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## LAMPIRAN

### LAMPIRAN 1

#### TABEL DAN GRAFIK HASIL PENGUJIAN

**Tabel A.1**

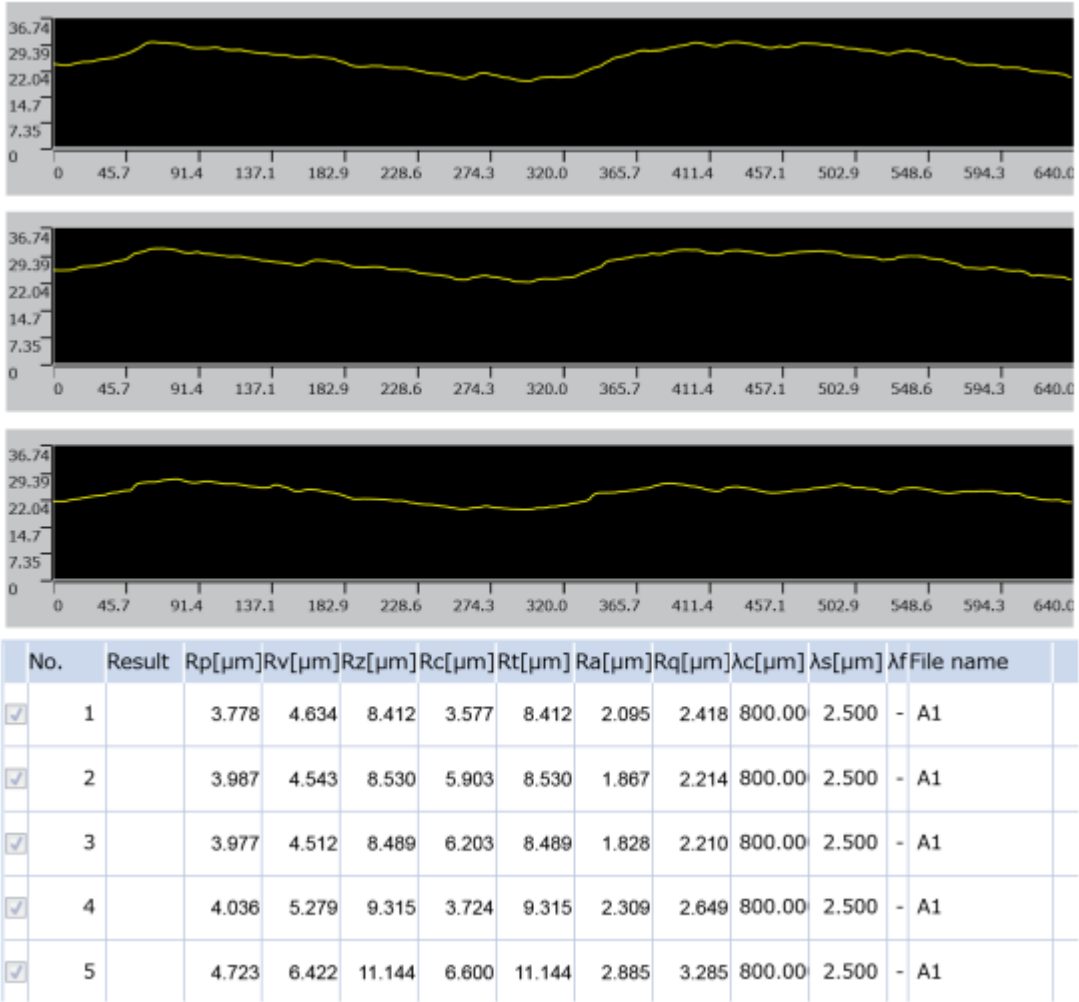
Tabel Pengujian Kekasaran AL 6061 Saat Proses Penarikan Menggunakan Pelumas

Diameter (mm)	Kecepatan Penarikan	Kekerasan Ra ( $\mu\text{m}$ )	Rata-rata ( $\mu\text{m}$ )
Tanpa Penarikan	2mm/menit	2.10	1.93
		1.87	
		1.83	
8.4		0.43	0.38
		0.32	
		0.40	
8.5		0.40	0.43
		0.43	
		0.46	
8.6		0.47	0.45
		0.43	
		0.44	
8.7	0.46	0.46	
	0.47		
	0.46		

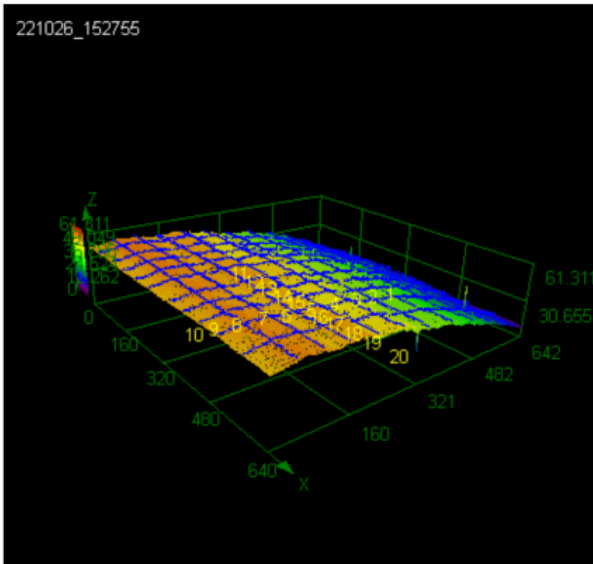
**Tabel A.2**

Tabel Pengujian Kekasaran AL 6061 Saat Proses Penarikan Tanpa Pelumas

Diameter (mm)	Kecepatan Penarikan	Kekerasan Ra ( $\mu\text{m}$ )	Rata-rata ( $\mu\text{m}$ )
Tanpa Penarikan	2mm/menit	2.10	1.93
		1.87	
		1.83	
8.4		0.40	0.41
		0.46	
		0.37	
8.5		0.45	0.45
		0.41	
		0.50	
8.6		0.64	0.53
		0.50	
		0.47	
8.7	0.61	0.55	
	0.53		
	0.52		



**Gambar A.1** Kekasaran Aluminium 6061 Tanpa Penarikan



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 Scanning mode: XYZ fast scan + Color  
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 Image size[μm]: 640x643  
 Objective lens: MPLAPONLEXT20x  
 Zoom: 1x

Image Name:221026\_152755  
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           λs 2.500 μm  
           λf -- μm  
 Filter:Gaussian Filter  
 Analysis parameter:R parameter

No.	Result	Rp[μm]	Rv[μm]	Rz[μm]	Rc[μm]	Rt[μm]	Ra[μm]	Rq[μm]	λc[μm]	λs[μm]	λf[μm]	File name
<input checked="" type="checkbox"/>	1	3.418	1.383	4.801	2.358	4.801	0.540	0.705	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	2	2.742	2.309	5.051	2.246	5.051	0.554	0.739	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	3	3.782	11.988	15.770	2.692	15.770	0.560	0.892	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	4	3.222	1.559	4.781	2.633	4.781	0.514	0.691	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	5	2.137	1.560	3.697	1.960	3.697	0.433	0.547	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	6	1.878	3.245	5.123	2.956	5.123	0.583	0.715	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	7	2.655	1.843	4.498	2.601	4.498	0.694	0.838	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	8	1.391	2.070	3.461	2.591	3.461	0.540	0.656	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	9	0.982	1.958	2.940	1.923	2.940	0.316	0.430	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	10	2.067	1.614	3.681	2.108	3.681	0.396	0.517	800.00	2.500	-	221026

**Gambar A.2** Kekasaran Aluminium 6061 Diameter 8,4 mm Setelah Proses Penarikan Menggunakan Pelumas

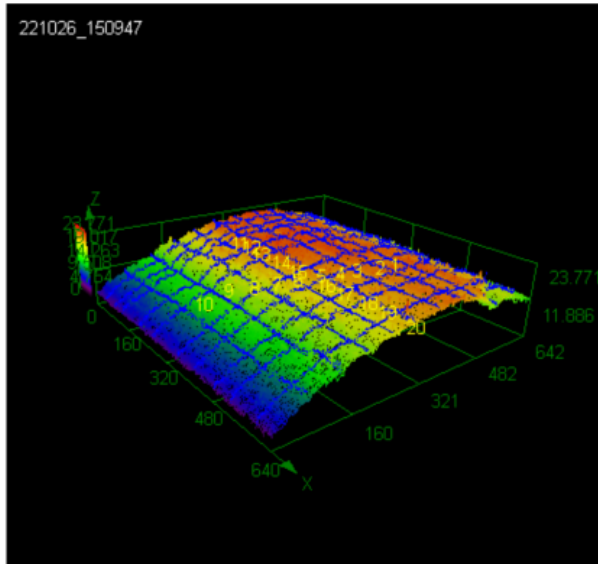
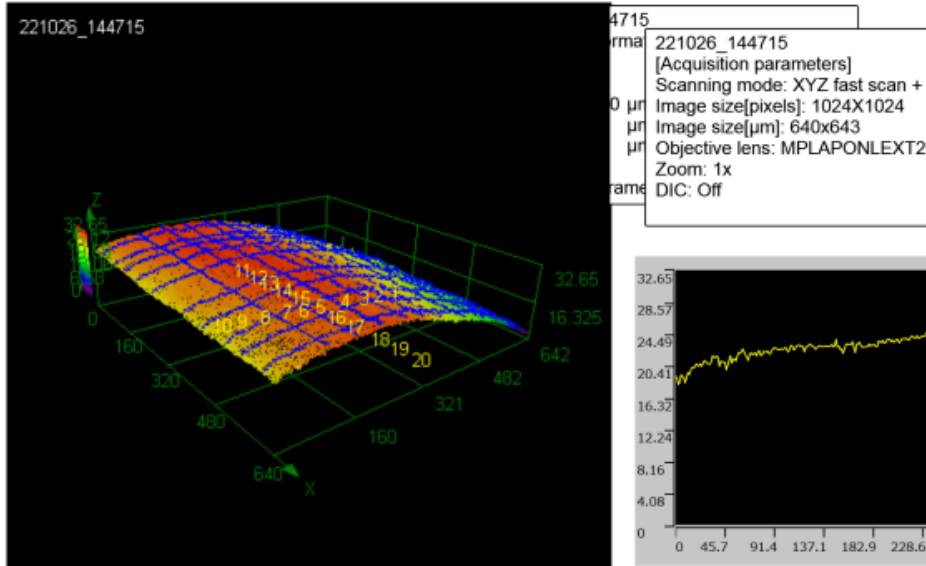


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 Filter:Gaussian Filter  
 Analysis parameter:R parameter

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 Image size[ $\mu$ m]: 640x643  
 Objective lens: MPLAPONLEXT2  
 Zoom: 1x  
 DIC: Off

No.	Result	Rp[ $\mu$ m]	Rv[ $\mu$ m]	Rz[ $\mu$ m]	Rc[ $\mu$ m]	Rt[ $\mu$ m]	Ra[ $\mu$ m]	Rq[ $\mu$ m]	$\lambda_c$ [ $\mu$ m]	$\lambda_s$ [ $\mu$ m]	$\lambda_f$ [ $\mu$ m]	File name
<input checked="" type="checkbox"/>	1	1.209	0.945	2.154	1.475	2.154	0.273	0.347	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	2	2.453	3.454	5.907	2.933	5.907	0.696	1.006	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	3	1.026	0.787	1.813	1.447	1.813	0.217	0.278	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	4	0.956	0.952	1.908	1.421	1.908	0.320	0.395	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	5	0.868	0.821	1.690	1.089	1.690	0.278	0.347	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	6	1.688	1.301	2.988	1.862	2.988	0.404	0.507	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	7	1.412	0.899	2.310	1.376	2.310	0.281	0.379	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	8	1.839	1.452	3.291	2.091	3.291	0.430	0.552	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	9	1.954	2.099	4.053	2.273	4.053	0.461	0.621	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	10	1.869	2.018	3.887	2.253	3.887	0.497	0.632	800.00	2.500	-	221026

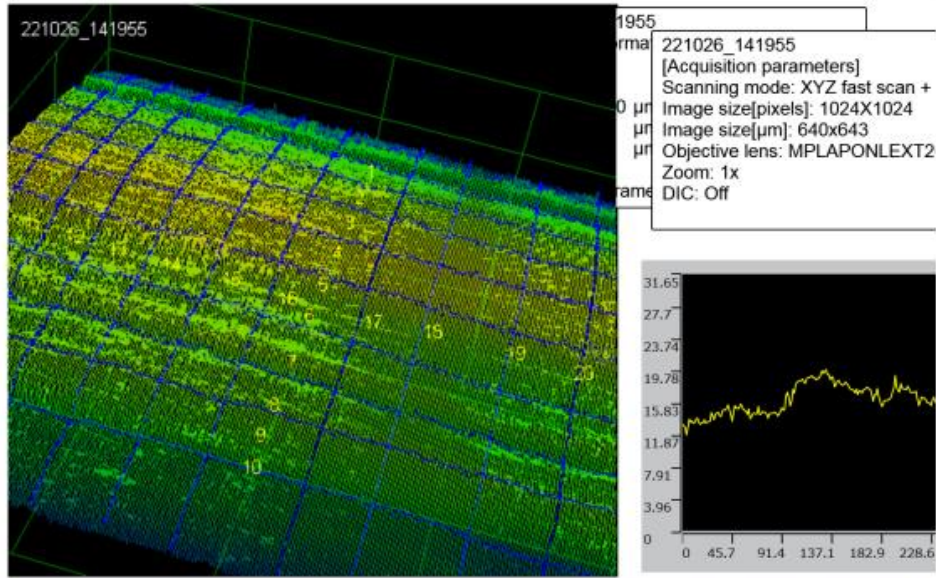
**Gambar A.3** Kekasaran Aluminium 6061 Diameter 8,5 mm Setelah Proses Penarikan Menggunakan Pelumas



No.	Result	Rp[μm]	Rv[μm]	Rz[μm]	Rc[μm]	Rt[μm]	Ra[μm]	Rq[μm]	λc[μm]	λs[μm]	λf[μm]	File name
<input checked="" type="checkbox"/>	1	4.407	1.851	6.258	3.121	6.258	0.525	0.732	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	2	2.112	1.740	3.852	2.446	3.852	0.567	0.675	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	3	2.090	1.838	3.929	1.677	3.929	0.496	0.605	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	4	1.253	1.253	2.506	1.710	2.506	0.468	0.550	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	5	2.880	2.092	4.971	1.846	4.971	0.434	0.598	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	6	1.140	1.084	2.224	1.557	2.224	0.332	0.410	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	7	1.424	1.737	3.161	1.693	3.161	0.440	0.525	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	8	1.207	1.294	2.501	2.045	2.501	0.311	0.383	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	9	1.492	1.308	2.800	1.706	2.800	0.311	0.391	800.00	2.500	-	221026_144715
<input checked="" type="checkbox"/>	10	0.918	0.964	1.882	1.321	1.882	0.241	0.314	800.00	2.500	-	221026_144715

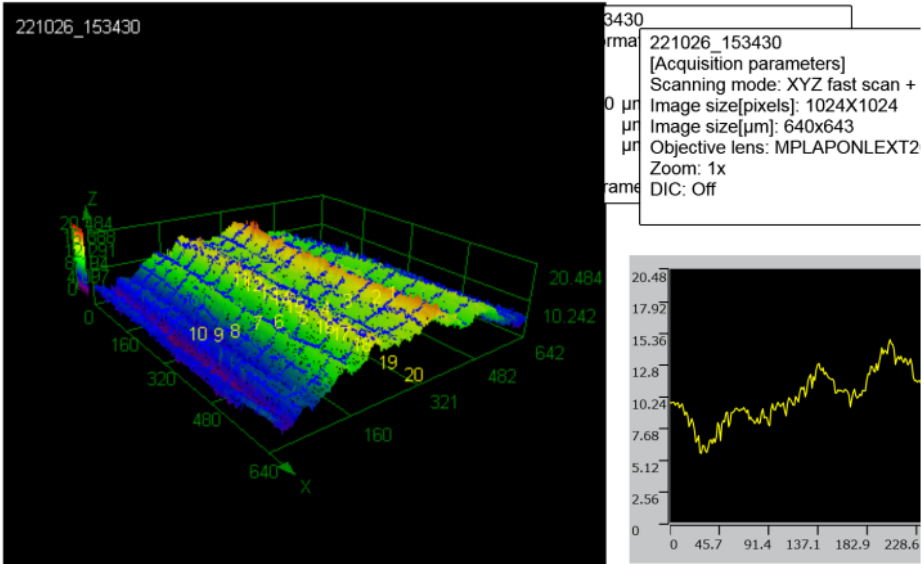
**Gambar A.4** Kekasaran Aluminium 6061 Diameter 8,6 mm Setelah Proses Penarikan Menggunakan Pelumas





No.	Result	Rp[μm]	Rv[μm]	Rz[μm]	Rc[μm]	Rt[μm]	Ra[μm]	Rq[μm]	Ac[μm]	As[μm]	λf[μm]	File name
<input checked="" type="checkbox"/>	1	2.827	1.832	4.660	2.500	4.660	0.460	0.637	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	2	1.760	1.209	2.969	1.368	2.969	0.371	0.453	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	3	1.075	1.220	2.295	1.321	2.295	0.289	0.378	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	4	1.357	1.285	2.642	1.639	2.642	0.263	0.349	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	5	1.162	0.911	2.073	1.341	2.073	0.222	0.293	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	6	1.988	1.466	3.454	2.524	3.454	0.412	0.533	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	7	1.886	1.502	3.388	2.496	3.388	0.459	0.557	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	8	1.763	1.915	3.678	2.078	3.678	0.474	0.593	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	9	0.892	1.348	2.240	1.367	2.240	0.235	0.321	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	10	1.711	1.430	3.141	2.415	3.141	0.408	0.502	800.00	2.500	-	221026

**Gambar A.5** Kekasaran Aluminium 6061 Diameter 8,7 mm Setelah Proses Penarikan Menggunakan Pelumas



No.	Result	Rp[μm]	Rv[μm]	Rz[μm]	Rc[μm]	Rt[μm]	Ra[μm]	Rq[μm]	λc[μm]	λs[μm]	λf[μm]	File name
<input checked="" type="checkbox"/>	1	2.252	1.649	3.900	2.566	3.900	0.401	0.555	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	2	1.160	2.323	3.483	1.781	3.483	0.459	0.595	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	3	2.470	1.434	3.904	1.640	3.904	0.324	0.423	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	4	1.342	2.460	3.802	2.286	3.802	0.581	0.710	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	5	2.451	1.545	3.995	2.527	3.995	0.581	0.745	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	6	1.240	1.056	2.296	0.939	2.296	0.274	0.372	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	7	2.746	2.916	5.663	2.553	5.663	0.550	0.675	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	8	0.928	1.559	2.487	1.395	2.487	0.368	0.474	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	9	2.955	1.651	4.606	2.190	4.606	0.527	0.695	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	10	1.313	1.375	2.687	1.554	2.687	0.408	0.502	800.00	2.500	-	221026

**Gambar A.6** Kekasaran Aluminium 6061 Diameter 8,4 mm Setelah Proses Penarikan Tanpa Pelumas

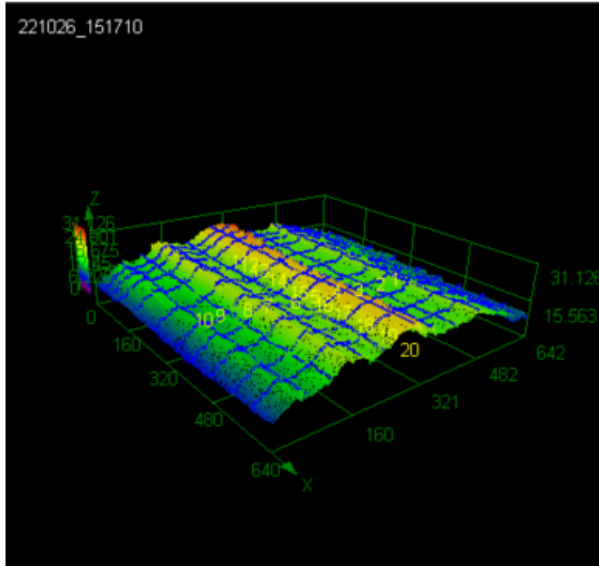


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            $\lambda$ f --  $\mu$ m  
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 Image size[ $\mu$ m]: 640x643  
 Objective lens: MPLAPONLEXT20x  
 Zoom: 1x  
 DIC: Off

No.	Result	Rp[ $\mu$ m]	Rv[ $\mu$ m]	Rz[ $\mu$ m]	Rc[ $\mu$ m]	Rt[ $\mu$ m]	Ra[ $\mu$ m]	Rq[ $\mu$ m]	$\lambda$ c[ $\mu$ m]	$\lambda$ s[ $\mu$ m]	$\lambda$ f[ $\mu$ m]	File nar
<input checked="" type="checkbox"/>	1	1.640	1.440	3.080	1.663	3.080	0.391	0.485	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	2	1.625	1.432	3.057	2.110	3.057	0.451	0.552	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	3	1.309	0.868	2.178	1.354	2.178	0.299	0.380	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	4	1.775	1.351	3.126	1.471	3.126	0.305	0.411	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	5	1.071	1.113	2.184	1.285	2.184	0.275	0.343	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	6	1.132	1.257	2.389	1.292	2.389	0.296	0.397	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	7	1.682	1.146	2.828	1.551	2.828	0.316	0.410	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	8	0.593	0.941	1.535	1.160	1.535	0.262	0.314	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	9	1.797	1.316	3.113	1.854	3.113	0.406	0.502	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	10	1.711	1.536	3.247	1.754	3.247	0.498	0.654	800.00	2.500	-	221026

**Gambar A.7** Kekasaran Aluminium 6061 Diameter 8,5 mm Setelah Proses Penarikan Tanpa Pelumas

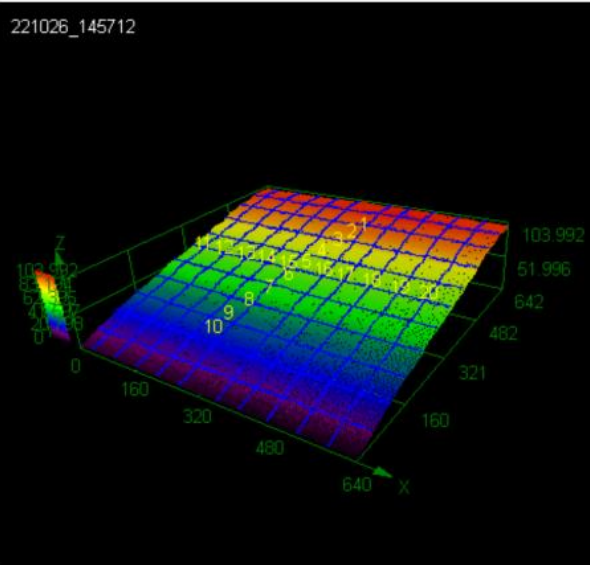
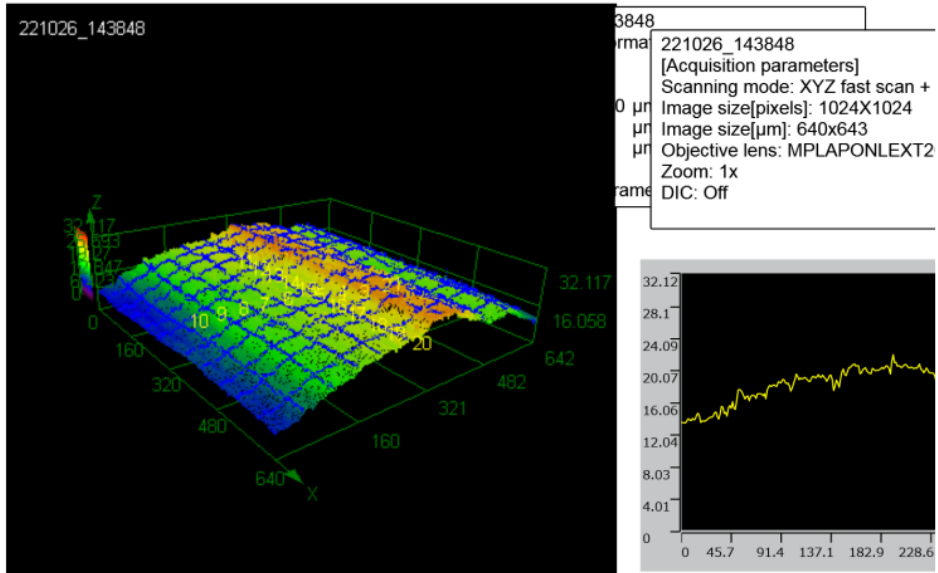


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           λf -- µm  
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 Analysis parameter:R parameter

No.	Result	Rp[µm]	Rv[µm]	Rz[µm]	Rc[µm]	Rt[µm]	Ra[µm]	Rq[µm]	λc[µm]	λs[µm]	λf[µm]	File nar
<input checked="" type="checkbox"/>	1	2.561	1.865	4.426	2.587	4.426	0.639	0.771	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	2	3.635	1.864	5.499	3.685	5.499	0.678	0.850	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	3	1.981	2.660	4.641	2.432	4.641	0.684	0.868	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	4	1.355	1.382	2.737	1.637	2.737	0.417	0.510	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	5	1.728	1.337	3.064	1.656	3.064	0.408	0.501	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	6	1.254	1.406	2.660	1.912	2.660	0.381	0.472	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	7	1.314	5.520	6.833	2.449	6.833	0.383	0.505	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	8	1.280	1.863	3.143	1.908	3.143	0.500	0.625	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	9	1.885	1.448	3.334	1.702	3.334	0.388	0.508	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	10	1.547	2.020	3.568	2.314	3.568	0.465	0.580	800.00	2.500	-	221026

**Gambar A.8** Kekasaran Aluminium 6061 Diameter 8,6 mm Setelah Proses Penarikan Tanpa Pelumas



No.	Result	Rp[μm]	Rv[μm]	Rz[μm]	Rc[μm]	Rt[μm]	Ra[μm]	Rq[μm]	λc[μm]	λs[μm]	λf[μm]	File name
<input checked="" type="checkbox"/>	1	2.012	1.413	3.425	1.636	3.425	0.398	0.501	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	2	1.735	2.586	4.321	2.203	4.321	0.497	0.664	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	3	1.068	2.309	3.376	1.552	3.376	0.395	0.537	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	4	1.378	2.408	3.787	1.419	3.787	0.308	0.404	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	5	2.126	2.098	4.224	2.484	4.224	0.606	0.743	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	6	1.791	1.750	3.542	2.660	3.542	0.449	0.578	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	7	2.162	1.525	3.687	2.121	3.687	0.525	0.648	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	8	4.992	2.094	7.085	2.526	7.085	0.516	0.699	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	9	4.146	1.983	6.130	3.493	6.130	0.670	0.856	800.00	2.500	-	221026
<input checked="" type="checkbox"/>	10	1.990	1.516	3.506	2.912	3.506	0.561	0.702	800.00	2.500	-	221026

**Gambar A.9** Kekasaran Aluminium 6061 Diameter 8,7 mm Setelah Proses Penarikan Tanpa Pelumas

**Tabel A.3** Tabel Pengujian Kekerasan Proses Penarikan Menggunakan Pelumas

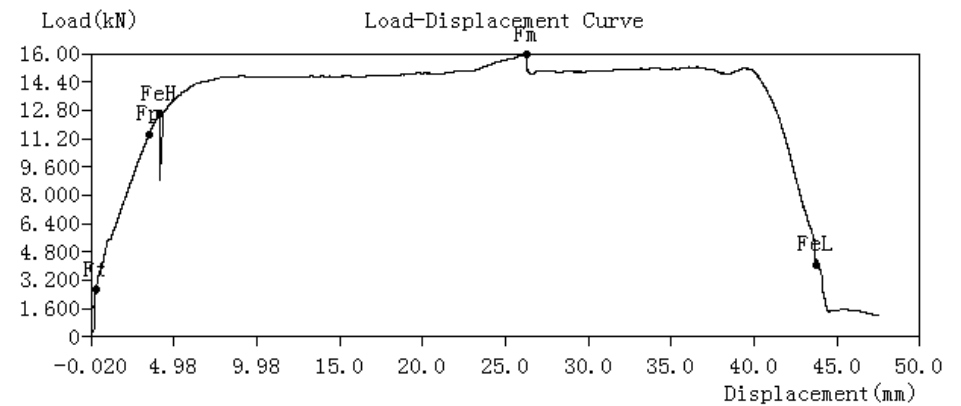
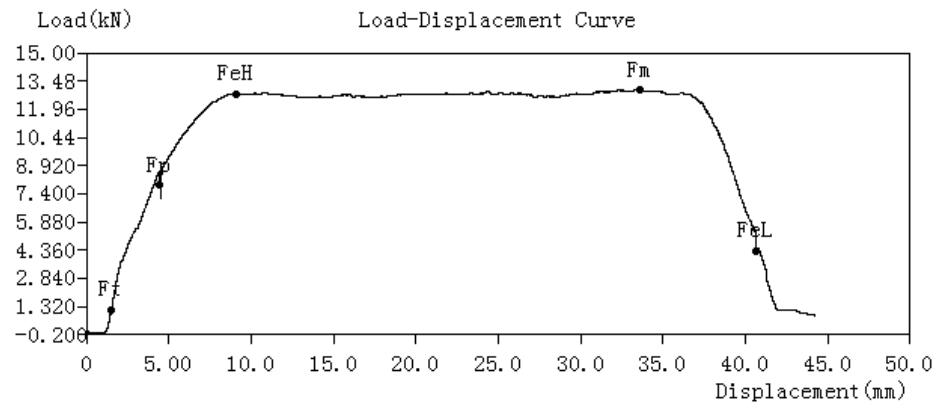
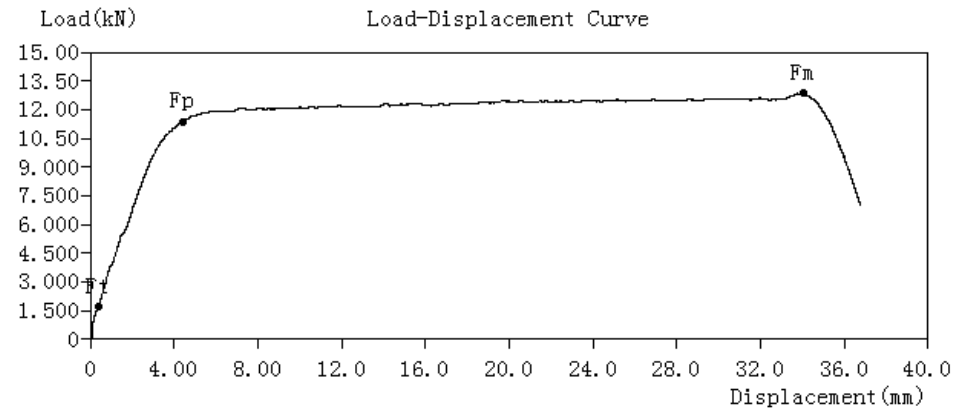
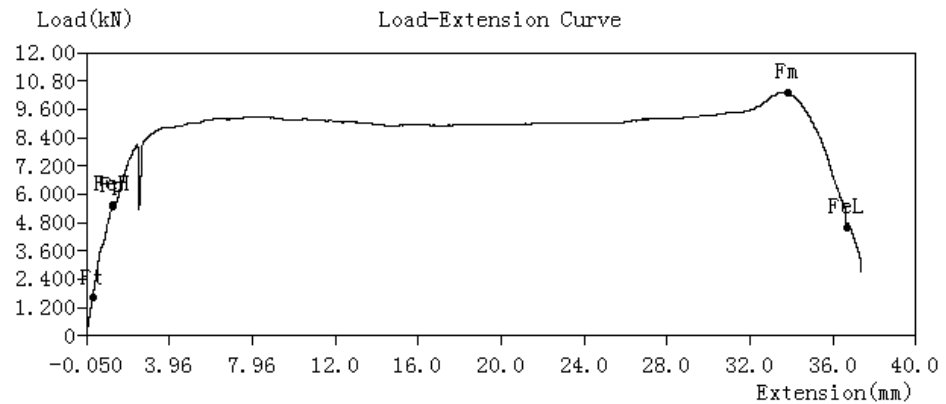
Diameter Awal	Kecepatan Penarikan	Kekerasan (HV)			Rata-rata (HV)	Standar Deviasi
		A	B	C		
8.4	2 mm/menit	88	91.4	94.4	91.27	2.61
8.5		95.9	91.2	96	94.37	2.74
8.6		99.6	99.7	98	99.10	0.95
8.7		105.9	105.9	100.8	104.20	2.94
Tanpa Penarikan		82.3	85.7	83.6	83.87	1.72

**Tabel A.4** Tabel Pengujian Kekerasan Proses Penarikan Tanpa Pelumas

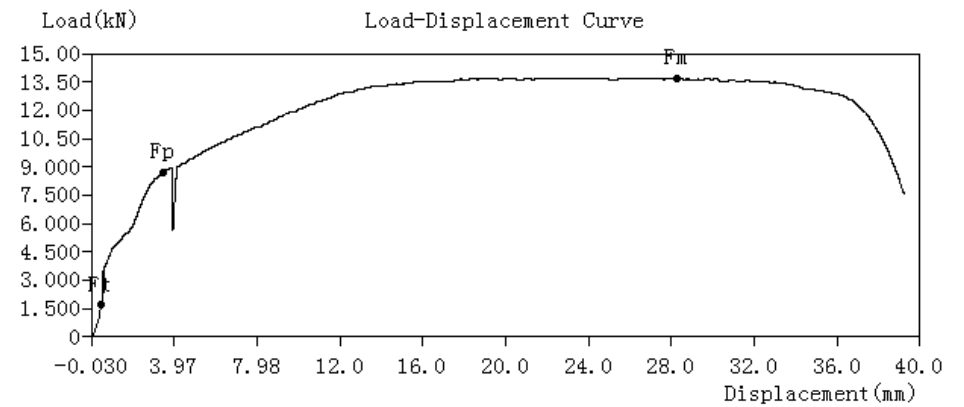
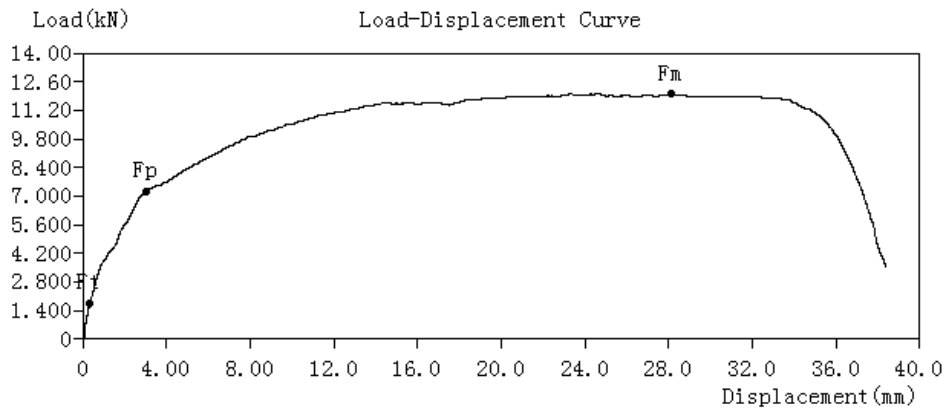
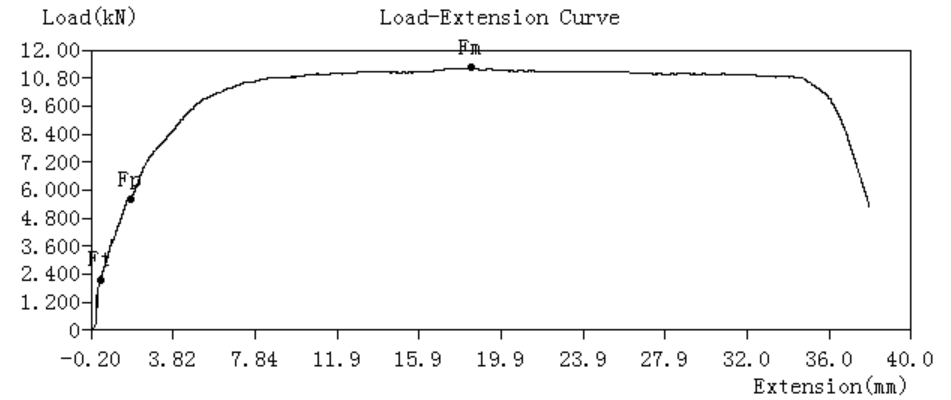
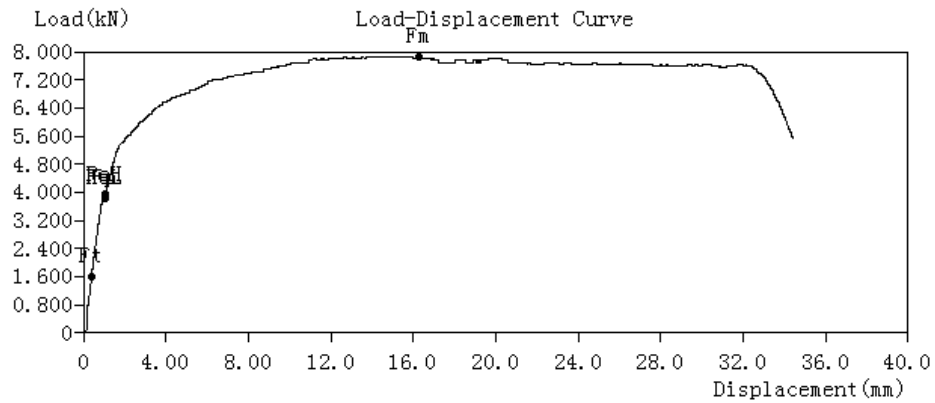
Diameter awal	Kecepatan Penarikan	Kekerasan (HV)			Rata-Rata (HV)	Standar Deviasi
		A	B	C		
8.4	2 mm/menit	83.3	94.5	91.6	89.80	5.81
8.5		91.9	95.4	92.6	93.30	1.85
8.6		97.2	91.2	92.6	93.67	3.14
8.7		103	99.8	100.8	101.20	1.64
Tanpa Penarikan		82.3	85.7	83.6	83.87	1.72

**Tabel A.5** Data Hasil Penarikan

Diameter Awal (mm)	Panjang Awal (cm)	Diameter Akhir (mm)	Data Hasil Penarikan	
			Pelumas	Tanpa Pelumas
8.4	3 cm	8	3.36	3.38
8.5		8	3.42	3.48
8.6		8	3.51	3.52
8.7		8	3.61	3.59



**Gambar A.10** Grafik Hasil Proses Penarikan Kondisi Menggunakan Pelumas Pelumas



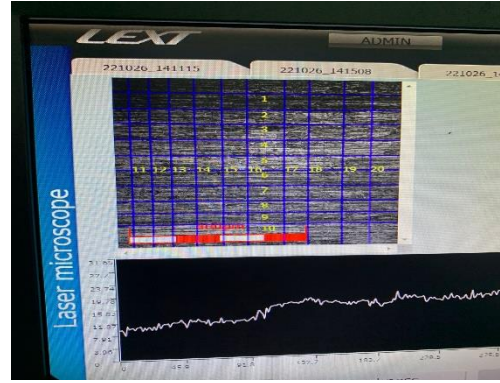
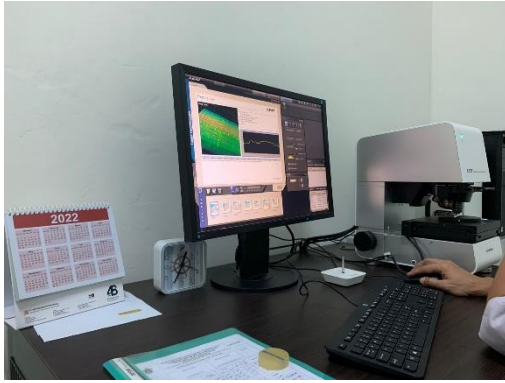
**Gambar A.11** Grafik Hasil Proses Penarikan Kondisi Tanpa Pelumas



**LAMPIRAN II**  
**DOKUMENTASI PENELITIAN**



**Gambar B.1** Proses Penarikan Aluminium 6061



**Gambar B.2** Pengujian Kekasaran dan Pengujian Cacat Permukaan



**Gambar B.3** Proses Etsa Sebelem Melakukan Pengujian Mikrostruktur



**Gambar B.4** Pengujian Kekerasan