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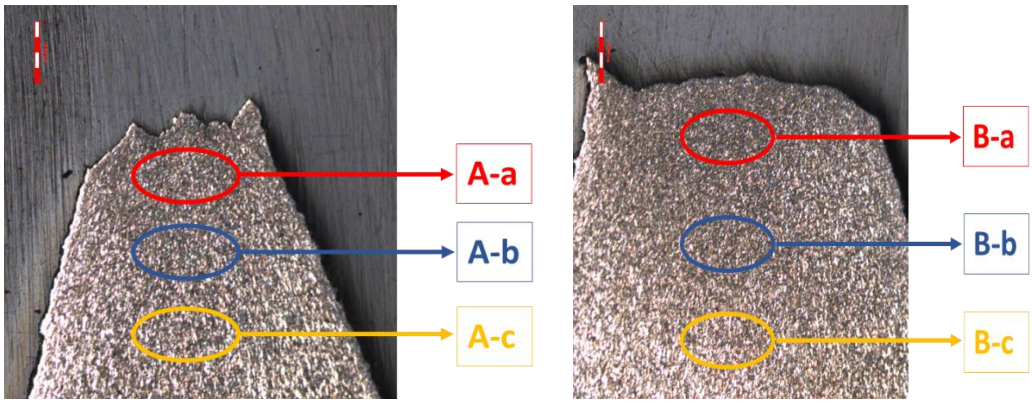
LAMPIRAN

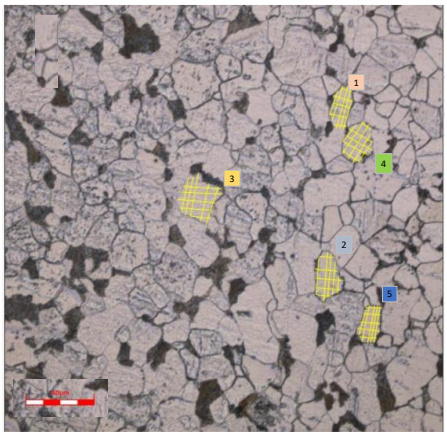
Lampiran A Titik Lokasi Pengamatan Struktur Mikro dan Pengukuran Grain Rasio

Lampiran A.1 Titik Lokasi Pengamatan Struktur Mikro dan Pengukuran Grain Rasio spesimen raw

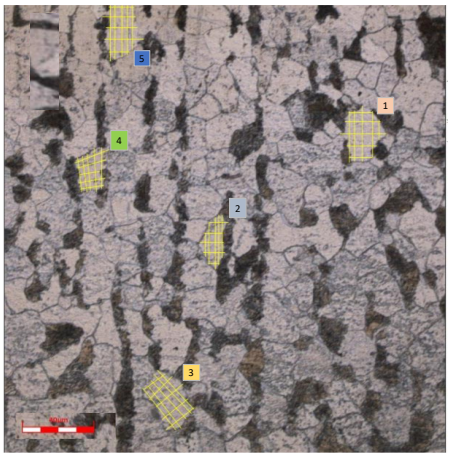


(A) (B)

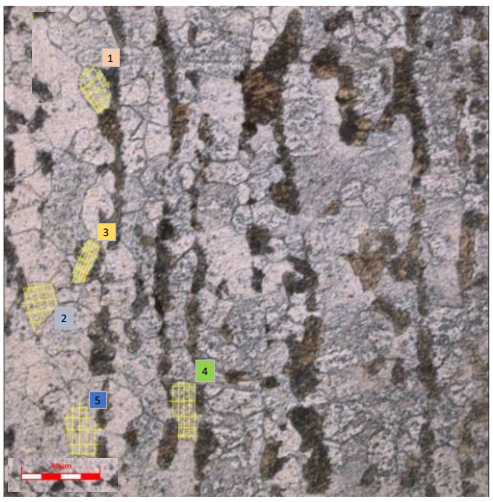
Bentuk patahan dan titik pengamatan struktur mikro pada spesimen setelah mengalami creep rupture*, (A) merupakan bagian tebal axial, (B) bagian sisi diameter luar dari superheater* tube



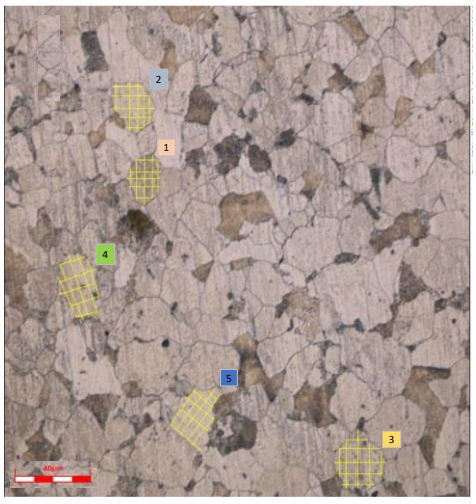
Titik lokasi pengamatan mikro struktur material raw bagian A-atas



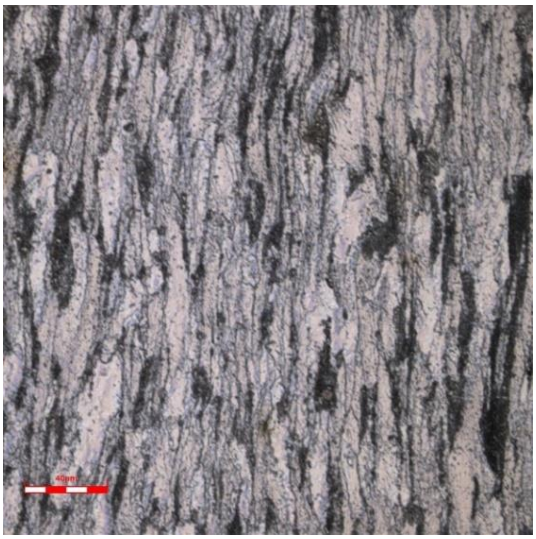
Titik lokasi pengamatan mikro struktur material raw bagian A-tengah



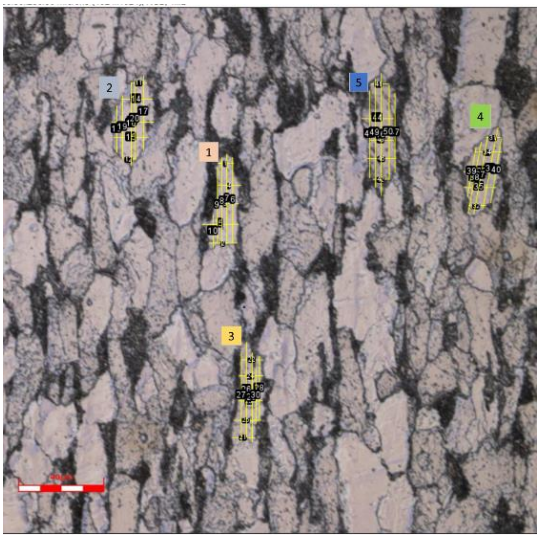
Titik lokasi pengamatan mikro struktur material raw bagian A-bawah



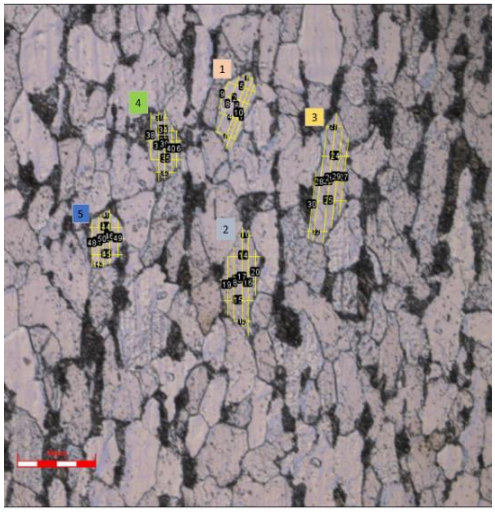
Titik lokasi pengamatan mikro struktur material raw bagian B



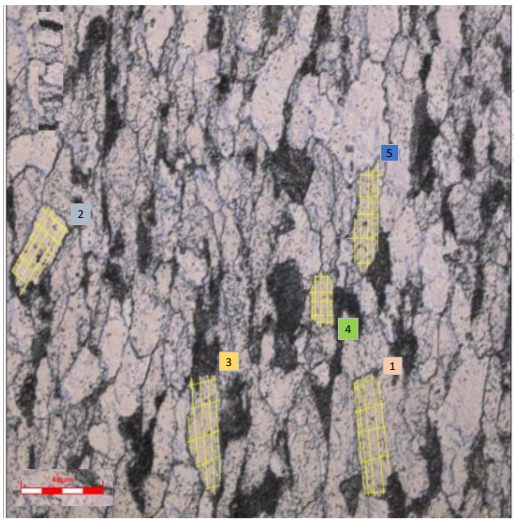
Struktur mikro material raw bagian A-a setelah mengalami creep



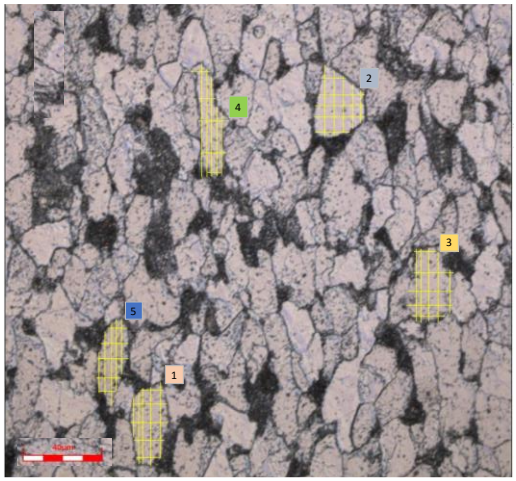
Struktur mikro material raw bagian A-b setelah mengalami creep



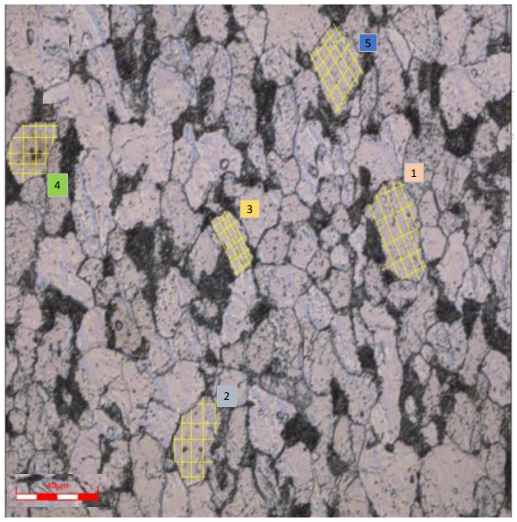
Struktur mikro material raw bagian A-c setelah mengalami *creep*



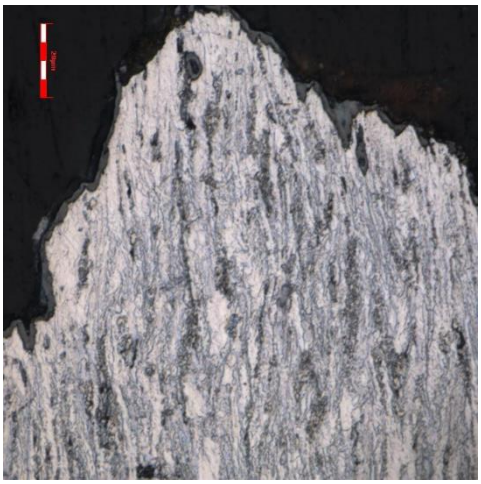
Struktur mikro material raw bagian B-a setelah mengalami *creep*



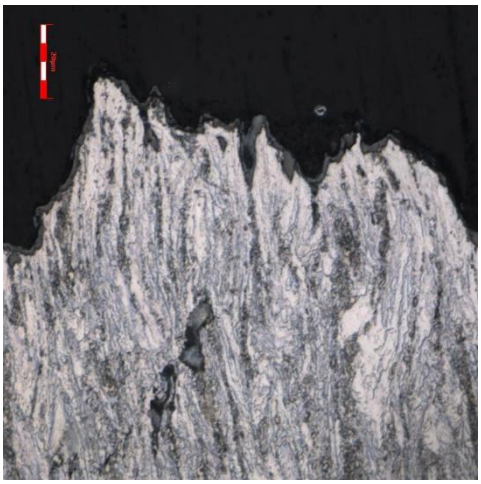
Struktur mikro material raw bagian B-b setelah mengalami *creep*



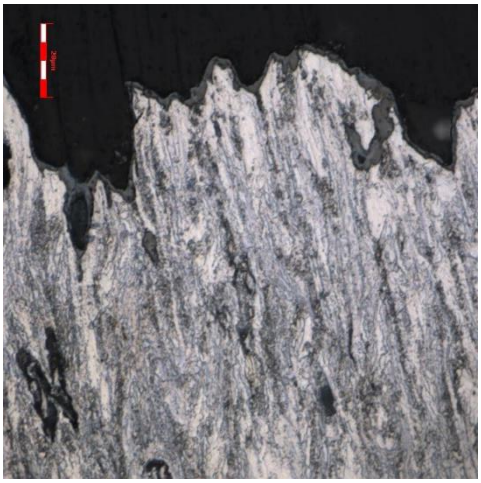
Struktur mikro material raw bagian B-c setelah mengalami *creep*



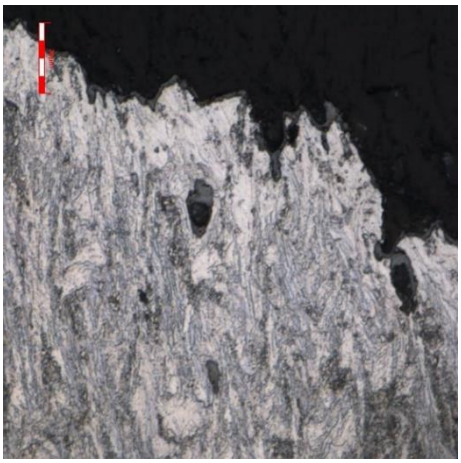
Struktur mikro jenis patahan yang terjadi pada material raw setelah pengujian tensile bagian A-1



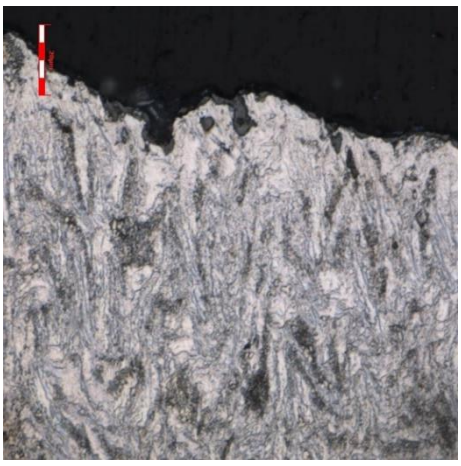
Struktur mikro jenis patahan yang terjadi bagian A-2 material raw setelah pengujian tensile



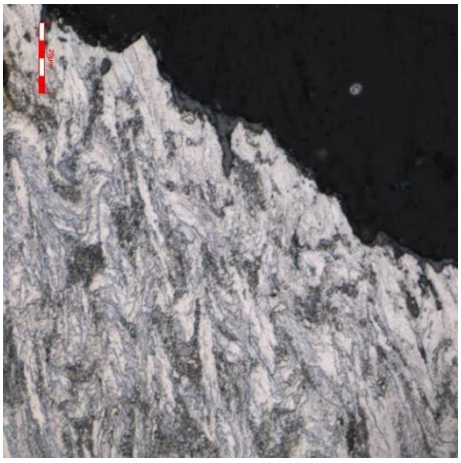
Struktur mikro jenis patahan yang terjadi bagian A-3 material raw setelah pengujian tensile



Struktur mikro jenis patahan yang terjadi bagian B-1 material raw setelah pengujian tensile

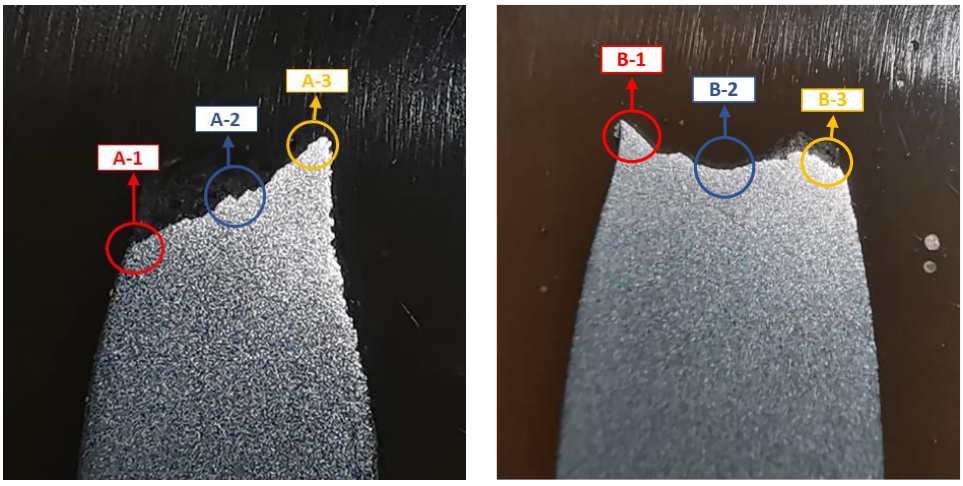


Struktur mikro jenis patahan yang terjadi bagian B-2 material raw setelah pengujian tensile



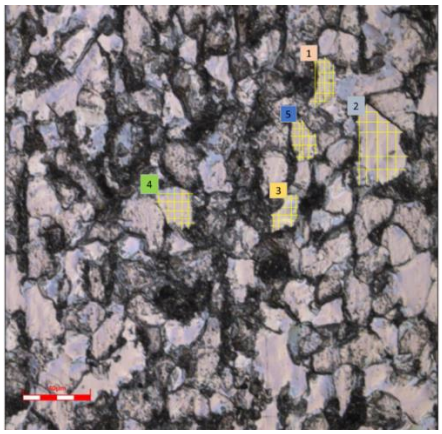
Struktur mikro jenis patahan yang terjadi bagian B-3 material raw setelah setelah pengujian tensile

Lampiran A.2 Titik Lokasi Pengamatan Struktur Mikro dan Pengukuran Grain Rasio Spesimen 4 mm

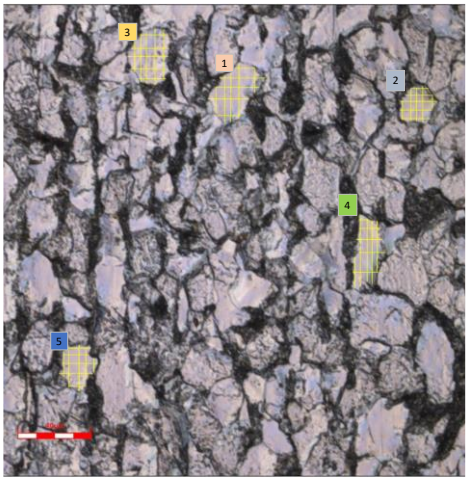


(A) (B)

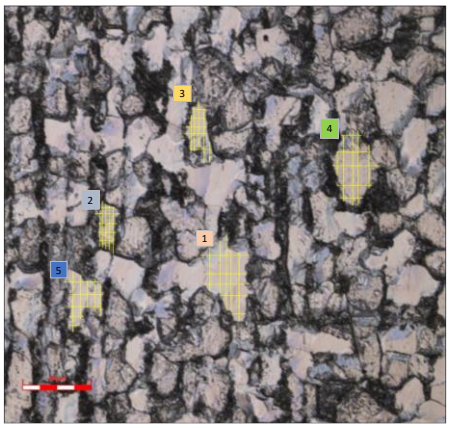
Bentuk patahan dan titik pengamatan struktur mikro pada spesimen 4 mm, (A) merupakan bagian tebal axial, (B) bagian sisi diameter luar dari *superheater* tube



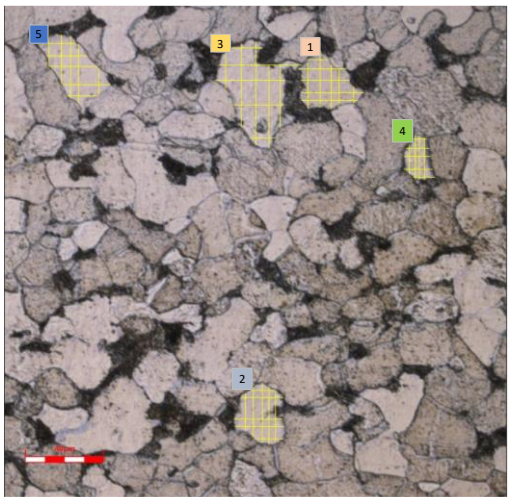
Struktur mikro spesimen 1 bagian A-atas setelah mengalami *creep displacement* 4mm



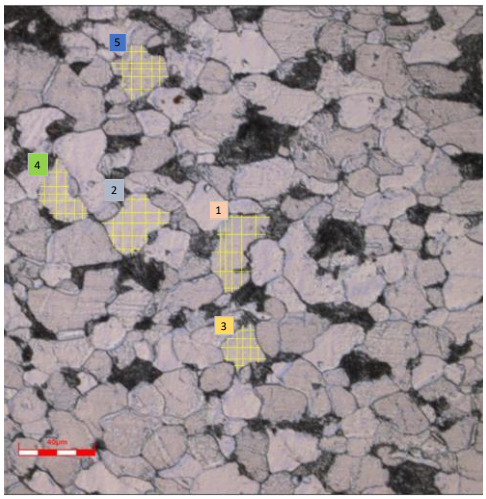
Struktur mikro spesimen 1 bagian A-tengah setelah mengalami *creep displacement* 4mm



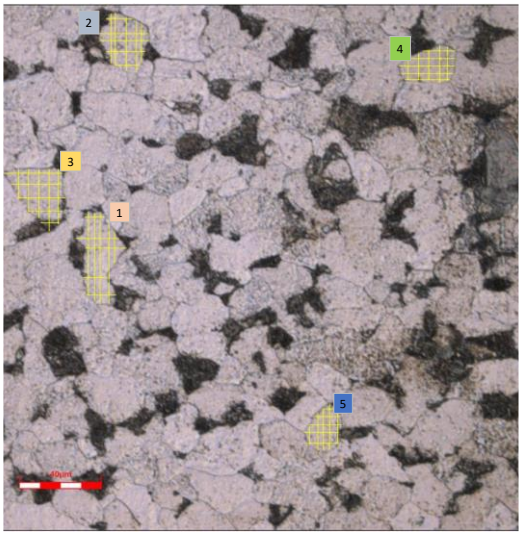
Struktur mikro spesimen 1 bagian A-bawah setelah mengalami *creep displacement* 4mm



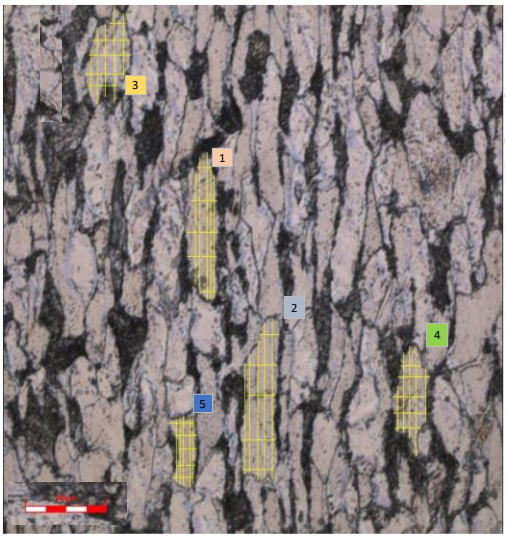
Struktur mikro spesimen 1 bagian B1 setelah mengalami *creep displacement* 4mm



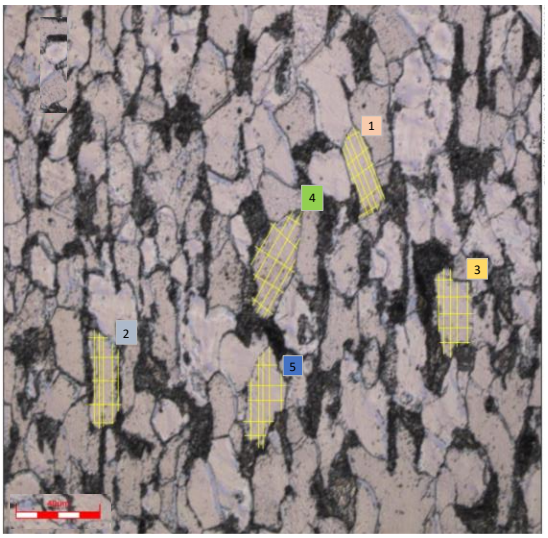
Struktur mikro spesimen 1 bagian B2 setelah mengalami *creep displacement* 4mm



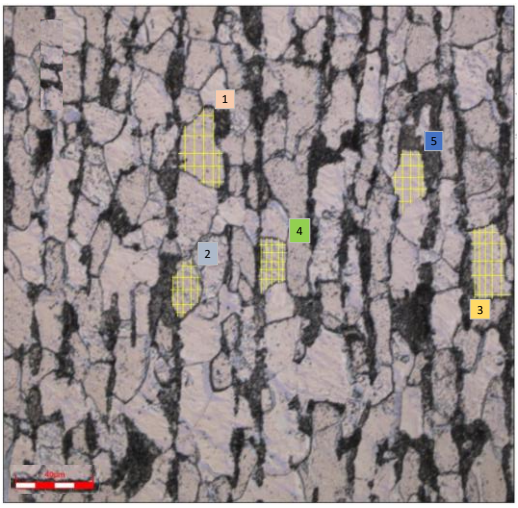
Struktur mikro spesimen 1 bagian B3 setelah mengalami *creep displacement* 4mm



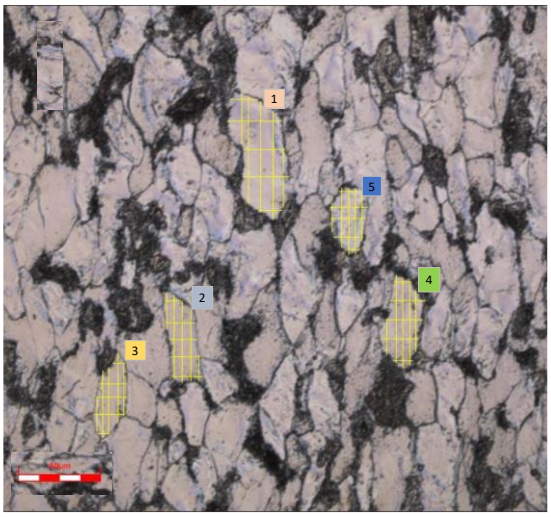
Struktur mikro spesimen 1 bagian A-a setelah setelah pengujian tensile



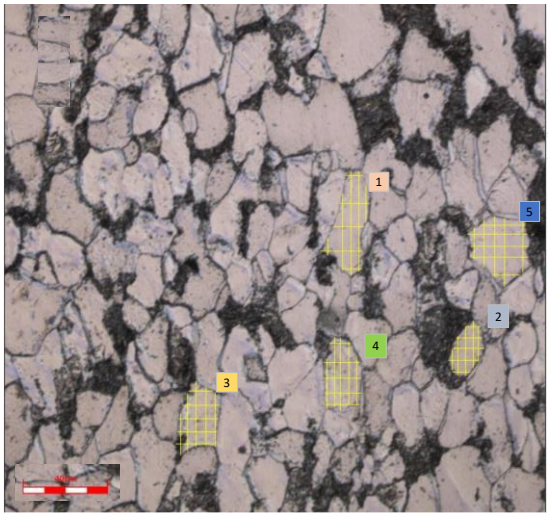
Struktur mikro spesimen 1 bagian A-b setelah pengujian tensile



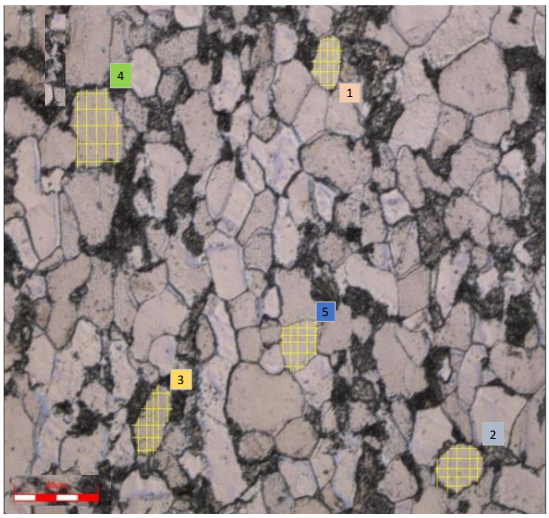
Struktur mikro spesimen 1 bagian A-c setelah setelah pengujian tensile



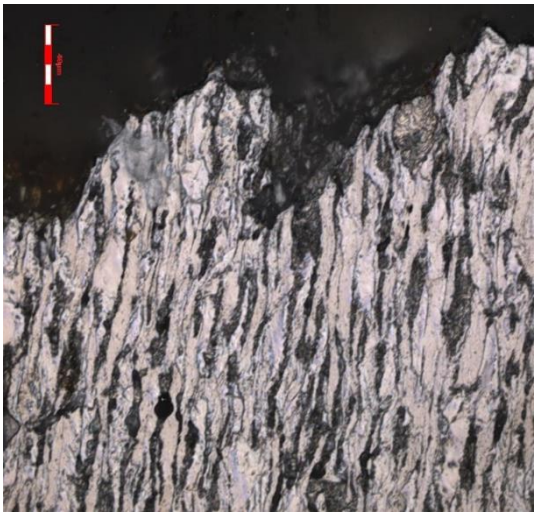
Struktur mikro spesimen 1 bagian B-a setelah setelah pengujian tensile



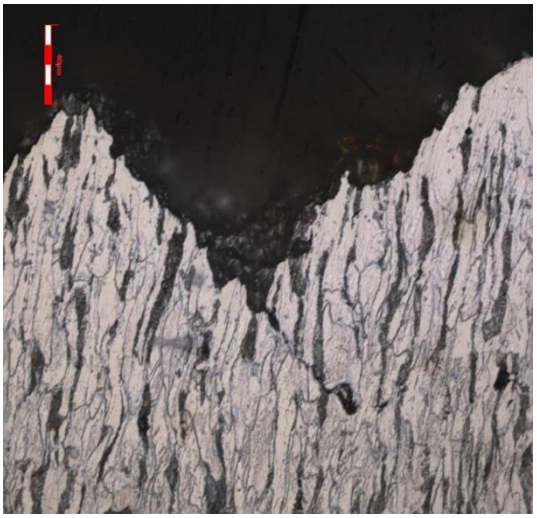
Struktur mikro spesimen 1 bagian B-b setelah pengujian tensile



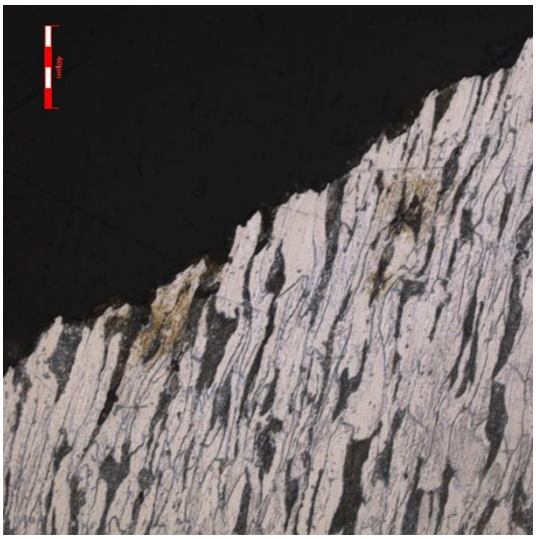
Struktur mikro spesimen 1 bagian B-c setelah setelah pengujian tensile



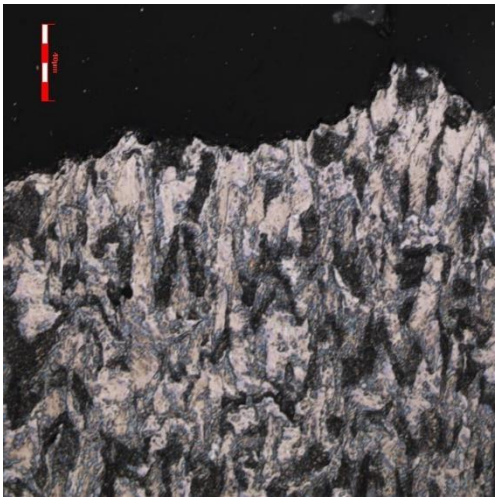
Struktur mikro spesimen 4 mm bagian A-1 setelah setelah pengujian tensile



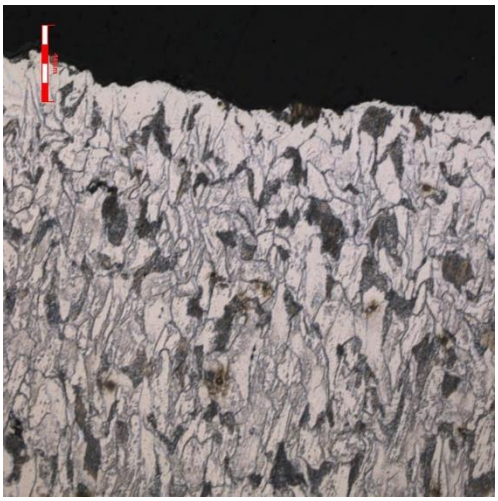
Struktur mikro spesimen 4 mm bagian A-2 setelah pengujian tensile



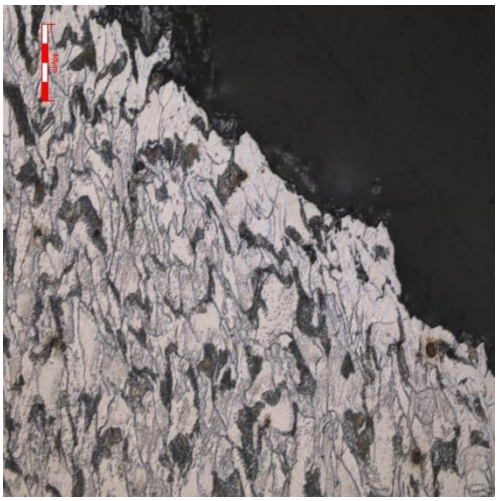
Struktur mikro spesimen 4 mm bagian A-3 setelah setelah pengujian tensile



Struktur mikro bentuk patahan spesimen 4 mm bagian B-1 setelah setelah pengujian tensile

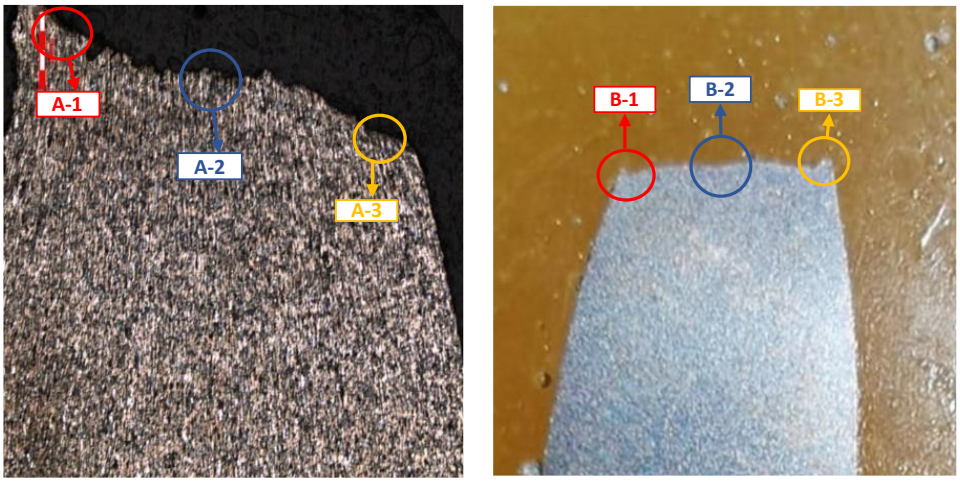


Struktur mikro bentuk patahan spesimen 4 mm bagian B-2 setelah pengujian tensile



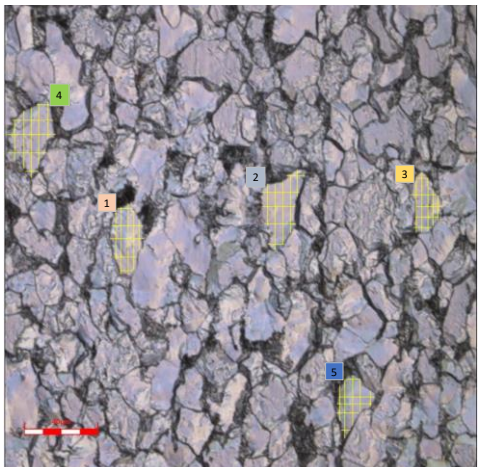
Struktur mikro bentuk patahan spesimen 4 mm bagian B-3 setelah setelah pengujian tensile

Lampiran A.3 Titik Lokasi Pengamatan Struktur Mikro dan Pengukuran Grain Rasio Spesimen 6 mm

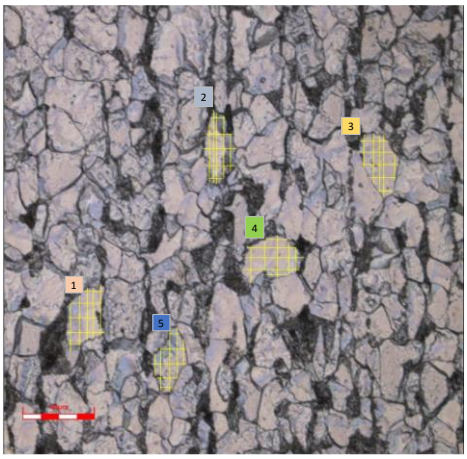


(A) (B)

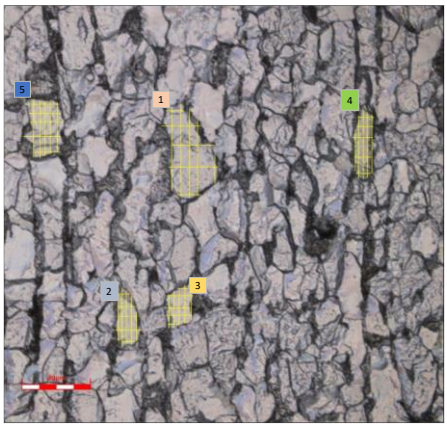
Bentuk patahan dan titik pengamatan struktur mikro pada spesimen 6 mm, (A) merupakan bagian tebal axial, (B) bagian sisi diameter luar dari *superheater* tube



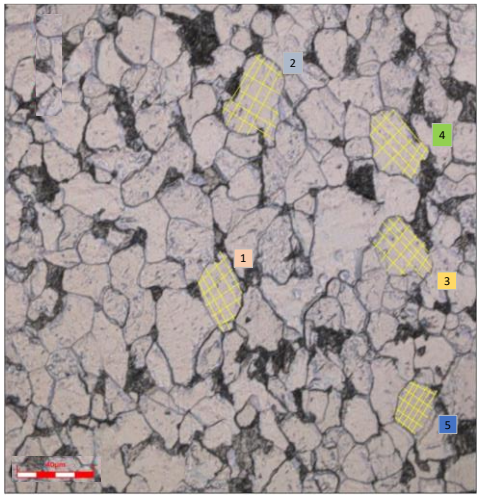
Struktur mikro spesimen 6 mm bagian A-atas setelah mengalami *creep*



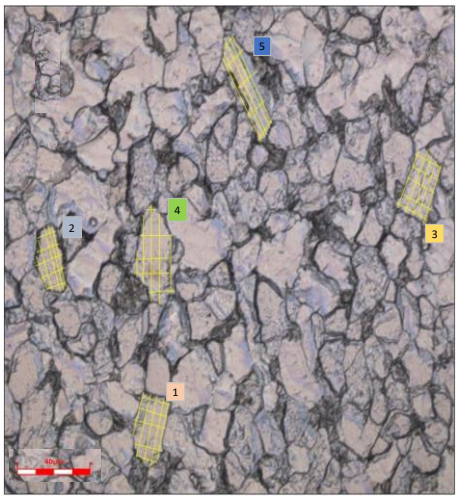
Struktur mikro spesimen 6 mm bagian A-tengah setelah mengalami *creep*



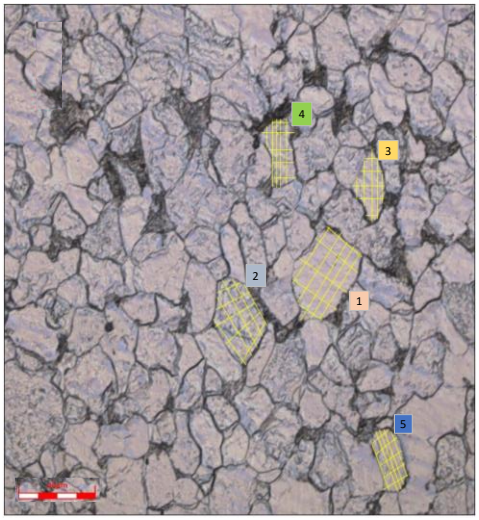
Struktur mikro spesimen 6 mm bagian A-bawah setelah mengalami *creep*



Struktur mikro spesimen 6 mm bagian B1 setelah mengalami

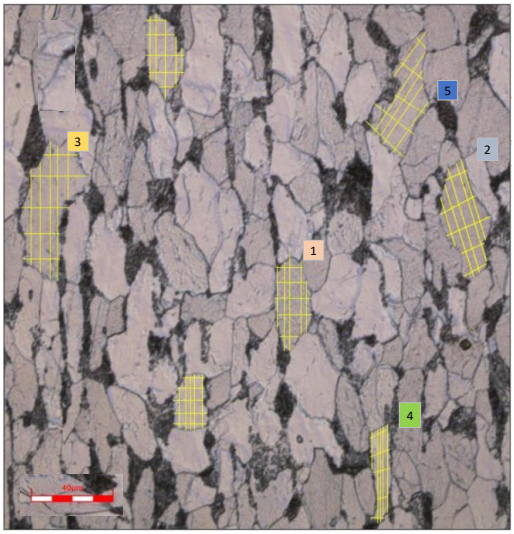


Struktur mikro spesimen 6 mm bagian B2 setelah mengalami

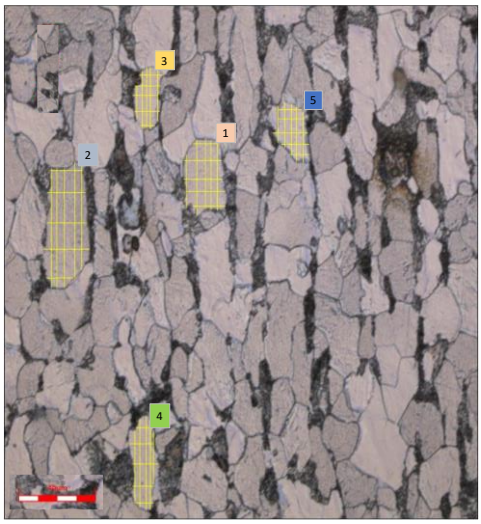


Struktur mikro spesimen 6 mm bagian B3 setelah mengalami

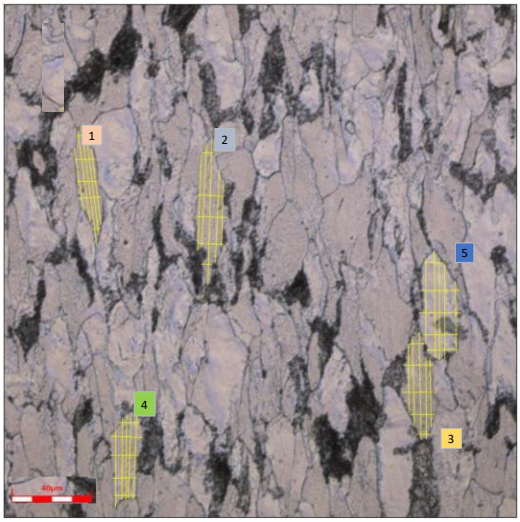
Struktur mikro spesimen 6 mm bagian A-a setelah setelah pengujian tensile



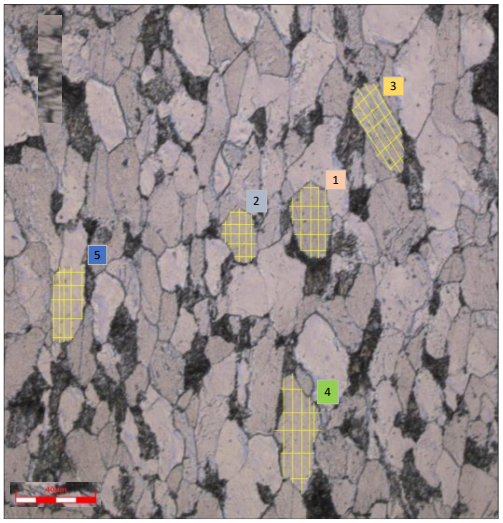
Struktur mikro spesimen 6 mm bagian A-b setelah pengujian tensile



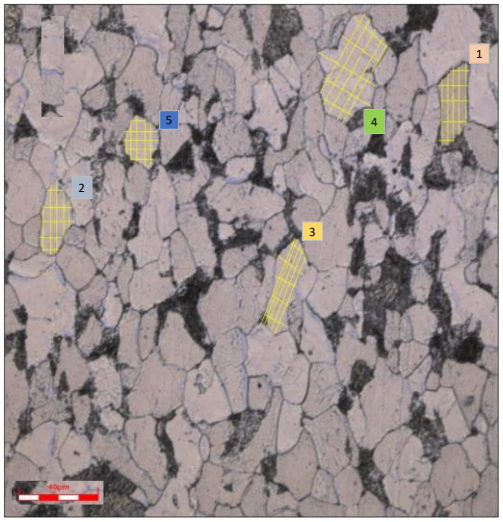
Struktur mikro spesimen 6 mm bagian A-c setelah setelah pengujian tensile



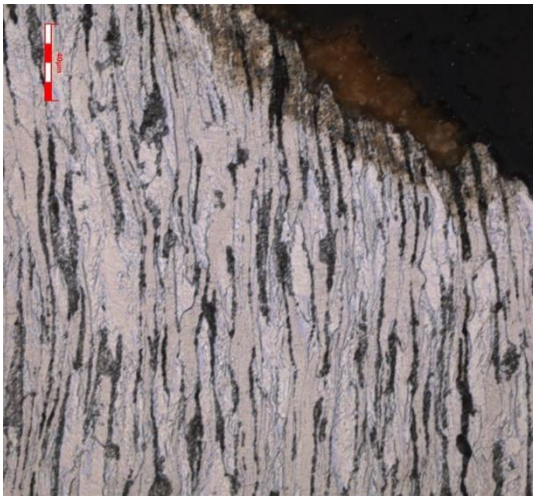
Struktur mikro spesimen 6 mm bagian B-a setelah setelah pengujian tensile



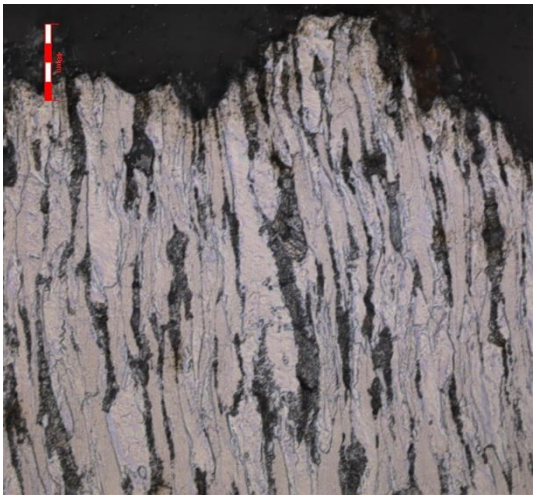
Struktur mikro spesimen 6 mm bagian B-b setelah pengujian tensile



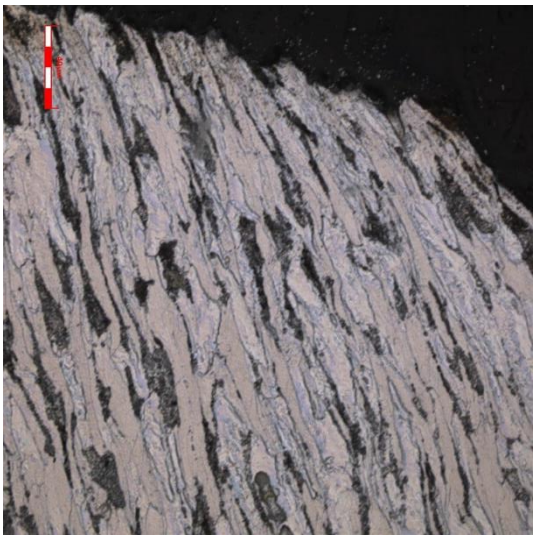
Struktur mikro spesimen 6 mm bagian B-c setelah setelah pengujian tensile



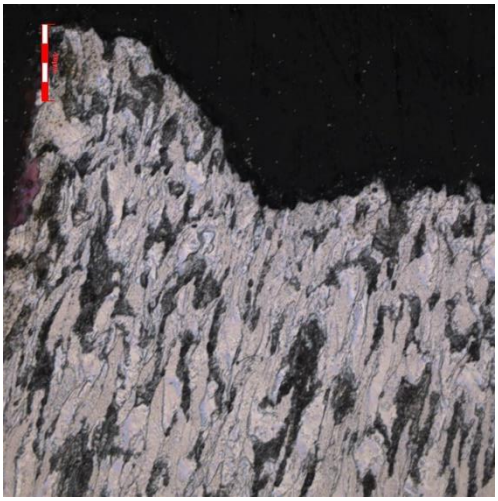
Struktur mikro spesimen 6 mm bagian A-1 setelah setelah pengujian tensile



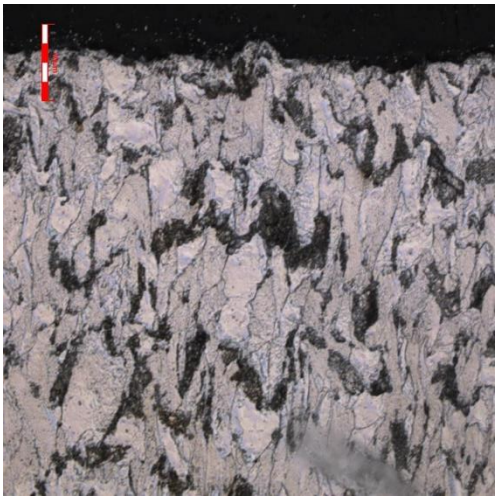
Struktur mikro spesimen 6 mm bagian A-2 setelah pengujian tensile



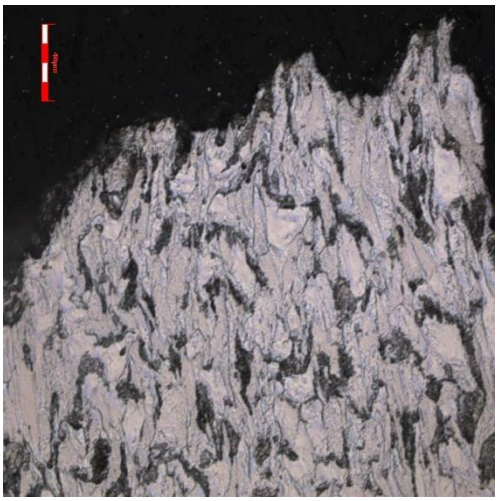
Struktur mikro spesimen 6 mm bagian A-3 setelah setelah pengujian tensile



Struktur mikro bentuk patahan spesimen 6 mm bagian B-1 setelah setelah pengujian tensile

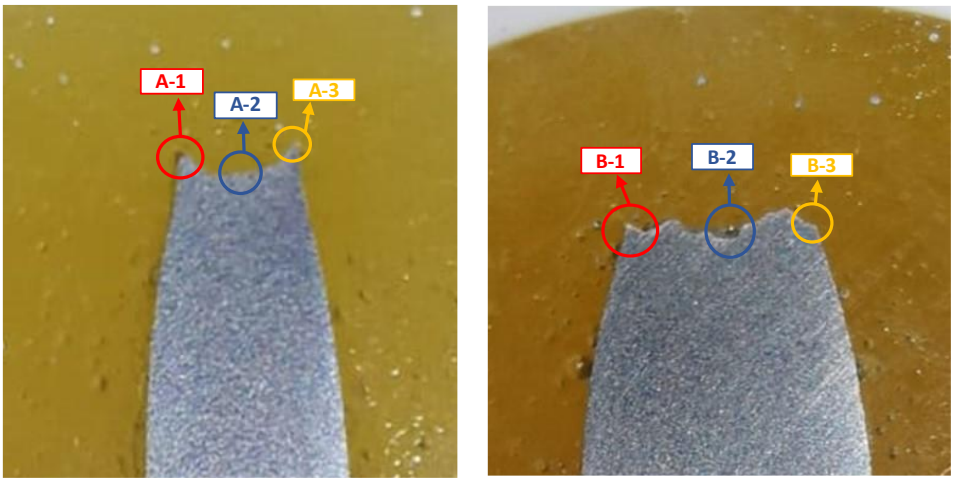


Struktur mikro bentuk patahan spesimen 6 mm bagian B-2 setelah pengujian tensile



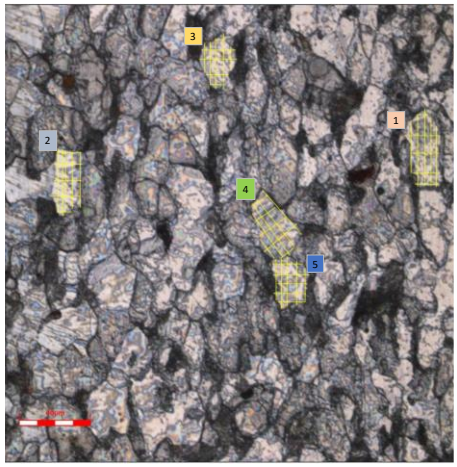
Struktur mikro bentuk patahan spesimen 6 mm bagian B-3 setelah setelah pengujian tensile

Lampiran A.4 Titik Lokasi Pengamatan Struktur Mikro dan Pengukuran Grain Rasio Spesimen 8 mm

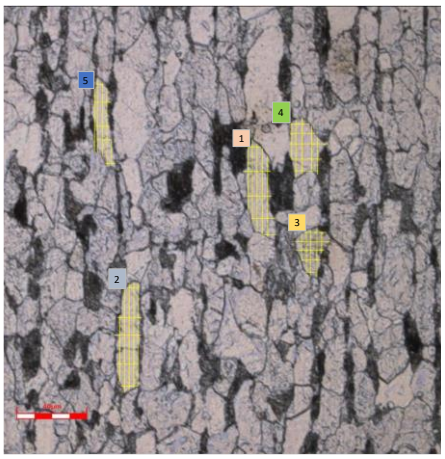


(A) (B)

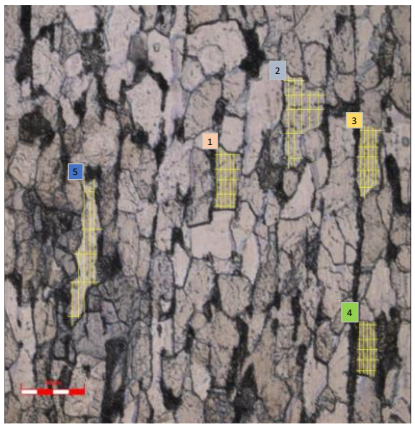
Bentuk patahan dan titik pengamatan struktur mikro pada spesimen 8 mm, (A) merupakan bagian tebal axial, (B) bagian sisi diameter luar dari *superheater* tube



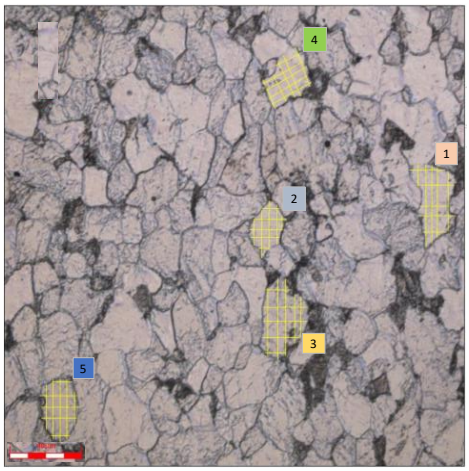
Struktur mikro spesimen 3 bagian A-atas setelah mengalami *creep displacement* 8 mm



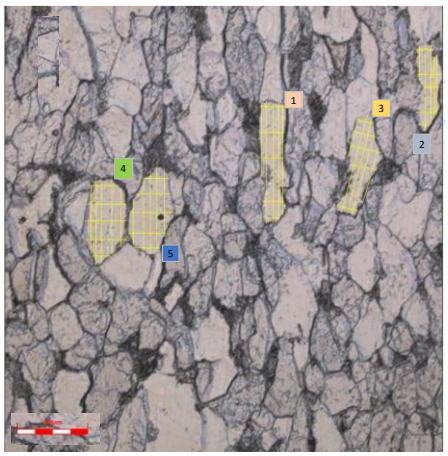
Struktur mikro spesimen 3 bagian A-tengah setelah mengalami *creep displacement* 8 mm



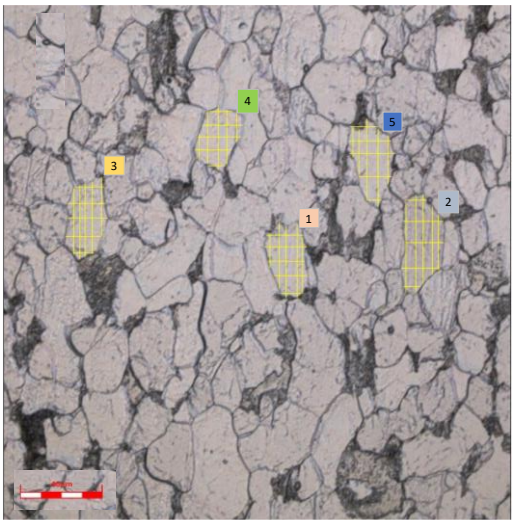
Struktur mikro spesimen 3 bagian A-bawah setelah mengalami *creep displacement* 8 mm



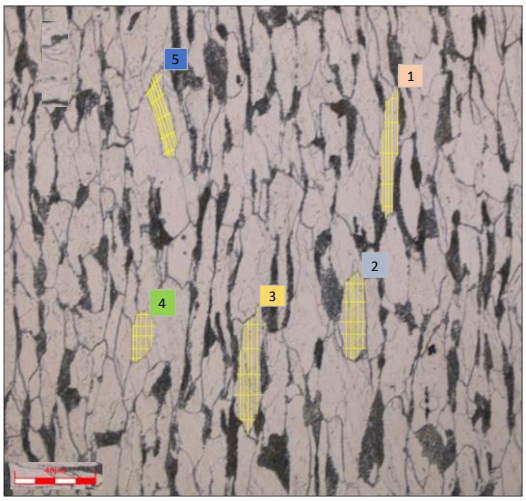
Struktur mikro spesimen 8 mm bagian B1 setelah mengalami *creep*



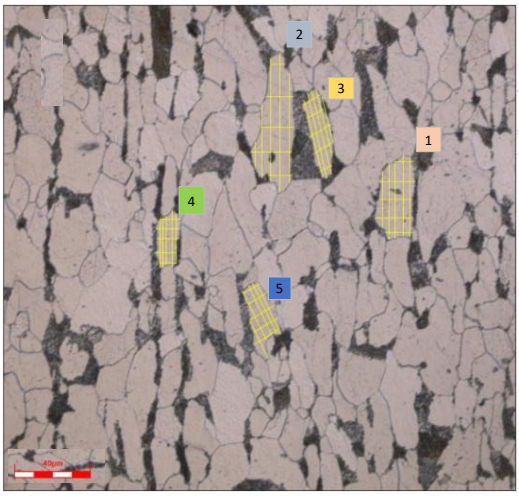
Struktur mikro spesimen 8 mm bagian B2 setelah mengalami *creep*



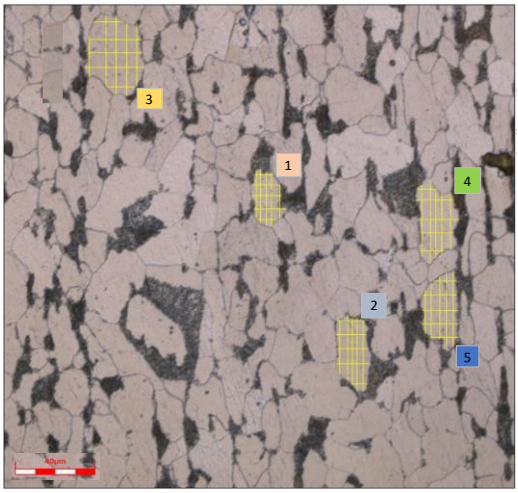
Struktur mikro spesimen 8 mm bagian B3 setelah mengalami *creep*



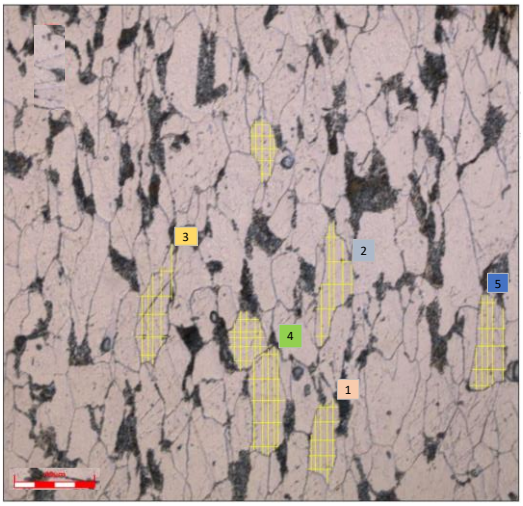
Struktur mikro spesimen 8 mm bagian A-a setelah setelah pengujian tensile



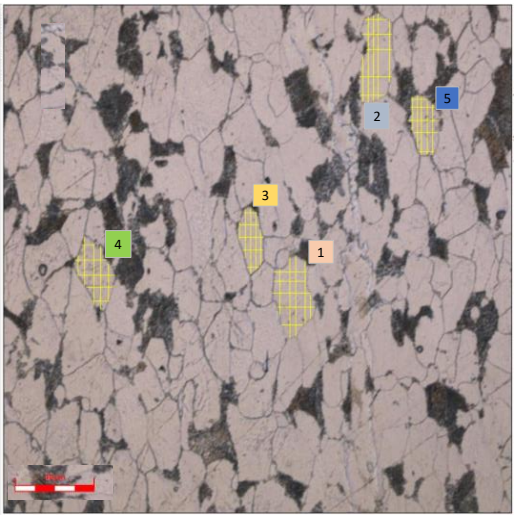
Struktur mikro spesimen 8 mm bagian A-b setelah pengujian tensile



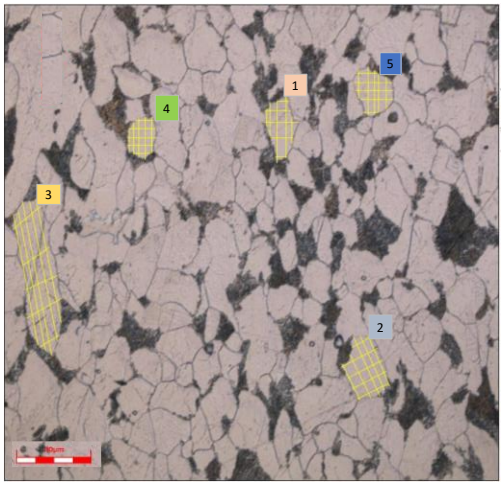
Struktur mikro spesimen 8 mm bagian A-c setelah setelah pengujian tensile



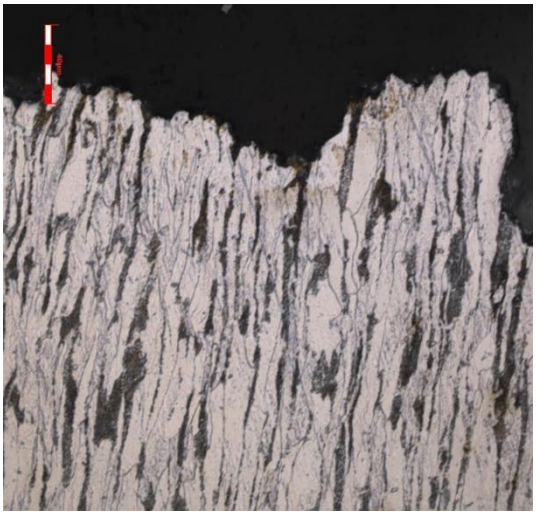
Struktur mikro spesimen 8 mm bagian B-a setelah setelah pengujian tensile



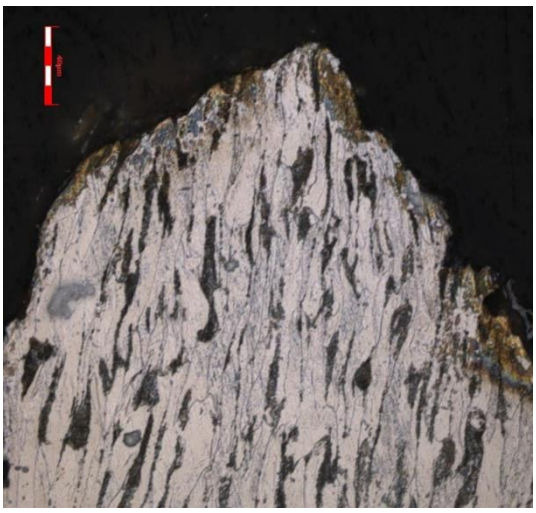
Struktur mikro spesimen 8 mm bagian B-b setelah pengujian tensile



Struktur mikro spesimen 8 mm bagian B-c setelah setelah pengujian tensile

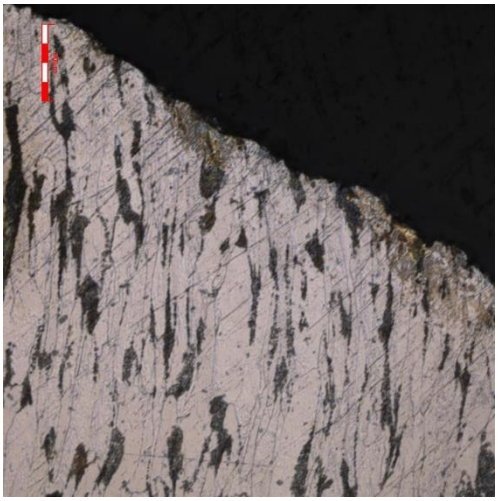


Struktur mikro spesimen 8 mm bagian A-1 setelah setelah pengujian tensile

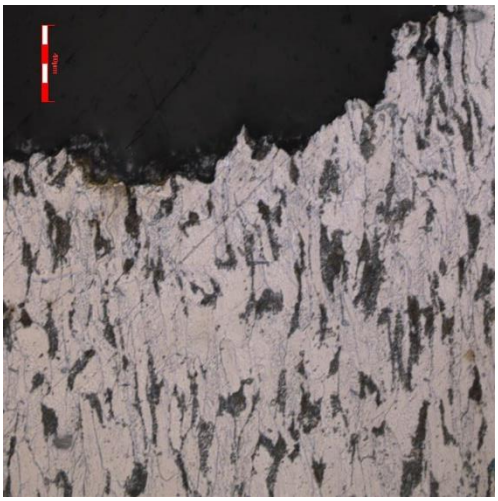


Struktur mikro spesimen 8 mm bagian A-2 setelah pengujian tensile

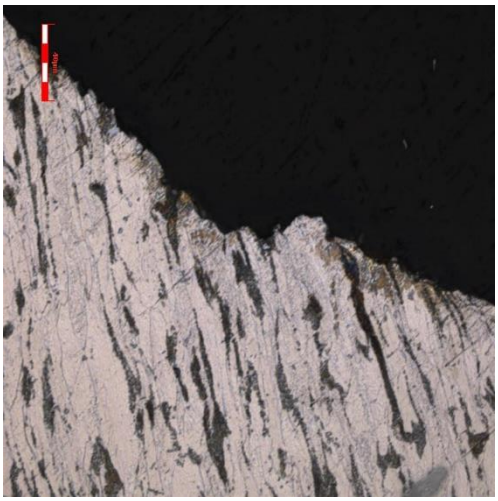
Struktur mikro spesimen 8 mm bagian A-3 setelah setelah pengujian tensile



Struktur mikro bentuk patahan spesimen 8 mm bagian B-1 setelah setelah pengujian tensile



Struktur mikro bentuk patahan spesimen 8 mm bagian B-2 setelah pengujian tensile



Struktur mikro bentuk patahan spesimen 8 mm bagian B-3 setelah setelah pengujian tensile

Lampiran B Data Pengujian *Grain Ratio*

Lampiran B.1 Data Pengukuran Grain Ratio Spesimen Raw

***Section* A-atas**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	9,389	21,165	0,443
2	12,413	21,636	0,573
3	20,120	23,090	0,871
4	13,986	18,814	0,743
5	10,974	20,608	0,532
Grain Ratio Average			0,664

Section A-tengah			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	18,257	24,778	0,737
2	10,633	23,323	0,456
3	18,488	29,970	0,617
4	15,823	21,360	0,741
5	17,154	29,342	0,585
Grain Ratio Average			0,684

***Section* A-Bawah**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	11,994	18,960	0,633
2	14,940	19,135	0,781
3	8,860	22,805	0,389
4	12,358	26,826	0,461
5	14,970	22,556	0,664
Grain Ratio Average			0,585

***Section* B1**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	14,545	18,909	0,769
2	17,990	19,686	0,914
3	20,965	21,542	0,973
4	17,354	28,662	0,605
5	16,392	26,065	0,629
Grain Ratio Average			0,843

***Section* B2**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	22.721	26.433	0,859
2	16.802	20.865	0,805
3	20.514	18.608	1,102
4	29.091	32.351	0,899
5	25.379	15.147	1,675
Grain Ratio Average			1,068

Section B3			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	20,336	17,247	1,179
2	17,990	16,772	1,073
3	20,965	17,542	1,195
4	17,354	18,662	0,930
5	20,344	16,690	1,219
Grain Ratio Average			1,125

Lampiran B.2 Data Pengukuran Grain Ratio Spesimen 4 mm

***Section* A-atas**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	10,8012	25,3734	0,425
2	22,467	39,3744	0,570
3	11,3134	14,564	0,776
4	17,2598	19,498	0,885
5	11,5402	19,0866	0,604
Grain Ratio Average			0,652

Section A-tengah			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	18,671	22,240	0,839
2	15,505	14,547	1,066
3	18,393	26,054	0,706
4	11,641	30,623	0,380
5	14,917	16,983	0,878
Grain Ratio Average			0,773

***Section* A-Bawah**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	20,543	37,401	0,549
2	10,498	27,129	0,387
3	10,852	24,883	0,436
4	18,473	34,776	0,531
5	14,940	24,227	0,617
Grain Ratio Average			0,504

***Section* B1**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	24,202	20,467	1,182
2	19,583	26,461	0,740
3	26,574	37,796	0,703
4	11,540	18,543	0,622
5	21,232	23,243	0,913
Grain Ratio Average			0,832

***Section* B2**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	18,214	31,547	0,577
2	21,585	21,786	0,991
3	14,373	16,889	0,851
4	16,805	19,069	0,881
5	21,585	21,032	1,026
Grain Ratio Average			0,865

Section B3			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	15,275	36,794	0,415
2	18,469	24,131	0,765
3	20,508	23,372	0,877
4	22,875	14,888	1,536
5	13,498	17,390	0,776
Grain Ratio Average			0,874

***Section* A-a**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	12,050	62,012	0,194
2	15,094	65,207	0,231
3	17,409	34,088	0,511
4	14,742	36,176	0,408
5	10,516	31,966	0,329
Grain Ratio Average			0,335

Section A-b			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	11,636	36,558	0,318
2	11,943	40,542	0,295
3	14,539	34,318	0,424
4	15,756	37,011	0,426
5	14,211	35,024	0,406
Grain Ratio Average			0,373

***Section* A-c**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	16,151	30,390	0,531
2	10,792	21,635	0,499
3	16,755	36,277	0,462
4	12,780	24,478	0,522
5	12,226	22,792	0,536
Grain Ratio Average			0,510

***Section* B-a**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	17,799	44,377	0,401
2	12,293	30,692	0,401
3	10,398	29,585	0,351
4	13,468	36,344	0,371
5	13,107	27,434	0,478
Grain Ratio Average			0,400

***Section* B-b**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	13,283	33,258	0,399
2	11,270	18,818	0,599
3	16,855	27,270	0,618
4	15,396	30,088	0,512
5	23,396	25,593	0,914
Grain Ratio Average			0,608

Section B-c			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	10,843	20,174	0,537
2	17,449	18,746	0,931
3	12,800	24,592	0,520
4	20,645	35,544	0,581
5	15,622	19,653	0,795
Grain Ratio Average			0,673

Lampiran B.3 Data Pengukuran Grain Ratio Spesimen 6 mm

***Section* A-atas**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	12,632	30,303	0,417
2	14,589	28,069	0,520
3	11,523	25,121	0,459
4	16,579	29,010	0,572
5	12,473	20,662	0,604
Grain Ratio Average			0,514

Section A-tengah			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	14,370	28,790	0,499
2	12,794	34,349	0,372
3	15,639	25,773	0,607
4	23,093	18,554	1,245
5	11,470	23,244	0,493
Grain Ratio Average			0,643

***Section* A-Bawah**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	20,076	46,132	0,435
2	10,549	29,451	0,358
3	11,659	21,224	0,549
4	9,590	36,593	0,262
5	19,129	33,817	0,566
Grain Ratio Average			0,434

***Section* B1**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	19,162	29,844	0,642
2	25,834	35,191	0,734
3	20,525	31,559	0,650
4	21,219	34,030	0,624
5	17,083	24,167	0,707
Grain Ratio Average			0,671

***Section* B2**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	16,008	32,579	0,491
2	13,213	29,924	0,442
3	17,820	33,343	0,534
4	15,829	36,170	0,438
5	12,188	52,228	0,233
Grain Ratio Average			0,427

Section B3			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	25,661	41,812	0,614
2	21,481	32,193	0,667
3	11,339	23,055	0,492
4	12,876	29,103	0,442
5	13,763	28,944	0,475
Grain Ratio Average			0,838

***Section* A-a**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	11,056	78,138	0,141
2	7,223	43,574	0,166
3	11,036	50,016	0,221
4	15,951	52,339	0,305
5	10,684	40,365	0,265
Grain Ratio Average			0,219

Section A-b			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	15,095	36,378	0,415
2	16,247	43,551	0,373
3	14,566	25,509	0,571
4	13,736	28,579	0,481
5	21,182	53,157	0,398
Grain Ratio Average			0,447

***Section* A-c**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	18,888	33,607	0,562
2	19,692	57,972	0,340
3	12,257	26,625	0,460
4	11,102	39,686	0,280
5	14,267	23,761	0,600
Grain Ratio Average			0,448

***Section* B-a**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	8,211	45,634	0,180
2	10,107	50,583	0,200
3	11,151	41,156	0,271
4	12,655	41,361	0,306
5	16,253	45,902	0,354
Grain Ratio Average			0,262

***Section* B-b**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	16,050	30,122	0,533
2	14,004	21,082	0,664
3	16,152	39,069	0,413
4	16,075	43,446	0,370
5	14,625	34,466	0,424
Grain Ratio Average			0,481

Section B-c			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	12,182	34,361	0,355
2	12,006	26,022	0,461
3	12,572	44,392	0,283
4	25,804	47,726	0,541
5	14,116	19,843	0,711
Grain Ratio Average			0,470

Lampiran B.4 Data Pengukuran Grain Ratio Spesimen 8 mm

***Section* A-atas**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	13,994	37,016	0,378
2	13,693	34,006	0,403
3	12,865	22,771	0,565
4	15,419	29,188	0,528
5	17,405	24,501	0,710
Grain Ratio Average			0,516

Section A-tengah			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	11,641	46,151	0,252
2	11,767	55,710	0,211
3	12,951	21,258	0,609
4	15,546	26,583	0,585
5	7,156	35,880	0,199
Grain Ratio Average			0,371

***Section* A-Bawah**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	14,312	34,718	0,412
2	16,739	37,846	0,442
3	12,674	39,144	0,324
4	12,464	32,034	0,389
5	12,170	55,433	0,220
Grain Ratio Average			0,357

***Section* B1**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	17,783	35,064	0,507
2	13,564	19,692	0,689
3	19,257	34,780	0,554
4	20,889	23,634	0,884
5	16,528	29,070	0,569
Grain Ratio Average			0,640

***Section* B2**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	12,835	61,564	0,208
2	10,650	36,144	0,295
3	14,019	43,135	0,325
4	19,290	41,896	0,460
5	19,391	39,385	0,492
Grain Ratio Average			0,356

Section B3			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	17,006	29,585	0,575
2	15,245	38,818	0,393
3	16,327	33,560	0,486
4	16,034	22,004	0,729
5	16,453	27,874	0,590
Grain Ratio Average			0,554

***Section* A-a**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	6,440	52,679	0,122
2	11,572	42,113	0,275
3	10,767	52,855	0,204
4	9,081	38,466	0,236
5	6,289	77,339	0,081
Grain Ratio Average			0,183

Section A-b			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	14,819	39,158	0,378
2	13,915	49,884	0,279
3	9,931	38,752	0,256
4	10,399	26,926	0,386
5	12,939	27,814	0,465
Grain Ratio Average			0,353

***Section* A-c**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	12,880	25,845	0,498
2	13,711	34,968	0,392
3	22,516	34,264	0,657
4	15,472	36,377	0,425
5	15,472	33,333	0,464
Grain Ratio Average			0,487

***Section* B-a**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	12,245	32,252	0,380
2	10,482	36,031	0,291
3	12,170	38,375	0,317
4	14,110	51,956	0,272
5	12,724	40,290	0,316
Grain Ratio Average			0,315

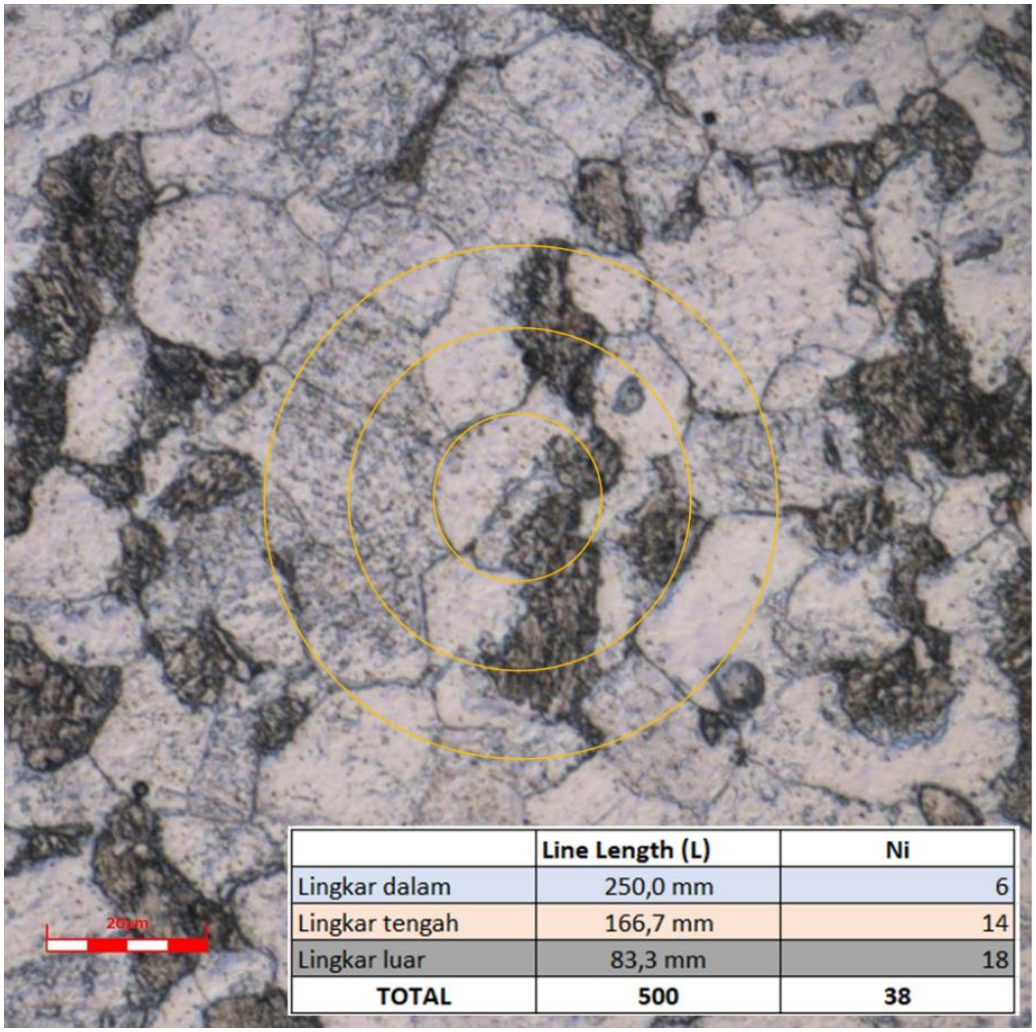
***Section* B-b**			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	16,387	29,697	0,552
2	13,639	36,882	0,370
3	8,975	22,815	0,393
4	12,403	22,941	0,541
5	11,118	25,361	0,438
Grain Ratio Average			0,458

Section B-c			
Grain	*Horizontal line Average*	*Vertical line Average*	*Ratio*
1	10,918	22,088	0,494
2	18,272	28,656	0,638
3	17,592	75,828	0,232
4	11,698	18,667	0,627
5	14,826	20,596	0,720
Grain Ratio Average			0,542

Lampiran C Data Pengukuran Besar Butir Rata-Rata

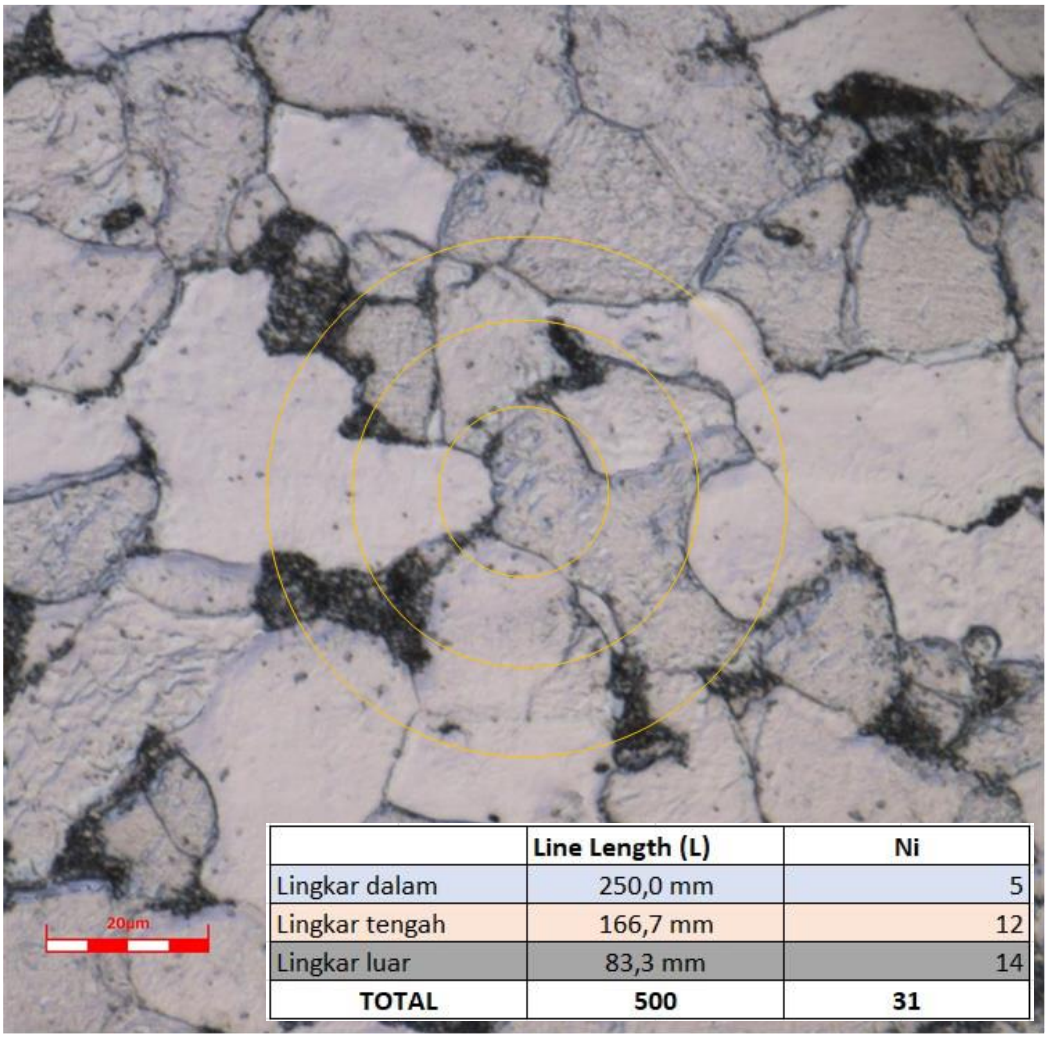
Lampiran C.1 Data perhitungan ASTM grain size Spesimen raw

N_i	L	M	$\bar{N}_L = \frac{N_i}{L/M}$	$\bar{\ell} = \frac{1}{\bar{N}_L}$	$G = (-6,643856 \log_{10} \bar{\ell}) - 3,288$
38	500	100	7,600	0,13158	2,564



Lampiran C.2 Data perhitungan ASTM grain size Spesimen 4 mm

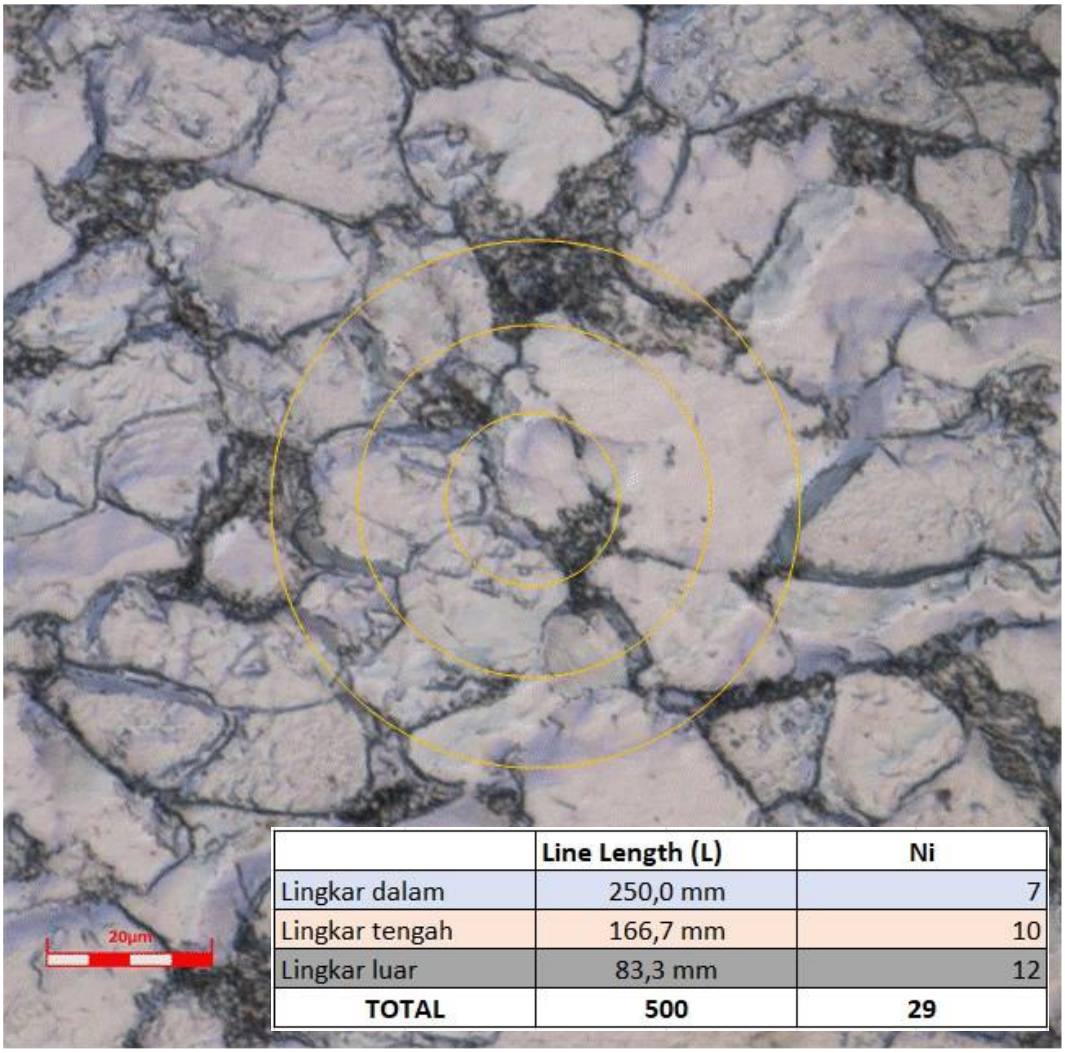
N_i	L	M	$\bar{N}_L = \frac{N_i}{L/M}$	$\bar{\ell} = \frac{1}{\bar{N}_L}$	$G = (-6,643856 \log_{10} \bar{\ell}) - 3,288$
31	500	100	6,200	0,16129	1,977



	Line Length (L)	Ni
Lingkar dalam	250,0 mm	5
Lingkar tengah	166,7 mm	12
Lingkar luar	83,3 mm	14
TOTAL	**500**	**31**

Lampiran C.3 Data perhitungan ASTM grain size Spesimen 6 mm

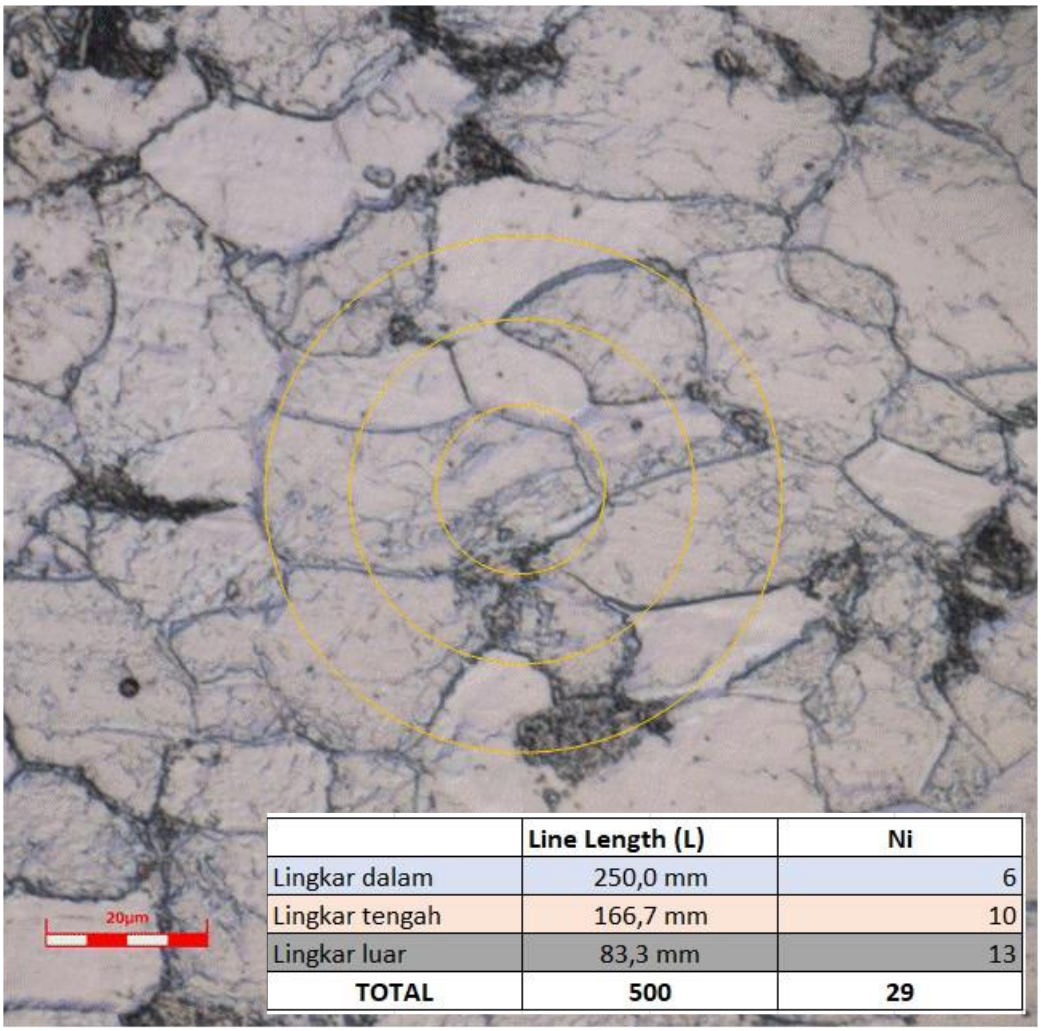
N_i	L	M	$\bar{N}_L = \frac{N_i}{L/M}$	$\bar{\ell} = \frac{1}{\bar{N}_L}$	$G = (-6,643856 \log_{10} \bar{\ell}) - 3,288$
29	500	100	5,800	0,17241	1,784



	Line Length (L)	Ni
Lingkar dalam	250,0 mm	7
Lingkar tengah	166,7 mm	10
Lingkar luar	83,3 mm	12
TOTAL	**500**	**29**

Lampiran C.4 Data perhitungan ASTM grain size Spesimen 8 mm

N_i	L	M	$\bar{N}_L = \frac{N_i}{L/M}$	$\bar{\ell} = \frac{1}{\bar{N}_L}$	$G = (-6,643856 \log_{10} \bar{\ell}) - 3,288$
29	500	100	5,800	0,17241	1,784



	Line Length (L)	Ni
Lingkar dalam	250,0 mm	6
Lingkar tengah	166,7 mm	10
Lingkar luar	83,3 mm	13
TOTAL	**500**	**29**

Lampiran D Data Pengujian Kekerasan

Lampiran D.1 Data pengujian kekerasan Spesimen raw

	B1			Average	B2			Average	B3			Average	**Total Average**
HV	156,4	154,2	158	156,2	158,9	151,2	159,4	156,5	153,4	158,1	156,6	156,0333333	**156,2**
HRB	81,8	81,1	82,3	81,733		80,1	82,7	81,4	80,8	82,3	81,9	81,667	**81,6**

Lampiran D.2 Data pengujian kekerasan Spesimen 4 mm

	B1			Average	B2			Average	B3			Average	**Total Average**
HV	114,7	115,4	116,6	115,6	122,0	119,6	116,9	119,5	114,0	112,5	110,1	112,2	**115,8**
HRB	63,8	64,2	64,9	64,3	68,0	66,4	65,0	66,5	63,3	62,3	61,4	62,3	**64,4**

Lampiran D.3 Data pengujian kekerasan Spesimen 6 mm

	B1			Average	B2			Average	B3			Average	**Total Average**
HV	117,2	112,4	114,4	114,7	120,2	122,6	119,0	120,6	115,5	117,0	114,4	115,6	**117,0**
HRB	65,2	62,2	63,2	63,5	66,7	68,3	66,0	67,0	64,3	65,1	63,5	64,3	**64,9**

Lampiran D. 4 Data pengujian kekerasan Spesimen 8 mm

	B1			Average	B2			Average	B3			Average	**Total Average**
HV	117,2	112,4	114,4	114,7	120,2	122,6	119,0	120,6	115,5	117,0	114,4	115,6	**117,0**
HRB	65,2	62,2	63,2	63,5	66,7	68,3	66,0	67,0	64,3	65,1	63,5	64,3	**64,9**

Lampiran E Dimensi Spesimen

Lampiran E.1 Dimensi spesimen 4 mm

SEBELUM CREEP

W1		W2		W3		W4		W5	
A	6,49	A	6,2	A	6,13	A	6,06	A	6,37
B	6,53	B	6,22	B	6,16	B	6,16	B	6,42
C	6,24	C	5,95	C	5,89	C	5,97	C	6,25
W ave	6,42		6,123333		6,06		6,063333		6,346667
T1		T2		T3		T4		T5	
A	4,65	A	4,67	A	4,72	A	4,71	A	4,7
B	4,63	B	4,62	B	4,71	B	4,68	B	4,68
T average	4,64		4,645		4,715		4,695		4,69

A1	A2	A3	A4	A5
29,7888	28,44288	28,5729	28,46735	29,76587

SETELAH CREEP

W1		W2		W3		W4		W5	
A		A		A		A		A	
B		B		B		B		B	
C		C		C		C		C	
W ave									
T1		T2		T3		T4		T5	
A		A		A		A		A	
B		B		B		B		B	
T average									

A1	A2	A3	A4	A5

SEBELUM TENSILE

W1		W2		W3		W4		W5	
W1		W2		W3		W4		W5	
A	6,3	A	5,88	A	5,78	A	5,79	A	6,09
B	6,4	B	5,86	B	5,81	B	5,86	B	6,13
C	6,01	C	5,55	C	5,7	C	5,73	C	5,97
T1		T2		T3		T4		T5	
A	4,19	A	4,09	A	3,9	A	4,07	A	4,25
B	4,18	B	4,01	B	3,91	B	3,94	B	4,19
T average	4,185		4,05		3,905		4,005		4,22

A1	A2	A3	A4	A5
25,82145	23,166	21,2432	22,04085	24,79953333

Lampiran E.2 Dimensi spesimen 6 mm

SEBELUM CREEP

W1		W2		W3		W4		W5	
A	6,34	A	6,08	A	5,92	A	5,9	A	6,04
B	6,41	B	6,21	B	6,04	B	6,05	B	6,14
C	6,4	C	6,24	C	6,05	C	6,03	C	6,09
W ave	6,383		6,177		6,003		5,993		6,090
T1		T2		T3		T4		T5	
A	4,35	A	4,38	A	4,38	A	4,41	A	5,54
B	4,34	B	4,39	B	4,38	B	4,43	B	4,51
T average	4,345		4,385		4,38		4,42		5,025

A1	A2	A3	A4	A5
27,735	27,084	26,294	26,490	30,602

SETELAH CREEP

W1		W2		W3		W4		W5	
A	6,07	A	5,64	A	5,37	A	5,44	A	5,79
B	6,22	B	5,72	B	5,45	B	5,5	B	5,94
C	6,22	C	5,8	C	5,5	C	5,57	C	5,9
W ave	6,170		5,720		5,440		5,503		5,877
T1		T2		T3		T4		T5	
A	4,19	A	4,09	A	3,9	A	4,07	A	4,25
B	4,18	B	4,01	B	3,91	B	3,94	B	4,19
T average	4,185		4,05		3,905		4,005		4,22

A1	A2	A3	A4	A5
25,821	23,166	21,243	22,040	24,799

SEBELUM TENSILE

W1		W2		W3		W4		W5	
A	6,12	A	5,6	A	5,21	A	5,3	A	5,68
B	6,14	B	5,66	B	5,38	B	5,46	B	5,83
C	6,07	C	5,66	C	5,36	C	5,46	C	5,94
W ave	6,11		5,64		5,316		5,406		5,816
T1		T2		T3		T4		T5	
A	4,06	A	3,86	A	3,72	A	3,88	A	4,07
B	4,01	B	3,88	B	3,78	B	3,9	B	4,02
T average	4,035		3,87		3,75		3,89		4,045

A1	A2	A3	A4	A5
24,653	21,826	19,937	21,031	23,528

Lampiran E. 3 Dimensi spesimen 8 mm

SEBELUM CREEP

W1		W2		W3		W4		W5	
A	6,29	A	6,07	A	5,97	A	6,05	A	6,28
B	6,33	B	6,06	B	6,03	B	6,09	B	5,34
C	6,19	C	5,83	C	5,79	C	5,87	C	6,24
W ave	6,270		5,987		5,930		6,003		5,953
T1		T2		T3		T4		T5	
A	4,63	A	4,59	A	4,64	A	4,63	A	4,69
B	4,58	B	4,57	B	4,59	B	4,52	B	4,62
T average	4,605		4,58		4,615		4,575		4,655

A1	A2	A3	A4	A5
28,873	27,419	27,367	27,465	27,713

SETELAH CREEP

W1		W2		W3		W4		W5	
A	5,87	A	5,26	A	5,1	A	5,52	A	5,84
B	5,88	B	5,27	B	5,16	B	5,55	B	6,06
C	5,87	C	5,02	C	4,95	C	5,49	C	5,56
W ave	5,873		5,183		5,070		5,520		5,820
T1		T2		T3		T4		T5	
A	4,24	A	3,85	A	3,88	A	3,94	A	4,94
B	4,19	B	3,87	B	3,76	B	4,11	B	4,28
T average	4,215		3,86		3,82		4,025		4,61

A1	A2	A3	A4	A5
24,756	20,008	19,367	22,218	26,830

SEBELUM TENSILE

W1		W2		W3		W4		W5	
A	5,81	A	5,09	A	5,09	A	5,25	A	8,86
B	5,85	B	5,08	B	5,18	B	5,39	B	5,9
C	5,83	C	4,91	C	4,94	C	5,12	C	5,55
W ave	5,830		5,027		5,070		5,253		6,770
T1		T2		T3		T4		T5	
A	4,1	A	3,9	A	3,88	A	3,94	A	4,26
B	4,12	B	3,79	B	3,91	B	3,99	B	4,22
T average	4,11		3,845		3,895		3,965		4,24

A1	A2	A3	A4	A5
23,961	19,328	19,748	20,829	28,705

Lampiran F Perhitungan Laju Creep

Lampiran F. 1 Perhitungan laju creep rupture

section	displacement awal	displacement akhir	Total $d\varepsilon$	Waktu awal	Waktu akhir	Total dt	Creep rate $d\varepsilon/dt$
1	4,954	5,165	0,211	455	710	255	0,0008
2	5,175	5,415	0,240	715	970	255	0,0009
3	5,419	5,708	0,289	975	1230	255	0,0011
4	5,713	6,050	0,337	1235	1490	255	0,0013
5	6,062	6,429	0,367	195	450	255	0,0014

Lampiran G Data Curva Creep

Lampiran G.1 Data curva creep rupture

CREEP-RUPTURE DATA													
MATERIAL		**GB 5310 20G**			SPECIMEN		4		THICKNESS			Minimum *(mm)*	4,74
TEMPERATURE		550°C			LOAD/MASS		75,1 kg					Average *(mm)*	4,75
No.	*Date*	*Time*			*Duration (hour)*	*Length / l (mm)*	*No.*	*Date*	*Time*			*Duration (hour)*	*Length / l (mm)*
		Hour	*Min.*	*Sec.*					*Hour*	*Min.*	*Sec.*		
1	7/09/2022 Start Load	10	00	00	--	1,98	**58**	--	14	45	00	--	4,06
2		10	05	00	--	2,04	**59**	--	14	50	00	--	4,08
3	--	10	10	00	--	2,092	**60**	--	14	55	00	--	4,106
4	--	10	15	00	--	2,14	**61**	--	15	00	00	--	4,13
5	--	10	20	00	--	2,20	**62**	--	15	05	00	--	4,15
6	--	10	25	00	--	2,248	**63**	--	15	10	00	--	4,17
7	--	10	30	00	--	2,30	**64**	--	15	15	00	--	4,189
8	--	10	35	00	--	2,35	**65**	--	15	20	00	--	4,21
9	--	10	40	00	--	2,40	**66**	--	15	25	00	--	4,23
10	--	10	45	00	--	2,445	**67**	--	15	30	00	--	4,248
11	--	10	50	00	--	2,49	**68**	--	15	35	00	--	4,267
12	--	10	55	00	--	2,54	**69**	--	15	40	00	--	4,29
13	--	11	00	00	--	2,58	**70**	--	15	45	00	--	4,30
14	--	11	05	00	--	2,630	**71**	--	15	50	00	--	4,32
15	--	11	10	00	--	2,675	**72**	--	15	55	00	--	4,339
16	--	11	15	00	--	2,719	**73**	--	16	00	00	--	4,36
17	--	11	20	00	--	2,76	**74**	--	16	05	00	--	4,37
18	--	11	25	00	--	2,805	**75**	--	16	10	00	--	4,39
19	--	11	30	00	--	2,85	**76**	--	16	15	00	--	4,406
20	--	11	35	00	--	2,889	**77**	--	16	20	00	--	4,42
21	--	11	40	00	--	2,93	**78**	--	16	25	00	--	4,44
22	--	11	45	00	--	2,97	**79**	--	16	30	00	--	4,45
23	--	11	50	00	--	3,009	**80**	--	16	35	00	--	4,468
24	--	11	55	00	--	3,048	**81**	--	16	40	00	--	4,48
25	--	12	00	00	--	3,087	**82**	--	16	45	00	--	4,50
26	--	12	05	00	--	3,12	**83**	--	16	50	00	--	4,51
27	--	12	10	00	--	3,16	**84**	--	16	55	00	--	4,53
28	--	12	15	00	--	3,20	**85**	--	17	00	00	--	4,540
29	--	12	20	00	--	3,23	**86**	--	17	05	00	--	4,55
30	--	12	25	00	--	3,270	**87**	--	17	10	00	--	4,56
31	--	12	30	00	--	3,30	**88**	--	17	15	00	--	4,57
32	--	12	35	00	--	3,34	**89**	--	17	20	00	--	4,575
33	--	12	40	00	--	3,37	**90**	--	17	25	00	--	4,583

34	--	12	45	00	--	3,407	**91**	--	17	30	00	--	4,59
35	--	12	50	00	--	3,439	**92**	--	17	35	00	--	4,597
36	--	12	55	00	--	3,47	**93**	--	17	40	00	--	4,608
37	--	13	00	00	--	3,50	**94**	--	17	45	00	--	4,612
38	--	13	05	00	--	3,53	**95**	--	17	50	00	--	4,624
39	--	13	10	00	--	3,57	**96**	--	17	55	00	--	4,628
40	--	13	15	00	--	3,60	**97**	--	18	00	00	--	4,638
41	--	13	20	00	--	3,63	**98**	--	18	05	00	--	4,644
42		13	25	00	--	3,65	**99**	--	18	10	00	--	4,647
43	--	13	30	00	--	3,684	**100**	--	18	15	00	--	4,65
44	--	13	35	00	--	3,712	**101**	--	18	20	00	--	4,658
45	--	13	40	00	--	3,740	**102**	--	18	25	00	--	4,668
46	--	13	45	00	--	3,77	**103**	--	18	30	00	--	4,67
47	--	13	50	00	--	3,79	**104**	--	18	35	00	--	4,68
48	--	13	55	00	--	3,82	**105**	--	18	40	00	--	4,69
49	--	14	00	00	--	3,847	**106**	--	18	45	00	--	4,705
50	--	14	05	00	--	3,87	**107**	--	18	50	00	--	4,708
51	--	14	10	00	--	3,90	**108**	--	18	55	00	--	4,71
52	--	14	15	00	--	3,92	**109**	--	19	00	00	--	4,715
53	--	14	20	00	--	3,95	**110**	--	19	05	00	--	4,718
54	--	14	25	00	--	3,97	**111**	--	19	10	00	--	4,723
55	--	14	30	00	--	3,994	**112**	--	19	15	00	--	4,728
56	--	14	35	00	--	4,02	**113**	--	19	20	00	--	4,73
57	--	14	40	00	--	4,04	**114**	--	19	25	00	--	4,739
115	--	19	30	00	--	4,749	**172**	--	00	15	00	--	5,022
116	--	19	35	00	--	4,75	**173**	--	00	20	00	--	5,022
117	--	19	40	00	--	4,759	**174**	--	00	25	00	--	5,03
118	--	19	45	00	--	4,765	**175**	--	00	30	00	--	5,034
119	--	19	50	00	--	4,77	**176**	--	00	35	00	--	5,043
120	--	19	55	00	--	4,774	**177**	--	00	40	00	--	5,045
121	--	20	00	00	--	4,783	**178**	--	00	45	00	--	5,05
122	--	20	05	00	--	4,786	**179**	--	00	50	00	--	5,054
123	--	20	10	00	--	4,795	**180**	--	00	55	00	--	5,06
124	--	20	15	00	--	4,798	**181**	--	01	00	00	--	5,065
125	--	20	20	00	--	4,8	**182**	--	01	05	00	--	5,068
126	--	20	25	00	--	4,804	**183**	--	01	10	00	--	5,073
127	--	20	30	00	--	4,809	**184**	--	01	15	00	--	5,078
128	--	20	35	00	--	4,813	**185**	--	01	20	00	--	5,085
129	--	20	40	00	--	4,815	**186**	--	01	25	00	--	5,09
130	--	20	45	00	--	4,819	**187**	--	01	30	00	--	5,095
131	--	20	50	00	--	4,822	**188**	--	01	35	00	--	5,097

132	--	20	55	00	--	4,83	**189**	--	01	40	00	--	5,1
133	--	21	00	00	--	4,835	**190**	--	01	45	00	--	5,105
134	--	21	05	00	--	4,835	**191**	--	01	50	00	--	5,11
135	--	21	10	00	--	4,842	**192**	--	01	55	00	--	5,115
136	--	21	15	00	--	4,85	**193**	--	02	00	00	--	5,12
137	--	21	20	00	--	4,855	**194**	--	02	05	00	--	5,124
138	--	21	25	00	--	4,868	**195**	--	02	10	00	--	5,126
139	--	21	30	00	--	4,868	**196**	--	02	15	00	--	5,13
140	--	21	35	00	--	4,869	**197**	--	02	20	00	--	5,133
141	--	21	40	00	--	4,875	**198**	--	02	25	00	--	5,136
142	--	21	45	00	--	4,897	**199**	--	02	30	00	--	5,14
143	--	21	50	00	--	4,889	**200**	--	02	35	00	--	5,144
144	--	21	55	00	--	4,89	**201**	--	02	40	00	--	5,146
145	--	22	00	00	--	4,895	**202**	--	02	45	00	--	5,148
146	--	22	05	00	--	4,9	**203**	--	02	50	00	--	5,15
147	--	22	10	00	--	4,9	**204**	--	02	55	00	--	5,155
148	--	22	15	00	--	4,905	**205**	--	03	00	00	--	5,157
149	--	22	20	00	--	4,913	**206**	--	03	05	00	--	5,16
150	--	22	25	00	--	4,92	**207**	--	03	10	00	--	5,165
151	--	22	30	00	--	4,92	**208**	--	03	15	00	--	5,175
152	--	22	35	00	--	4,927	**209**	--	03	20	00	--	5,176
153	--	22	40	00	--	4,932	**210**	--	03	25	00	--	5,18
154	--	22	45	00	--	4,933	**211**	--	03	30	00	--	5,182
155	--	22	50	00	--	4,952	**212**	--	03	35	00	--	5,188
156	--	22	55	00	--	4,945	**213**	--	03	40	00	--	5,193
157	--	23	00	00	--	4,95	**214**	--	03	45	00	--	5,197
158	--	23	05	00	--	4,956	**215**	--	03	50	00	--	5,2
159	--	23	10	00	--	4,963	**216**	--	03	55	00	--	5,205
160	--	23	15	00	--	4,967	**217**	--	04	00	00	--	5,21
161	--	23	20	00	--	4,97	**218**	--	04	05	00	--	5,216
162	--	23	25	00	--	4,974	**219**	--	04	10	00	--	5,218
163	--	23	30	00	--	4,98	**220**	--	04	15	00	--	5,22
164	--	23	35	00	--	4,984	**221**	--	04	20	00	--	5,226
165	--	23	40	00	--	4,992	**222**	--	04	25	00	--	5,228
166	--	23	45	00	--	4,994	**223**	--	04	30	00	--	5,234
167	--	23	50	00	--	4,999	**224**	--	04	35	00	--	5,24
168	--	23	55	00	--	5,006	**225**	--	04	40	00	--	5,242
169	08/09/2022	00	00	00	--	5,01	**226**	--	04	45	00	--	5,247
170	--	00	05	00	--	5,01	**227**	--	04	50	00	--	5,252
171	--	00	10	00	--	5,018	**228**	--	04	55	00	--	5,26
229	--	05	00	00	--	5,266	**286**	--	09	45	00	--	5,557

230	--	05	05	00	--	5,27	**287**	--	09	50	00	--	5,564
231	--	05	10	00	--	5,27	**288**	--	09	55	00	--	5,57
232	--	05	15	00	--	5,28	**289**	--	10	00	00	--	5,58
233	--	05	20	00	--	5,288	**290**	--	10	05	00	--	5,585
234	--	05	25	00	--	5,29	**291**	--	10	10	00	--	5,59
235	--	05	30	00	--	5,294	**292**	--	10	15	00	--	5,596
236	--	05	35	00	--	5,3	**293**	--	10	20	00	--	5,6
237	--	05	40	00	--	5,302	**294**	--	10	25	00	--	5,608
238	--	05	45	00	--	5,308	**295**	--	10	30	00	--	5,612
239	--	05	50	00	--	5,313	**296**	--	10	35	00	--	5,62
240	--	05	55	00	--	5,318	**297**	--	10	40	00	--	5,626
241	--	06	00	00	--	5,322	**298**	--	10	45	00	--	5,63
242	--	06	05	00	--	5,328	**299**	--	10	50	00	--	5,638
243	--	06	10	00	--	5,331	**300**	--	10	55	00	--	5,64
244	--	06	15	00	--	5,339	**301**	--	11	00	00	--	5,648
245	--	06	20	00	--	5,349	**302**	--	11	05	00	--	5,65
246	--	06	25	00	--	5,35	**303**	--	11	10	00	--	5,657
247	--	06	30	00	--	5,359	**304**	--	11	15	00	--	5,66
248	--	06	35	00	--	5,359	**305**	--	11	20	00	--	5,67
249	--	06	40	00	--	5,36	**306**	--	11	25	00	--	5,676
250	--	06	45	00	--	5,365	**307**	--	11	30	00	--	5,682
251	--	06	50	00	--	5,37	**308**	--	11	35	00	--	5,69
252	--	06	55	00	--	5,375	**309**	--	11	40	00	--	5,698
253	--	07	00	00	--	5,381	**310**	--	11	45	00	--	5,702
254	--	07	05	00	--	5,389	**311**	--	11	50	00	--	5,708
255	--	07	10	00	--	5,399	**312**	--	11	55	00	--	5,713
256	--	07	15	00	--	5,4	**313**	--	12	00	00	--	5,718
257	--	07	20	00	--	5,405	**314**	--	12	05	00	--	5,723
258	--	07	25	00	--	5,41	**315**	--	12	10	00	--	5,73
259	--	07	30	00	--	5,415	**316**	--	12	15	00	--	5,734
260	--	07	35	00	--	5,419	**317**	--	12	20	00	--	5,74
261	--	07	40	00	--	5,425	**318**	--	12	25	00	--	5,748
262	--	07	45	00	--	5,43	**319**	--	12	30	00	--	5,753
263	--	07	50	00	--	5,439	**320**	--	12	35	00	--	5,758
264	--	07	55	00	--	5,445	**321**	--	12	40	00	--	5,763
265	--	08	00	00	--	5,45	**322**	--	12	45	00	--	5,77
266	--	08	05	00	--	5,455	**323**	--	12	50	00	--	5,775
267	--	08	10	00	--	5,46	**324**	--	12	55	00	--	5,78
268	--	08	15	00	--	5,462	**325**	--	13	00	00	--	5,79
269	--	08	20	00	--	5,467	**326**	--	13	05	00	--	5,792
270	--	08	25	00	--	5,471	**327**	--	13	10	00	--	5,795

271	--	08	30	00	--	5,475	**328**	--	13	15	00	--	5,802
272	--	08	35	00	--	5,48	**329**	--	13	20	00	--	5,807
273	--	08	40	00	--	5,485	**330**	--	13	25	00	--	5,812
274	--	08	45	00	--	5,49	**331**	--	13	30	00	--	5,818
275	--	08	50	00	--	5,495	**332**	--	13	35	00	--	5,823
276	--	08	55	00	--	5,502	**333**	--	13	40	00	--	5,83
277	--	09	00	00	--	5,51	**334**	--	13	45	00	--	5,839
278	--	09	05	00	--	5,511	**335**	--	13	50	00	--	5,845
279	--	09	10	00	--	5,52	**336**	--	13	55	00	--	5,85
280	--	09	15	00	--	5,53	**337**	--	14	00	00	--	5,858
281	--	09	20	00	--	5,534	**338**	--	14	05	00	--	5,87
282	--	09	25	00	--	5,538	**339**	--	14	10	00	--	5,876
283	--	09	30	00	--	5,54	**340**	--	14	15	00	--	5,882
284	--	09	35	00	--	5,548	**341**	--	14	20	00	--	5,888
285	--	09	40	00	--	5,55	**342**	--	14	25	00	--	5,894
343	--	14	30	00	--	5,9	**400**	--	19	15	00	--	6,31
344	--	14	35	00	--	5,908	**401**	--	19	20	00	--	6,318
345	--	14	40	00	--	5,913	**402**	--	19	25	00	--	6,322
346	--	14	45	00	--	5,92	**403**	--	19	30	00	--	6,33
347	--	14	50	00	--	5,934	**404**	--	19	35	00	--	6,34
348	--	14	55	00	--	5,94	**405**	--	19	40	00	--	6,355
349	--	15	00	00	--	5,95	**406**	--	19	45	00	--	6,36
350	--	15	05	00	--	5,958	**407**	--	19	50	00	--	6,367
351	--	15	10	00	--	5,963	**408**	--	19	55	00	--	6,375
352	--	15	15	00	--	5,97	**409**	--	20	00	00	--	6,383
353	--	15	20	00	--	5,974	**410**	--	20	05	00	--	6,39
354	--	15	25	00	--	5,98	**411**	--	20	10	00	--	6,396
355	--	15	30	00	--	5,99	**412**	--	20	15	00	--	6,4
356	--	15	35	00	--	5,997	**413**	--	20	20	00	--	6,412
357	--	15	40	00	--	6,003	**414**	--	20	25	00	--	6,42
358	--	15	45	00	--	6,01	**415**	--	20	30	00	--	6,429
359	--	15	50	00	--	6,022	**416**	--	20	35	00	--	6,438
360	--	15	55	00	--	6,03	**417**	--	20	40	00	--	6,45
361	--	16	00	00	--	6,04	**418**	--	20	45	00	--	6,463
362	--	16	05	00	--	6,045	**419**	--	20	50	00	--	6,472
363	--	16	10	00	--	6,05	**420**	--	20	55	00	--	6,48
364	--	16	15	00	--	6,062	**421**	--	21	00	00	--	6,5
365	--	16	20	00	--	6,068	**422**	--	21	05	00	--	6,5
366	--	16	25	00	--	6,074	**423**	--	21	10	00	--	6,502
367	--	16	30	00	--	6,082	**424**	--	21	15	00	--	6,512
368	--	16	35	00	--	6,093	**425**	--	21	20	00	--	6,528

369	--	16	40	00	--	6,1	**426**	--	21	25	00	--	6,54
370	--	16	45	00	--	6,107	**427**	--	21	30	00	--	6,548
371	--	16	50	00	--	6,12	**428**	--	21	35	00	--	6,56
372	--	16	55	00	--	6,13	**429**	--	21	40	00	--	6,568
373	--	17	00	00	--	6,136	**430**	--	21	45	00	--	6,575
374	--	17	05	00	--	6,14	**431**	--	21	50	00	--	6,583
375	--	17	10	00	--	6,149	**432**	--	21	55	00	--	6,59
376	--	17	15	00	--	6,15	**433**	--	22	00	00	--	6,605
377	--	17	20	00	--	6,16	**434**	--	22	05	00	--	6,613
378	--	17	25	00	--	6,17	**435**	--	22	10	00	--	6,623
379	--	17	30	00	--	6,176	**436**	--	22	15	00	--	6,63
380	--	17	35	00	--	6,188	**437**	--	22	20	00	--	6,643
381	--	17	40	00	--	6,2	**438**	--	22	25	00	--	6,65
382	--	17	45	00	--	6,21	**439**	--	22	30	00	--	6,658
383	--	17	50	00	--	6,215	**440**	--	22	35	00	--	6,668
384	--	17	55	00	--	6,223	**441**	--	22	40	00	--	6,68
385	--	18	00	00	--	6,23	**442**	--	22	45	00	--	6,692
386	--	18	05	00	--	6,235	**443**	--	22	50	00	--	6,7
387	--	18	10	00	--	6,239	**444**	--	22	55	00	--	6,718
388	--	18	15	00	--	6,239	**445**	--	23	00	00	--	6,72
389	--	18	20	00	--	6,245	**446**	--	23	05	00	--	6,73
390	--	18	25	00	--	6,25	**447**	--	23	10	00	--	6,742
391	--	18	30	00	--	6,257	**448**	--	23	15	00	--	6,75
392	--	18	35	00	--	6,27	**449**	--	23	20	00	--	6,763
393	--	18	40	00	--	6,275	**450**	--	23	25	00	--	6,775
394	--	18	45	00	--	6,283	**451**	--	23	30	00	--	6,784
395	--	18	50	00	--	6,293	**452**	--	23	35	00	--	6,798
396	--	18	55	00	--	6,305	**453**	--	23	40	00	--	6,805
397	--	19	00	00	--	6,306	**454**	--	23	45	00	--	6,817
398	--	19	05	00	--	6,308	**455**	--	23	50	00	--	6,821
399	--	19	10	00	--	6,31	**456**	--	23	55	00	--	6,834
457	09/09/2022	00	00	00	--	6,848	**514**	--	04	45	00	--	7,613
458	--	00	05	00	--	6,856	**515**	--	04	50	00	--	7,628
459	--	00	10	00	--	6,87	**516**	--	04	55	00	--	7,64
460	--	00	15	00	--	6,883	**517**	--	05	00	00	--	7,652
461	--	00	20	00	--	6,89	**518**	--	05	05	00	--	7,667
462	--	00	25	00	--	6,903	**519**	--	05	10	00	--	7,69
463	--	00	30	00	--	6,916	**520**	--	05	15	00	--	7,703
464	--	00	35	00	--	6,928	**521**	--	05	20	00	--	7,72
465	--	00	40	00	--	6,942	**522**	--	05	25	00	--	7,732
466	--	00	45	00	--	6,954	**523**	--	05	30	00	--	7,754

467	--	00	50	00	--	6,965	**524**	--	05	35	00	--	7,775
468	--	00	55	00	--	6,972	**525**	--	05	40	00	--	7,793
469	--	01	00	00	--	6,984	**526**	--	05	45	00	--	7,808
470	--	01	05	00	--	6,995	**527**	--	05	50	00	--	7,825
471	--	01	10	00	--	7,018	**528**	--	05	55	00	--	7,842
472	--	01	15	00	--	7,02	**529**	--	06	00	00	--	7,86
473	--	01	20	00	--	7,033	**530**	--	06	05	00	--	7,88
474	--	01	25	00	--	7,045	**531**	--	06	10	00	--	7,895
475	--	01	30	00	--	7,055	**532**	--	06	15	00	--	7,912
476	--	01	35	00	--	7,07	**533**	--	06	20	00	--	7,933
477	--	01	40	00	--	7,08	**534**	--	06	25	00	--	7,95
478	--	01	45	00	--	7,092	**535**	--	06	30	00	--	7,967
479	--	01	50	00	--	7,107	**536**	--	06	35	00	--	7,985
480	--	01	55	00	--	7,12	**537**	--	06	40	00	--	8,005
481	--	02	00	00	--	7,145	**538**	--	06	45	00	--	8,024
482	--	02	05	00	--	7,147	**539**	--	06	50	00	--	8,048
483	--	02	10	00	--	7,158	**540**	--	06	55	00	--	8,062
484	--	02	15	00	--	7,173	**541**	--	07	00	00	--	8,078
485	--	02	20	00	--	7,186	**542**	--	07	05	00	--	8,1
486	--	02	25	00	--	7,2	**543**	--	07	10	00	--	8,127
487	--	02	30	00	--	7,213	**544**	--	07	15	00	--	8,143
488	--	02	35	00	--	7,224	**545**	--	07	20	00	--	8,163
489	--	02	40	00	--	7,238	**546**	--	07	25	00	--	8,185
490	--	02	45	00	--	7,25	**547**	--	07	30	00	--	8,21
491	--	02	50	00	--	7,27	**548**	--	07	35	00	--	8,225
492	--	02	55	00	--	7,282	**549**	--	07	40	00	--	8,244
493	--	03	00	00	--	7,296	**550**	--	07	45	00	--	8,26
494	--	03	05	00	--	7,308	**551**	--	07	50	00	--	8,28
495	--	03	10	00	--	7,32	**552**	--	07	55	00	--	8,302
496	--	03	15	00	--	7,336	**553**	--	08	00	00	--	8,32
497	--	03	20	00	--	7,35	**554**	--	08	05	00	--	8,343
498	--	03	25	00	--	7,367	**555**	--	08	10	00	--	8,366
499	--	03	30	00	--	7,378	**556**	--	08	15	00	--	8,385
500	--	03	35	00	--	7,392	**557**	--	08	20	00	--	8,402
501	--	03	40	00	--	7,403	**558**	--	08	25	00	--	8,428
502	--	03	45	00	--	7,419	**559**	--	08	30	00	--	8,45
503	--	03	50	00	--	7,433	**560**	--	08	35	00	--	8,472
504	--	03	55	00	--	7,452	**561**	--	08	40	00	--	8,494
505	--	04	00	00	--	7,467	**562**	--	08	45	00	--	8,52
506	--	04	05	00	--	7,482	**563**	--	08	50	00	--	8,546
507	--	04	10	00	--	7,498	**564**	--	08	55	00	--	8,56

508	--	04	15	00	--	7,513	**565**	--	09	00	00	--	8,582
509	--	04	20	00	--	7,542	**566**	--	09	05	00	--	8,606
510	--	04	25	00	--	7,55	**567**	--	09	10	00	--	8,633
511	--	04	30	00	--	7,563	**568**	--	09	15	00	--	8,65
512	--	04	35	00	--	7,58	**569**	--	09	20	00	--	8,68
513	--	04	40	00	--	7,594	**570**	--	09	25	00	--	8,7
571	--	09	30	00	--	8,723	**628**	--	14	15	00	--	10,542
572	--	09	35	00	--	8,75	**629**	--	14	20	00	--	10,583
573	--	09	40	00	--	8,775	**630**	--	14	25	00	--	10,63
574	--	09	45	00	--	8,8	**631**	--	14	30	00		10,678
575	--	09	50	00	--	8,82	**632**	--	14	35	00		10,718
576	--	09	55	00	--	8,85	**633**	--	14	40	00		10,76
577	--	10	00	00	--	8,872	**634**	--	14	45	00		10,808
578	--	10	05	00	--	8,9	**635**	--	14	50	00		10,865
579	--	10	10	00	--	8,92	**636**	--	14	55	00		10,9
580	--	10	15	00	--	8,945	**637**	--	15	00	00		10,954
581	--	10	20	00	--	8,974	**638**	--	15	05	00		11
582	--	10	25	00	--	9,002	**639**	--	15	10	00		11,055
583	--	10	30	00	--	9,03	**640**	--	15	15	00		11,1
584	--	10	35	00	--	9,056	**641**	--	15	20	00		11,16
585	--	10	40	00	--	9,08	**642**	--	15	25	00		11,21
586	--	10	45	00	--	9,11	**643**	--	15	30	00		11,26
587	--	10	50	00	--	9,14	**644**	--	15	35	00		11,32
588	--	10	55	00	--	9,16	**645**	--	15	40	00		11,38
589	--	11	00	00	--	9,194	**646**	--	15	45	00		11,438
590	--	11	05	00	--	9,218	**647**	--	15	50	00		11,5
591	--	11	10	00	--	9,248	**648**	--	15	55	00		11,565
592	--	11	15	00	--	9,278	**649**	--	16	00	00		11,63
593	--	11	20	00	--	9,31	**650**	--	16	05	00		11,69
594	--	11	25	00	--	9,36	**651**	--	16	10	00		11,75
595	--	11	30	00	--	9,37	**652**	--	16	15	00		11,823
596	--	11	35	00	--	9,395	**653**	--	16	20	00		11,895
597	--	11	40	00	--	9,43	**654**	--	16	25	00		11,975
598	--	11	45	00	--	9,46	**655**	--	16	30	00		12,047
599	--	11	50	00	--	9,484	**656**	--	16	35	00		12,114
600	--	11	55	00	--	9,517	**657**	--	16	40	00		12,184
601	--	12	00	00	--	9,55	**658**	--	16	45	00		12,264
602	--	12	05	00	--	9,58	**659**	--	16	50	00		12,345
603	--	12	10	00	--	9,61	**660**	--	16	55	00		12,427
604	--	12	15	00	--	9,648	**661**	--	17	00	00		12,515
605	--	12	20	00	--	9,678	**662**	--	17	05	00		12,6

606	--	12	25	00	--	9,713	**663**	--	17	10	00		12,69
607	--	12	30	00	--	9,74	**664**	--	17	15	00		12,786
608	--	12	35	00	--	9,78	**665**	--	17	20	00		12,886
609	--	12	40	00	--	9,813	**666**	--	17	25	00		12,987
610	--	12	45	00	--	9,842	**667**	--	17	30	00		13,09
611	--	12	50	00	--	9,88	**668**	--	17	35	00		13,21
612	--	12	55	00	--	9,91	**669**	--	17	40	00		13,32
613	--	13	00	00	--	9,952	**670**	--	17	45	00		13,453
614	--	13	05	00	--	9,982	**671**	--	17	50	00		13,58
615	--	13	10	00	--	10,028	**672**	--	17	55	00		13,717
616	--	13	15	00	--	10,064	**673**	--	18	00	00		13,87
617	--	13	20	00	--	10,1	**674**	--	18	05	00		14,027
618	--	13	25	00	--	10,135	**675**	--	18	10	00		14,21
619	--	13	30	00	--	10,172	**676**	--	18	15	00		14,4
620	--	13	35	00	--	10,21	**677**	--	18	20	00	--	14,62
621	--	13	40	00	--	10,252	**678**	--	18	25	00	--	14,86
622	--	13	45	00	--	10,295	**679**	--	18	30	00	--	15,09
623	--	13	50	00	--	10,335	**680**	--	18	35	00	--	15,48
624	--	13	55	00	--	10,374	**681**	--	18	40	00	--	15,918
625	--	14	00	00	--	10,417	**682**	Fructure	18	45	00	--	16,637
626	--	14	05	00	--	10,456	**683**	--					
627	--	14	10	00	--	10,49	**684**	--					

盛德钢管 TS2710G20-2016 常州盛德无缝钢管有限公司 CHANGZHOU SHENGTAK SEAMLESS STEEL TUBE CO.,LTD.

产 品 质 量 证 明 书
INSPECTION CERTIFICATE

SD-WF-JZ-24
江苏省常州市西郊邹区镇 邮编：213144
Zouqu Town,West Suburbs of Changzhou City,
Jiangsu province,China. Post Code:213144
Tel:0519-883832158 Fax:0519-83632723
http://www.shengdechina.com

合同号 CONTACT C201603899
收货单位 PURCHASER 东方电气集团东方锅炉股份有限公司
产品名称 PRODUCT 高压锅炉用无缝钢管
产品标准 PRODUCT STANDARD DG1893-2015+GB5310-2008
管坯供方 SUPPLIER OF BILLETS:ZHONGTIAN 中天钢铁
制造方法 MANUFACTURE METHOD COLD DRAWN 冷拔
生产许可证号 LICENCE NO. TS2710G20-2020
质保书编号 SHEET NO. 162649

序号 No.	钢级 Steel Grade	炉号 Heat No.	批号 Lot No.	规格 Size 外径(mm) Diameter	壁厚(mm) Thickness	长度(m) Length	重量(kg) Weight	支数 Pieces	件数 Bundles	工艺性能 Technological Properties 扁扁 Flatten	扩口 Flaring	弯曲 Wuping	水压 Hydro	探伤 Crack Detection 涡流 GB/T7735-03 EDDY DETECTION	超声波 GB/T5777-03.2 ULTRASONIC DETECTION	表面尺寸 Surface & Dimensions	低倍检验 MACROETCH TEST	非金属夹杂物检验 NON-METALLIC INCLUSIONS A 粗	A 细	B 粗	B 细	C 粗	C 细	D 粗	D 细	Ds
1	20G	YN-168	0912-0240	38.1	4MT	1800上齐	3822	90	2	合格 (OK)	合格 (OK)	-	-	合格 (OK)	合格 (OK)	合格 (OK)	合格 (OK)	0.5	1	0	1	0	0	0.5	1	0
2																										
3																										
4																										
合计 Total							3822	90	2																	

序号 NO.	冶炼号 HEAT NO.	元素 element	化学成分(%) Chenical Composition C	Si	Mn	P	S	Cr	Ni	Cu	Al	Mo	Ti	V	力学性能 Mechanical Properties 抗拉强度 Rm Tensile Strength (MPa)	屈服强度 ReL Yield Strength (MPa)	伸长率A Elongation (%)	冲击功 Akv Impact (J)	硬度 Hardness (HB)	金相 Metallography 脱碳层 Decarborized (mm) 外 cut	内 inter	合计 Total	显微组织 Micro Structure	晶粒度(级) Grain Size
规定标准值			0.17~0.23	0.17~0.37	0.35~0.65	≤0.025	≤0.015	≤0.25	≤0.25	≤0.20	—	≤0.15	—	≤0.08	410~550	≥245	≥21	—	65~85	≤0.3	≤0.4	≤0.6	F+P	4-10
1	YN-168	LA	0.19	0.19	0.51	0.009	0.003	0.07	0.01	0.11	—	0.006	—	0.002	452	317	38.5	—	75.75.75	0.0	0.07	0.07	F+P	8.0-8.5
		PA	0.19	0.20	0.51	0.009	0.004	0.06	0.05	0.10	—	0.006	—	0.002	459	309	38.0	—	76.76.76	0.0	0.00	0.00		8.0-8.5
2																								
3																								
4																								

注释
1. 探伤盲区已切除. THE BLIND ZONES FOR ET/UT HAVE BEEN ELIMINATED.
2. 整管拉伸.
3. 交货状态:正火 (NORMALIZATION) : 900℃保温 20 分钟.
4. LA:冶炼分析, PA:成品分析(For chemical composition,LA stands for Ladle analysis,PA stands for product analysis)
5. 本钢管未经补焊和拼接(NO REPAIRS BY WELDING HAVE BEEN PERFORMED)
6. 附件管坯质保书(THE BILLET CERTIFICATE IS APPACHED)(最高许用温度 460℃)

备注 REMARK
兹证明本表所列产品，均依标准与合同规定制造和检验，并符合标准和合同要求
WE HERECER TIFICATE THAT THE MATERIAL HEREIN DESCRIBED HAS MANUFACTURED, SAMPLED, TESTED IN ACCORDANCE WITH ABOVE STAND ARD SPECIFICATION SATISFIED THE REQUIREMENTS.

质量证明书章 MUSS CERCIFY SEAL

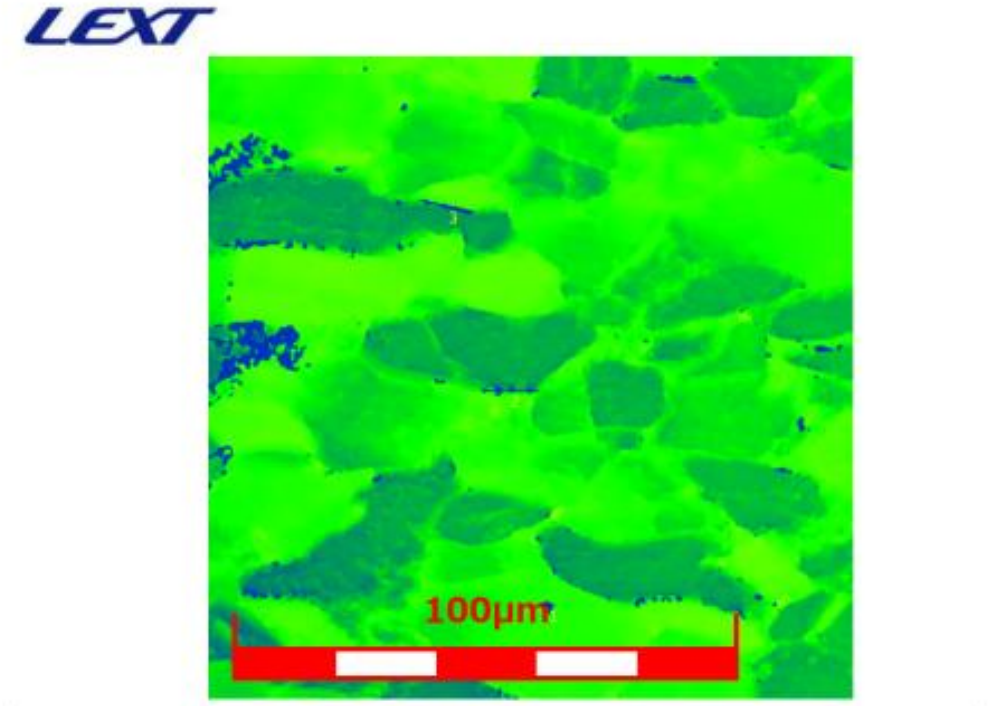
常州盛德无缝钢管有限公司 质量证明书专用章

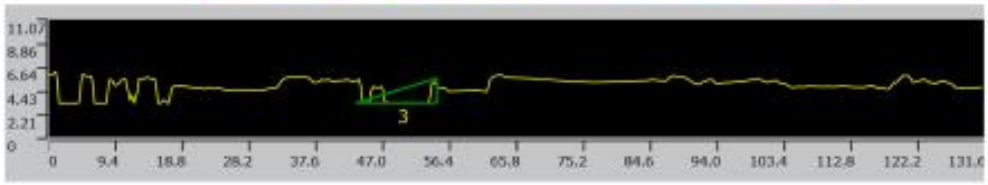
质量负责人 QUALITY MANAGER 黄琪

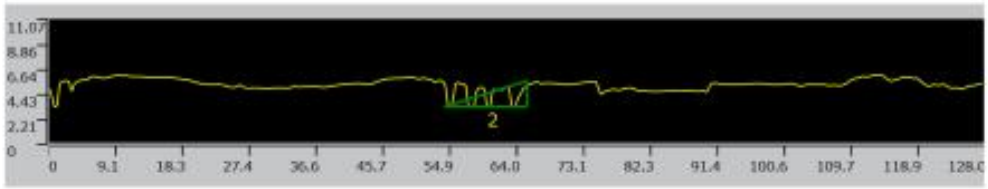
签发人 ISSUED BY 蒋雪英

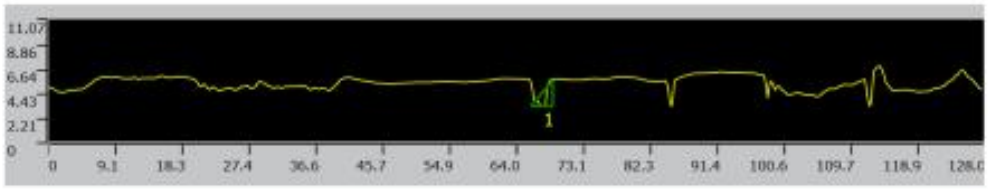
签发日期 ISSUED DATE 2016年9月17日

Lampiran I Data Pengukuran Void Dan Micro Crack









	No.	Result	Width[µm]	Height[µm]	Length[µm]	Angle[°]	File name
☑	1		2.993	2.341	3.800	38.028	spec B(7) bag B2-1000x
☑	2		11.333	2.341	11.573	11.670	spec B(7) bag B2-1000x
☑	3		11.483	2.341	11.719	11.522	spec B(7) bag B2-1000x

1/1 7/25/2023

Lampiran J Dokumentasi Proses Pengambilan Data