	
0.009	0.000	0.000	0.013R	



TUGAS : 04 Februari 1999 NO. : 01 NO. : 1 dari 1	DEPT : Produksi LINE : Casting POS/OP No. :	DEPT. HEAD SECT. HEAD LINE	STATUS DOKUMEN 
PROCESS <b>CHECK HARDNESS PISTON</b>		ILUSTRASI	
PROSEDUR	SIMBOL	HAL - HAL PENTING ( KEY POINT )	DOKUMEN TERKAIT QSP-M-02 . Sistim mutu
Ambil sample piston		1.1 Sample setelah proses treatment 1.2 Tiap kranjang = 4 pcs	
Grinda di bagian scrit piston		2.1 Kedudukan piston x table rata	
Check hardness		3.1 Gunakan alat penguji yang tersedia 3.2 Standard 65 ~ 80 HRB	
Tulis hasil pengecekan di check sheet		4.1 Item di check sheet diisi	
Beri tanda piston yang di check		5.1 Tulis di piston , hasil HRB dan tanggal produksinya 5.2 Bila hasil Hardness " N/G " maka piston akan diproses ulang sesuai dengan SOP-MPD-0124	
CATATAN REVISI KETERANGAN		SIMBOL  = PRODUKSI / SAFETY  = QUALITY  = STOCK / PENYIMPANAN	
Penambahan Key Point 5.2			



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PROSES  
: 28 Januari 1999  
: 01  
: 1 dari 1

**SOLUTION & AGING**

LINE : Casting Piston  
POS / OP No. :  
DEPT. HEAD :  
SECT. HEAD :  
LINE H



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**ILUSTRASI**

**HAL - HAL PENTING (KEY POINT)**

- 1.1 RC Fan, Water Heater, Agitator, Heater menyala
- 1.2 Posisi first start di OFF
- 1.3 Cont - Man di posisi manual
- 2.1 Temperatur
  - Solution = 495 ± 5°C
  - Aging = 210 ± 5°C
  - Water Cooling = 75 ~ 76 °C
- 3.1 Pemanasan solution → 3 jam
- 3.2 Pendinginan solution → 5 menit
- 3.3 Penirisan air → 8 menit
- 3.4 Pemanasan Aging → 3 jam
- 3.5 Pendinginan dengan fan → ± 20 menit

**PROSEDUR**

hidupkan panel kontrol solution  
Masukkan piston ke solution + Aging  
sama waktu pemanasan dan pendinginan



**DOKUMEN TERKAIT**

**SIMBOL**

- = PRODUKSI / SAFETY
- = QUALITY
- = STOCK / PENYIMPANAN

**CATATAN REVISI**

**CODE**

KETERANGAN

Penambahan Prosedur No.3



STATUS DOKUMEN

REVISI:











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FAKULTAS TEKNIK

Pengaruh Suhu Pelarutan Dan Penuaan Terhadap Struktur Mikro Dan Kekerasan Paduan AC8P

Wildan Novianto, Dr. K. Viktor Malay, DEA

JURUSAN TEKNIK MESIN PROGRAM DIPLOMA

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Jl. Grafika No. 2A Yogyakarta Telp. 902269, 548637

Fax. (0274) 546400

Program Diploma Teknik Mesin Universitas Gadjah Mada menerangkan bahwa :

Nama : Wildan Novianto  
Alamat : Yogyakarta  
NIM : 99/133936/TK/24778  
Program Studi : S1  
Fakultas : Teknik  
Universitas / Instansi : Universitas Gadjah Mada

lah mengadakan Penelitian Perlakuan Panas & Uji Kekerasan dengan menggunakan  
Treatment Furnace dan Microhardness Tester,

da :

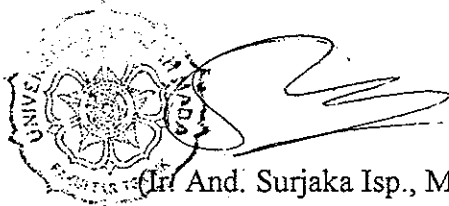
Hari / Tanggal : Kamis, 11 Oktober 2001  
Waktu : Pukul 17.00 – 21.00 WIB  
Tempat : Laboratorium Bahan Teknik  
Keperluan : Skripsi

Demikian surat keterangan ini dibuat supaya dapat digunakan sebagaimana mestinya.

Yogyakarta, 18 Oktober 2001.

Mengetahui,

Kepala Laboratorium Bahan Teknik



(Ir. And. Surjaka Isp., M.T.)

NIP : 131 626 449

95 °C - 3 h / 75 °C - 10' / after 3 h

Titik	HVN
1	117.1
2	117.6
3	117.8
4	117.8
5	120.6

II. As Cast ( 43 hari )

Titik	HVN
1	110.7
2	108.4
3	107.0
4	112.2
5	110.5

95 °C - 3 h / 75 °C - 10' / 210 °C - 3 h

Titik	HVN
1	154.4
2	154.4
3	154.0
4	156.0
5	152.4

IV. 525 °C - 2 h / 75 °C - 10' / 260 °C - 2 h

Titik	HVN
1	144.9
2	133.0
3	129.5
4	130.2
5	137.9

140 °C - 2 h / 75 °C - 10' / 260 °C - 2 h

Titik	HVN
1	123.9
2	131.4
3	134.6
4	141.3
5	131.7

VI. 510 °C - 2 h / 75 °C - 10' / 260 °C - 2 h

Titik	HVN
1	144.9
2	148.6
3	150.1
4	152.4
5	154.8

Titik	HVN
1	118.4
2	144.9
3	137.9
4	125.4
5	145.6

95 °C - 3 h / 75 °C - 10' / 210 °C - 3 h / 260 °C - 2 h

Titik	HVN
1	138.9
2	144.2
3	136.6
4	137.9
5	127.7

95 °C - 45' / 540 °C - 1 h / 75 °C - 10' / 260 °C - 2 h

Titik	HVN
1	153.2
2	153.2
3	135.2
4	138.9
5	137.9

Yogyakarta, 18 Oktober 2001

Petugas



( Lilik Dwi Setyana )



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d	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	9272.	9089.	8912.	8740.	8572.	8410.	8252.	8094.	7949.	7804.
2	7653.	7525.	7392.	7261.	7135.	7011.	6891.	6773.	6659.	6548.
3	6439.	6333.	6230.	6129.	6030.	5934.	5843.	5757.	5674.	5592.
4	5486.	5403.	5321.	5242.	5164.	5089.	5018.	4951.	4889.	4832.
5	4731.	4664.	4598.	4534.	4471.	4410.	4350.	4293.	4239.	4188.
6	4121.	4066.	4013.	3961.	3910.	3859.	3810.	3762.	3714.	3668.
7	3622.	3577.	3533.	3490.	3447.	3406.	3365.	3325.	3285.	3246.
8	3282.	3171.	3134.	3098.	3062.	3028.	2995.	2962.	2929.	2896.
9	2968.	2858.	2799.	2749.	2700.	2653.	2608.	2563.	2518.	2474.
10	2568.	2525.	2515.	2489.	2464.	2439.	2414.	2389.	2365.	2341.
11	2318.	2295.	2272.	2250.	2228.	2206.	2185.	2164.	2143.	2123.
12	2102.	2083.	2063.	2044.	2025.	2006.	1987.	1969.	1951.	1933.
13	1915.	1898.	1887.	1865.	1848.	1832.	1815.	1799.	1784.	1768.
14	1753.	1738.	1723.	1708.	1693.	1679.	1665.	1651.	1637.	1623.
15	1610.	1596.	1583.	1570.	1557.	1543.	1532.	1520.	1508.	1495.
16	1484.	1472.	1468.	1449.	1437.	1426.	1415.	1404.	1393.	1382.
17	1372.	1351.	1351.	1340.	1328.	1320.	1310.	1291.	1281.	1281.
18	1272.	1253.	1253.	1244.	1235.	1226.	1217.	1208.	1200.	1191.
19	1183.	1174.	1166.	1158.	1150.	1142.	1134.	1126.	1118.	1110.
20	1102.	1093.	1087.	1080.	1073.	1065.	1058.	1051.	1044.	1037.
21	1038.	1023.	1017.	1010.	1003.	996.7	990.2	983.8	977.4	971.1
22	964.9	958.6	952.5	946.4	940.4	934.4	928.5	922.7	916.9	911.2
23	895.5	899.8	894.3	888.7	883.2	877.8	872.4	867.1	861.8	856.6
24	861.4	848.3	841.2	836.2	831.2	826.2	821.3	816.4	811.5	806.6
25	802.1	787.4	792.7	788.1	783.5	779.0	774.5	770.0	765.5	761.2
26	756.9	752.6	748.3	744.1	739.9	735.7	731.6	727.5	723.4	719.4
27	715.4	711.5	707.5	703.7	699.9	696.0	692.2	688.4	684.7	681.0
28	677.3	673.6	670.0	666.4	662.9	659.3	655.8	652.4	648.9	645.5
29	642.1	638.7	635.4	632.1	628.8	625.5	622.3	619.1	615.9	612.7
30	609.6	606.5	603.4	600.3	597.3	594.3	591.3	588.3	585.3	582.3
31	579.5	576.6	573.7	570.9	568.1	565.3	562.5	559.7	557.0	554.3
32	551.6	548.9	546.2	543.6	541.0	538.4	535.8	533.2	530.7	528.1
33	525.6	523.1	520.7	518.2	515.8	513.3	510.9	508.5	506.2	503.9
34	501.5	499.1	496.8	494.5	492.3	490.0	487.8	485.5	483.3	481.1
35	478.9	476.8	474.5	472.5	470.3	468.2	466.1	464.0	462.0	459.9
36	457.9	455.8	453.0	451.0	449.0	447.0	445.0	443.0	441.0	439.0
37	438.2	436.3	434.4	432.5	430.7	428.9	427.1	425.3	423.5	421.5
38	417.3	416.2	414.4	412.7	410.9	409.2	407.4	405.7	404.0	402.1
39	402.4	400.8	399.1	397.4	395.6	393.9	392.2	390.5	388.8	387.0
40	389.6	388.2	386.6	385.0	383.4	381.8	380.2	378.5	376.9	375.2
41	370.9	369.4	367.9	366.5	365.0	363.5	362.1	360.7	359.3	357.9
42	356.5	355.1	353.7	352.3	351.0	349.6	348.2	346.9	345.6	344.2
43	342.9	341.6	340.3	339.0	337.7	336.4	335.1	333.8	332.6	331.3
44	328.8	328.8	327.6	326.4	325.2	324.0	322.7	321.5	320.3	319.2
45	318.0	316.8	315.6	314.5	313.3	312.2	311.1	309.9	308.8	307.6
46	306.5	305.4	304.3	303.2	302.1	301.0	299.9	298.8	297.8	296.7



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d	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
111	75.25	75.12	74.98	74.85	74.71	74.58	74.45	74.31	74.18	74.05
112	73.92	73.78	73.65	73.52	73.39	73.26	73.13	73.00	72.87	72.74
113	72.61	72.48	72.36	72.23	72.10	71.97	71.85	71.72	71.59	71.47
114	71.35	71.22	71.10	70.97	70.85	70.72	70.60	70.48	70.35	70.23
115	70.11	69.99	69.87	69.75	69.62	69.50	69.38	69.26	69.14	69.03
116	68.91	68.79	68.67	68.55	68.43	68.32	68.20	68.08	67.97	67.85
117	67.73	67.62	67.50	67.39	67.27	67.16	67.04	66.93	66.82	66.70
118	66.59	66.48	66.36	66.25	66.14	66.03	65.92	65.81	65.70	65.59
119	65.48	65.37	65.26	65.15	65.04	64.93	64.82	64.71	64.60	64.50
120	64.39	64.28	64.17	64.07	63.96	63.86	63.75	63.64	63.54	63.43
121	63.33	63.22	63.12	63.02	62.91	62.81	62.71	62.60	62.50	62.40
122	62.30	62.19	62.09	61.99	61.89	61.79	61.69	61.59	61.49	61.39
123	61.29	61.19	61.09	60.99	60.89	60.79	60.69	60.59	60.49	60.39
124	60.30	60.20	60.10	60.00	59.91	59.82	59.72	59.63	59.53	59.44
125	59.34	59.25	59.15	59.06	58.96	58.87	58.78	58.68	58.59	58.50
126	58.40	58.31	58.22	58.13	58.03	57.94	57.85	57.76	57.67	57.58
127	57.40	57.30	57.20	57.10	57.00	56.90	56.80	56.70	56.60	56.50
128	56.35	56.25	56.15	56.05	55.95	55.85	55.75	55.65	55.55	55.45
129	55.31	55.21	55.11	55.01	54.91	54.81	54.71	54.61	54.51	54.41
130	54.37	54.27	54.17	54.07	53.97	53.87	53.77	53.67	53.57	53.47
131	53.33	53.23	53.13	53.03	52.93	52.83	52.73	52.63	52.53	52.43
132	52.30	52.20	52.10	52.00	51.90	51.80	51.70	51.60	51.50	51.40
133	51.27	51.17	51.07	50.97	50.87	50.77	50.67	50.57	50.47	50.37
134	50.30	50.20	50.10	50.00	49.90	49.80	49.70	49.60	49.50	49.40
135	49.34	49.24	49.14	49.04	48.94	48.84	48.74	48.64	48.54	48.44
136	48.30	48.20	48.10	48.00	47.90	47.80	47.70	47.60	47.50	47.40
137	47.30	47.20	47.10	47.00	46.90	46.80	46.70	46.60	46.50	46.40
138	46.30	46.20	46.10	46.00	45.90	45.80	45.70	45.60	45.50	45.40
139	45.30	45.20	45.10	45.00	44.90	44.80	44.70	44.60	44.50	44.40
140	44.30	44.20	44.10	44.00	43.90	43.80	43.70	43.60	43.50	43.40
141	43.30	43.20	43.10	43.00	42.90	42.80	42.70	42.60	42.50	42.40
142	42.30	42.20	42.10	42.00	41.90	41.80	41.70	41.60	41.50	41.40
143	41.30	41.20	41.10	41.00	40.90	40.80	40.70	40.60	40.50	40.40
144	40.30	40.20	40.10	40.00	39.90	39.80	39.70	39.60	39.50	39.40
145	39.30	39.20	39.10	39.00	38.90	38.80	38.70	38.60	38.50	38.40
146	38.30	38.20	38.10	38.00	37.90	37.80	37.70	37.60	37.50	37.40
147	37.30	37.20	37.10	37.00	36.90	36.80	36.70	36.60	36.50	36.40
148	36.30	36.20	36.10	36.00	35.90	35.80	35.70	35.60	35.50	35.40
149	35.30	35.20	35.10	35.00	34.90	34.80	34.70	34.60	34.50	34.40
150	34.30	34.20	34.10	34.00	33.90	33.80	33.70	33.60	33.50	33.40
151	33.30	33.20	33.10	33.00	32.90	32.80	32.70	32.60	32.50	32.40
152	32.30	32.20	32.10	32.00	31.90	31.80	31.70	31.60	31.50	31.40
153	31.30	31.20	31.10	31.00	30.90	30.80	30.70	30.60	30.50	30.40
154	30.30	30.20	30.10	30.00	29.90	29.80	29.70	29.60	29.50	29.40
155	29.30	29.20	29.10	29.00	28.90	28.80	28.70	28.60	28.50	28.40
156	28.30	28.20	28.10	28.00	27.90	27.80	27.70	27.60	27.50	27.40
157	27.30	27.20	27.10	27.00	26.90	26.80	26.70	26.60	26.50	26.40
158	26.30	26.20	26.10	26.00	25.90	25.80	25.70	25.60	25.50	25.40
159	25.30	25.20	25.10	25.00	24.90	24.80	24.70	24.60	24.50	24.40
160	24.30	24.20	24.10	24.00	23.90	23.80	23.70	23.60	23.50	23.40
161	23.30	23.20	23.10	23.00	22.90	22.80	22.70	22.60	22.50	22.40
162	22.30	22.20	22.10	22.00	21.90	21.80	21.70	21.60	21.50	21.40
163	21.30	21.20	21.10	21.00	20.90	20.80	20.70	20.60	20.50	20.40
164	20.30	20.20	20.10	20.00	19.90	19.80	19.70	19.60	19.50	19.40
165	19.30	19.20	19.10	19.00	18.90	18.80	18.70	18.60	18.50	18.40

d	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	9461	9327	9197	9068	8943	8820	8708	8580	8456	8333
2	8242	8133	8026	7922	7819	7719	7628	7522	7428	7335
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Vickers hardness number (VHN)	Brinell hardness number (BHN)	Rockwell hardness number	R <sub>B</sub>	R <sub>C</sub>
400	379			40.8
390	369			39.8
380	360			38.8
370	350			37.7
360	341			36.6
350	331			35.5
340	322			34.4
330	313			31.4
320	303			32.2
310	294			31.0
300	284			29.8
295	280			29.2
290	275			28.5
285	270			27.8
280	265			27.1
275	261			26.4
270	256			25.6
265	252			24.8
260	247			24.0
255	243			23.1
250	238		98.1	22.2
245	233		96.7	21.3
240	228		95.0	20.3
230	219		93.4	
220	209		91.5	
210	200		89.5	
200	190		87.1	
190	181		85.0	
180	171		81.7	
170	162		78.7	
160	152		75.0	
150	143		71.2	
140	133		66.7	
130	124		62.3	
120	114		56.2	
110	105		52.0	
100	95		48.0	
95	90		41.0	
90	86			
85	81			

Vickers hardness number (VHN)	Brinell hardness number (BHN)	Rockwell hardness number	R <sub>B</sub>	R <sub>C</sub>
940				68.0
920				67.5
900				67.0
880				66.4
860				65.9
840				65.3
820				64.7
800				64.0
780				63.3
760				62.5
740				61.8
720				61.0
700				60.1
690				59.7
680				59.2
670				58.8
660				58.3
650				57.8
640				57.3
630				56.8
620				56.3
610				55.7
600				55.2
590				54.7
580				54.1
570				53.6
560				53.0
550				52.3
540				51.7
530				51.1
520				50.5
510				49.8
500				49.1
490				48.4
480				47.7
470				47.1
460				46.5
450				46.1
440				45.3
430				44.5
420				43.6
410				42.7
				41.8

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# Some Properties of Selected Elements



UNIVERSITAS GADJAH MADA

Element	Symbol	Melting point, °C	Density, g/cm <sup>3</sup>	Atomic radius, nm	Crystal structure† (20°C)	Lattice constant a, nm
Al	Al	660	2.70	0.143	FCC	0.40496
Sb	Sb	630	6.70	0.138	Rhombohedral	0.45067
As	As	817	5.72	0.125	Rhombohedral	0.4131
Ka	Ka	714	3.5	0.217	BCC	0.5019
Be	Be	1278	1.85	0.113	HCP	0.22856
B	B	2030	2.34	0.097	Orthorhombic	0.35832
Br	Br	-7.2	3.12	0.119	Orthorhombic	
Cd	Cd	321	8.65	0.148	HCP	0.29788
Ca	Ca	846	1.55	0.197	FCC	0.5582
C	C	3550	2.25	0.077	Hexagonal	0.24612
Cs	Cs	28.7	1.87	0.190	BCC	
Cl	Cl	-101	1.9	0.099	Tetragonal	
Cr	Cr	1975	7.19	0.126	BCC	0.28846
Co	Co	1498	8.85	0.128	HCP	0.2505
Cu	Cu	1083	8.96	0.128	FCC	0.36147
F	F	-220	1.3	0.071		
Ga	Ga	29.8	5.91	0.135	Orthorhombic	

† of solid at 20°C.  
† Crystal structures exist at other temperatures.

Lattice constant a, nm

Crystal structure† (20°C)

Atomic radius, nm

Density, g/cm<sup>3</sup>

Melting point, °C

Symbol

Element

Germanium	Ge	937	5.32	0.139	Diamond cubic	0.56576
Gold	Au	1063	19.3	0.144	FCC	0.40788
Helium	He	-270	...	...	HCP	
Hydrogen	H	-259	...	0.046	Hexagonal	
Iodine	I	157	7.31	0.162	FC tetragonal	
Iridium	Ir	114	4.94	0.136	Orthorhombic	
Iridium	Ir	2454	22.4	0.135	FCC	
Iron	Fe	1536	7.87	0.124	BCC	
Lead	Pb	327	11.34	0.175	FCC	
Lithium	Li	180	0.53	0.157	BCC	
Magnesium	Mg	650	1.74	0.160	HCP	
Manganese	Mn	1245	7.43	0.118	Cubic†	
Mercury	Hg	-38.4	14.19	0.155	Rhombohedral	
Molybdenum	Mo	2610	10.2	0.140	BCC	
Neon	Ne	-248.7	1.45	0.160	FCC	
Nickel	Ni	1453	8.9	0.125	FCC	
Nickelium	Nb	2415	8.6	0.143	BCC	
Nitrogen	N	-240	1.03	0.071	Hexagonal	
Osmium	Os	2700	22.57	0.135	HCP	
Oxygen	O	-218	1.43	0.060	Cubic†	
Palladium	Pd	1552	12.0	0.137	FCC	
Phosphorus (white)	P	44.2	1.83	0.110	Cubic†	
Platinum	Pt	1769	21.4	0.139	FCC	
Potassium	K	63.9	0.86	0.238	BCC	
Rhenium	Re	3180	21.0	0.136	HCP	
Rhodium	Rh	1966	12.4	0.134	FCC	
Ruthenium	Ru	2500	12.2	0.125	HCP	
Scandium	Sc	1539	2.99	0.160	FCC	
Silicon	Si	1410	2.34	0.117	Diamond cubic	
Silver	Ag	961	10.5	0.144	FCC	
Sodium	Na	97.8	0.97	0.192	BCC	
Strontium	Sr	768	2.60	0.215	FCC	
Sulfur (yellow)	S	119	2.07	0.104	Orthorhombic	
Tantalum	Ta	2996	16.6	0.143	BCC	
Tin	Sn	232	7.30	0.158	Tetragonal	
Titanium	Ti	1668	4.51	0.147	HCP	
Tungsten	W	3410	19.3	0.141	BCC	
Uranium	U	1132	19.0	0.138	Orthorhombic†	
Vanadium	V	1900	6.1	0.136	BCC	
Zinc	Zn	419.5	7.13	0.137	HCP	
Zirconium	Zr	1852	6.49	0.160	HCP	

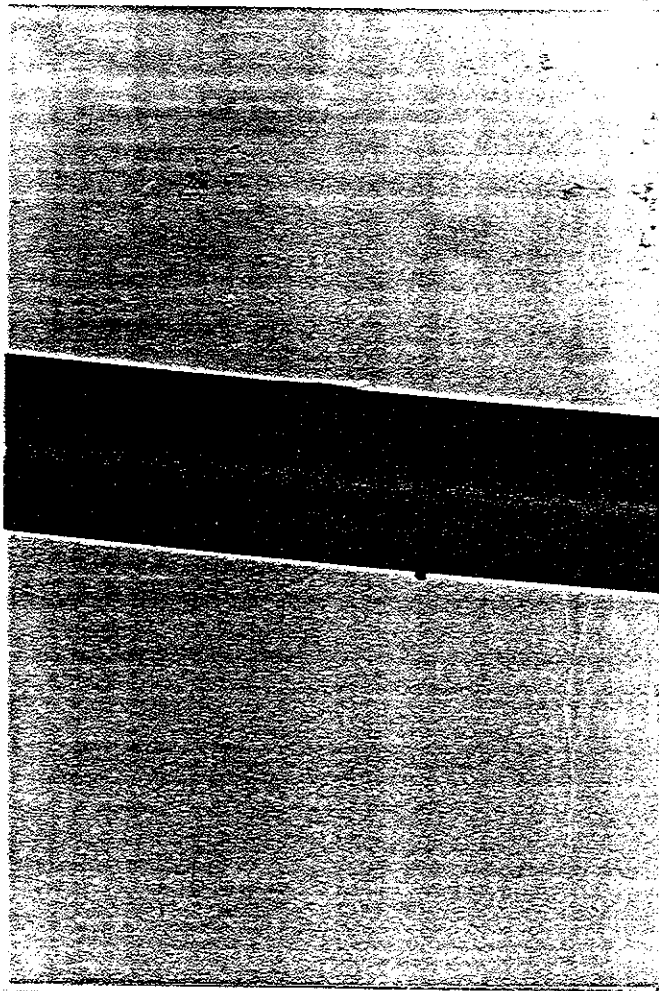
† of solid at 20°C.  
† Other crystal structures exist at other temperatures.



Hasil foto memiliki ukuran perbesaran yang berbeda dengan perbesaran pada mikroskop. Perbandingan ukuran tersebut diperlihatkan dengan pemotretan kawat berdiameter 180  $\mu\text{m}$  dengan perbesaran mikroskop 100 kali. Diketahui dari ukuran foto kawat tersebut berdiameter 2.3 cm (23000  $\mu\text{m}$ ) sehingga perbesaran foto sesungguhnya adalah :

$$\frac{23000}{180} = 127.8 \text{ kali}$$

Jadi panjang 1 cm (10000  $\mu\text{m}$ ) dari foto menunjukkan panjang sesungguhnya sebesar  $\frac{10000}{127.8} = 78.3 \mu\text{m}$



Gambar kawat berdiameter 180  $\mu\text{m}$  dipotret dengan perbesaran 100 kali.

