



LAMPIRAN

A. Bukti Administrasi Penelitian

1. Pelaksanaan proses *heat treatmen* di Ruang Laboratorium Teknik Mesin Universitas Jember.

	KEMENTRIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI UNIVERSITAS NEGERI JEMBER FAKULTAS TEKNIK Jln. kalimantan No. 47 Kampus Tegalboto, Jember 68121 Telp. (0331) , 484977 – 19 Fax. (0331) 484977
<u>SURAT KETERANGAN</u>	
Yang bertanda tangan di bawah ini menerangkan bahwa :	
Nama Mahasiswa	: Galang Goldy Putra A S B
Nim	: 1610641035
Fak / Jurusan	: Teknik / Teknik Mesin Universitas Muhammadiyah Jember
Telah Melaksanakan :	
Penelitian	: Pengujian Material
Materi Penelitian	: Uji Heat Treatmen
Tanggal Pelaksanaan	: 14 Juli 2020
Data	: Terlampir
Demikian surat keterangan ini dibuat untuk dipergunakan sebagaimana mestinya.	
Jember, 15 Juli 2020 Mengetahui, Kepala Laboratorium Uji Material Fakultas Teknik Universitas Jember	
<u>Dedi Dwilaksana, S. T., M.T</u> NIP. 1969120111996021001	

2. Pelaksanaan proses Uji Tarik di Ruang Laboratorium Teknik Mesin Universitas Muhammadiyah Malang.



UNIVERSITAS MUHAMMADIYAH MALANG
FAKULTAS TEKNIK – JURUSAN TEKNIK MESIN
LABORATORIUM TEKNIK MESIN
Jln. Raya Tlogomas No. 246 Telp. (0341) , 463513 – 19 Fax. (0341) 460782 Malang 65144

SURAT KETERANGAN
Nomor : E.6.b/ 019 /LTM/FT-UMM/ VII /2020

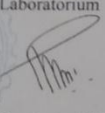
Yang bertanda tangan di bawah ini menerangkan bahwa :

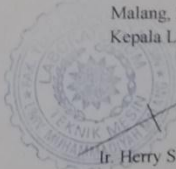
Nama Mahasiswa : **Galang Goldy Putra**
No. Induk : **1610641035**
Fak / Jurusan : **Teknik / Teknik Mesin**
Universitas Muhammadiyah Jember

Telah Melaksanakan :

Penelitian : **Pengujian Material**
Materi Penelitian : **Uji Tarik**
Uji Kekerasan
Tanggal Pelaksanaan : **20 Juli 2020**
Data : **Terlampir**

Demikian surat keterangan ini dibuat untuk dipergunakan sebagaimana mestinya.

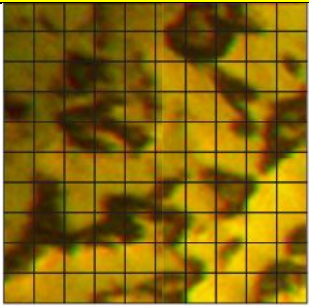
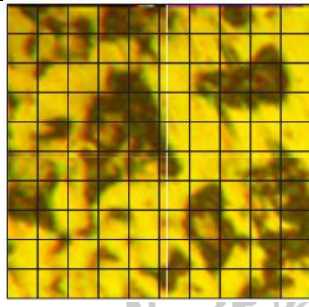
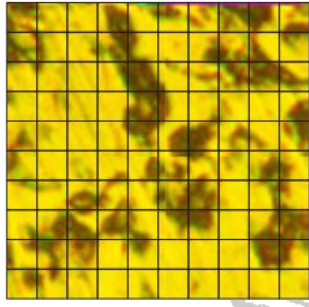
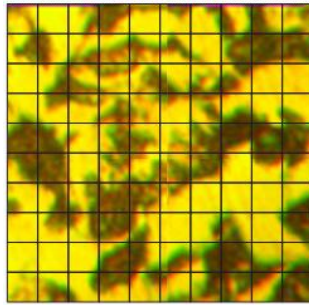
Malang, 22 Juli 2020
Kepala Laboratorium

Ir. Herry Suprianto, MT

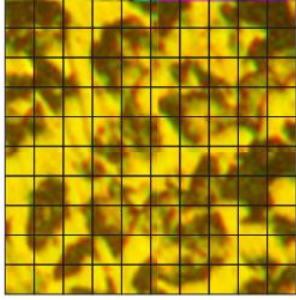
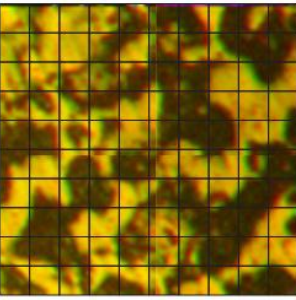
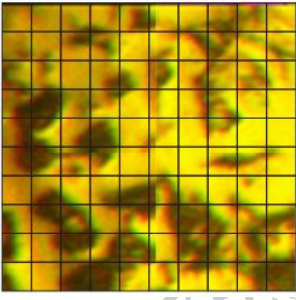
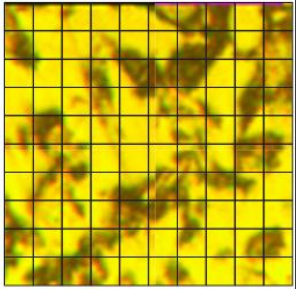
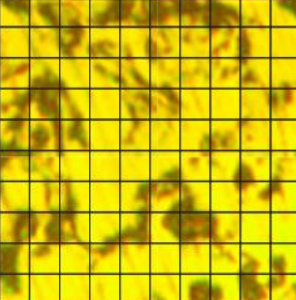


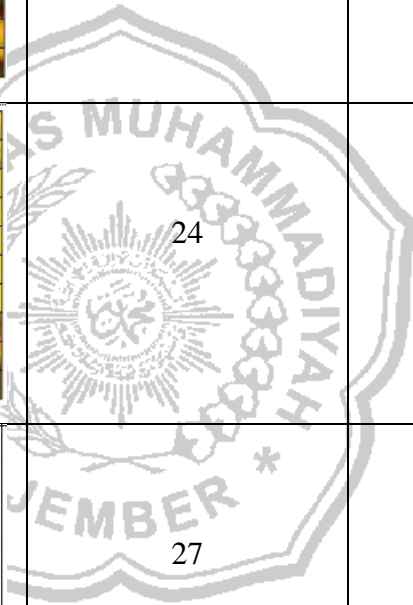
SHOT ON OPPO

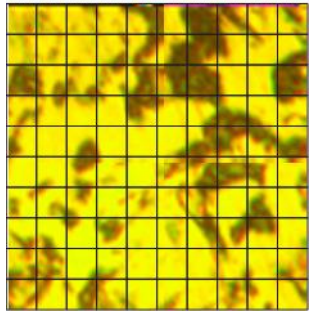
B. Lampiran Keterangan Perhitungan Hasil Struktur Mikro

1. Tabel Grib Struktur Mikro Tanpa Perlakuan.

NO	GAMBAR	PERLITE	FERRITE
1		31	69
2		34	66
3		26	74
4		36	64

5		31	69
6		42	58
7		24	76
8		27	73
9		18	82



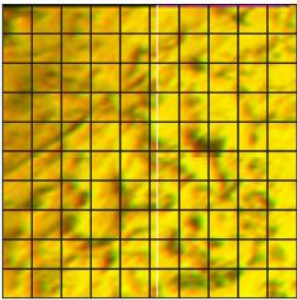
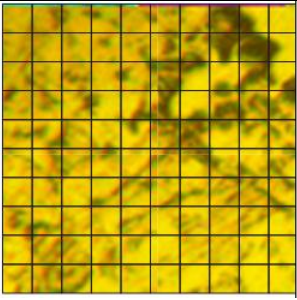
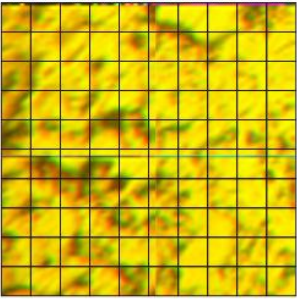
10		23	77
JUMLAH		292	708

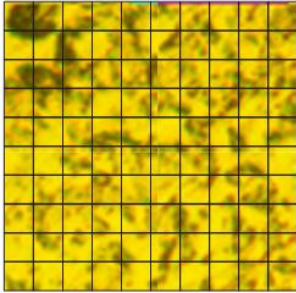
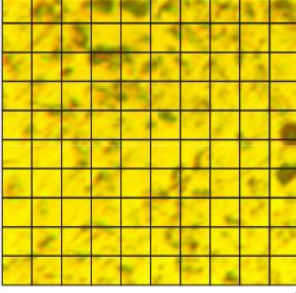
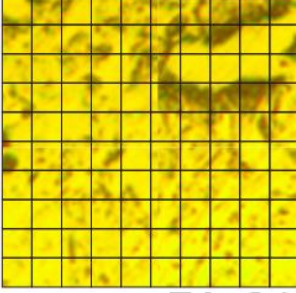
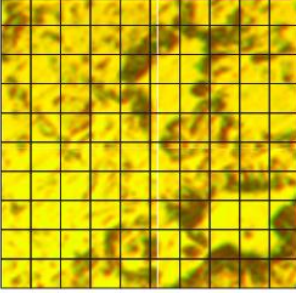
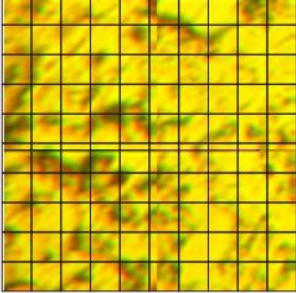
No	Perlite (x)	Ferrite (y)	(x - \bar{x})	(x - \bar{x}) ²	(y - \bar{y})	(y - \bar{y}) ²
1	15,5	34,5	0,9	0,81	-0,9	0,81
2	17	33	2,4	5,76	-2,4	5,76
3	13	37	-1,6	2,56	1,6	2,56
4	18	32	3,4	11,56	-3,4	11,56
5	15,5	34,5	0,9	0,81	-0,9	0,81
6	21	29	6,4	40,96	-6,4	40,96
7	12	38	-2,6	6,76	2,6	6,76
8	13,5	36,5	-1,1	1,21	1,1	1,21
9	9	41	-5,6	31,36	5,6	31,36
10	11,5	38,5	-3,1	9,61	3,1	9,61
Jumlah	146	354	0	111,4	0	111,4

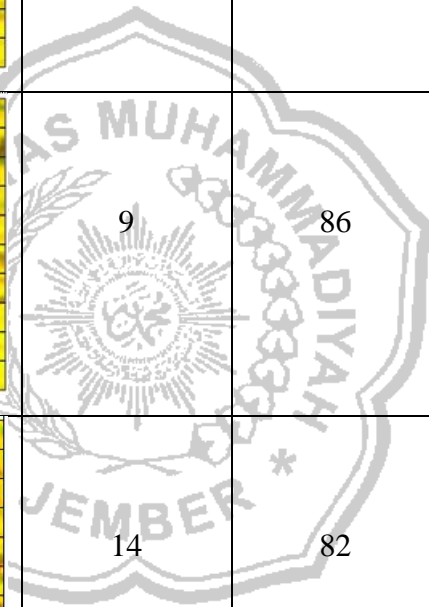
Keterangan	Perlite (x)	Ferrite (y)
Nilai rata-rata	$\bar{x} = \frac{\sum x}{n} = \frac{146}{10} = 14,6$	$\bar{y} = \frac{\sum y}{n} = \frac{354}{10} = 35,4$
Standart deviasi	$Sd = \sqrt{\frac{\sum (x - \bar{x})^2}{(n-1)}} = \sqrt{\frac{2(111,4)}{9}} = 22,8$	$Sd = \sqrt{\frac{\sum (y - \bar{y})^2}{(n-1)}} = \sqrt{\frac{2(111,4)}{9}} = 22,8$

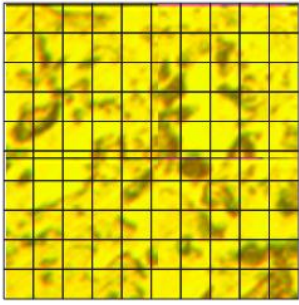
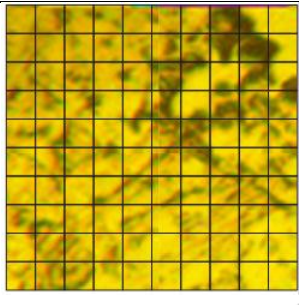
Simpangan rata-rata	$S\bar{d} = \sqrt{\frac{111,4}{90}} = 1,11$	$S\bar{d} = \sqrt{\frac{111,4}{90}} = 1,11$
Kesalahan relatif	$Kr = \frac{s\bar{d}}{\bar{x}} \times 100\% = 7,60\%$	$Kr = \frac{s\bar{d}}{\bar{y}} \times 100\% = 3,13\%$
Keseeksamaan	$K = 100\% - 7,60\% = 92,4\%$	$K = 100\% - 3,13\% = 96,87\%$
Hasil pengukuran	$H_p = x \pm sd = 14,6 \pm 1,11$	$H_p = y \pm sd = 35,4 \pm 1,11$

2. Tabel Grib Struktur Mikro Dengan Pendinginan Oli SAE 10

NO	GAMBAR	PERLITE	FERRITE	MARTENSITE
1		11	76	13
2		15	70	15
3		18	62	20

4		8	86	6
5		4	87	9
6		9	86	5
7		14	82	4
8		12	58	30

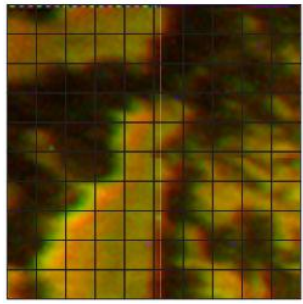
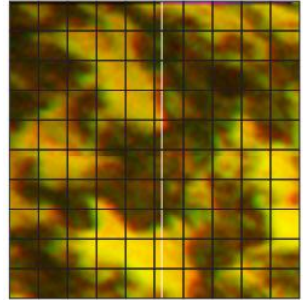


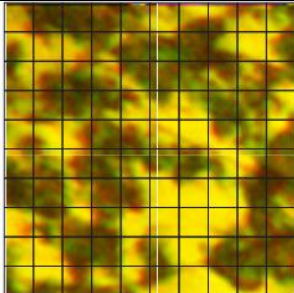
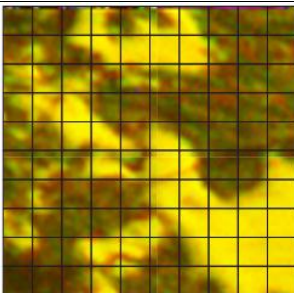
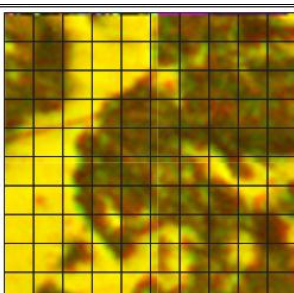
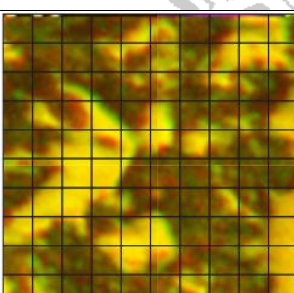
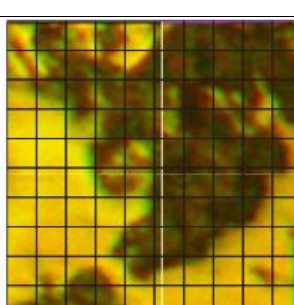
9		13	77	10
10		10	78	12
JUMLAH		114	762	124

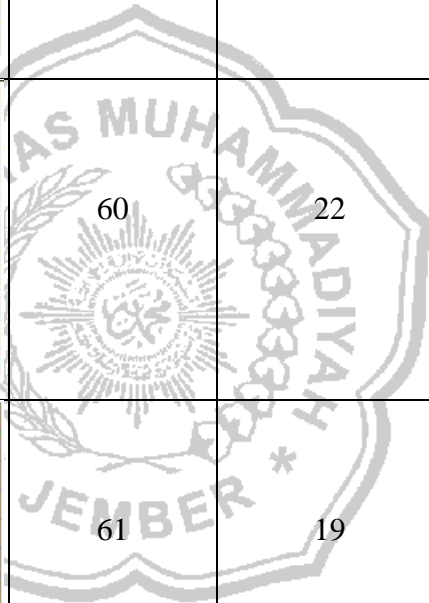
No	Perlite (x)	Ferrite (y)	Martensite (s)	(x - \bar{x})	(x - \bar{x}) ²	(y - \bar{y})	(y - \bar{y}) ²	(s - \bar{s})	(s - \bar{s}) ²
1	5,5	38	6,5	-0,2	0,04	-0,1	0,01	0,3	0,09
2	7,5	35	7,5	1,8	3,24	-3,1	9,61	1,3	1,69
3	9	31	10	3,3	10,89	-7,1	50,41	3,8	14,44
4	4	43	3	-1,7	2,89	4,9	24,01	-3,2	10,24
5	2	43,5	4,5	-3,7	13,69	5,4	29,16	-1,7	2,89
6	4,5	43	2,5	-1,2	1,44	4,9	24,01	-3,7	13,69
7	7	41	2	1,3	1,69	2,9	8,41	-4,2	17,64
8	6	29	15	0,3	0,09	-9,1	82,81	8,8	77,44
9	6,5	38,5	5	0,8	0,64	0,4	0,16	-1,2	1,44
10	5	39	6	-0,7	0,49	0,9	0,81	-0,2	0,04
Jumlah	57	381	62	0	35,1	0	229,4	0	139,6

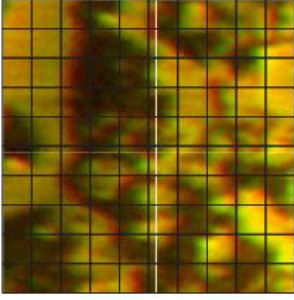
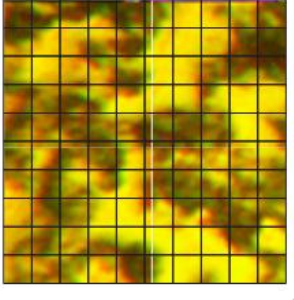
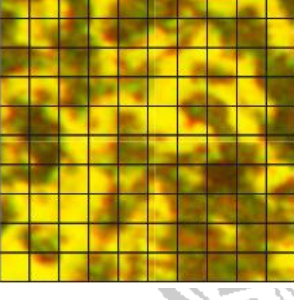
Keterangan	<i>Perlite</i>	<i>Ferrite</i>	<i>Martensite</i>
Nilai rata-rata	$\bar{x} = \frac{\sum x}{n} = \frac{57}{10} = 5,7$	$\bar{y} = \frac{\sum y}{n} = \frac{381}{10} = 38,1$	$s = \frac{\sum s}{n} = \frac{62}{10} = 6,2$
Standart deviasi	$Sd = \sqrt{\frac{2(\sum x - \bar{x})^2}{(n-1)}} = \sqrt{\frac{2(35,1)}{9}} = 2,79$	$Sd = \sqrt{\frac{2(\sum y - \bar{y})^2}{(n-1)}} = \sqrt{\frac{2(229,1)}{9}} = 7,13$	$Sd = \sqrt{\frac{2(\sum s - \bar{s})^2}{(n-1)}} = \sqrt{\frac{2(139,6)}{9}} = 5,56$
Simpangan rata-rata	$S\bar{d} = \sqrt{\frac{35,1}{90}} = 0,62$	$S\bar{d} = \sqrt{\frac{229,4}{90}} = 1,59$	$S\bar{d} = \sqrt{\frac{139,6}{90}} = 1,24$
Kesalahan relatif	$Kr = \frac{s\bar{d}}{\bar{x}} \times 100\% = 10,8\%$	$Kr = \frac{s\bar{d}}{\bar{y}} \times 100\% = 4,17\%$	$Kr = \frac{s\bar{d}}{s} \times 100\% = 20\%$
Keseksamaan	$K = 100\% - 10,8\% = 89,2\%$	$K = 100\% - 4,17\% = 95,83\%$	$K = 100\% - 20\% = 80\%$
Hasil pengukuran	$Hp = x \pm sd = 5,7 \pm 0,62$	$Hp = y \pm sd = 38,1 \pm 1,59$	$Hp = s \pm sd = 6,2 \pm 1,24$

3. Tabel Grib Struktur Mikro Dengan Pendingin Oli SAE 140.

NO	GAMBAR	<i>PERLITE</i>	<i>FERRITE</i>	<i>MARTENSITE</i>
1		54	31	15
2		60	20	20

3		55	30	15
4		60	23	17
5		60	22	18
6		61	19	20
7		52	31	17



8		57	23	20
9		60	22	18
10		52	30	18
JUMLAH		571	251	178

No	Perlite (x)	Ferrite (y)	Martensite (s)	(x - \bar{x})	(x - \bar{x}) ²	(y - \bar{y})	(y - \bar{y}) ²	(s - \bar{s})	(s - \bar{s}) ²
1	27	15,5	7,5	-1,55	2,4025	2,95	8,7025	-1,4	1,96
2	30	10	10	1,45	2,1025	-2,55	6,5025	1,1	1,21
3	27,5	15	7,5	-1,05	1,1025	2,45	6,0025	-1,4	1,96
4	30	11,5	8,5	1,45	2,1025	-1,05	1,1025	-0,4	0,16
5	30	11	9	1,45	2,1025	-1,55	2,4025	0,1	0,01
6	30,5	9,5	10	1,95	3,8025	-3,05	9,3025	1,1	1,21
7	26	15,5	8,5	-2,55	6,5025	2,95	8,7025	-0,4	0,16
8	28,5	11,5	10	-0,05	0,0025	-1,05	1,1025	1,1	1,21
9	30	11	9	1,45	2,1025	-1,55	2,4025	0,1	0,01
10	26	15	9	-2,55	6,5025	2,45	6,0025	0,1	0,01
Jumlah	285,5	125,5	89	0	28,725	0	52,225	0	7,9

Keterangan	Perlite	Ferrite	Martensite
Nilai rata-rata	$\bar{x} = \frac{\sum x}{n} = \frac{285,5}{10} = 28,55$	$\bar{y} = \frac{\sum y}{n} = \frac{125,5}{10} = 12,55$	$s = \frac{\sum s}{n} = \frac{89}{10} = 8,9$
Standart deviasi	$Sd = \sqrt{\frac{2(\sum x - \bar{x})^2}{(n-1)}} = \sqrt{\frac{2(28,725)}{9}} = 2,52$	$Sd = \sqrt{\frac{2(\sum y - \bar{y})^2}{(n-1)}} = \sqrt{\frac{2(52,225)}{9}} = 3,40$	$Sd = \sqrt{\frac{2(\sum s - \bar{s})^2}{(n-1)}} = \sqrt{\frac{2(7,9)}{9}} = 1,32$
Simpangan rata-rata	$S\bar{d} = \sqrt{\frac{28,725}{90}} = 0,56$	$S\bar{d} = \sqrt{\frac{52,225}{90}} = 0,76$	$S\bar{d} = \sqrt{\frac{7,9}{90}} = 0,29$
Kesalahan relatif	$Kr = \frac{s\bar{d}}{\bar{x}} \times 100\% = 1,96\%$	$Kr = \frac{s\bar{d}}{\bar{y}} \times 100\% = 6,05\%$	$Kr = \frac{s\bar{d}}{\bar{s}} \times 100\% = 3,25\%$
Keseeksamaan	$K = 100\% - 1,96\% = 98,04\%$	$K = 100\% - 6,05\% = 93,95\%$	$K = 100\% - 3,25\% = 96,75\%$
Hasil pengukuran	$Hp = x \pm sd = 28,55 \pm 0,56$	$Hp = y \pm sd = 12,55 \pm 0,76$	$Hp = s \pm sd = 8,9 \pm 0,29$

C. Dokumentasi Pelaksanaan Penelitian.

1. Spesimen Baja AISI 1045 yang sudah dibentuk sesuai dengan ukuran standart ASTM E8 A48.



2. Pemasukan spesimen baja ke dalam mesin furnace untuk dilakukan proses perlakuan panas dengan suhu 850°C .



3. Pengambilan spesimen dari mesin furnace yang sudah di panaskan dengan suhu 850°C yang kemudian dimasukkan ke larutan media pendingin.



4. Larutan variasi media pendingin Oli SAE 10.



5. Larutan variasi media pendingin Oli SAE 140.



6. Hasil spesimen yang sudah dilakukan *quenching* dengan larutan pendingin Oli SAE 10.



7. Hasil spesimen yang sudah dilakukan *quenching* dengan larutan pendingin Oli SAE 140.



8. Spesimen tanpa perlakuan.



9. Proses pelaksanaan uji tarik.



10. Hasil spesimen variasi media pendingin Oli SAE 10 dan 140 yang sudah dilakukan uji tarik .





11. Hasil spesimen struktur mikro dengan variasi media pendingin Oli SAE 10, 140 dan spesimen tanpa perlakuan.

Tanpa perlakuan	Oli SAE 10	Oli SAE 140
		

BIODATA PENULIS



Nama : Galang Goldy Putra Amilinda Setia Budi
Tempat,Tanggal Lahir : Jember, 02 februari 2020
Jenis Kelamin : Laki - laki
Agama : Islam
Alamat : DUSUN PTPN XII RT 002 RW 011 Banjarsari
Kec.Bangsalsari Kab.Jember Prov.Jawa Timur
Telepon/No HP : 082234948133
Email : galanggoldy.98@gmail.com
Pekerjaan : Mahasiswa

Riwayat Pendidikan :

1. SDN BANJARSARI 01 (2004 - 2010)
2. SMP NEGERI 02 RAMBIPUJI (2010 - 2013)
3. SMK NEGERI 05 JEMBER (2013 - 2016)
4. Universitas Muhammadiyah jember (2016 - 2020)