



LAMPIRAN

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LAMPIRAN 1
SERTIFIKAT PABRIK (MILL CERTIFICATE) DAN KOMPOSISI KIMIA
DARI BAJA LEMBARAN 316L

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VOX S.A. 11700 B LA ARMOA 46 12 5402 46 12 54 11 46 12 54 07				INSPECTION CERTIFICATE CERTIFICAT D'INSPECTION		3.1			
ACCORDING TO EN 10204				CERTIFICATE N° PO 091112 10001 7 / 1 DATE:					
BY A. PERRIN GASTON CHEF OPERAIRE SA		DATE ORDER N° 191000		YOUR ORDER N° 191000					
TRADING MARK VOLVO MOTOR		INSPECTOR'S SIGNATURE 		STEEL MAKING PROCESS ACCEL STEEL					
REFS EN 10204		HYDROGEN-INDUCED CRACKING COMPLIANT WITH EN 10204		GRADE S235JR					
WEIGHT 10.000		DIAMETERS 120.00		MARK 24					
CONTENT DRAWS C		LENGTH 1200.00		QUANTITY 24					
TESTER N° 044693		TESTER C		TESTER C					
CHEMICAL ANALYSIS / COMPOSITION CHIMIQUE (%)									
	C	EN	AVG	RD	IV	VI	F	S	SI
MINUS	0.030	18.000	2.000	0.030	0.150	10.000	0.030	0.000	0.200
	0.027	18.708	1.227	0.112	0.044	10.288	0.024	0.004	0.300
MECANICAL PROPERTIES / CARACTERISTIQUES MECANQUES									
	RD	EN	RD	RD	RD	RD	RD	RD	RD
MINUS	485.00	170.00	40.00	25.00					
	500.00	206.23	45.54	41.00					
REMARKS / REMARQUES Les caractéristiques sont 1050 à 1100 ° C. voir la conformité avec les spécifications							REMARKS / REMARQUES Satisfactory		
INSPECTOR AND DISCIPLINARY CONTROL (Signature)							INSPECTOR (Signature)		



INSPECTION CERTIFICATE
CERTIFICAT DE RÉCEPTION 3.1.8

ACCORDING TO EN 10204
 2.0.1.2

CERTIFICATE N°
 CERTIFICATION 52 012 1 / 1

SA PERINDO SEPTI - CREDIT BRIEF 014,000,000,000
 NUMBER: S 03 17107 00789 AP-11703
 Indonésia

Our order no.
 n commande DR 30646

Your order no.
 votre commande

GRADE
 MARQUE
 ACN 200
 A101 316L

FINISH
 FINI
 30

INSPECTOR'S STAMP
 CACHET DE L'AGENT DE CONTRÔLE

STEELMAKING PROCESS
 PROCÉDÉ D'ÉLABORATION

CONTENT CONTENU	DIMENSIONS DES ÉLÉMENTS		MARKS MARQUE	QUANTITY QUANTITÉ	SAMPLING
	THICKNESS ÉPAISSEUR	WIDTH LARGEUR			
0120V6 A	1,00	1.320,00		1	0120V6
0120V6 B	1,60	1.220,00		1	0120V6
0120V6 C	2,00	1.220,00		1	0120V6

ANALYSIS		COMPOSITION CHIMIQUE (%)						
C	CR	Fe	Si	Mn	P	S	BT	
0,030	16,050	2,000	0,045	0,030	1,000			
0,024	16,915	1,205	0,135	0,045	10,150	0,045	0,002	

I. PROPERTIES		CARACTÉRISTIQUES MÉCANIQUES			
Yield strength R _e	Tensile strength R _m	Elongation A	Impact energy KV 10	Impact energy J	Impact energy J
610,3	297,6	33,7	150,0		

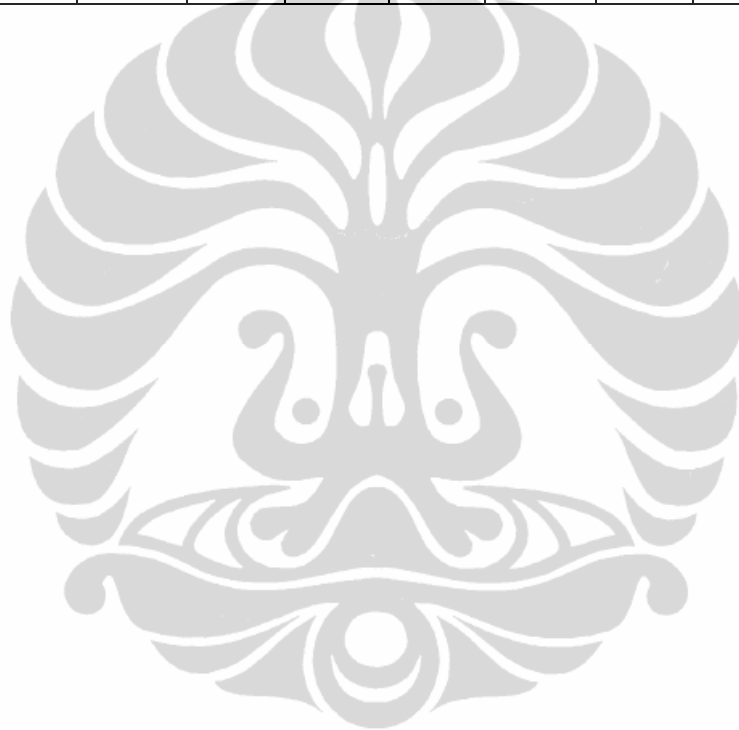
REGION TEST
 RÉGION À CONTRÔLER

SURFACE AND DIMENSIONAL CONTROL
 INSPECTION DIMENSIONNELLE ET VISUELLE

SATISFACTORY
 Satisfaisant

Tabel Komposisi Kimia Baja Lembaran 316L

TEBAL (mm)	Unsur (%)								
	C	Cr	Mn	Mo	N	Ni	P	S	Si
Standar S31603^[4]	0,03	16-18	2	2-3	0,1	10-14	0,045	0,03	1
1,5	0,024	16,915	1,295	2,138	0,042	10,157	0,029	0,002	0,389
3	0,023	16,708	1,237	2,118	0,044	10,296	0,034	0,004	0,303



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LAMPIRAN 2
KOMPOSISI KIMIA KAWAT LAS (FILLER)

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Tabel Komposisi Kimia Kawat Las SMAW AWS A5.4

AWS	Elemen Ion dalam Pelindung Elektroda	Unsur (%)										
		C	Cr	Ni	Mo	Cb (Nb) plus Ta	Mn	Si	P	S	N	Cu
E316L-16	K	0,04	17-20	11-14	2-3	-	0,5-2,5	0,9	0,04	0,03	-	0,75

Tabel Komposisi Kimia Kawat Las GTAW AWS A5.9

AWS	Unsur (%)								
	C	Cr	Ni	Mn	Si	P	S	Mo	Cu
ER316L	Max 0,03	18-20	11-14	1-2,5	0,3-0,65	Max 0,03	Max 0,03	2-3	Max 0,75

Tabel Komposisi Kimia Filler TGX 316L^[21]

Alloy	Unsur (%)					
	C	Si	Mn	Cr	Ni	Lainnya
TGX 316L	0,016	0,87	1,55	18,89	12,47	Mo : 2,32



LAMPIRAN 3
PARAMETER PENGELASAN

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Ketebalan material 1,5 mm : *Single Pass*

Ketebalan material 3 mm : *Double Pass*

METODE	TEBAL (mm)	I (A)	V (V)	KECEPATAN LAS (cm/menit)	HEAT INPUT (J/mm)	KETERANGAN
SMAW (Shielded Metal Arc Welding)	1,5 3	22 30	19 19	62,5 62,5 & 57,6	401,28 547,2 & 593,75	10. Filler : E316L-16 Merk Denki 18Cr-13Ni 2mm
GTAW (Gas Tungsten Arc Welding)	1,5 3	30 45	14 14	72,8 70,0 & 69,1	346,15 540 & 547,04	<ul style="list-style-type: none"> • Shielding Gas Torch : Argon Murni • No Gas Back Purging • Filler : ER316L 1,6 mm
GTAW (Gas Tungsten Arc Welding)	1,5 3	30 45	14 14	69,4 67,5 & 66,6	363,11 560 & 567,57	<ul style="list-style-type: none"> • Shielding Gas Torch : Argon Murni • Gas Back Purging : Argon Murni • Filler : ER316L 1,6 mm
GTAW (Gas Tungsten Arc Welding)	1,5 3	40 50 & 60	20 30 & 40	73 70,0 & 69,0	657,53 1285,71 & 2086,96	<ul style="list-style-type: none"> • Shielding Gas Torch : Argon Murni • No Gas Back Purging • Filler : TGX 316L Merk Kobelco (R316LT1-5) 2,2 mm
SMAW + GTAW	SMAW GTAW	22 30	19 14	62,5 69,4	401,28 363,11	<ul style="list-style-type: none"> • Shielding Gas Torch : Argon Murni • Gas Back Purging : Argon murni

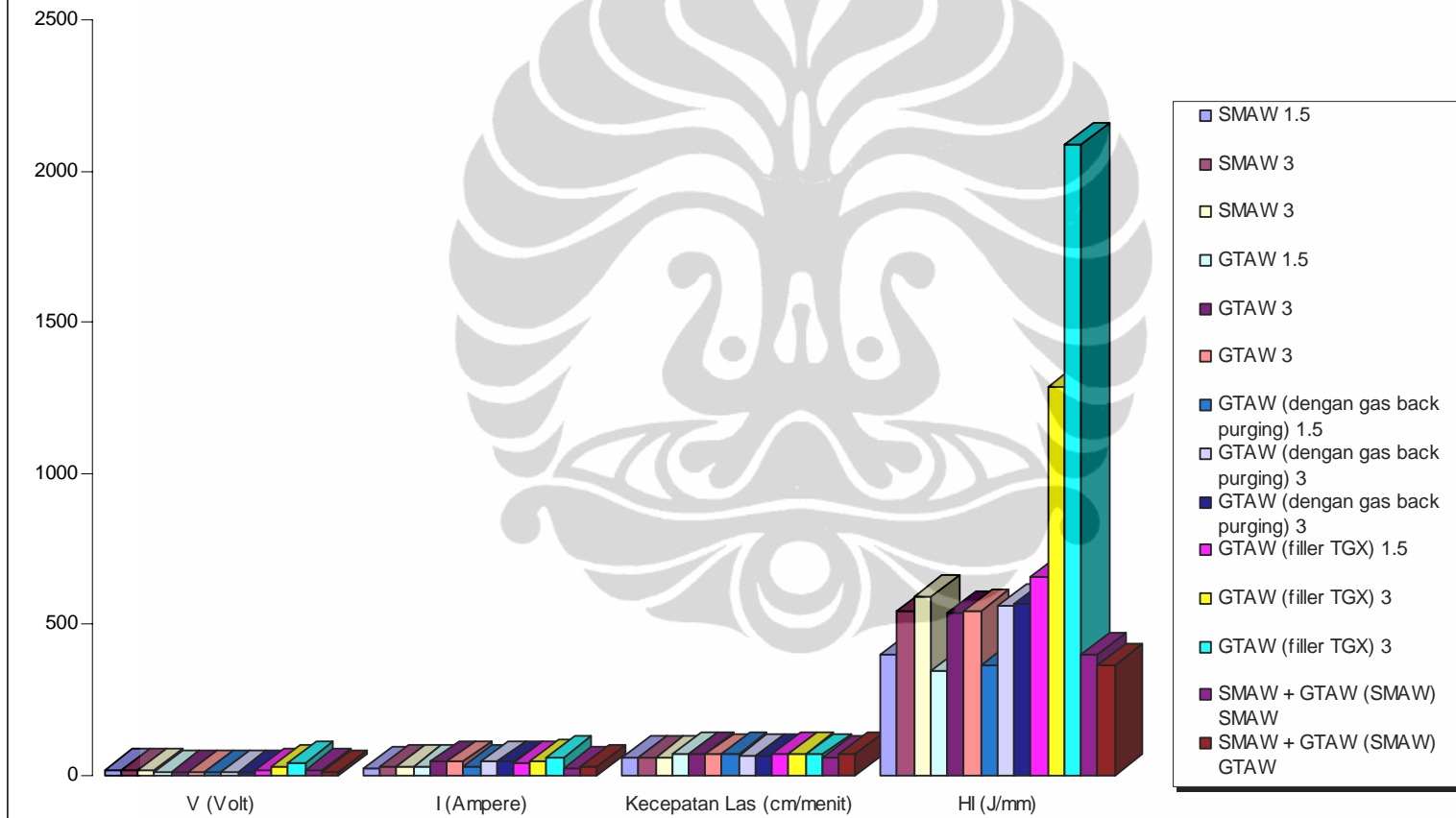
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						<ul style="list-style-type: none">• Filler SMAW : Filler : E316L- 16 Merk Denki 18Cr-13Ni 2mm• Filler GTAW : ER316L 1,6 mm
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Parameter Las



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LAMPIRAN 4
PENGAMATAN VISUAL SAMPEL HASIL PENGELASAN

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Identitas Sampel Hasil Pengelasan :

Sampel 1 : SMAW 1,5 mm

Sampel 2 : SMAW 3 mm

Sampel 3 : GTAW 1,5 mm tanpa *gas back purging*

Sampel 4 : GTAW 3 mm tanpa *gas back purging*

Sampel 5 : GTAW 1,5 mm

Sampel 6 : GTAW 3 mm

Sampel 7 : GTAW 1,5 mm dengan filler TGX

Sampel 8 : GTAW 3 mm dengan filler TGX

Sampel 9 : SMAW + GTAW 1,5 mm

Sampel 10 : SMAW + GTAW 3 mm

Dimensi sampel : 25 mm x 50 mm

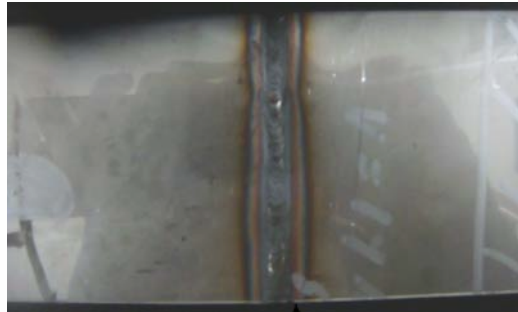


Gambar Pengamatan Visual Sampel 10 → 1, Ketebalan 1,5 mm, Metoda SMAW



Gambar Pengamatan Visual Sampel 2, Ketebalan 3 mm, Metoda SMAW

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Gambar Pengamatan Visual Sampel 3, Ketebalan 1,5 mm, Metoda GTAW Tanpa
Gas Back Purgig



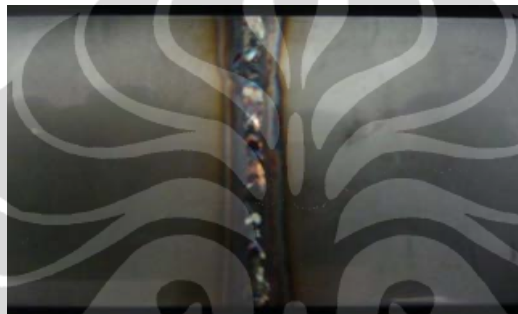
Gambar Pengamatan Visual Sampel 4, Ketebalan 3 mm, Metoda GTAW Tanpa
Gas Back Purgig



Gambar Pengamatan Visual Sampel 5, Ketebalan 1,5 mm, Metoda GTAW



Gambar Pengamatan Visual Sampel 6, Ketebalan 3 mm, Metoda GTAW



Gambar Pengamatan Visual Sampel 7, Ketebalan 1,5 mm, Metoda GTAW dengan Filler
TGX



Gambar Pengamatan Visual Sampel 8, Ketebalan 3 mm, Metoda GTAW dengan Filler
TGX



Gambar Pengamatan Visual Sampel 9, Ketebalan 1,5 mm, Metoda SMAW + GTAW

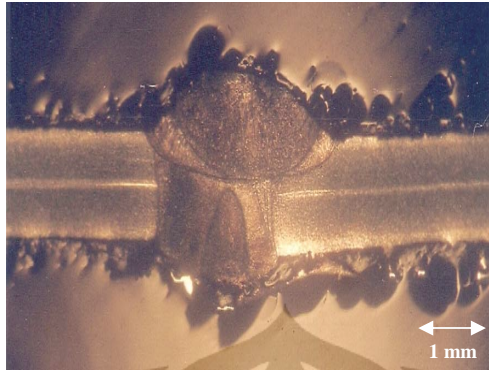


Gambar Pengamatan Visual Sampel 10, Ketebalan 3 mm, Metoda SMAW +
GTAW



LAMPIRAN 5
PENGAMATAN FOTO MAKRO SAMPEL HASIL PENGELASAN

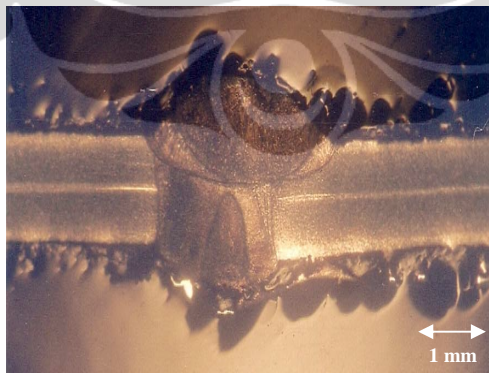
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Gambar Pengamatan Foto Makro Sampel 1, Ketebalan 1,5 mm, Metoda SMAW

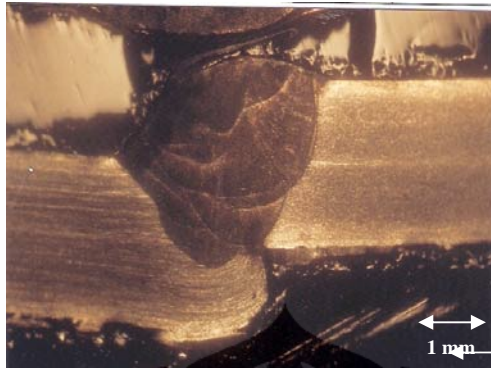


Gambar Pengamatan Foto Makro Sampel 2, Ketebalan 3 mm, Metoda SMAW

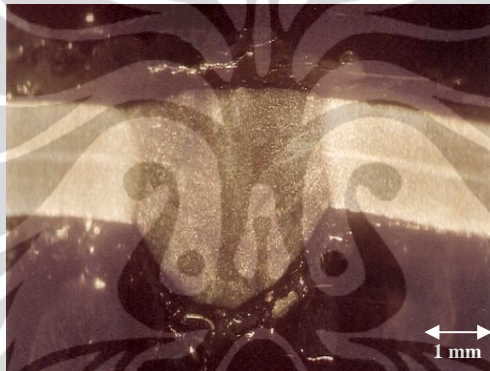


Gambar Pengamatan Foto Makro Sampel 3, Ketebalan 1,5 mm, Metoda GTAW

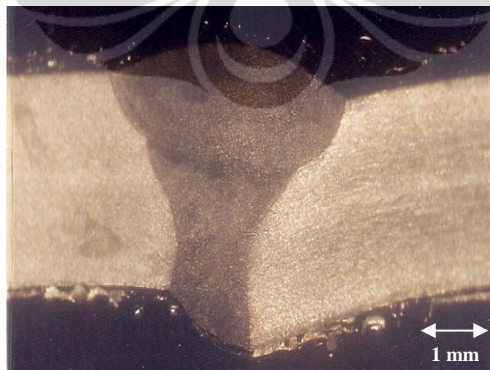
Tanpa Gas Back Purging



Gambar Pengamatan Foto Makro Sampel 4, Ketebalan 3 mm, Metoda GTAW
Tanpa *Gas Back Purgin*



Gambar Pengamatan Foto Makro Sampel 5, Ketebalan 1,5 mm, Metoda GTAW



Gambar Pengamatan Foto Makro Sampel 6, Ketebalan 3 mm, Metoda GTAW



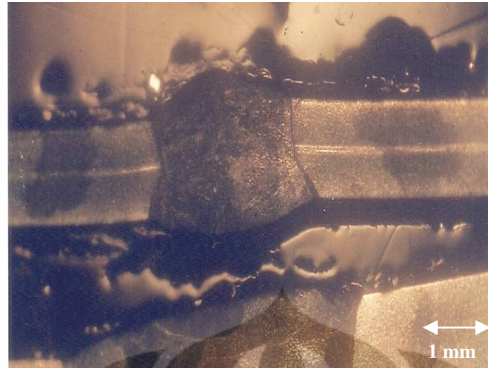
Gambar Pengamatan Foto Makro Sampel 7, Ketebalan 1,5 mm, Metoda GTAW
Dengan Filler TGX



Gambar Pengamatan Foto Makro Sampel 8, Ketebalan 3 mm, Metoda GTAW
Dengan Filler TGX



Gambar Pengamatan Foto Makro Sampel 9, Ketebalan 1,5 mm, Metoda SMAW +
GTAW



Gambar Pengamatan Foto Makro Sampel 10, Ketebalan 3 mm, Metoda SMAW + GTAW

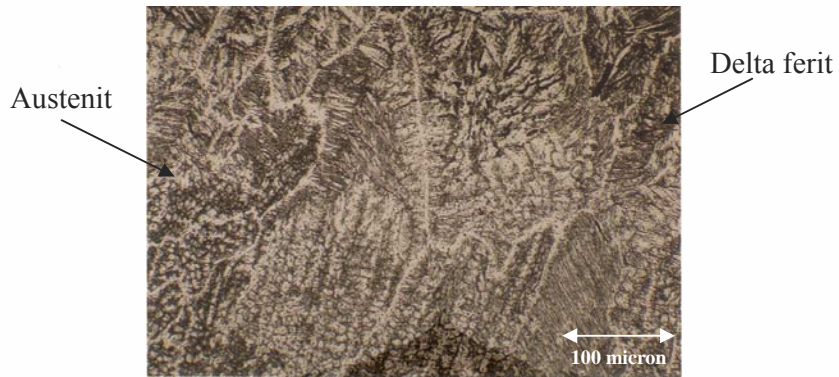


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LAMPIRAN 6
PENGAMATAN FOTO MIKRO *WELD METAL* SAMPEL HASIL
PENGELASAN

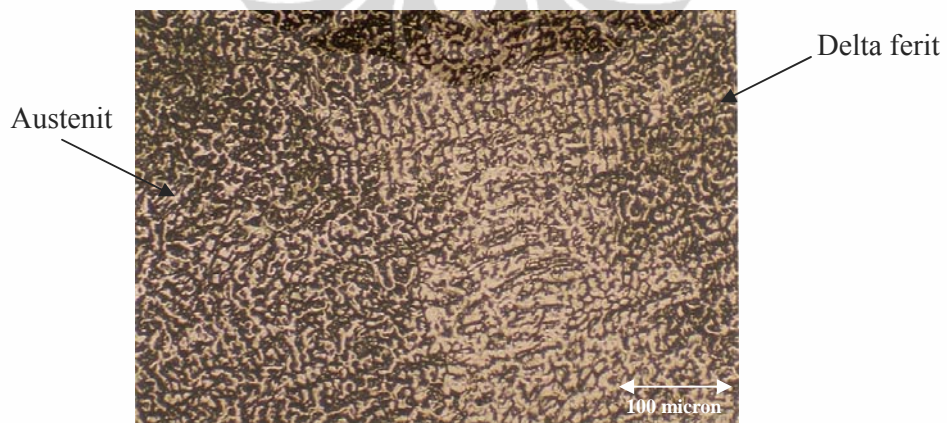
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Gambar Struktur Mikro WM Sampel 1, Ketebalan 1,5 mm SMAW

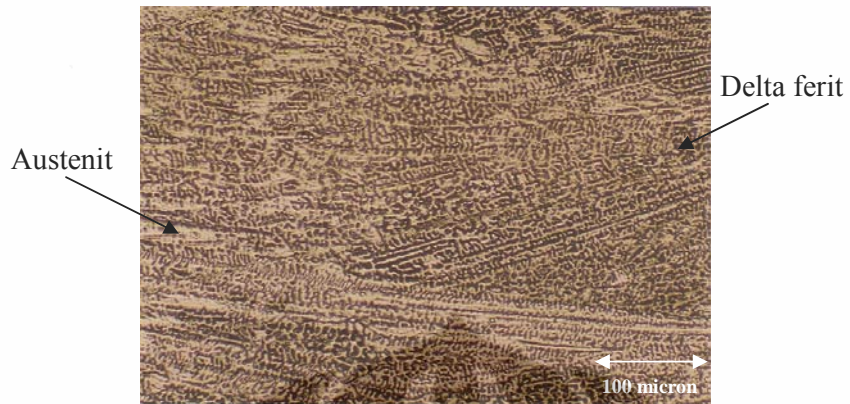


Gambar Struktur Mikro WM Sampel 2, Ketebalan 3 mm SMAW

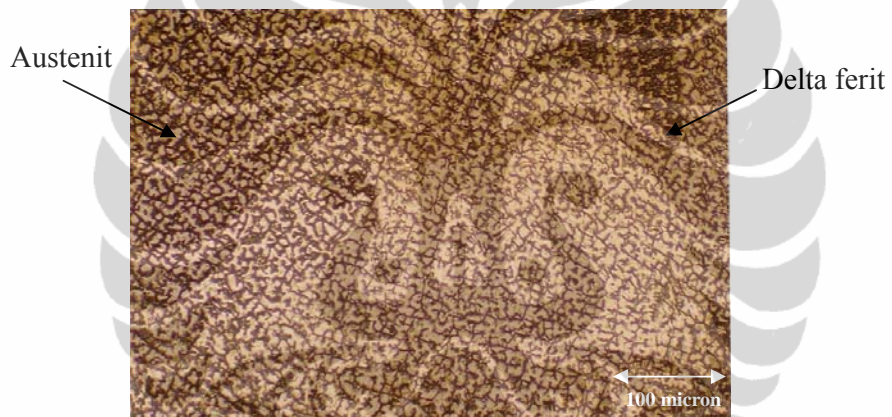


Gambar Struktur Mikro WM Sampel 3, Ketebalan 1,5 mm GTAW Tanpa Gas
Back Purgin

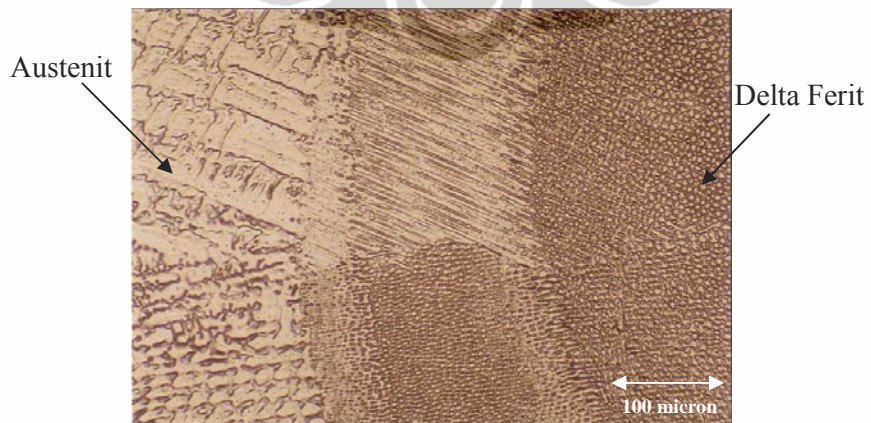
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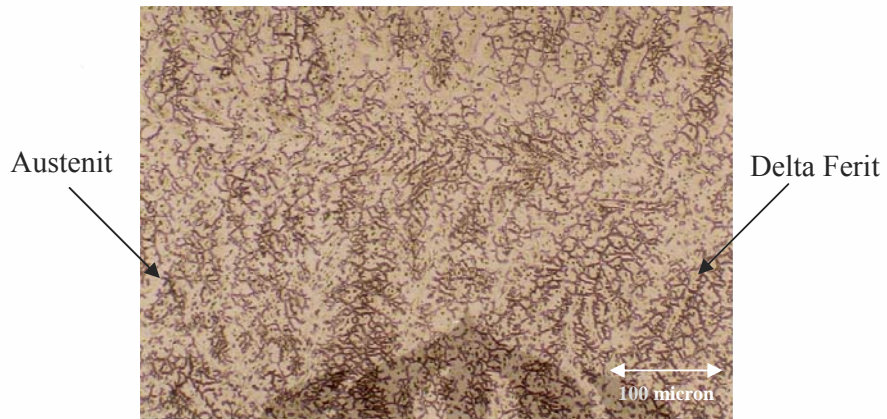
Gambar Struktur Mikro WM Sampel 4, Ketebalan 3 mm GTAW Tanpa *Gas Back Purgin*



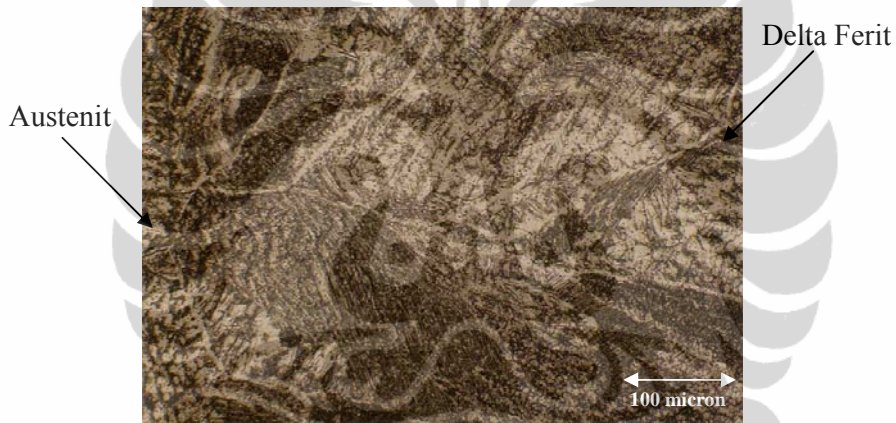
Gambar Struktur Mikro WM Sampel 5, Ketebalan 1,5 mm GTAW



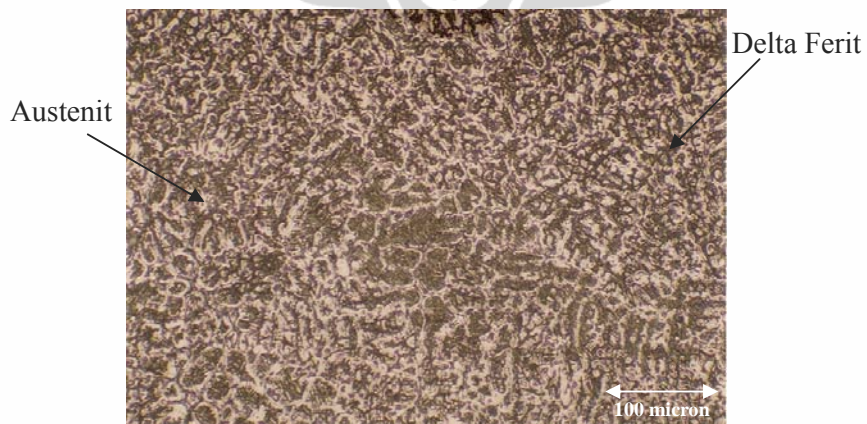
Gambar Struktur Mikro WM Sampel 6, Ketebalan 3 mm GTAW



Gambar Struktur Mikro WM Sampel 7, Ketebalan 1,5 mm GTAW dengan filler TGX

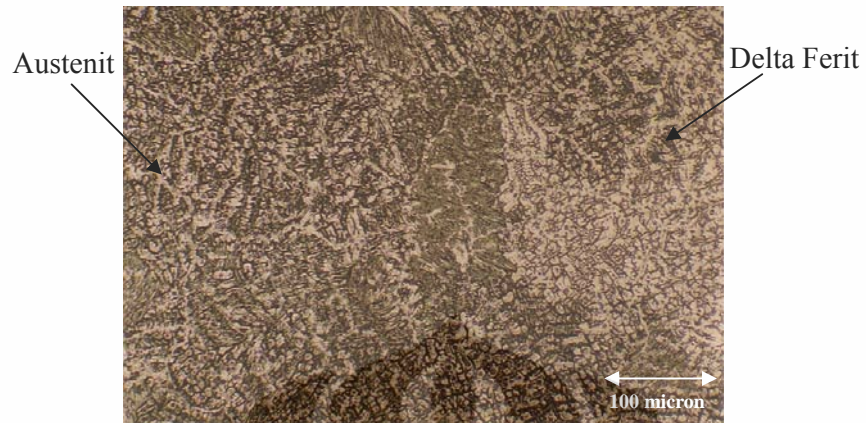


Gambar Struktur Mikro WM Sampel 8, Ketebalan 3 mm GTAW dengan filler TGX

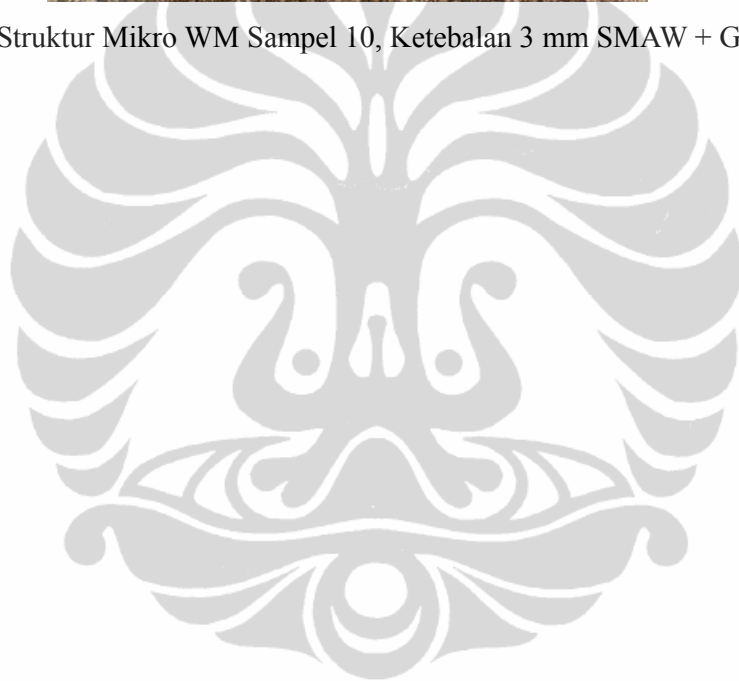


Gambar Struktur Mikro WM Sampel 9, Ketebalan 1,5 mm SMAW + GTAW

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Gambar Struktur Mikro WM Sampel 10, Ketebalan 3 mm SMAW + GTAW





LAMPIRAN 7
TABEL KEKERASAN MIKRO Hv

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Tabel Kekerasan VHN (kg/mm²)

VHN		1	2	3	4	5	Rata-Rata
Sampel	Daerah						
1	BM	244	243	247	285	281	260
	HAZ	283	313	326	324	270	303
	WM	344	279	277	314	327	308
2	BM	211	206	216	221	224	215
	HAZ	237	231	229	240	230	233
	WM	294	236	262	246	265	261
3	BM	234	237	236	256	262	245
	HAZ	245	253	253	251	243	249
	WM	289	251	271	250	268	266
4	BM	204	216	219	219	235	219
	HAZ	262	250	257	244	268	256
	WM	287	250	253	289	264	269
5	BM	236	251	241	238	250	243
	HAZ	285	287	261	294	314	288
	WM	221	264	270	228	287	254
6	BM	223	229	235	238	235	232
	HAZ	207	219	229	211	203	214
	WM	236	244	226	233	195	227
7	BM	220	219	223	227	226	223
	HAZ	245	228	257	231	229	238
	WM	227	225	248	225	238	233
8	BM	218	216	232	219	275	232
	HAZ	243	270	253	230	253	250
	WM	209	225	229	221	253	227
9	BM	227	256	243	241	240	241

	HAZ	271	285	286	275	286	281
	WM	321	277	345	286	248	295
10	BM	219	219	211	234	227	222
	HAZ	259	254	259	204	230	241
	WM	299	279	263	259	279	276



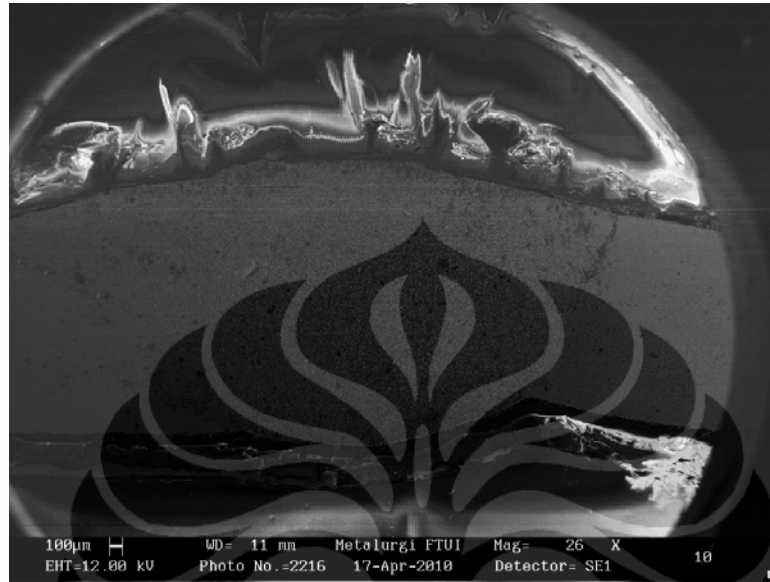
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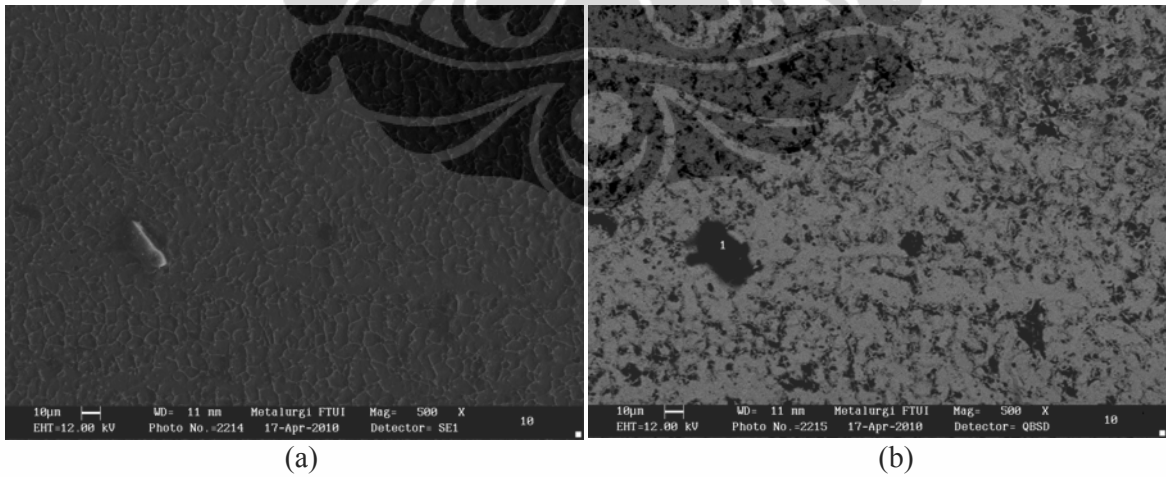
LAMPIRAN 8
PENGAMATAN SEM & HASIL EDS

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1. Sampel Tebal 1,5 mm Metoda SMAW



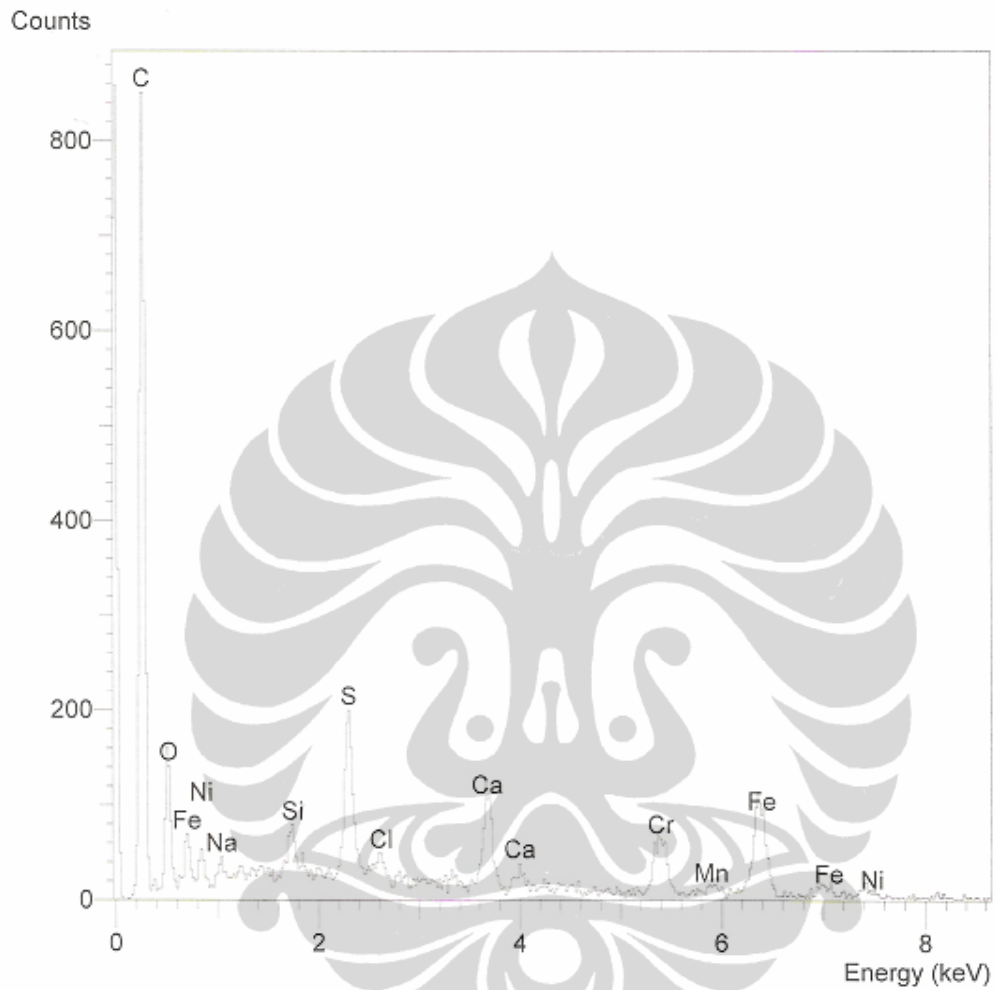
Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 1,5 mm Metoda SMAW



Bintik Hitam Sampel 1,5 mm Metoda SMAW dengan Perbesaran 500x (a)

Secondary Electron, (b) *Back Scattered Electron*

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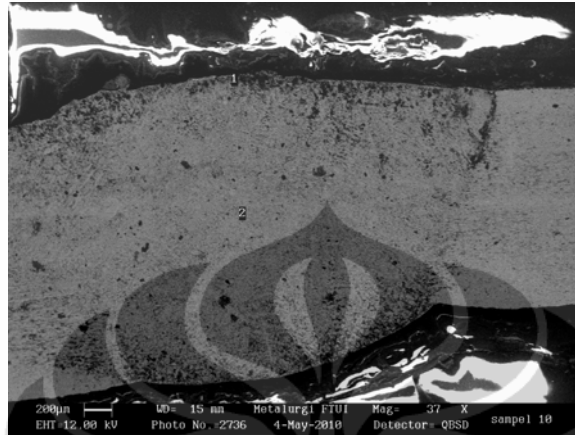


Hasil EDS Bintik Hitam Pada Sampel 1,5 mm Metoda SMAW

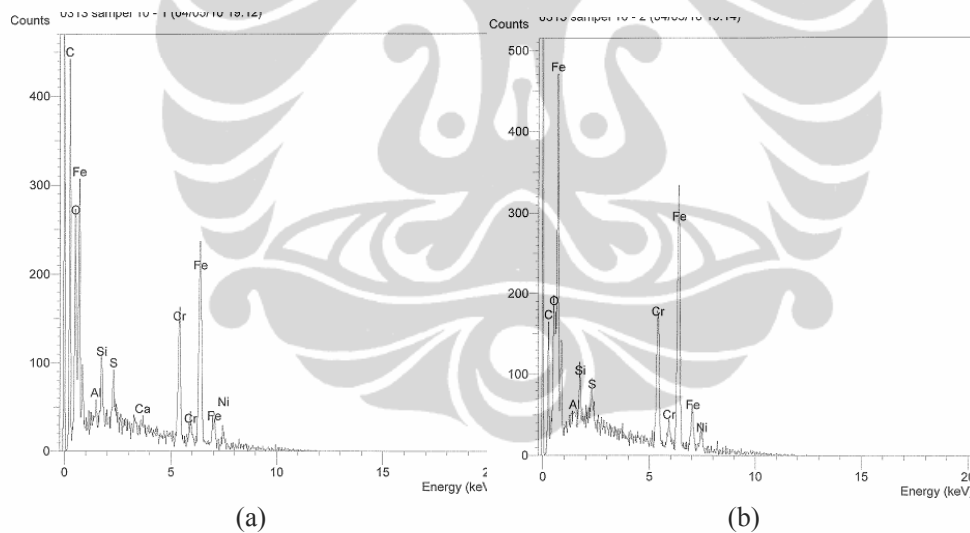
Tabel Hasil EDS Bintik Hitam Pada Sampel 1,5 mm Metoda SMAW

Unsur	C	O	Na	Si	S	Cl	Ca	Cr	Mn	Fe	Ni
% Element	8,42	5,70	1,46	0,91	7,31	4,35	11,16	12,12	0,20	39,93	8,46

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 1,5 mm Metoda SMAW



Hasil EDS Area WM Sampel 1,5 mm Metoda SMAW (a) Bagian Permukaan, (b) Bagian Dalam

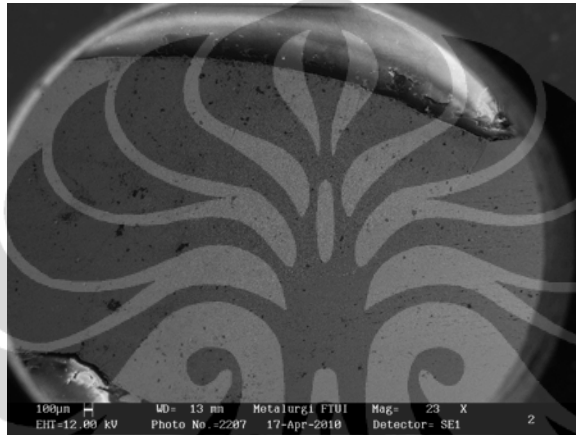
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda SMAW di Bagian Permukaan

Unsur	C	O	Si	S	Ca	Cr	Fe	Ni
% Element	2,49	5,60	1,09	1,28	0,74	18,11	60,50	10,20

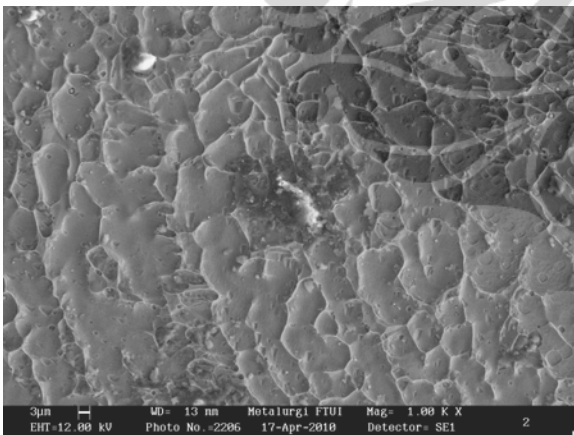
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda SMAW di Bagian Dalam

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	0,93	2,51	0,65	0,94	16,02	66,44	12,53

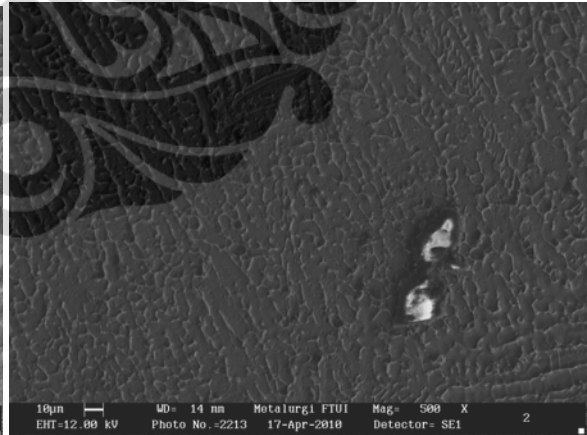
2. Sampel Tebal 3 mm Metoda SMAW



Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 3 mm Metoda SMAW

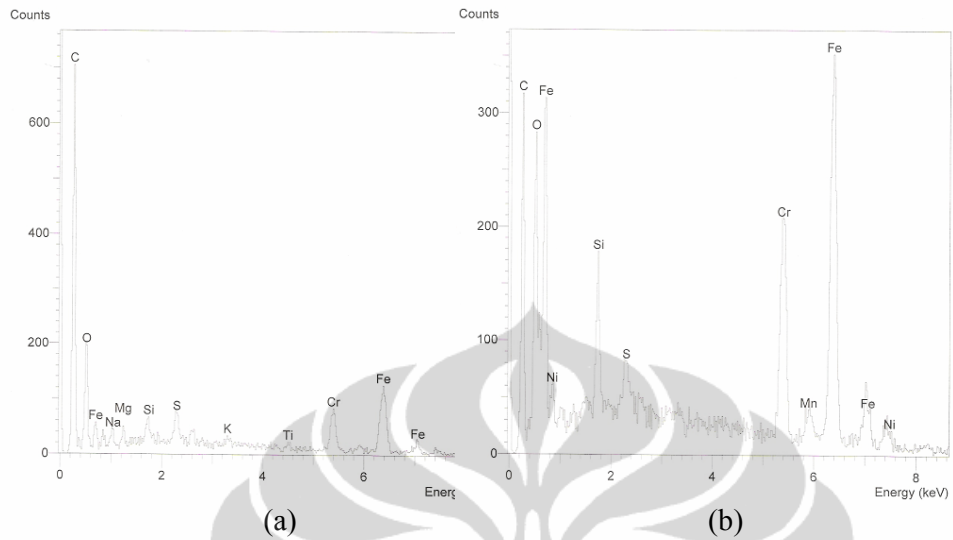


(a)



(b)

Bintik Hitam Pada Sampel 3 mm Metoda SMAW (a) Bintik Hitam 1 Dengan *Secondary Electron* Perbesaran 1000x, (b) Bintik Hitam 2 Dengan *Secondary Electron* Perbesaran 500x



Hasil EDS Pada Sampel 3 mm Metoda SMAW (a) Bintik Hitam 1, (b) Bintik Hitam 2

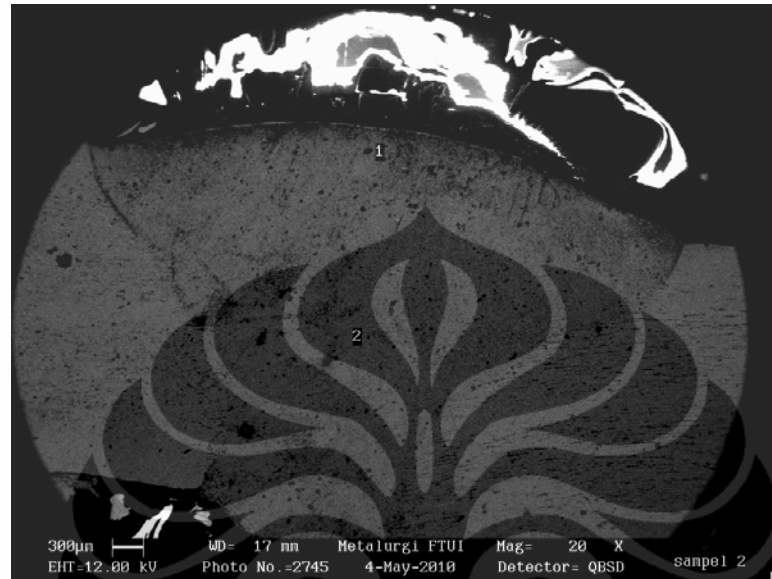
Tabel Hasil EDS Bintik Hitam 1 Pada Sampel 3 mm Metoda SMAW

Unsur	C	O	Na	Mg	Si	S	K	Ti	Cr	Fe
% Element	6,89	7,49	2,56	1,13	0,94	3,08	1,50	2,50	16,46	57,46

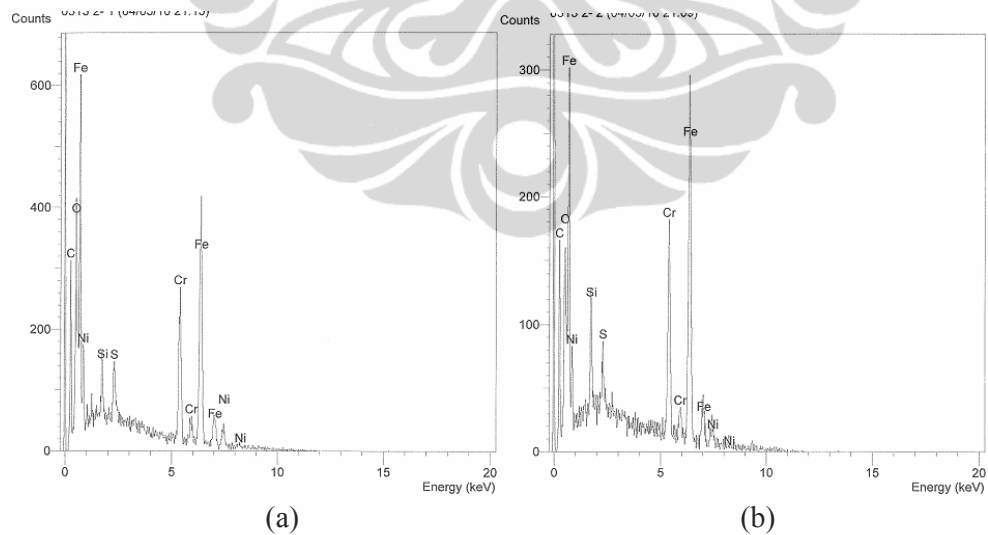
Tabel Hasil EDS Bintik Hitam 2 Pada Sampel 3 mm Metoda SMAW

Unsur	C	O	Si	S	Cr	Mn	Fe	Ni
% Element	1,40	3,54	1,26	0,94	17,89	0,30	64,72	9,96

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 3 mm Metoda SMAW



Hasil EDS Area WM Sampel 3mm Metoda SMAW (a) Bagian permukaan, (b) Bagian Dalam

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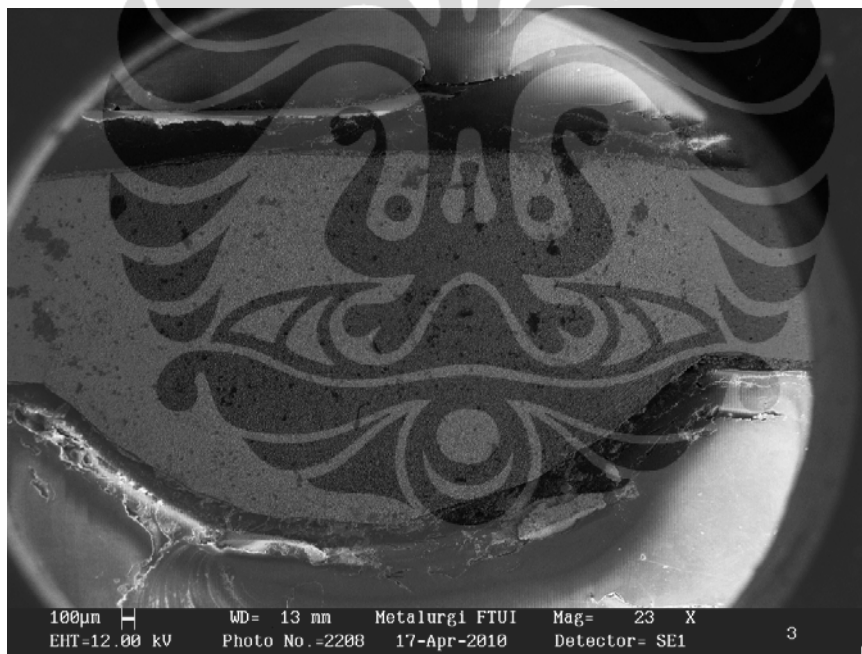
Tabel Hasil EDS Area WM Sampel 3 mm Metoda SMAW di Bagian Permukaan

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	1,15	5,11	0,83	1,64	17,14	61,63	12,50

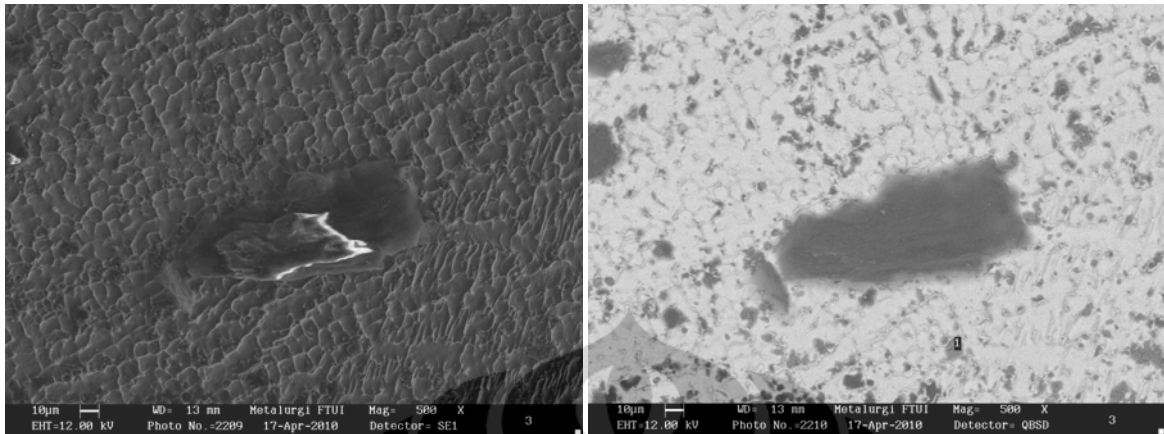
Tabel Hasil EDS Area WM Sampel 3 mm Metoda SMAW di Bagian Dalam

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	1,09	2,92	1,15	1,14	17,95	65,82	9,94

3. Sampel Tebal 1,5 mm Metoda GTAW Tanpa *Gas Back Purgig*

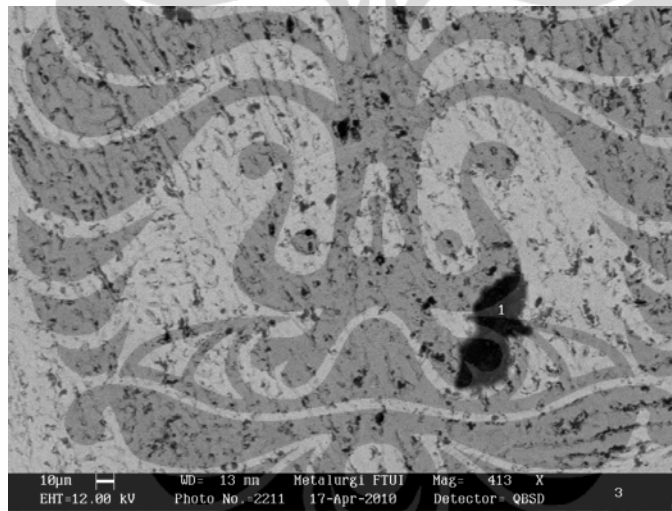


Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purgig*



(a)

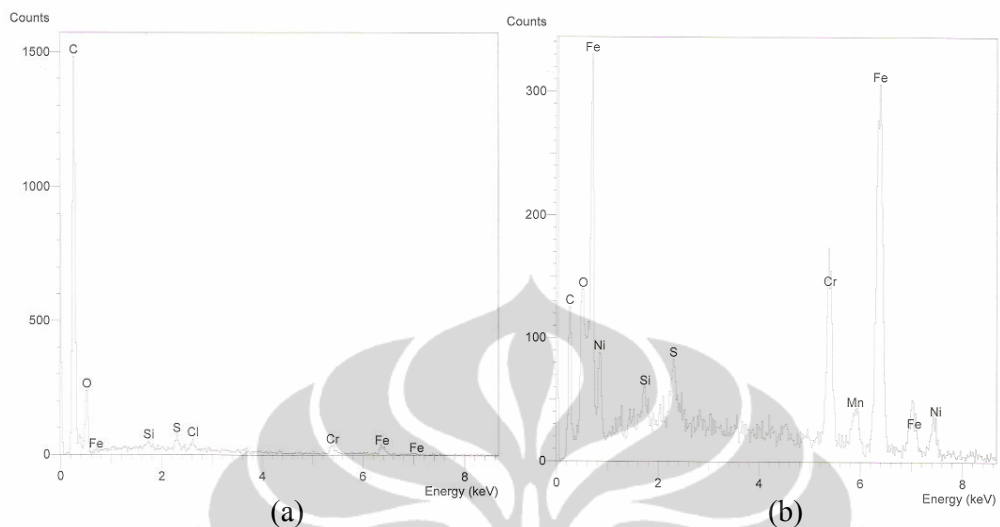
(b)



(c)

Bintik-Bintik Hitam Pada Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purging* (a) Bintik hitam 1 *Secondary Electron* Perbesaran 500x, (b) Bintik hitam 2 *Back Scattered Electron* 500x, (c) Bintik Hitam 2 *Back Scattered Electron* 413x

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Hasil EDS Pada Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purgung* (a) Bintik Hitam 1, (b) Bintik Hitam 2

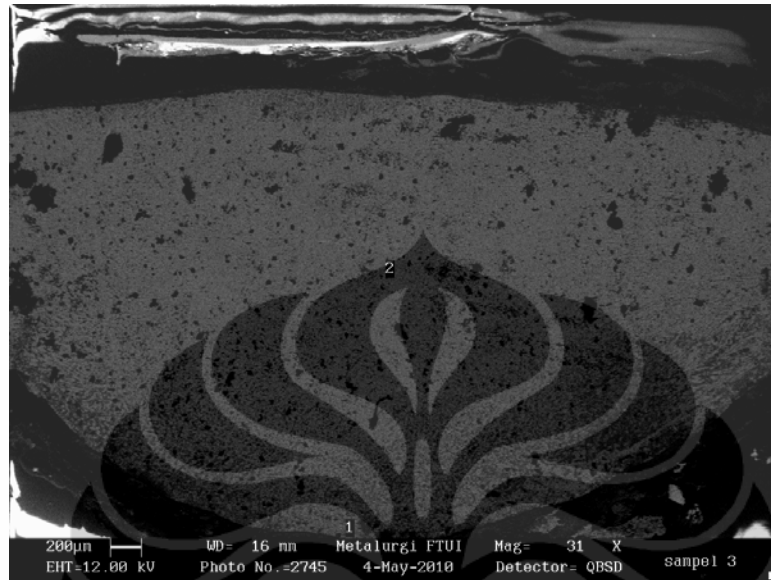
Tabel Hasil EDS Bintik Hitam 1 Pada Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purgung*

Unsur	C	O	Si	S	Cl	Cr	Fe
% Element	30,17	17,06	0,83	3,63	9,95	12,33	26,04

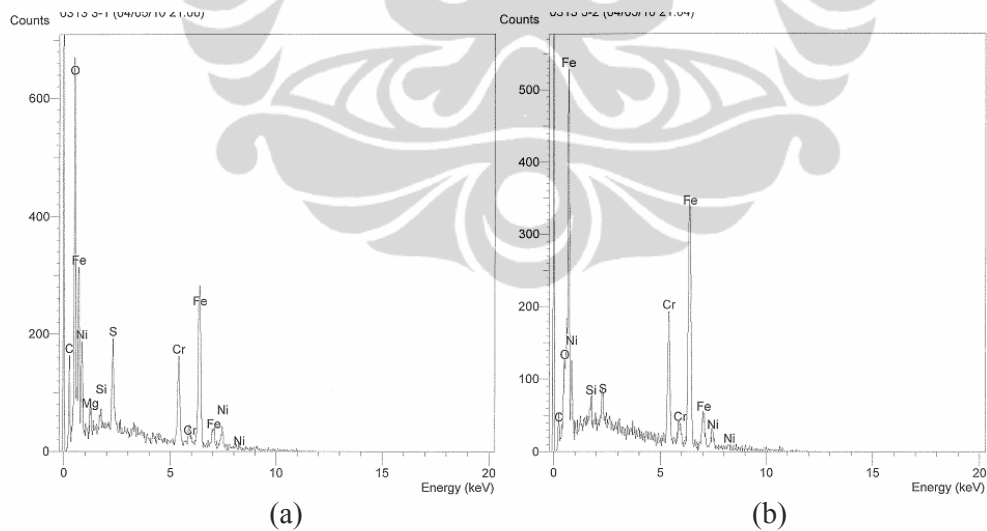
Tabel Hasil EDS Bintik Hitam 2 Pada Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purgung*

Unsur	C	O	Si	S	Cr	Mn	Fe	Ni
% Element	0,97	1,89	0,34	1,05	15,20	2,00	62,64	15,90

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purgings*



Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purgings* (a) Bagian permukaan, (b) Bagian Dalam

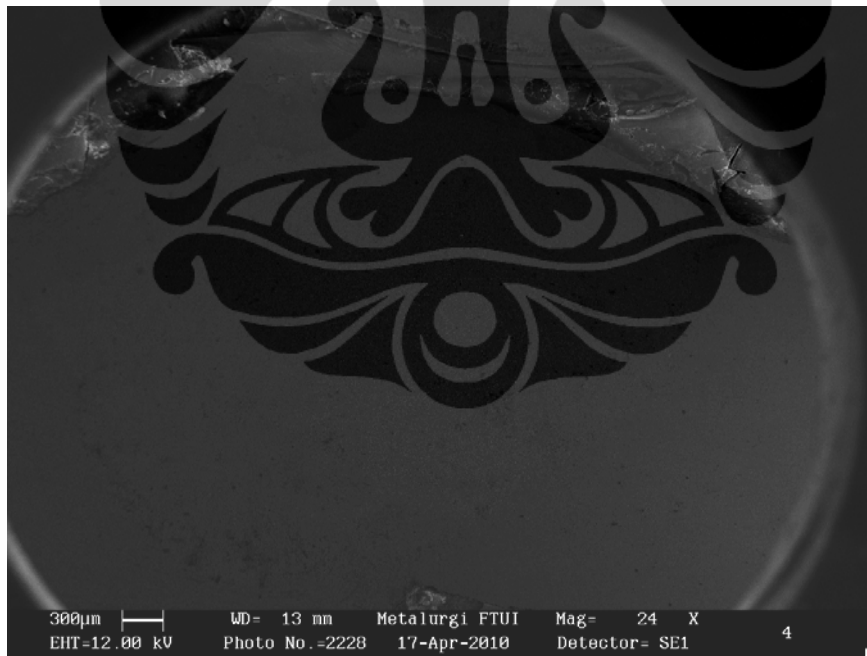
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purging* di Bagian Permukaan

Unsur	C	O	Mg	Si	S	Cr	Fe	Ni
% Element	0,94	10,70	0,75	0,25	3,25	13,86	55,51	14,74

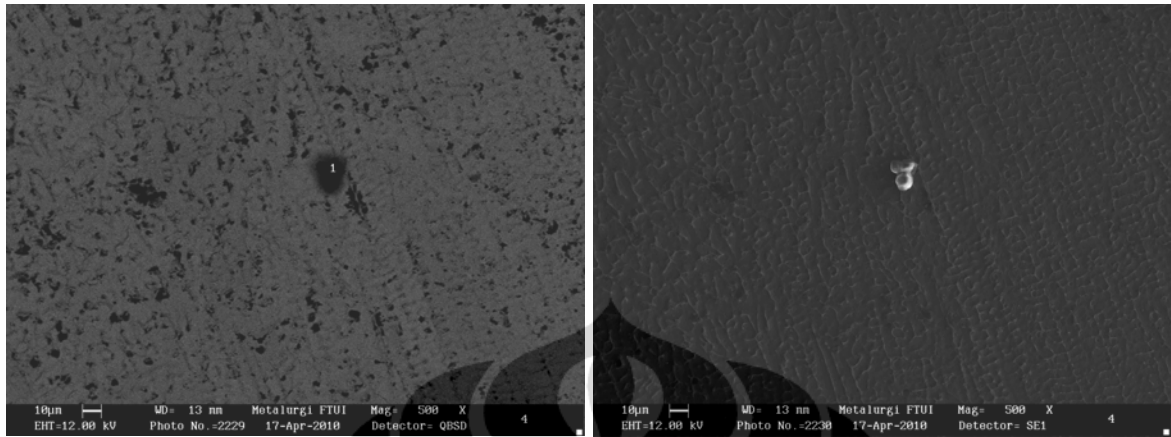
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW Tanpa *Gas Back Purging* di Bagian Dalam

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	0,46	1,61	0,34	0,98	15,55	68,64	12,42

4. Sampel Tebal 3 mm Metoda GTAW Tanpa *Gas Back Purging*



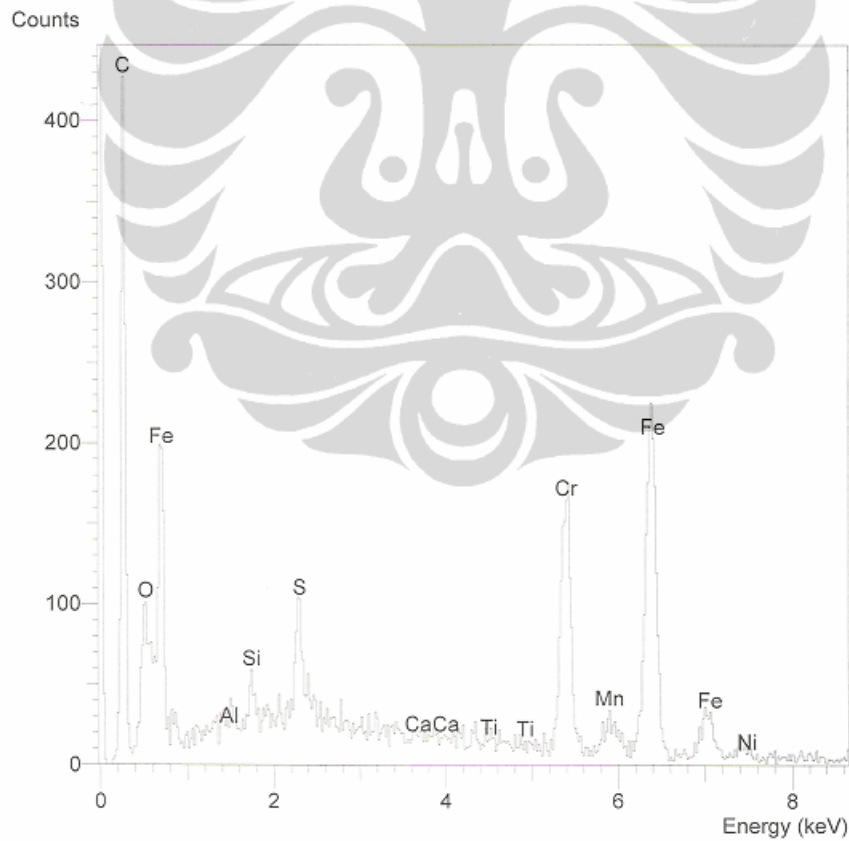
Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 3 mm Metoda GTAW Tanpa *Gas Back Purging*



(a)

(b)

Bintik Hitam Pada Sampel 3 mm Metoda GTAW Tanpa *Gas Back Purging* dengan Perbesaran 500x (a) *Back Scattered Electron*, (b) *Secondary Electron*



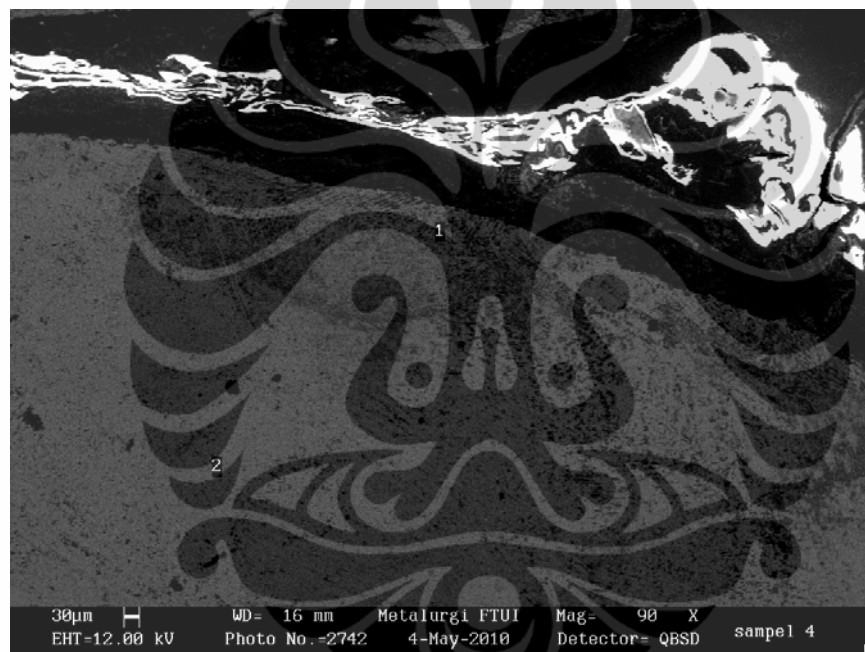
Hasil EDS Bintik Hitam Pada Sampel 3 mm Metoda GTAW Tanpa *Gas Back Purging*

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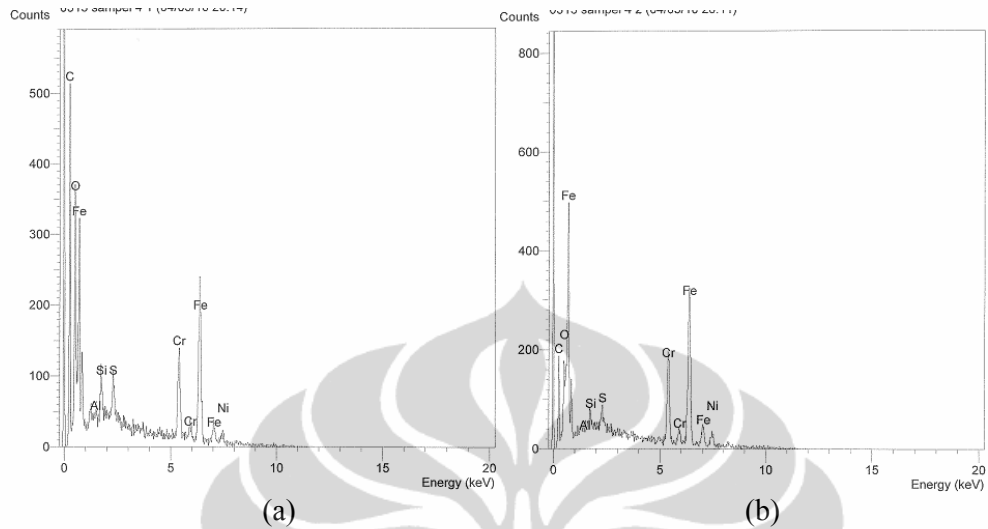
Tabel Hasil EDS Bintik Hitam Pada Sampel 3 mm Metoda GTAW Tanpa Gas Back Purging

Unsur	C	O	Al	Si	S	Ca	Ti	Cr	Fe
% Element	2,72	2,06	0,29	0,41	2,26	0,30	0,12	23,93	67,91

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 3 mm Metoda GTAW Tanpa Gas Back Purging



Hasil EDS Area WM Sampel 3 mm Metoda GTAW Tanpa *Gas Back Purgig* (a) Bagian permukaan, (b) Bagian Dalam

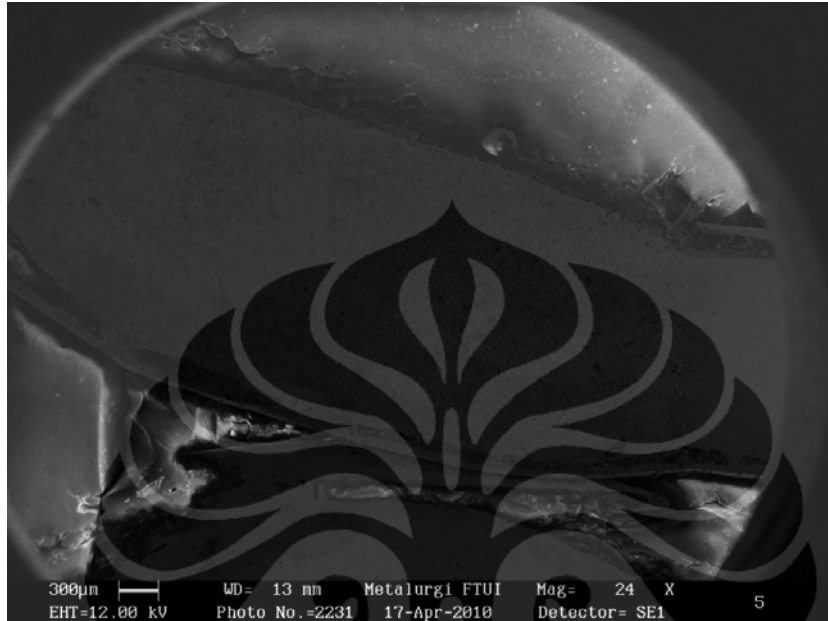
Tabel Hasil EDS Area WM Sampel 3 mm Metoda GTAW Tanpa *Gas Back Purgig* di Bagian Permukaan

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	2,96	7,95	1,03	1,94	15,90	61,07	9,15

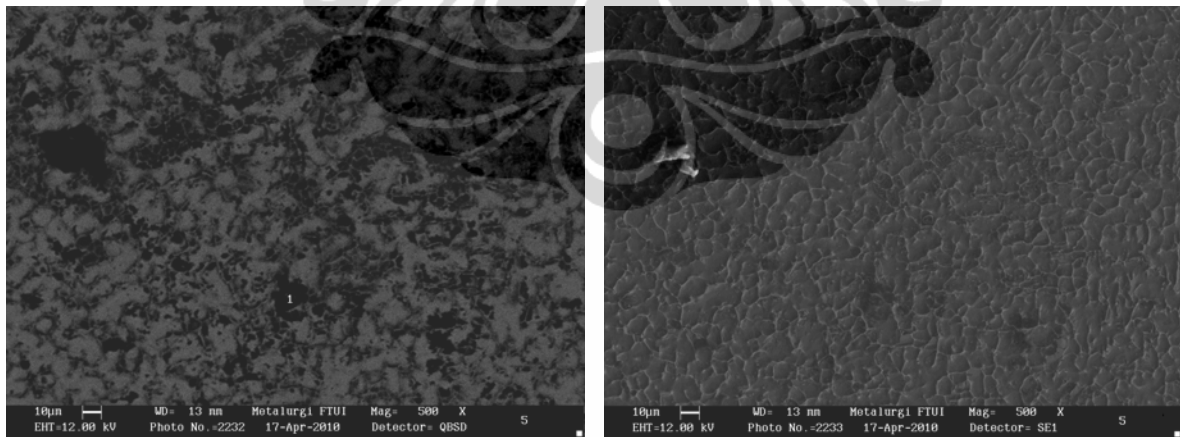
Tabel Hasil EDS Area WM Sampel 3 mm Metoda GTAW Tanpa *Gas Back Purgig* di Bagian Dalam

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	1,05	2,43	0,35	0,83	16,75	66,43	12,15

5. Sampel Tebal 1,5 mm Metoda GTAW



Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 1,5 mm Metoda GTAW

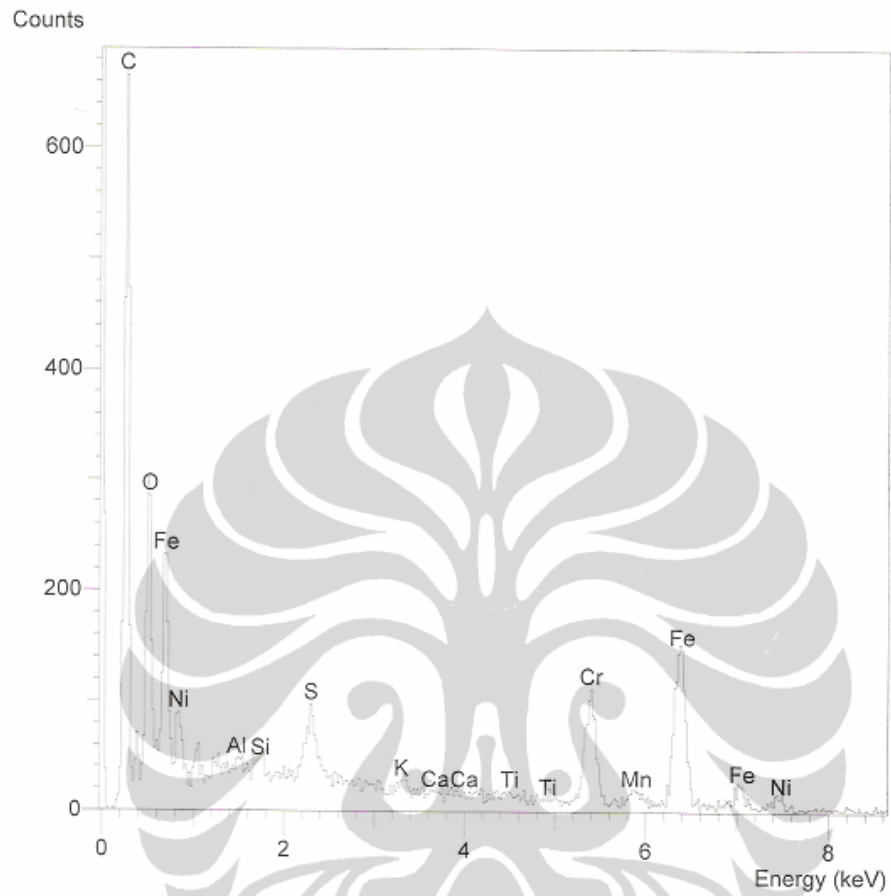


(a)

(b)

Bintik Hitam Pada Sampel 1,5 mm Metoda GTAW Perbesaran 500x (a) *Back Scattered Electron*, (b) *Secondary Electron*

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Hasil EDS Bintik Hitam Pada Sampel 1,5 mm Metoda GTAW

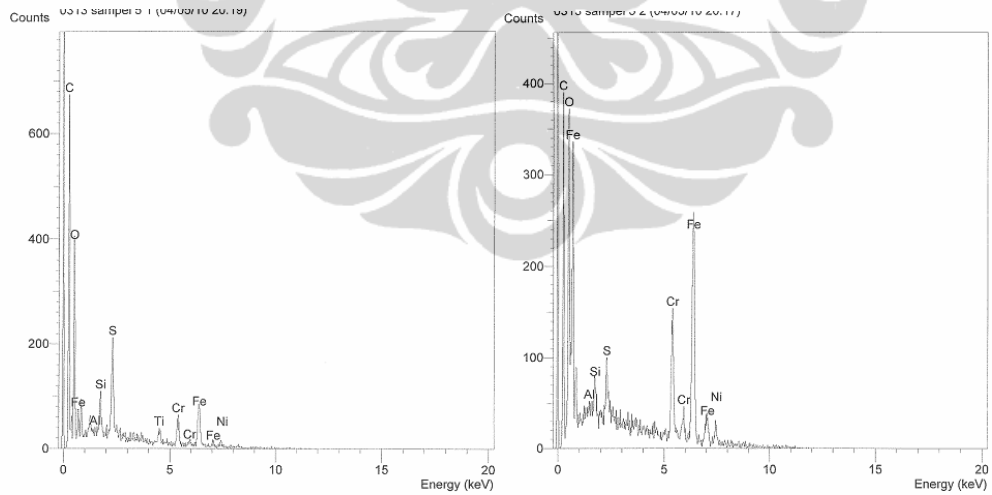
Tabel Hasil EDS Bintik Hitam Pada Sampel 1,5 mm Metoda GTAW

Unsur	C	O	Al	Si	S	K	Ca	Ti	Cr	Fe	Ni
% Element	4,71	8,05	0,22	0,45	2,26	1,45	0,08	0,47	16,50	54,44	11,37

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 1,5 mm Metoda GTAW



(a)

(b)

Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW (a) Bagian permukaan (b) Bagian Dalam

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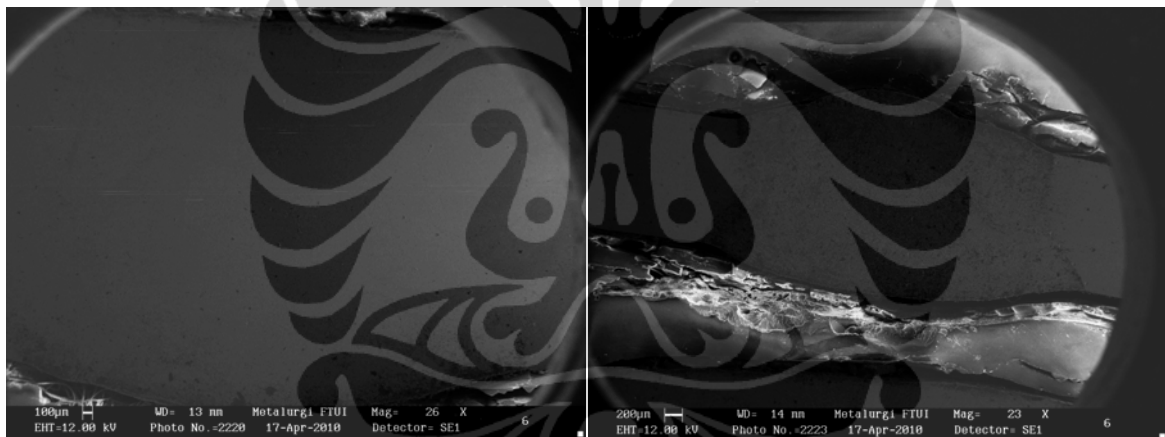
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW di Bagian Permukaan

Unsur	C	O	Si	S	Ti	Cr	Fe	Ni
% Element	7,59	18,43	1,75	9,11	4,57	11,21	37,12	10,22

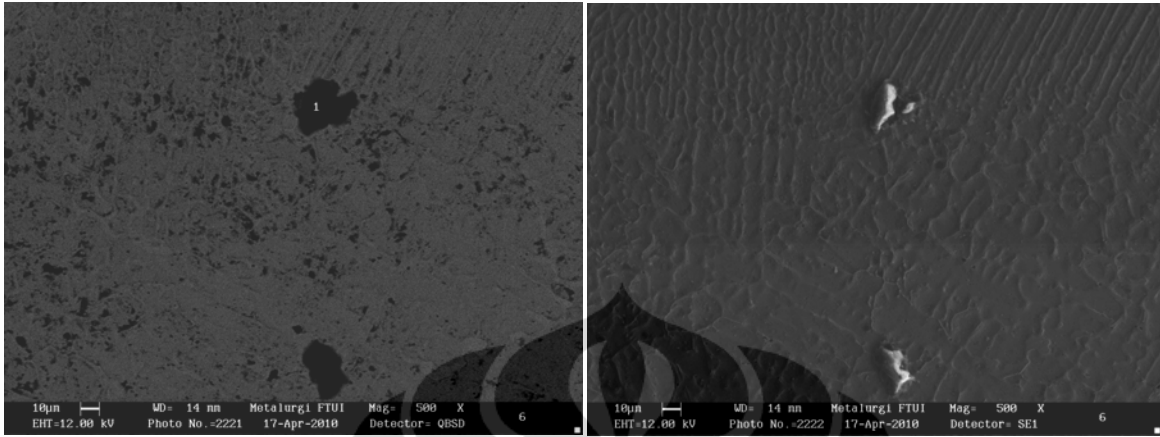
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW di Bagian Dalam

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	2,13	7,03	0,53	1,68	16,00	61,57	11,05

6. Sampel Tebal 3 mm Metoda GTAW



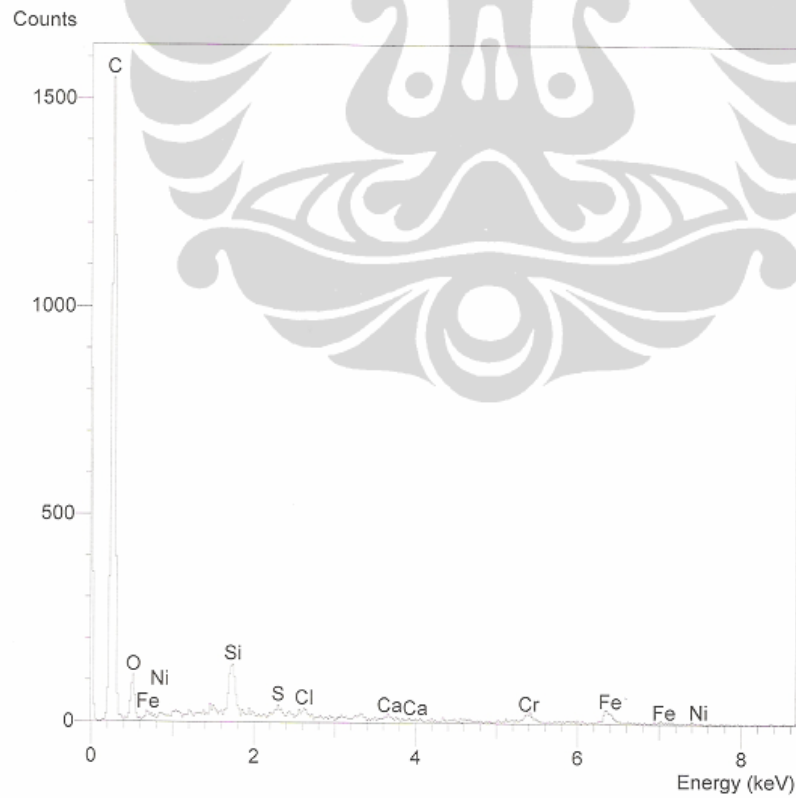
Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 3 mm Metoda GTAW



(a)

(b)

Bintik Hitam Pada Sampel 3 mm Metoda GTAW Perbesaran 500x (a) *Back Scattered Electron*, (b) *Secondary Electron*



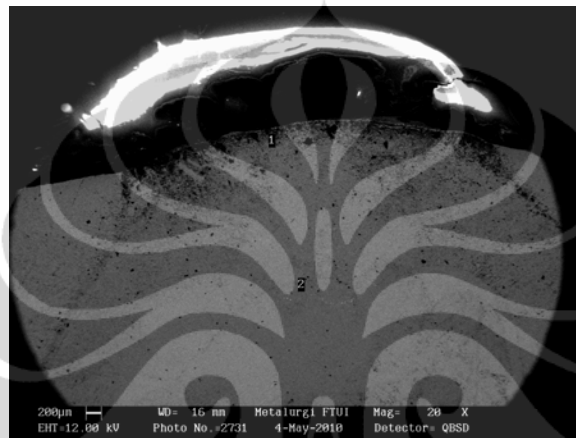
Hasil EDS Bintik-Bintik Hitam Pada Sampel 3 mm Metoda GTAW

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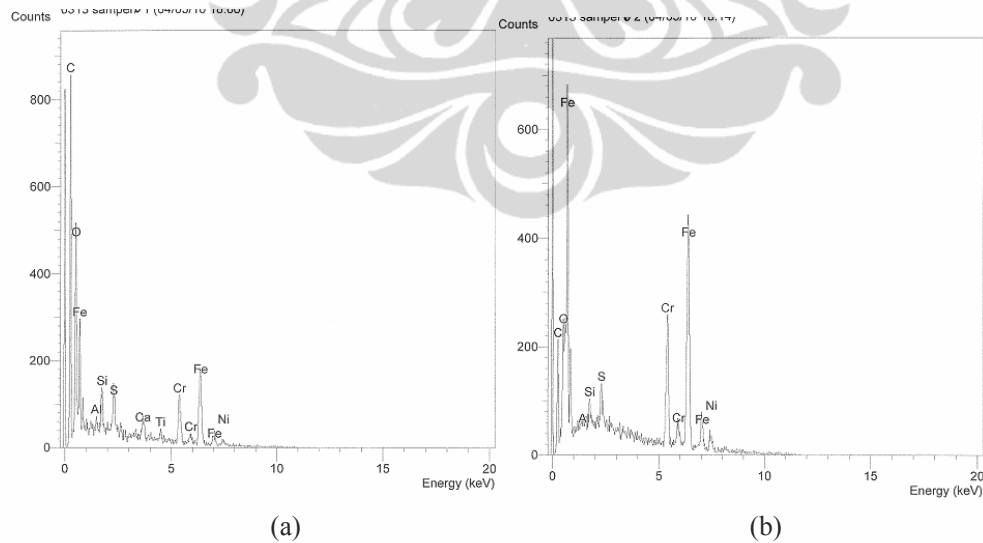
Tabel Hasil EDS Bintik Hitam Pada Sampel 3 mm Metoda GTAW

Unsur	C	O	Si	S	Cl	Ca	Cr	Fe	Ni
% Element	33,19	9,29	5,33	1,83	6,10	1,97	9,63	26,94	5,73

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 3 mm Metoda GTAW



Hasil EDS Area WM Sampel 3 mm Metoda GTAW (a) Bagian Permukaan, (b) Bagian Dalam

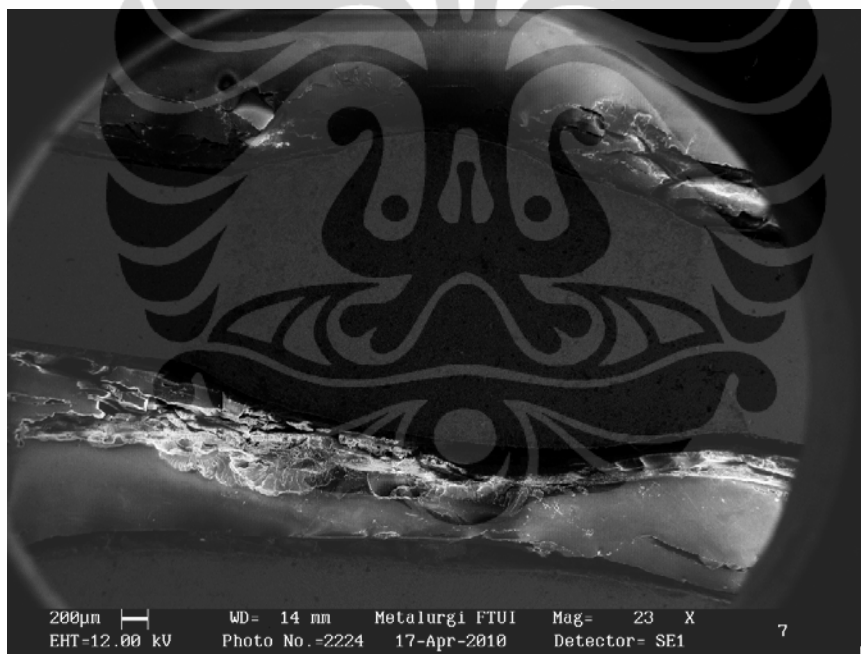
Tabel Hasil EDS Area WM Sampel 3 mm Metoda GTAW di Bagian Permukaan

Unsur	C	O	Si	S	Ca	Ti	Cr	Fe	Ni
% Element	4,61	13,69	1,51	3,09	3,13	2,27	14,68	50,50	6,51

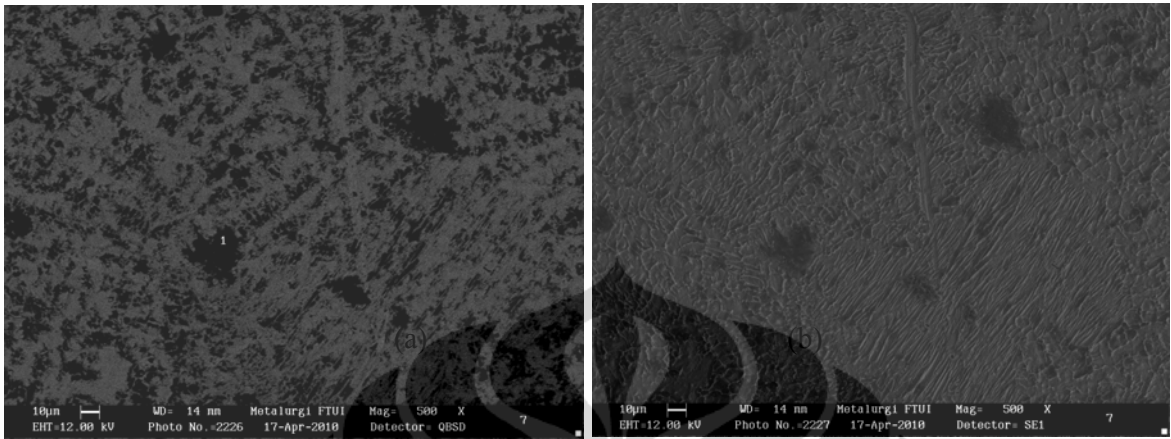
Tabel Hasil EDS Area WM Sampel 3 mm Metoda GTAW di Bagian Dalam

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	0,84	2,51	0,38	1,30	17,01	67,40	10,56

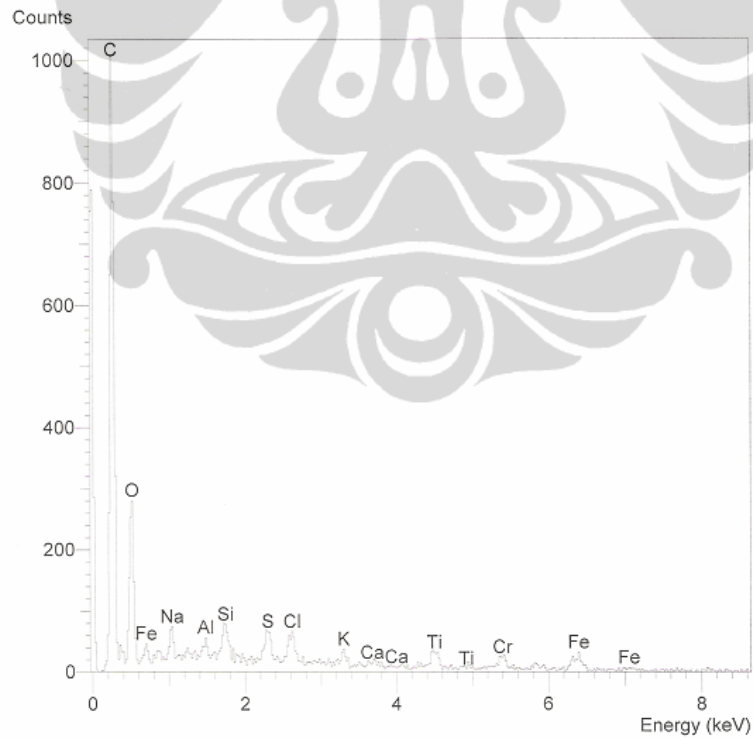
7. Sampel Tebal 1,5 mm Metoda GTAW dengan Filler TGX



Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 1,5 mm Metoda GTAW dengan Filler TGX



Bintik Hitam Pada Sampel 1,5 mm Metoda GTAW dengan Filler TGX Perbesaran 500x (a) *Back Scattered Electron*, (b) *Secondary Electron*



Hasil EDS Bintik-Bintik Hitam Pada Sampel 1,5 mm Metoda GTAW dengan Filler TGX

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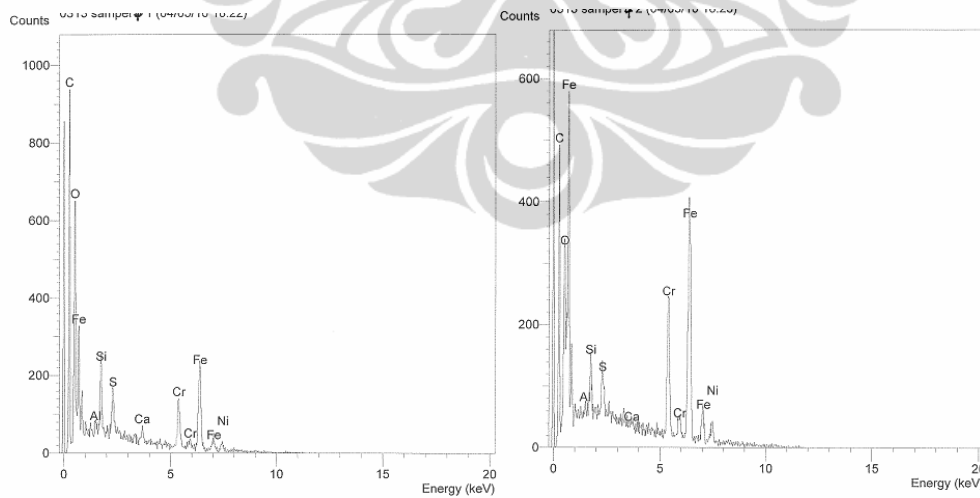
Tabel Hasil EDS Bintik Hitam Pada Sampel 1,5 mm Metoda GTAW dengan Filler TGX

Unsur	C	O	Na	Al	Si	S	Cl	K	Ca	Ti	Cr	Fe
% Element	18,94	24,81	4,28	0,92	1,61	3,61	12,53	3,03	1,16	7,80	6,45	14,86

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 1,5 mm Metoda GTAW dengan Filler TGX



(a)

(b)

Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW dengan Filler TGX (a) Bagian Permukaan, (b) Bagian Dalam

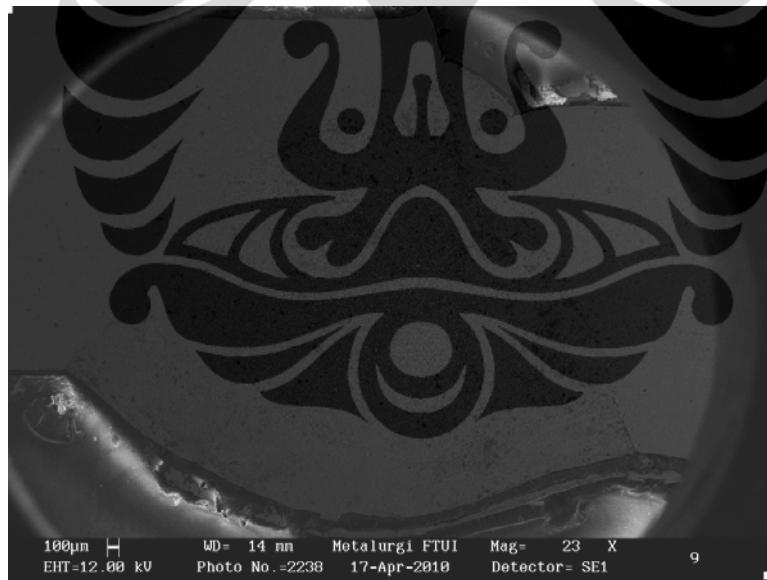
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW dengan Filler TGX di Bagian Permukaan

Unsur	C	O	Si	S	Ca	Cr	Fe	Ni
% Element	4,33	13,07	2,22	3,04	1,99	13,16	51,48	10,72

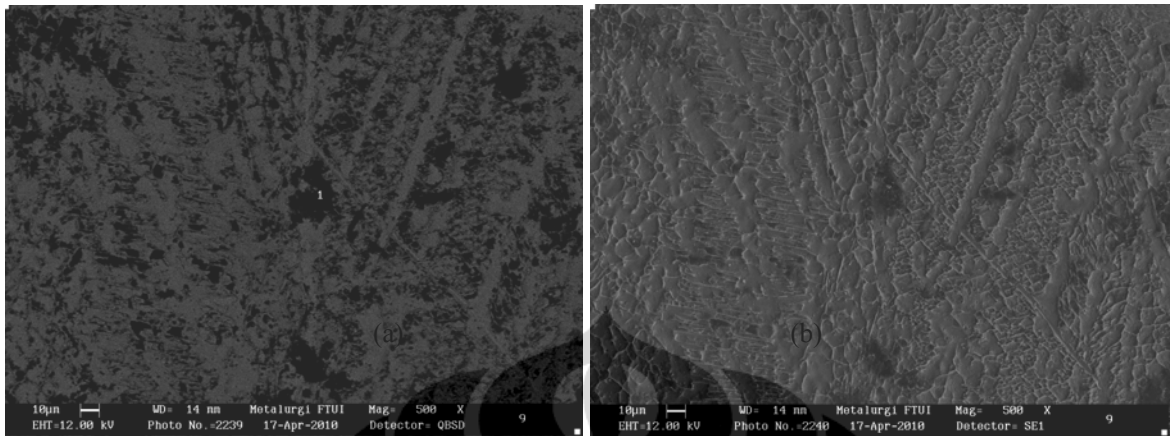
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda GTAW dengan filler TGX di Bagian Dalam

Unsur	C	O	Si	S	Ca	Cr	Fe	Ni
% Element	1,68	4,13	0,87	1,56	0,60	16,48	62,97	11,71

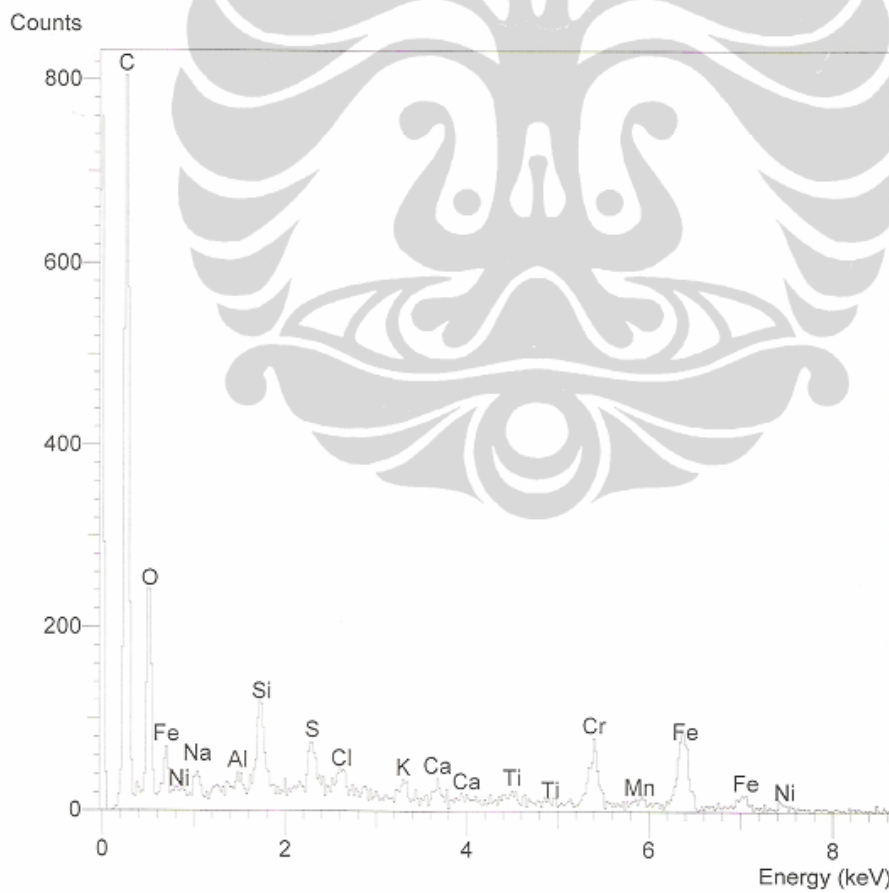
8. Sampel Tebal 3 mm Metoda GTAW dengan Filler TGX



Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 3 mm Metoda GTAW dengan Filler TGX



Bintik Hitam Pada Sampel 3 mm Metoda GTAW dengan Filler TGX Perbesaran 500x (a) *Back Scattered Electron*, (b) *Secondary Electron*



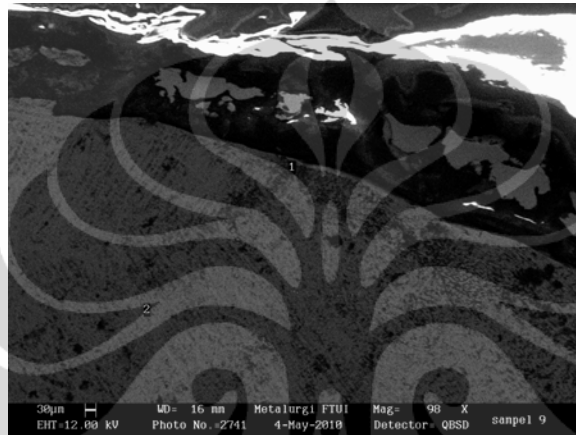
Hasil EDS Bintik-Bintik Hitam Pada Sampel 3 mm Metoda GTAW dengan Filler TGX

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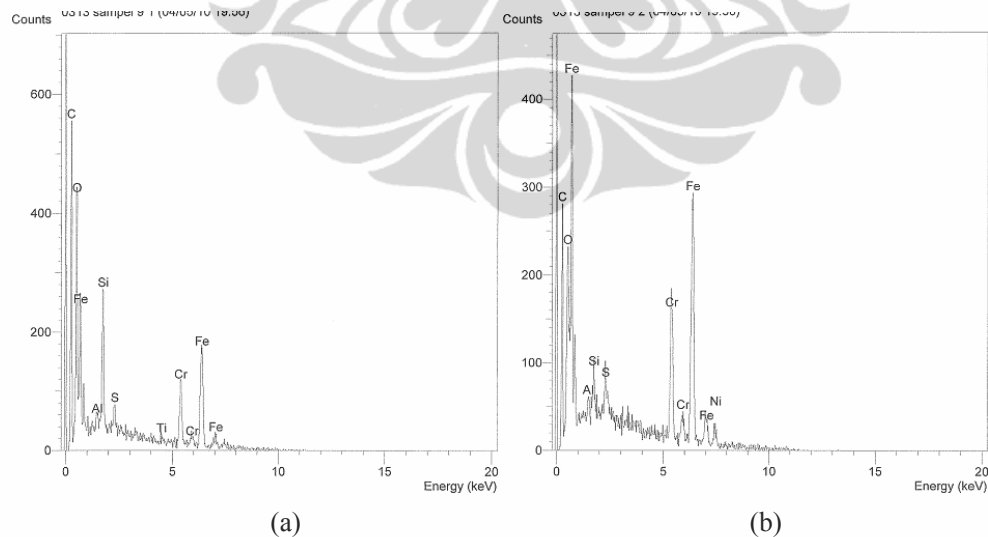
Tabel Hasil EDS Bintik Hitam Pada Sampel 3 mm Metoda GTAW dengan filler TGX

Unsur	C	O	Na	Al	Si	S	Cl	K	Ca	Ti	Cr	Fe	Ni
% Element	8,97	11,65	2,52	0,39	2,36	2,64	5,22	2,17	2,28	1,42	13,78	39,93	6,66

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 3 mm Metoda GTAW dengan Filler TGX



Hasil EDS Area WM Sampel 3 mm Metoda GTAW dengan Filler TGX (a) Bagian permukaan, (b) Bagian Dalam

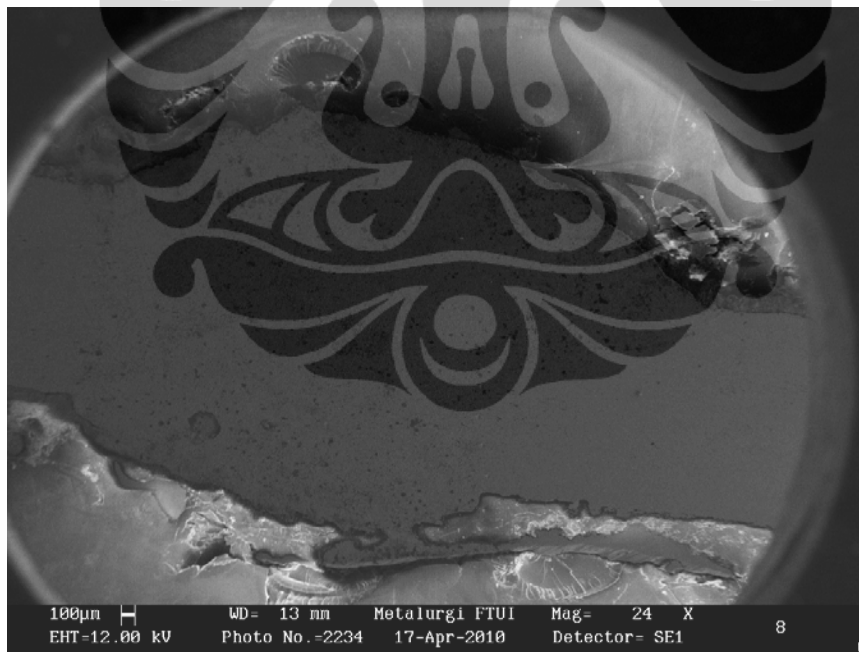
Tabel Hasil EDS Area WM Sampel 3 mm Metoda GTAW dengan Filler TGX di
Bagian Permukaan

Unsur	C	O	Si	S	Ti	Cr	Fe
% Element	4,07	11,30	4,07	1,55	1,77	16,76	60,48

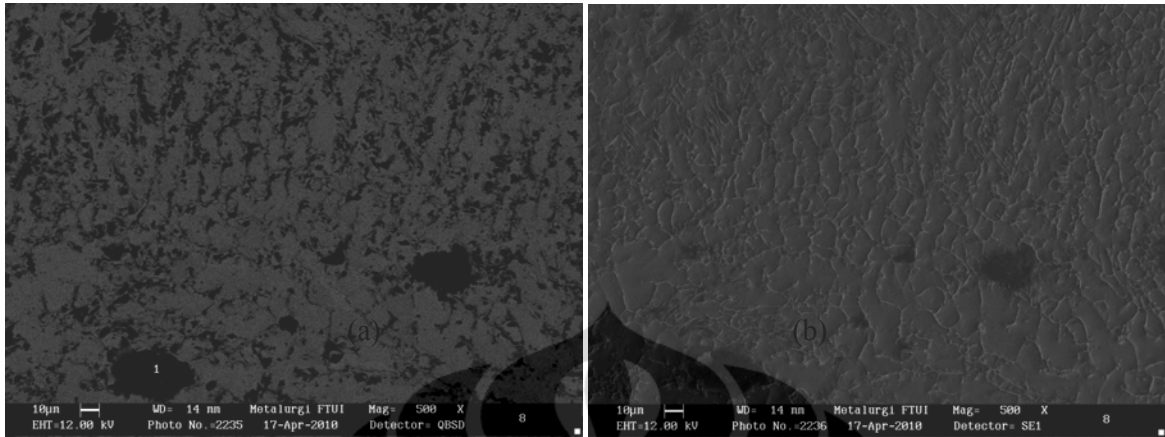
Tabel Hasil EDS Area WM Sampel 3 mm Metoda GTAW dengan Filler TGX di
Bagian Dalam

Unsur	C	O	Si	S	Cr	Fe	Ni
% Element	1,49	3,78	0,64	0,89	17,49	63,91	11,79

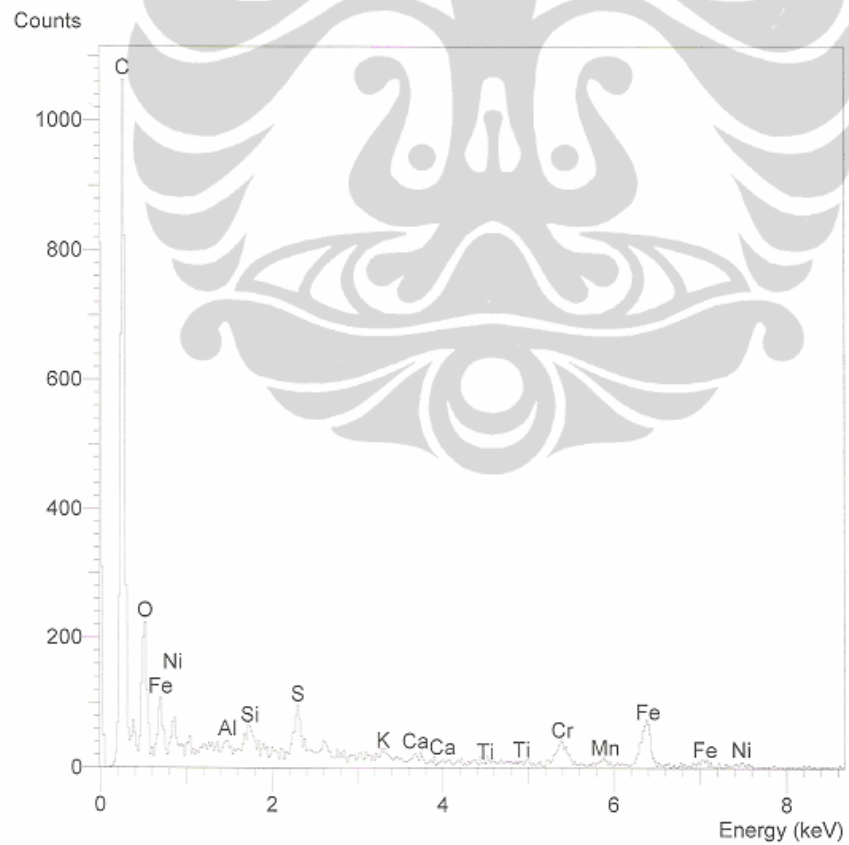
9. Sampel Tebal 1,5 mm Metoda SMAW + GTAW



Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 1,5 mm Metoda
SMAW + GTAW



Bintik Hitam Pada Sampel 1,5 mm Metoda SMAW + GTAW Perbesaran 500x (a) *Back Scattered Electron*, (b) *Secondary Electron*



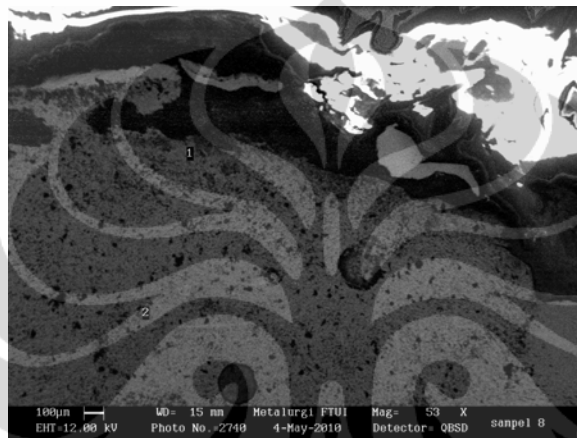
Hasil EDS Bintik-Bintik Hitam Pada Sampel 1,5 mm Metoda SMAW + GTAW

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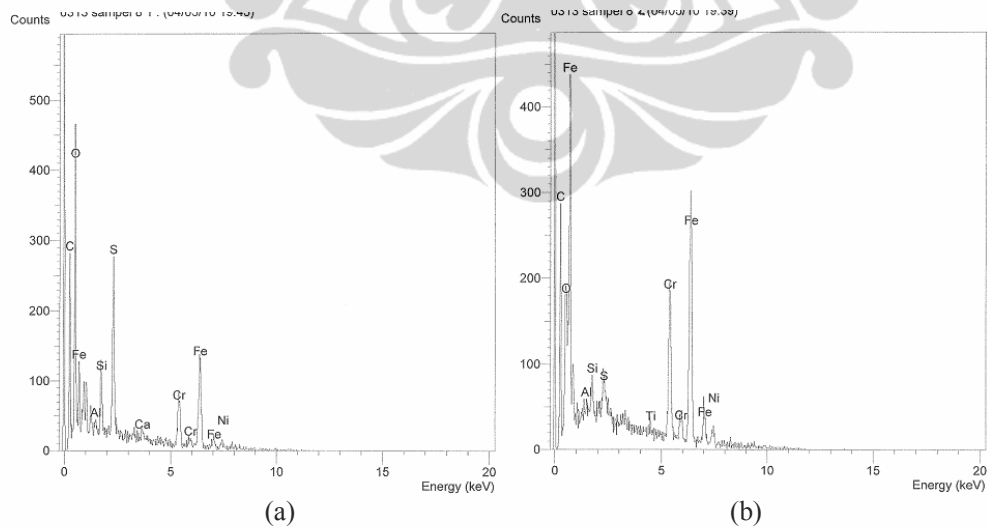
Tabel Hasil EDS Bintik Hitam Pada Sampel 1,5 mm Metoda SMAW + GTAW

Unsur	C	O	Al	Si	S	K	Ca	Ti	Cr	Fe	Ni
% Element	13,84	11,32	0,53	1,28	4,87	1,71	1,92	0,79	10,74	46,17	6,82

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 1,5 mm Metoda SMAW + GTAW



Hasil EDS Area WM Sampel 1,5 mm Metoda SMAW + GTAW (a) Bagian permukaan, (b) Bagian Dalam

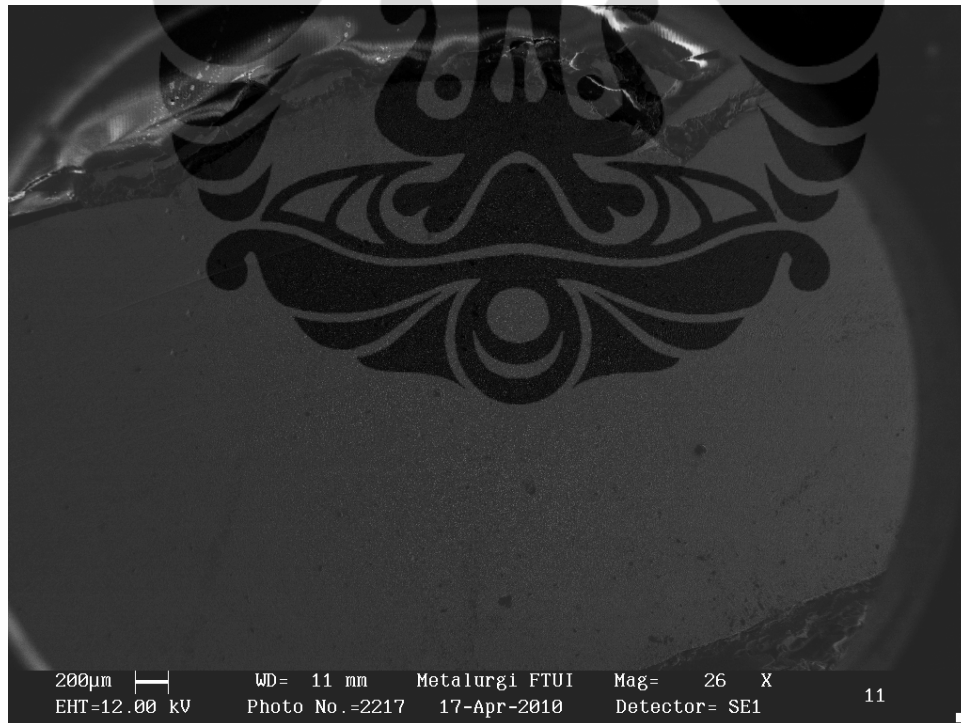
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda SMAW + GTAW di Bagian Permukaan

Unsur	C	O	Si	S	Ca	Cr	Fe	Ni
% Element	3,53	15,54	2,04	10,63	1,23	13,57	45,59	7,47

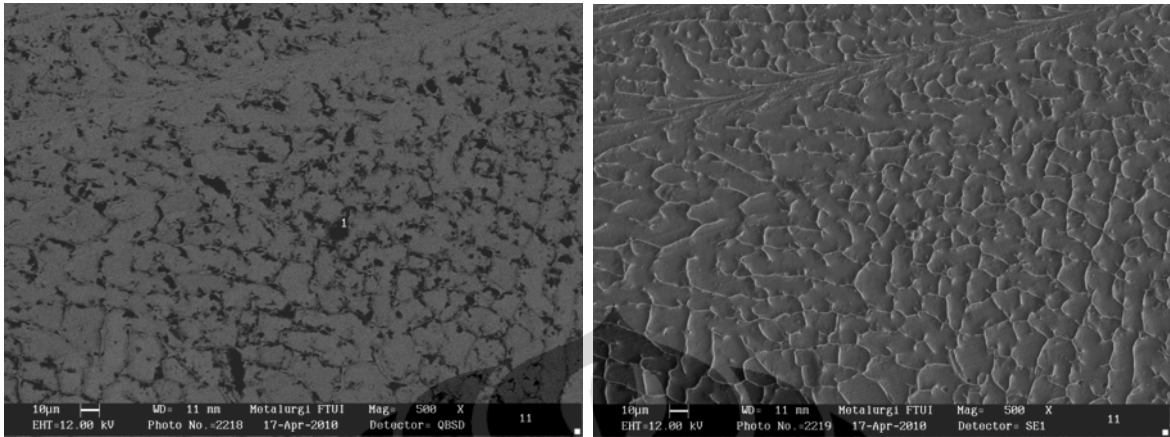
Tabel Hasil EDS Area WM Sampel 1,5 mm Metoda SMAW + GTAW di Bagian Dalam

Unsur	C	O	Si	S	Ti	Cr	Fe	Ni
% Element	1,43	3,30	0,51	1,10	0,86	18,04	64,16	10,61

10. Sampel Tebal 3 mm Metoda SMAW + GTAW



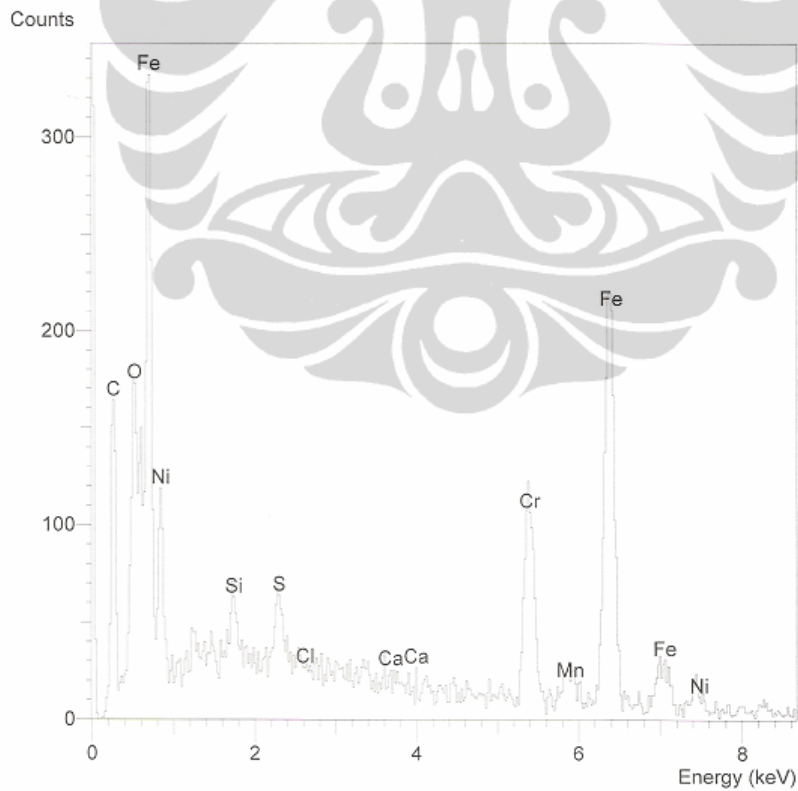
Penampang Melintang Permukaan *Weld Metal* (WM) Sampel 3 mm Metoda SMAW + GTAW



(a)

(b)

Bintik Hitam Pada Sampel 3 mm Metoda SMAW + GTAW Perbesaran 500x (a)
Back Scattered Electron, (b) *Secondary Electron*



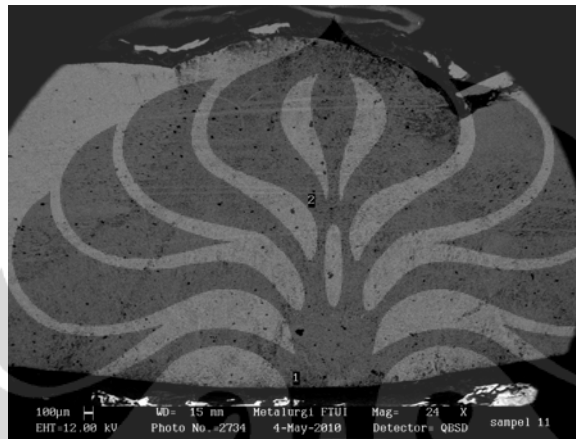
Hasil EDS Bintik-Bintik Hitam Pada Sampel 3 mm Metoda SMAW + GTAW

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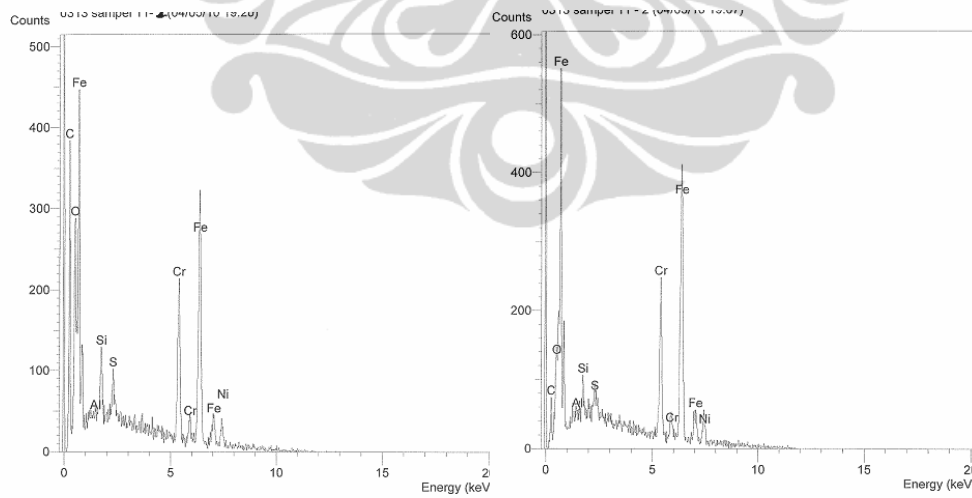
Tabel Hasil EDS Bintik Hitam Pada Sampel 3 mm Metoda SMAW + GTAW

Unsur	C	O	Si	S	Cl	Ca	Cr	Mn	Fe	Ni
% Element	1,53	3,29	0,55	1,35	0,14	0,19	15,23	1,36	64,65	11,71

Perbandingan Kadar Oksida di Permukaan dengan di Dalam Area WM



Penampang Melintang Sampel 3 mm Metoda SMAW + GTAW



(a)

(b)

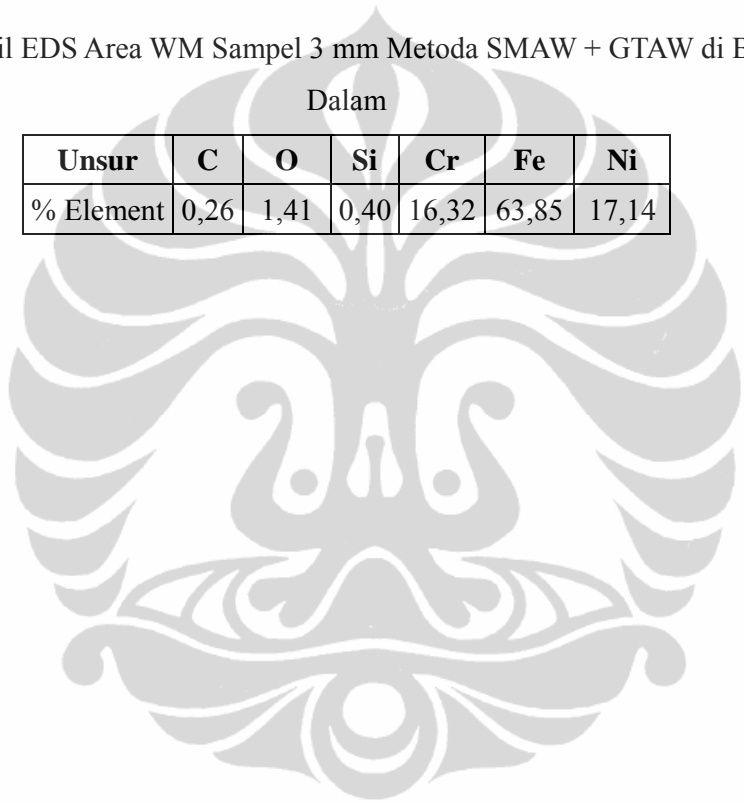
Hasil EDS Area Sampel 3 mm SMAW + GTAW (a) Bagian Permukaan, (b) Bagian Dalam

Tabel Hasil EDS Area WM Sampel 3 mm Metoda SMAW + GTAW di Bagian
Permukaan

Unsur	C	O	Si	S	Ca	Cr	Fe	Ni
% Element	1,68	4,36	0,84	0,97	1,99	17,93	59,65	14,57

Tabel Hasil EDS Area WM Sampel 3 mm Metoda SMAW + GTAW di Bagian
Dalam

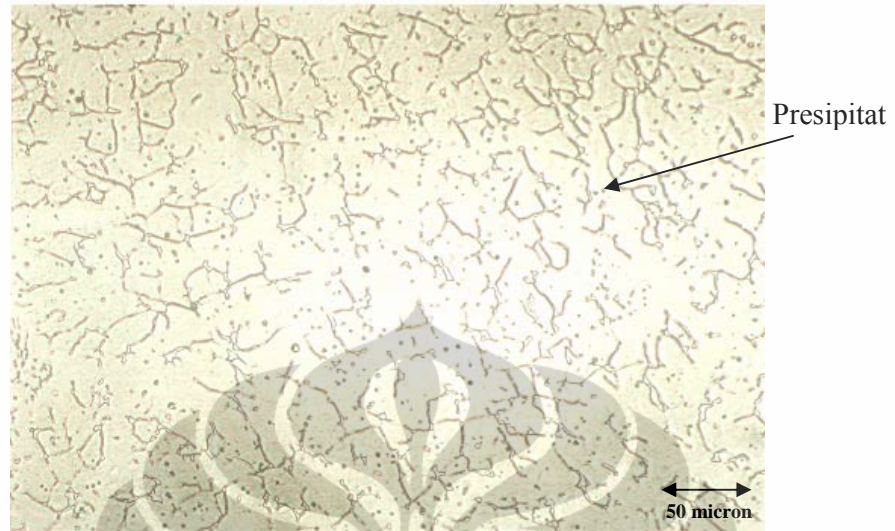
Unsur	C	O	Si	Cr	Fe	Ni
% Element	0,26	1,41	0,40	16,32	63,85	17,14



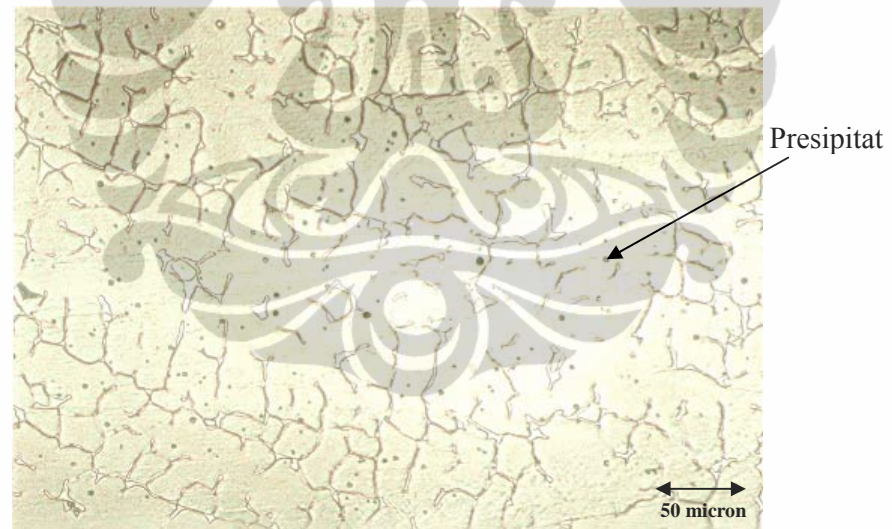


LAMPIRAN 9
PENGAMATAN FOTO MAKRO PRESIPITAT

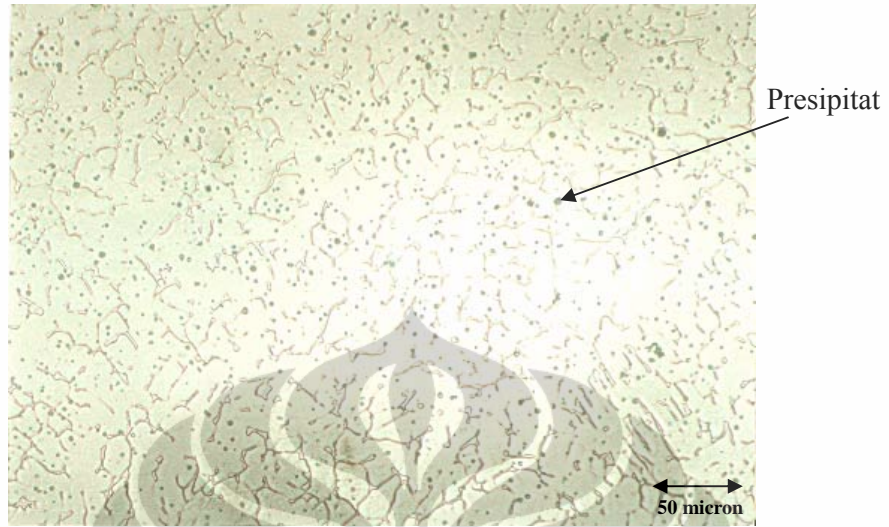
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Gambar Foto Makro Presipitat Sampel 1, Ketebalan 1,5 mm metoda SMAW



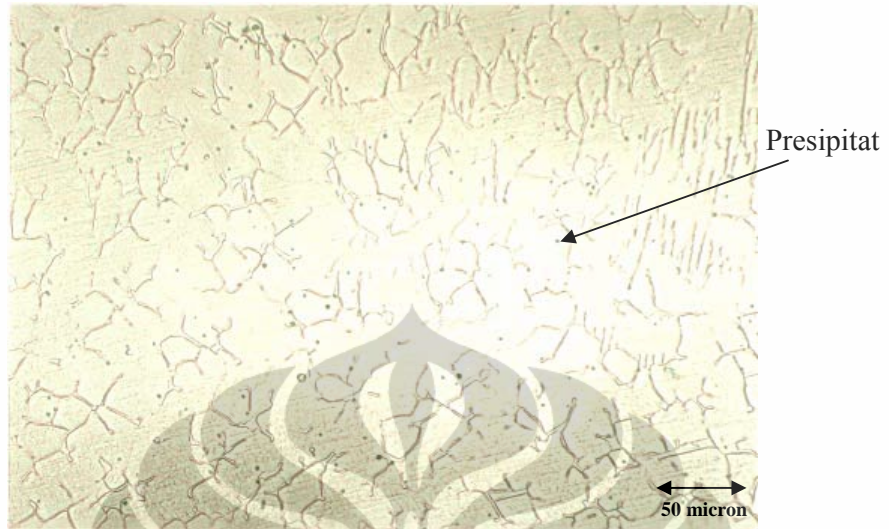
Gambar Foto Makro Presipitat Sampel 2, Ketebalan 3 mm metoda SMAW



Gambar Foto Makro Presipitat Sampel 3, Ketebalan 1,5 mm metoda GTAW tanpa *gas back purging*



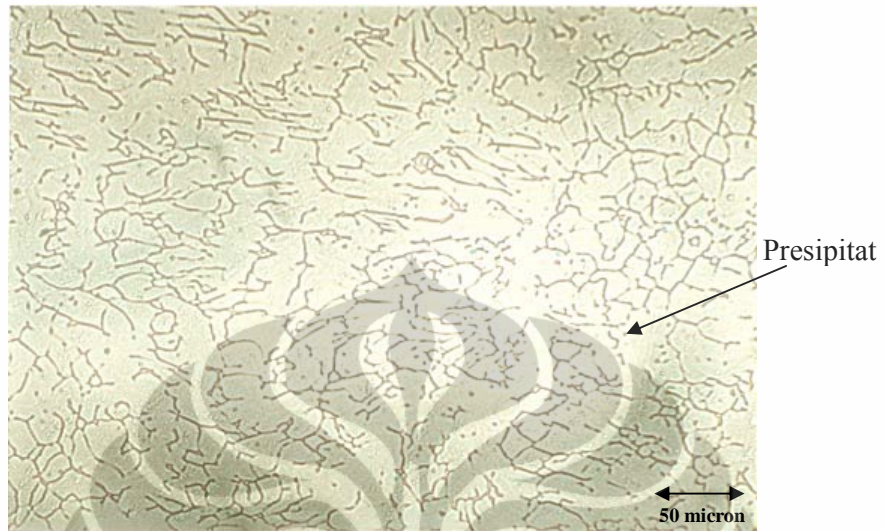
Gambar Foto Makro Presipitat Sampel 4, Ketebalan 3 mm metoda GTAW tanpa *gas back purging*



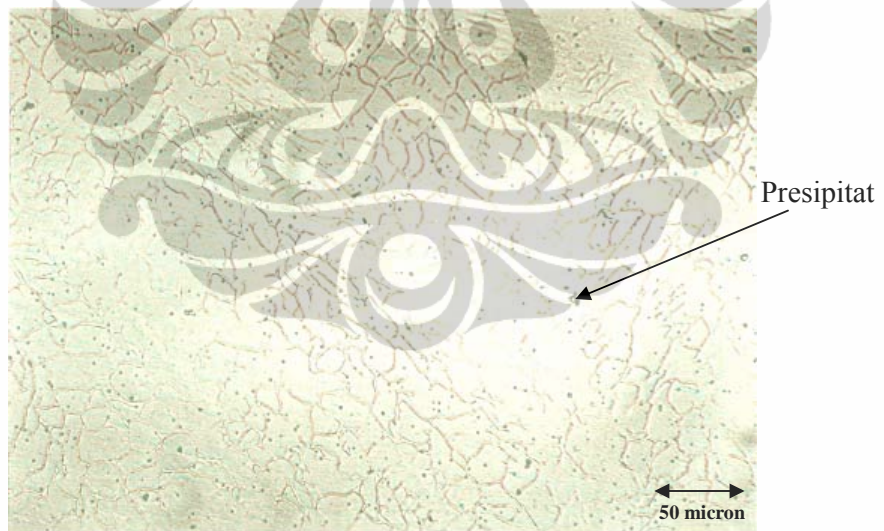
Gambar Foto Makro Presipitat Sampel 5, Ketebalan 1,5 mm metoda GTAW



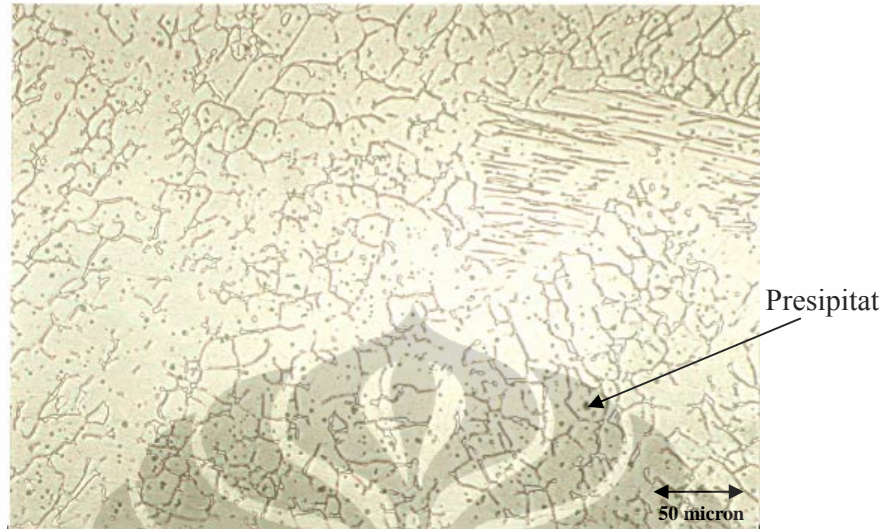
Gambar Foto Makro Presipitat Sampel 6, Ketebalan 3 mm metoda GTAW



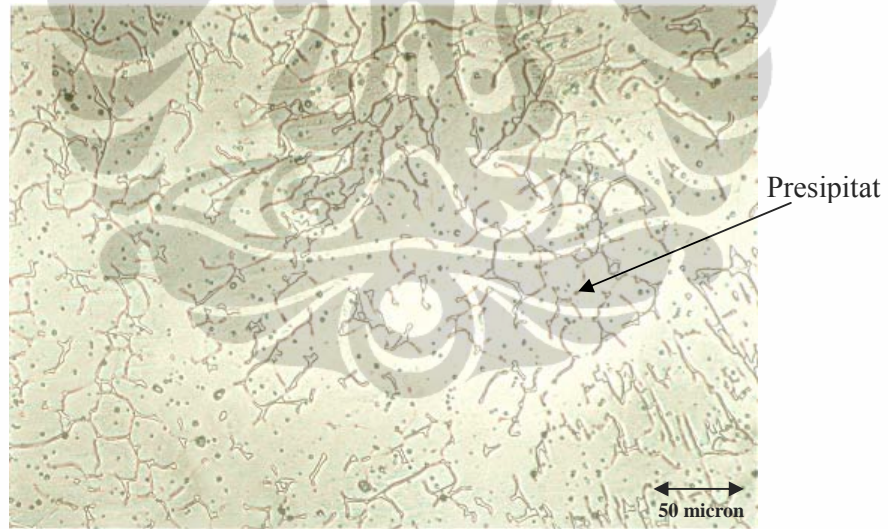
Gambar Foto Makro Presipitat Sampel 7, Ketebalan 1,5 mm metoda GTAW Dengan Filler TGX



Gambar Foto Makro Presipitat Sampel 8, Ketebalan 3 mm metoda GTAW Dengan Filler TGX



Gambar Foto Makro Presipitat Sampel 9, Ketebalan 1,5 mm metoda SMAW + GTAW



Gambar Foto Makro Presipitat Sampel 10, Ketebalan 3 mm metoda SMAW + GTAW








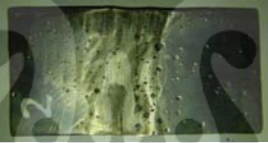

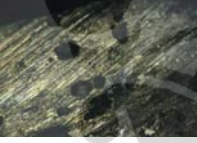

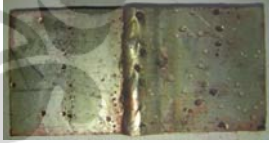
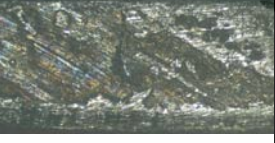
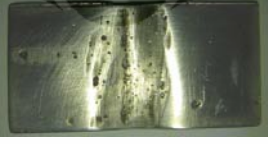
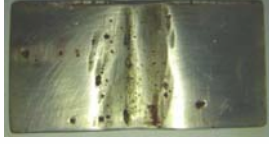



LAMPIRAN 10
HASIL PENGAMATAN FOTO MAKRO, VISUAL SEBELUM &
SESUDAH NDT HASIL PENGUJIAN KETAHANAN KOROSI *PITTING*

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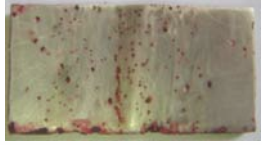











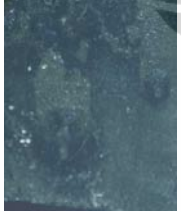

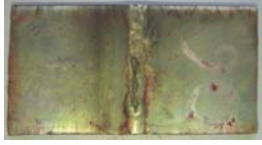
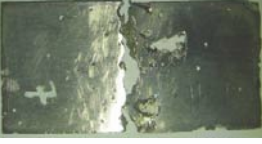
Skala : \longleftrightarrow

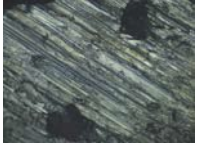
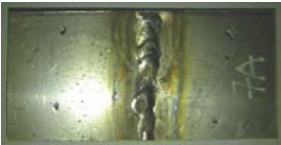
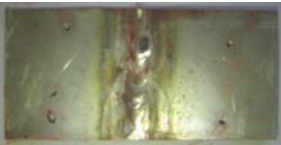
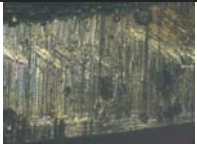
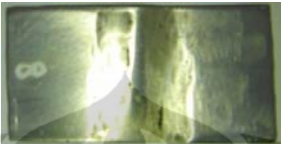
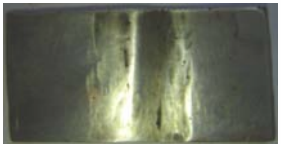
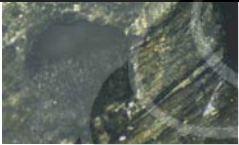
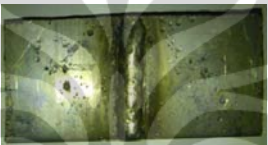

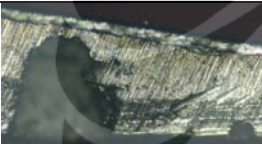


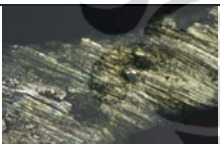


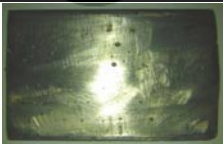



1 mm

Tabel Foto Makro & Visual NDT Sampel Hasil Pengujian Ketahanan Pitting

No	Foto Makro	Visual Sebelum NDT	Visual Setelah NDT
1	-	 Identitas Sampel 10 → 1	 Identitas Sampel 10 → 1
1A	-	 Identitas Sampel 10 → 1	 Identitas Sampel 10 → 1
2	 (Perbesaran 50x)	 Identitas Sampel 10 → 1	 Identitas Sampel 10 → 1
2A	 (Perbesaran 50x)	 Identitas Sampel 10 → 1	 Identitas Sampel 10 → 1
3	 (Perbesaran 50x)	 Identitas Sampel 10 → 1	 Identitas Sampel 10 → 1
3A	 (Perbesaran 100x)	 Identitas Sampel 10 → 1	 Identitas Sampel 10 → 1

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4	 (Perbesaran 50x)		
4A	 (Perbesaran 50x)		
5	 (Perbesaran 100x)		
5A	 (Perbesaran 50x)		
6	-		
6A	 (Perbesaran 50x)		
7	-		-

7A	 (Perbesaran 100x)		
8	 (Perbesaran 50x)		
8A	 (Perbesaran 50x)		
9	 (Perbesaran 50x) Identitas 9 → 1	 Identitas 9 → 1	 Identitas 9 → 1
9A	 (Perbesaran 50x) Identitas 9 → 1	 Identitas 9 → 1	 Identitas 9 → 1
10	-	 Identitas 9 → 10	 Identitas 9 → 10
10A	-	 Identitas 9 → 10	 Identitas 9 → 10



LAMPIRAN 11
TABEL PENGHILANGAN BERAT (*WEIGHT LOSS*)

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Tabel Penghilangan Berat (*Weight Loss*)

Sampel	Berat Sebelum Diuji Ketahanan Pitting (gram)	Berat Setelah Diuji Ketahanan Pitting (gram)	Selisih Berat, W (gram)	Penghilangan Berat (mpy)
1	15,9249	14,6576	1,2673	606
2	28,3760	26,7217	1,6543	791
3	13,8928	12,3905	1,5023	719
4	29,3438	26,8470	2,4968	1.194
5	13,9841	12,7741	1,2100	579
6	29,2208	27,8332	1,3876	664
7	13,7351	11,4136	2,3215	1.110
8	28,4603	27,1377	1,3226	633
9	14,3522	13,0918	1,2604	603
10	33,7756	32,2657	1,5099	722
1A	18,1139	16,3145	1,7994	861
2A	29,5121	27,6291	1,8830	901
3A	14,8499	13,0571	1,7928	858
4A	30,1337	27,8720	2,2617	1.082
5A	14,7138	12,9061	1,8077	852
6A	30,3798	27,4297	2,9501	1.411
7A	14,3894	12,8903	1,4991	717
8A	28,8761	27,0123	1,8638	892
9A	14,5281	12,8287	1,6994	813
10A	36,4561	34,6723	1,7838	853



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Identitas sampel untuk grafik *surface roughness meter* adalah :

Sampel 1 : SMAW + GTAW 1,5 mm

Sampel 2 : SMAW 3 mm

Sampel 3 : GTAW 1,5 mm Tanpa *Gas Back Purgig*

Sampel 4 : GTAW 3 mm Tanpa *Gas Back Purgig*

Sampel 5 : GTAW 1,5 mm

Sampel 6 : GTAW 3 mm

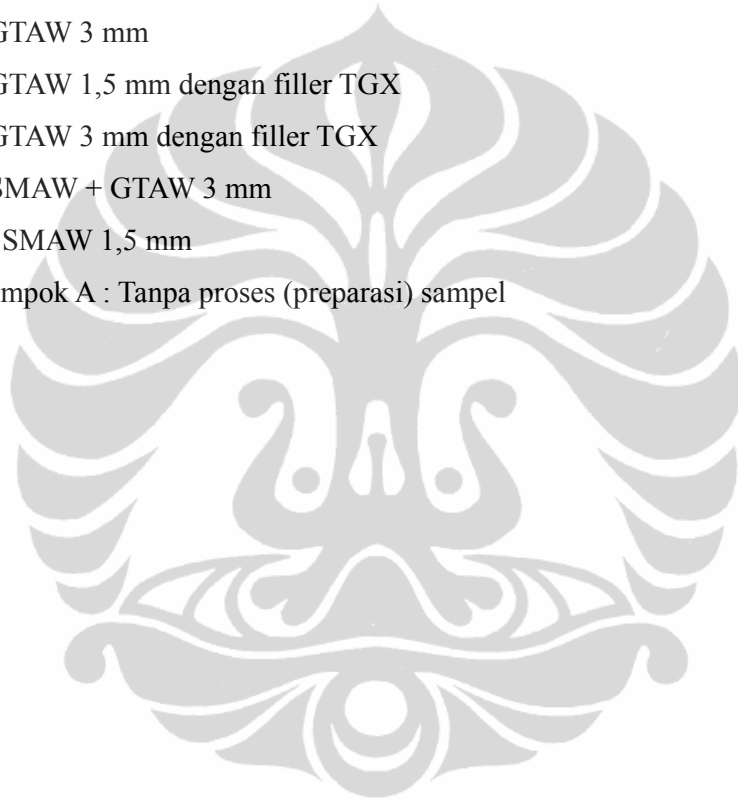
Sampel 7 : GTAW 1,5 mm dengan filler TGX

Sampel 8 : GTAW 3 mm dengan filler TGX

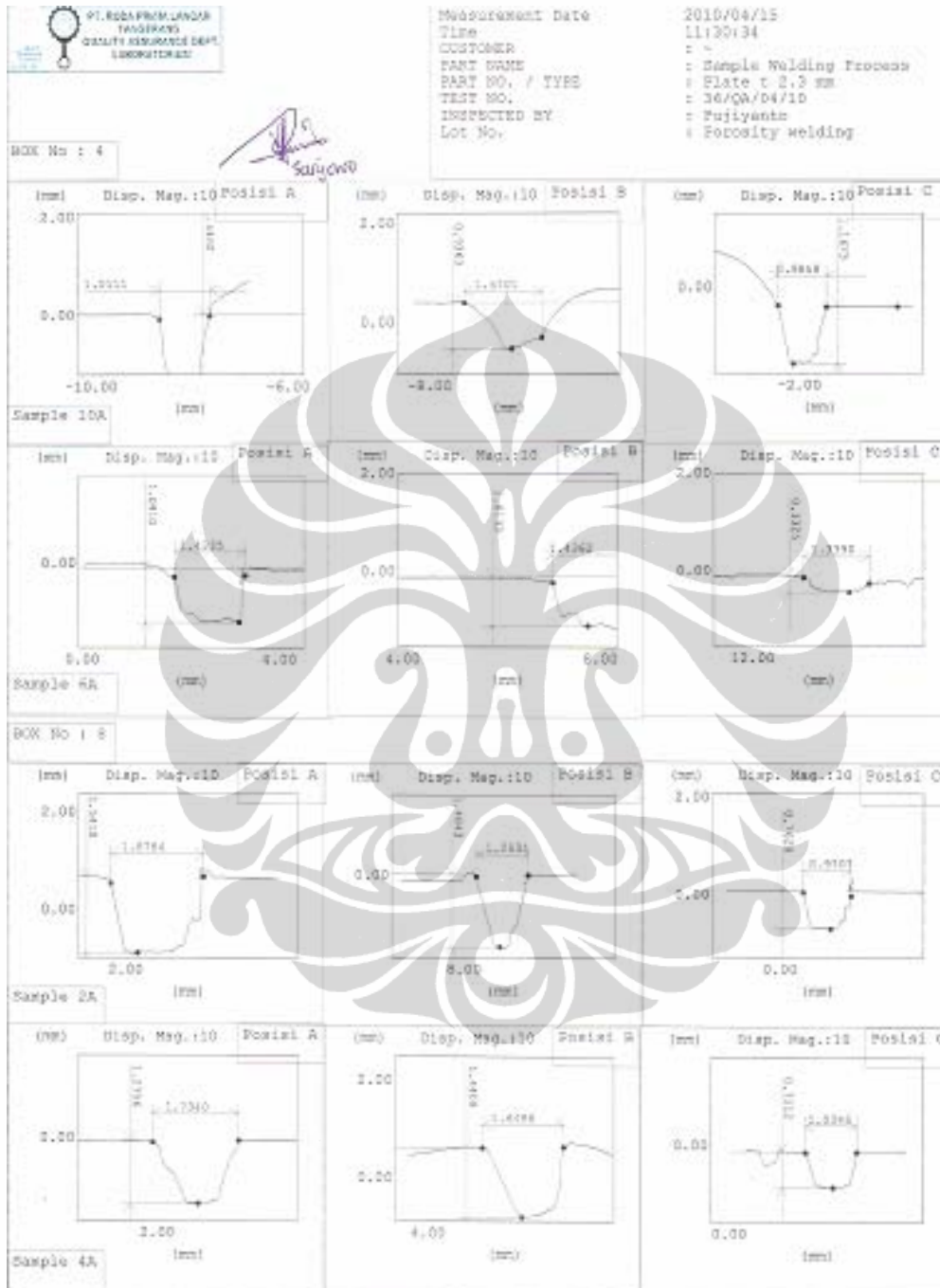
Sampel 9 : SMAW + GTAW 3 mm

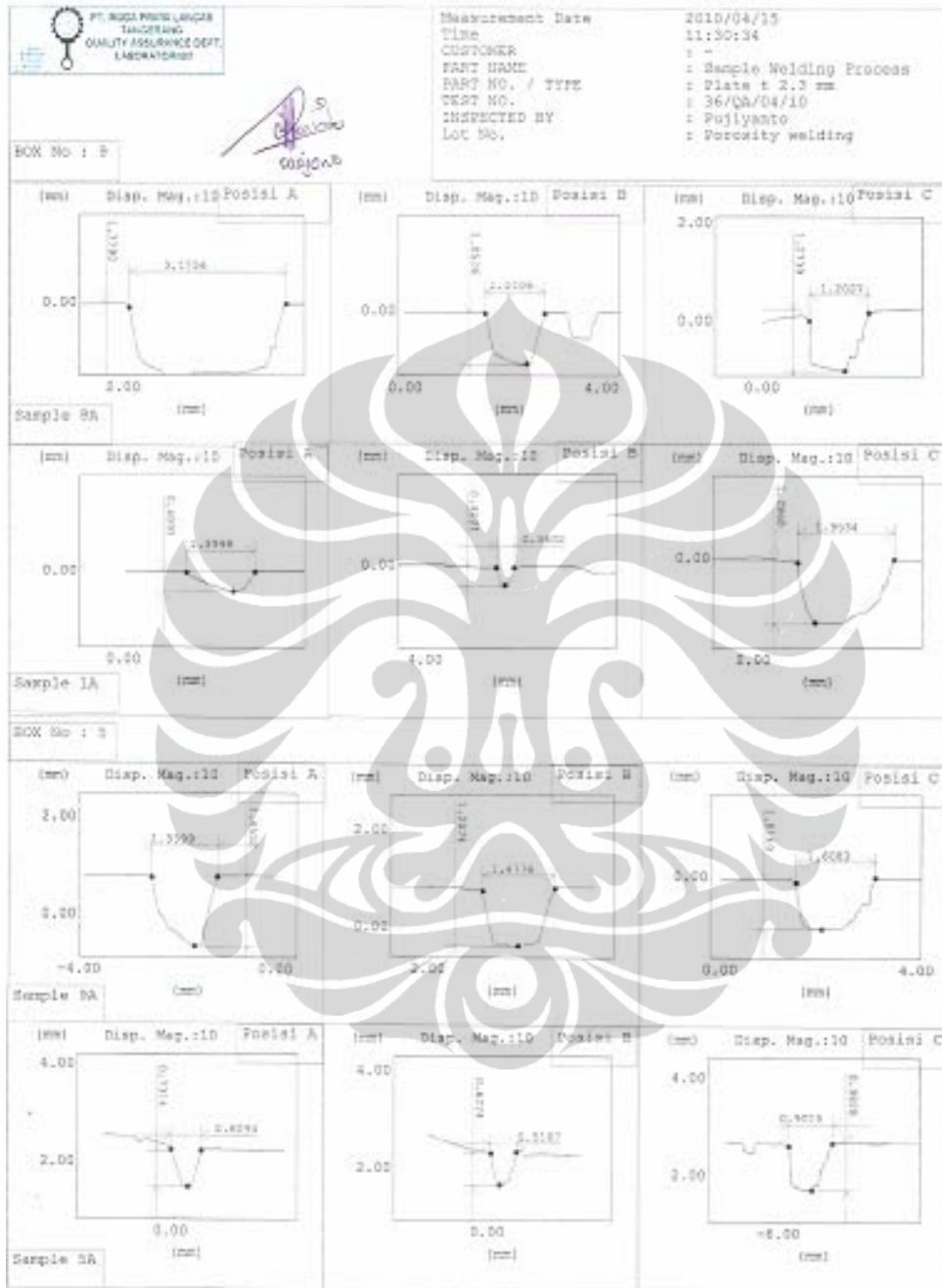
Sampel 10 : SMAW 1,5 mm

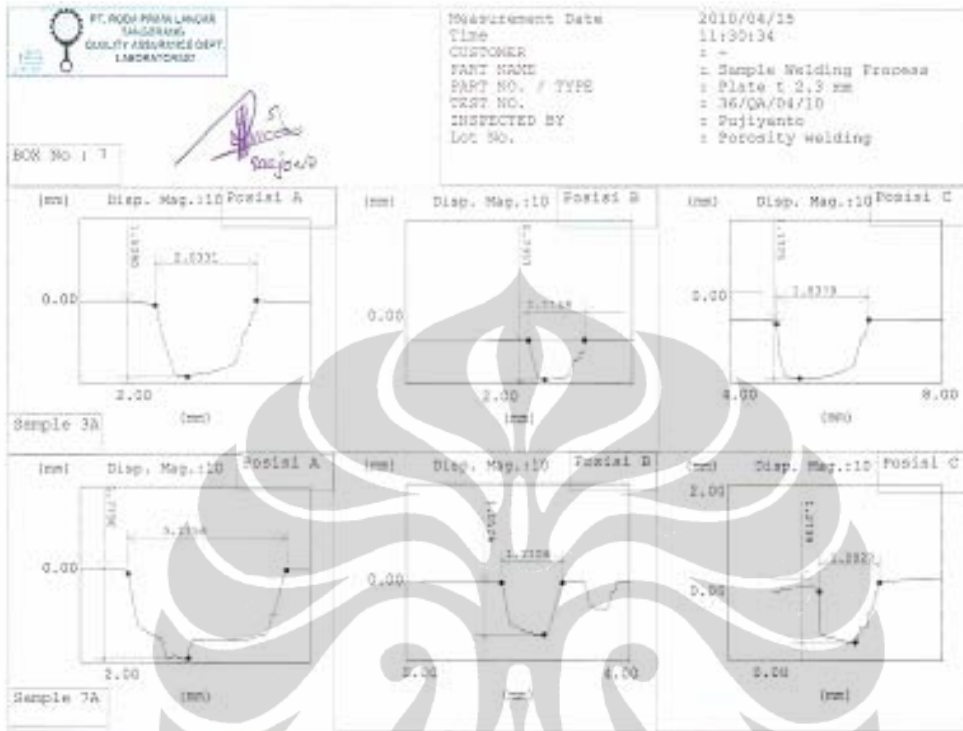
Sampel kelompok A : Tanpa proses (preparasi) sampel

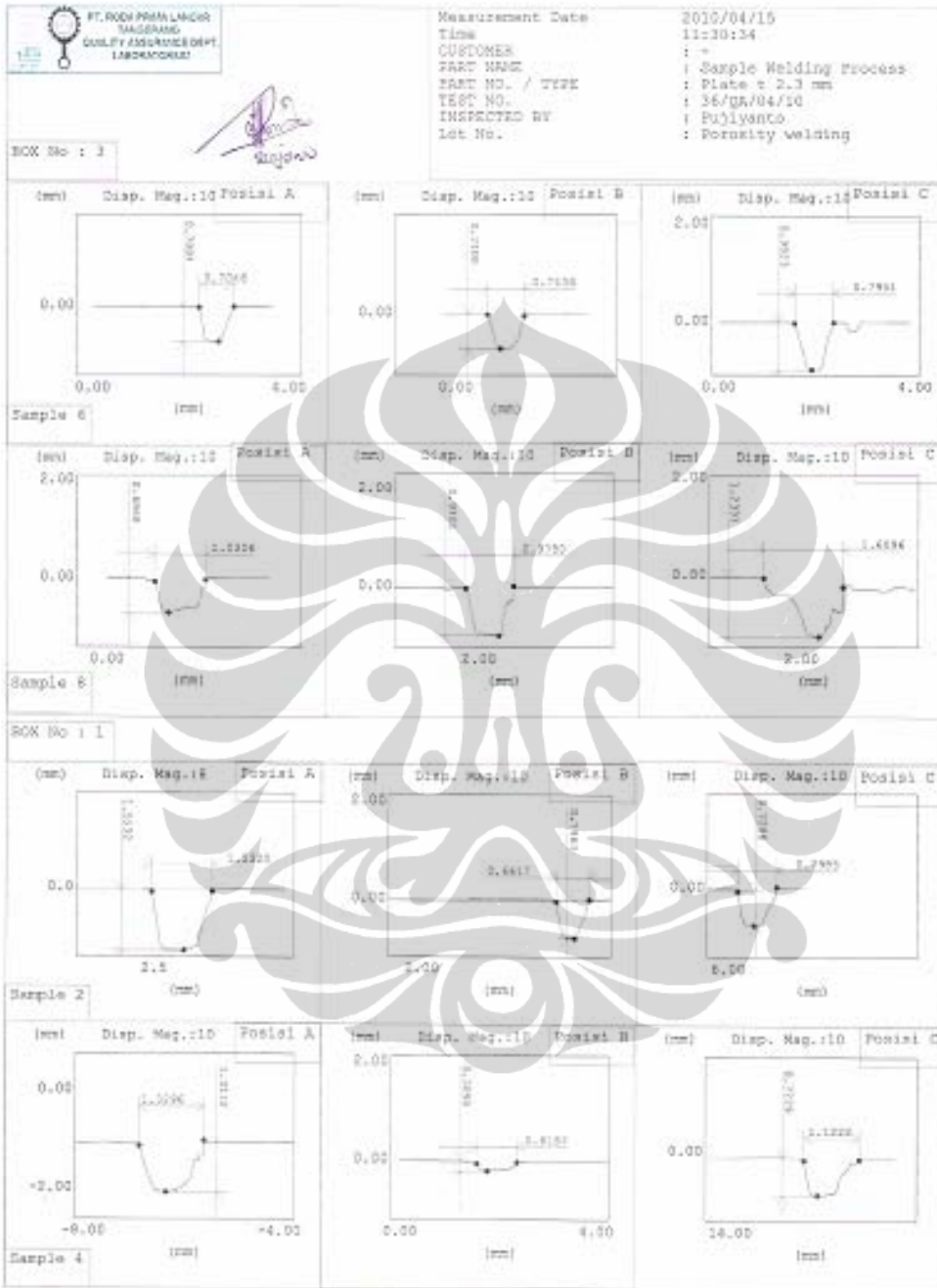


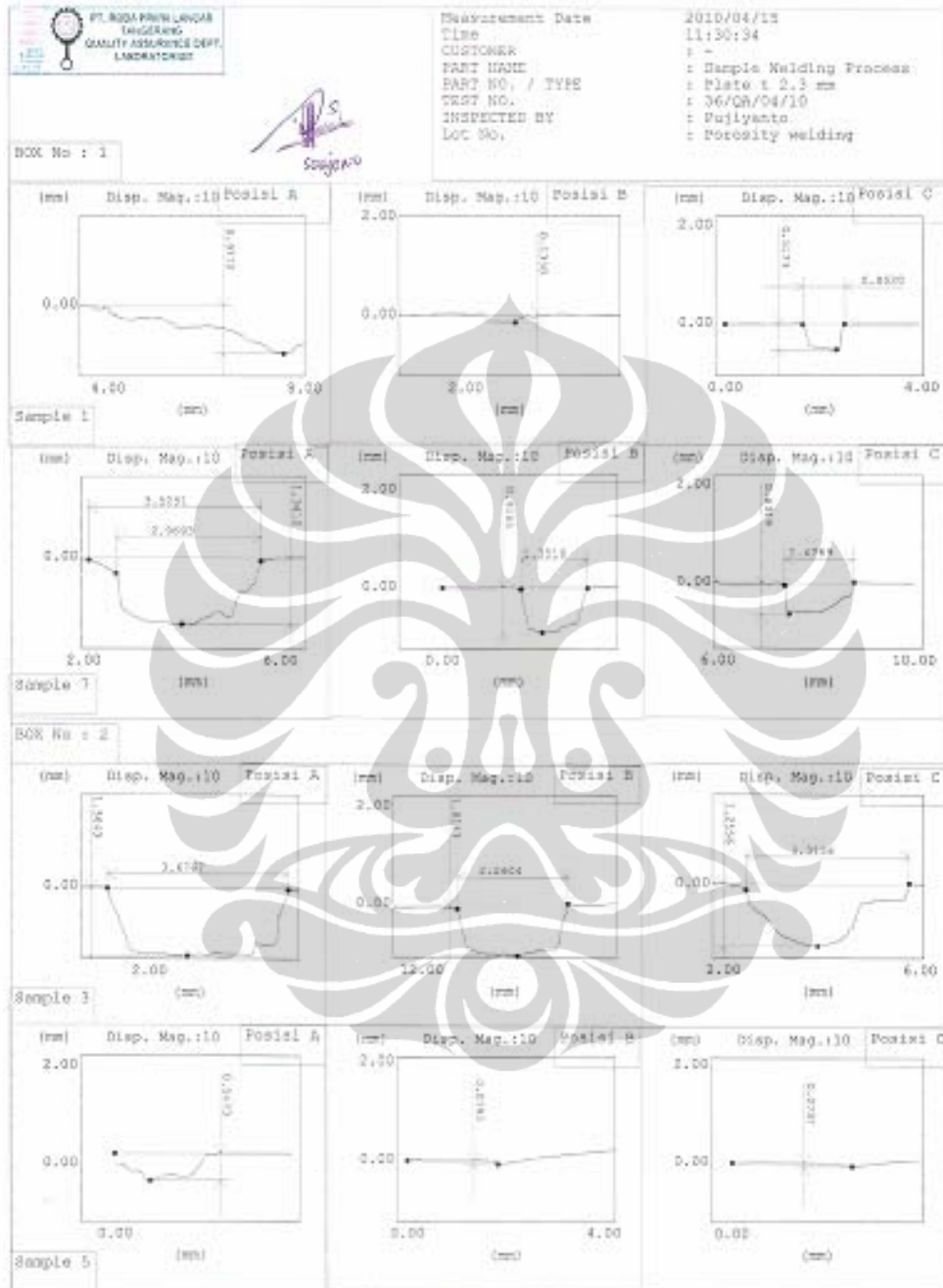
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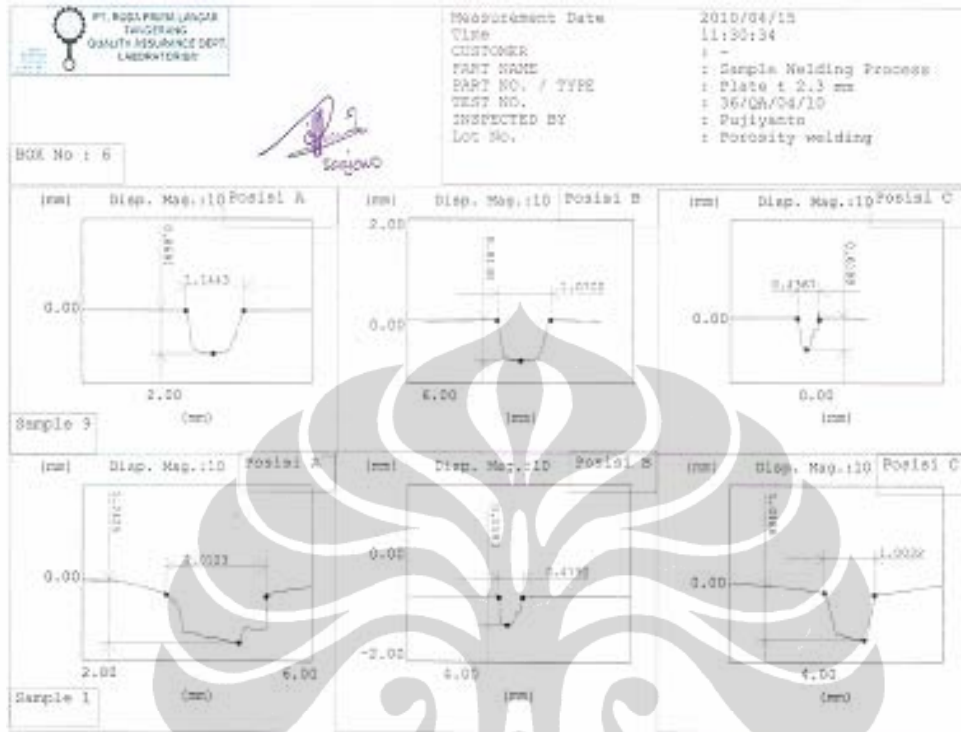














LAMPIRAN 13
TABEL *PITTING FACTOR (DEPTH TO WEIGHT LOSS RATIO)*

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Tabel *Pitting Factor (Depth to Weight Loss Ratio)*

Posisi		A		B		C		Rata-Rata
Sampel		Dimensi	Ratio	Dimensi	Ratio	Dimensi	Ratio	
1	p	1,2425	0,002	0,5593	0,0009	1,0486	0,002	0,002 ± 0,0006
	d	606		606		606		
2	p	1,5532	0,002	0,7963	0,001	0,7288	0,0009	0,001 ± 0,0006
	d	791		791		791		
3	p	1,3643	0,002	1,0147	0,001	1,2556	0,002	0,002 ± 0,0006
	d	719		719		719		
4	p	1,0112	0,0008	0,2090	0,0002	0,7729	0,0006	0,0005 ± 0,0003
	d	1.194		1.194		1.194		
5	p	0,5473	0,0009	0,0793	0,0001	0,0737	0,0001	0,0004 ± 0,0005
	d	579		579		579		
6	p	0,7046	0,001	0,7436	0,001	0,7951	0,001	0,001 ± 0
	d	664		664		664		
7	p	1,3412	0,001	0,9165	0,0008	0,6349	0,0006	0,0008 ± 0,0002
	d	1.110		1.110		1.110		
8	p	0,6868	0,001	0,9701	0,002	1,2337	0,002	0,002 ± 0,0006
	d	633		633		633		
9	p	0,9712	0,002	0,1350	0,0002	0,5173	0,0009	0,001 ± 0,0009
	d	603		603		603		
10	p	0,8691	0,001	0,8130	0,001	0,6188	0,0009	0,001 ± 0,0001
	d	722		722		722		
1A	p	0,4482	0,0005	0,9360	0,001	1,1673	0,001	0,001 ± 0,0003
	d	861		861		861		
2A	p	1,5410	0,002	1,4843	0,002	0,7628	0,0008	0,002 ± 0,0007

	d	901		901		901		
3A	p	1,5090	0,002	0,7957	0,0009	1,1725	0,001	0,001 ± 0,0006
	d	858		858		858		
4A	p	1,2796	0,001	1,4408	0,001	0,7512	0,0007	0,0009 ± 0,0002
	d	1.082		1.082		1.082		
5A	p	1,4552	0,002	1,2074	0,001	1,0149	0,001	0,001 ± 0,0006
	d	852		852		852		
6A	p	1,0910	0,0008	1,0133	0,0007	0,3325	0,0002	0,0006 ± 0,0003
	d	1.411		1.411		1.411		
7A	p	1,7790	0,002	1,0526	0,001	1,2027	0,002	0,002 ± 0,0006
	d	717		717		717		
8A	p	1,7790	0,002	1,0526	0,001	1,2739	0,001	0,001 ± 0,0006
	d	892		892		892		
9A	p	0,4093	0,0005	0,4021	0,0005	1,2860	0,002	0,0009 ± 0,0009
	d	813		813		813		
10A	p	0,7314	0,0009	0,6274	0,0007	0,9828	0,001	0,0009 ± 0,0002
	d	853		853		853		