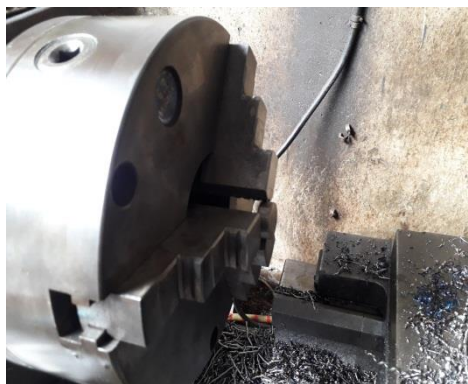
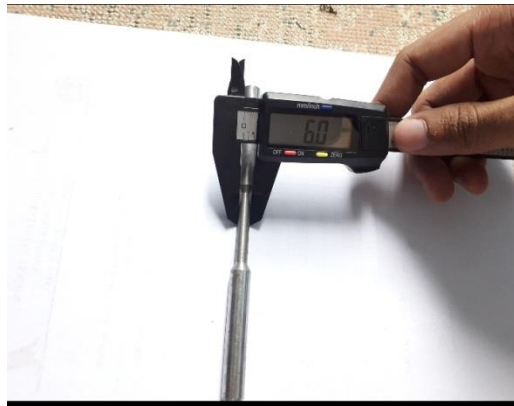


## LAMPIRAN

### A. Pembuatan spesimen Uji Tarik Dan kekerasan







## B. Proses Heattreatment

Perlengkapan pada proses Heattreatment



Alat untuk proses Heattreatment (Furnace)



Sarung tangan anti panas (safety)



Gunting penjepit spesimen



Media Quenching Air mineral, Oli dan larutan garam dengan volume masing masing 1500 ml



Spesimen yang akan di Heattreatment



Temperatur 850°C



Temperatur 900°C



Temperatur 950°C

### C. Proses Quenching dan Kodefikasi Spesimen





Kodefikasi Spesimen Uji tarik Dan kekerasan setelah Proses Heattreatment 850°C  
Dengan Quenching Air mineral,Oli dan larutan Garam



Kodefikasi Spesimen Uji tarik Dan kekerasan setelah Proses Heattreatment 900°C  
Dengan Quenching Air mineral,Oli dan larutan Garam



Kodefikasi Spesimen Uji tarik dan kekerasan setelah Proses Heattreatment 950<sup>0</sup>C Dengan Quenching Air mineral,Oli dan larutan Garam.



#### D. Proses Uji Tarik



Mesin Uji tarik Lab Material  
Universitas 17 Agustus Surabaya



Spesimen Sebelum Di Uji



Spesimen Setelah Uji Tarik dengan Heattreatment Temperatur 850°C,900°C dan 950°C dengan Quenching media Air mineral,Oli dan Larutan garam.



Foto Dokumentasi di Lab Material Universitas 17 Agustus 1945 Surabaya

## E. Pengolahan Data Setelah Proses Uji Tarik



**LABORATORIUM MATERIAL TEKNIK  
FAKULTAS TEKNIK MESIN  
UNIVERSITAS 17 AGUSTUS 1945**



Nama Mahasiswa : Andik Kristanto  
NBI : 1421600113  
Tanggal Pengujian : 1 April 2020

**Data Hasil Pengujian Tarik Bahan Baja ST-41 Tanpa Heattreatment (A)**

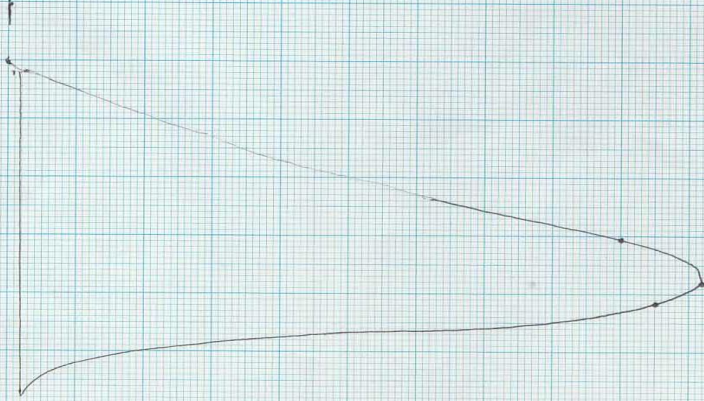
Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,6	3,6	3,6
Luas Penampang $A_0$ (mm) <sup>2</sup>	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	37,6	38,2	37,9
pertambahan panjang ( $\Delta L_{max}$ )	5,6	6,2	5,9
Beban Luluh, $P_\gamma$ (kg)	1241,46	816,14	1028,8
Beban Maksimum, $P_{max}$ (kg)	1545	1350	1447,5
Beban Putus, $P_p$ (kg)	1310,43	1349,77	1330,1
Tegangan Luluh, (kg/mm <sup>2</sup> )	44,01	28,63	36,32
Tegangan Max (kg/mm <sup>2</sup> )	54,78	47,36	51,07
Tegangan Putus (kg/mm <sup>2</sup> )	46,46	47,86	47,16

Surabaya, 1 April 2020

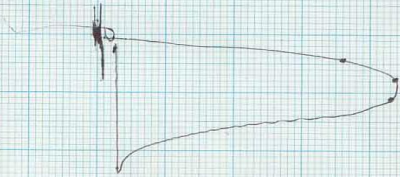


Lab Material

$$A(20) = 15 \text{ kgf}$$



$$A(20) = 1350 \text{ kgf (Belohn 6000 kgf)}$$



## A

### Spesimen 1(a) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1545 \text{ kgf}}{112 \text{ (kotak)}} = 13,794/\text{kotak}$$

$$P_{\gamma} = 13,794 \times 90 \text{ (kotak)} = 1241,46 \text{ kg}$$

$$P_p = 13,794 \times 95 \text{ (kotak)} = 1310,43 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1545}{28,2} = 54,78 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1241,46}{28,2} = 44,01 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1310,43}{28,2} = 46,46 \text{ kg/mm}^2$$

### Spesimen 2(b) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1350 \text{ kgf}}{43 \text{ (kotak)}} = 31,39/\text{kotak}$$

$$P_{\gamma} = 31,39 \times 26 \text{ (kotak)} = 816,14 \text{ kg}$$

$$P_p = 31,39 \times 43 \text{ (kotak)} = 1349,77 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1350}{28,2} = 47,36 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{816,14}{28,2} = 28,63 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1349,77}{28,2} = 47,86 \text{ kg/mm}^2$$



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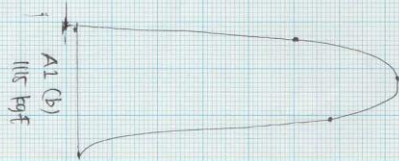
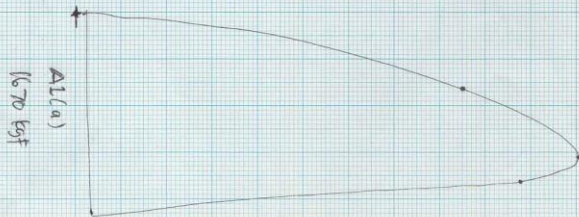
Nama Mahasiswa : Andik Kristanto  
NBI 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Heattreatment Temperatur 850°C  
Dengan Quenching Air Mineral (A1)

Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,5	3,9	3,7
Luas Penampang $A_0$ (mm <sup>2</sup> )	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	41,7	39,0	40,35
pertambahan panjang ( $\Delta L_{max}$ )	9,7	7,0	8,3
Beban Luluh, $P_y$ (kg)	1290,3	724	1007,15
Beban Maksimum, $P_{max}$ (kg)	1670	1115	1392,5
Beban Putus, $P_p$ (kg)	1487,64	839,84	1163,74
Tegangan Luluh, (kg/mm <sup>2</sup> )	45,74	25,67	35,70
Tegangan Max (kg/mm <sup>2</sup> )	59,21	39,53	49,37
Tegangan Putus (kg/mm <sup>2</sup> )	52,75	29,78	41,26

Surabaya, 1 April 2020





## A1

Spesimen 1(a) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1670 \text{ kgf}}{110 \text{ (kotak)}} = 15,18/\text{kotak}$$

$$P_{\gamma} = 15,18 \times 85 \text{ (kotak)} = 1290,3 \text{ kg}$$

$$P_p = 15,18 \times 98 \text{ (kotak)} = 1487,64 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1670}{28,2} = 59,21 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1290}{28,2} = 45,74 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1487,64}{28,2} = 52,75 \text{ kg/mm}^2$$

Spesimen 2(b) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1115 \text{ kgf}}{77 \text{ (kotak)}} = 14,48/\text{kotak}$$

$$P_{\gamma} = 14,48 \times 50 \text{ (kotak)} = 724 \text{ kg}$$

$$P_p = 14,48 \times 58 \text{ (kotak)} = 839,84 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1115}{28,2} = 39,53 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{724}{28,2} = 25,67 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{839,84}{28,2} = 29,78 \text{ kg/mm}^2$$





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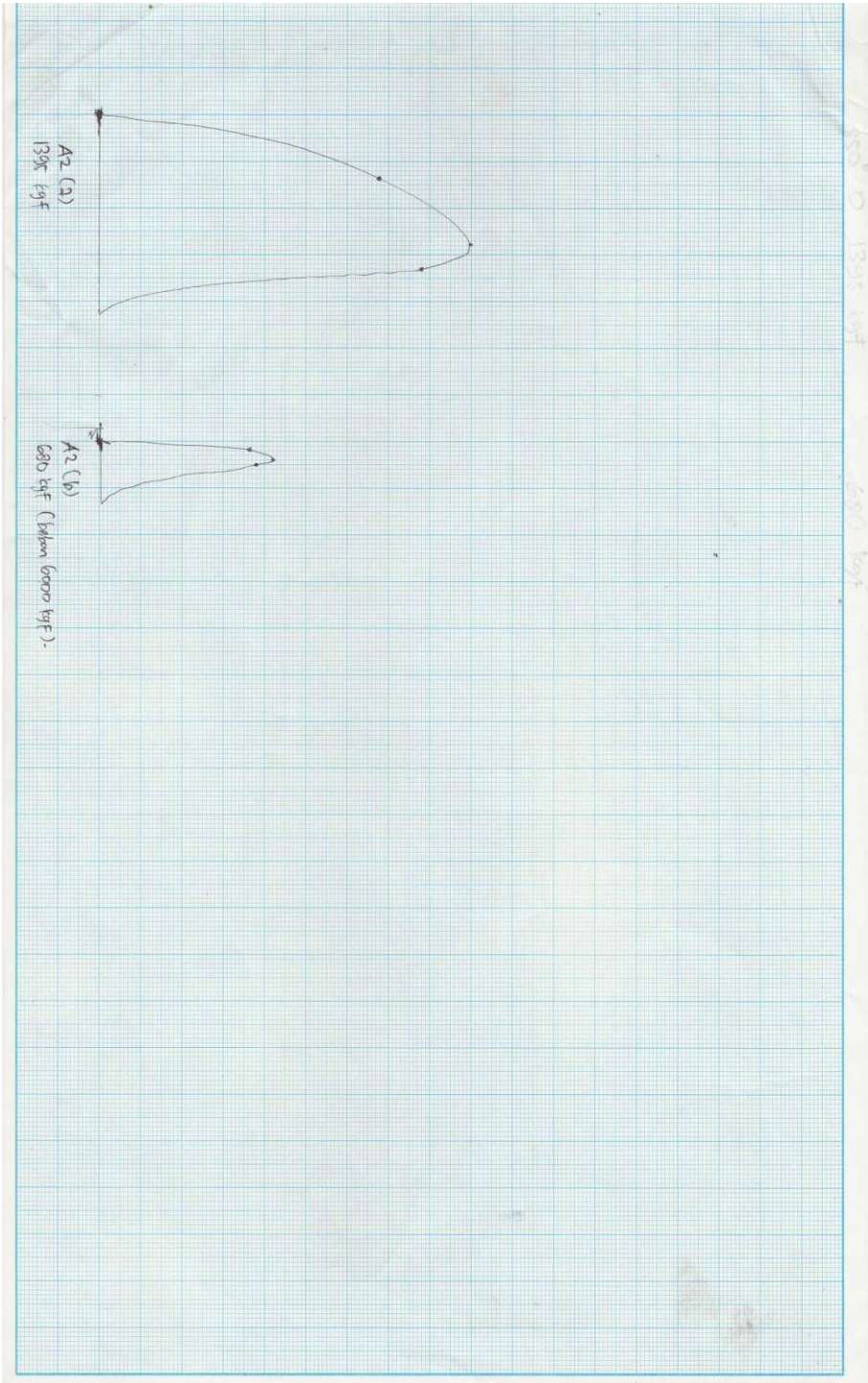
Nama Mahasiswa : Andik Kristanto  
NBI : 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Heattreatment Temperatur 850°C  
Dengan Quenching Oli (A2)

Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,3	3,8	3,5
Luas Penampang $A_0$ (mm) <sup>2</sup>	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	41,0	39,1	40,05
pertambahan panjang ( $\Delta L_{max}$ )	9,0	7,1	8,05
Beban Luluh, $P_f$ (kg)	1065,56	582,84	824,2
Beban Maksimum, $P_{max}$ (kg)	1395	680	1037,5
Beban Putus, $P_p$ (kg)	1222,26	615,22	918,74
Tegangan Luluh, (kg/mm <sup>2</sup> )	37,76	20,66	29,01
Tegangan Max (kg/mm <sup>2</sup> )	49,46	24,11	36,78
Tegangan Putus (kg/mm <sup>2</sup> )	43,34	21,81	32,57

Surabaya, 1 April 2020





## A2

### Spesimen 1(a) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o) &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1395 \text{ kgf}}{89 \text{ (kotak)}} = 15,67 / \text{kotak}$$

$$P_{\gamma} = 15,67 \times 68 \text{ (kotak)} = 1065,56 \text{ kg}$$

$$P_p = 15,67 \times 78 \text{ (kotak)} = 1222,26 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1395}{28,2} = 49,46 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1065,56}{28,2} = 37,76 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1222,26}{28,2} = 43,34 \text{ kg/mm}^2$$

### Spesimen 2(b) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o) &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{680 \text{ kgf}}{42 \text{ (kotak)}} = 16,19 / \text{kotak}$$

$$P_{\gamma} = 16,19 \times 36 \text{ (kotak)} = 582,84 \text{ kg}$$

$$P_p = 14,48 \times 38 \text{ (kotak)} = 615,22 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{680}{28,2} = 24,11 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{582,84}{28,2} = 20,66 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{615,22}{28,2} = 21,81 \text{ kg/mm}^2$$



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UNIVERSITAS 17 AGUSTUS 1945



Nama Mahasiswa : Andik Kristanto  
NBI : 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Temperatur 850°C  
Dengan Quenching Larutan Garam (A3)

Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,4	3,4	3,4
Luas Penampang $A_0$ (mm) <sup>2</sup>	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	41,9	42,0	41,95
pertambahan panjang ( $\Delta L_{max}$ )	9,9	10,0	9,95
Beban Luluh, $P_\gamma$ (kg)	850,5	959,49	904,99
Beban Maksimum, $P_{max}$ (kg)	1225	1280	1252,5
Beban Putus, $P_p$ (kg)	1088,64	1035,64	1062,14
Tegangan Luluh, (kg/mm <sup>2</sup> )	30,15	34,02	32,08
Tegangan Max (kg/mm <sup>2</sup> )	43,33	45,39	44,36
Tegangan Putus (kg/mm <sup>2</sup> )	38,60	36,72	37,66

Surabaya, 1 April 2020

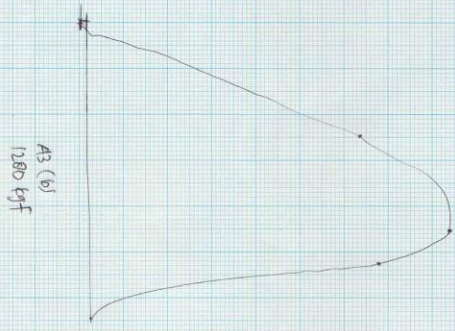
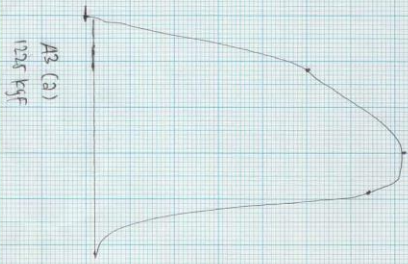


Lab. MATERIAL  
Teknik Mesin  
UNTAG Surabaya

Lab Material

850 G 1211 19F

250 19F



### A3

Spesimen 1(a) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o) &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1225 \text{ kgf}}{72 \text{ (kotak)}} = 17,01/\text{kotak}$$

$$P_{\gamma} = 17,01 \times 50 \text{ (kotak)} = 850,5 \text{ kg}$$

$$P_p = 17,01 \times 64 \text{ (kotak)} = 1088,64 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1225}{28,2} = 43,33 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{850,5}{28,2} = 30,15 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1088,64}{28,2} = 38,60 \text{ kg/mm}^2$$

Spesimen 2(b) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o) &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1280 \text{ kgf}}{84 \text{ (kotak)}} = 15,23 /\text{kotak}$$

$$P_{\gamma} = 15,23 \times 63 \text{ (kotak)} = 959,49 \text{ kg}$$

$$P_p = 14,48 \times 68 \text{ (kotak)} = 1035,64 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1280}{28,2} = 45,39 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{959,49}{28,2} = 34,02 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1035,64}{28,2} = 36,72 \text{ kg/mm}^2$$



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UNIVERSITAS 17 AGUSTUS 1945

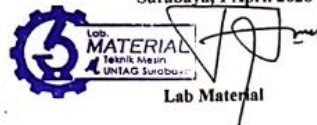


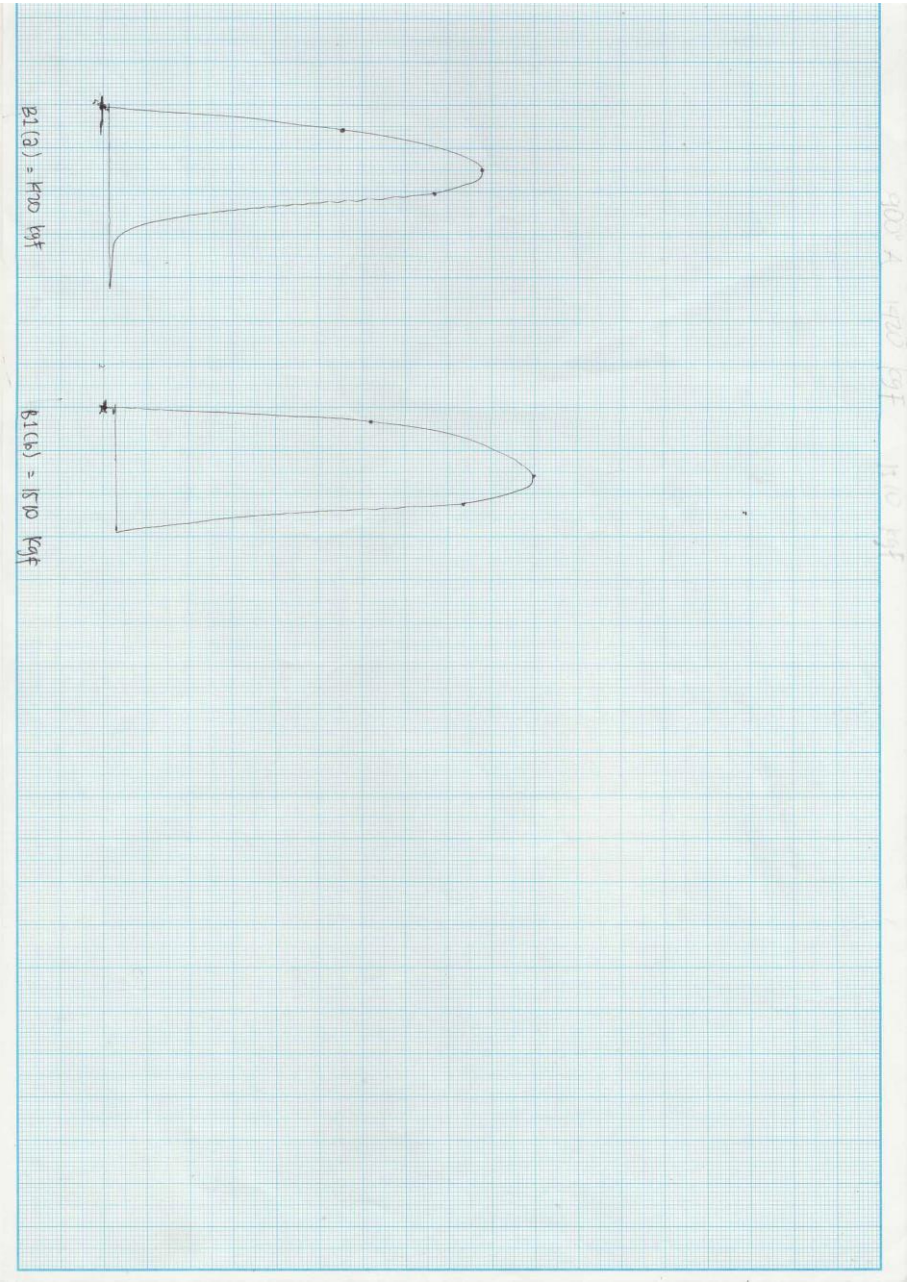
Nama Mahasiswa : Andik Kristanto  
NBI 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Temperatur 900°C  
Dengan Quenching Air Mineral (B1)

Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,6	3,7	3,65
Luas Penampang $A_0$ (mm) <sup>2</sup>	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	39,9	40,6	40,25
pertambahan panjang ( $\Delta L_{max}$ )	7,9	8,6	8,25
Beban Luluh, $P_y$ (kg)	887,15	945,5	916,32
Beban Maksimum, $P_{max}$ (kg)	1420	1510	1465
Beban Putus, $P_p$ (kg)	1258,14	1265,75	1261,94
Tegangan Luluh, (kg/mm <sup>2</sup> )	31,45	33,52	32,48
Tegangan Max (kg/mm <sup>2</sup> )	50,35	53,54	51,94
Tegangan Putus (kg/mm <sup>2</sup> )	44,61	44,88	44,74

Surabaya, 1 April 2020







## **B1**

Spesimen 1(a) :

$$\begin{aligned} \text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2 \end{aligned}$$

$$P_{\max} = \frac{1420 \text{ kgf}}{88 \text{ (kotak)}} = 16,13/\text{kotak}$$

$$P_{\gamma} = 16,13 \times 55 \text{ (kotak)} = 887,15 \text{ kg}$$

$$P_p = 16,13 \times 78 \text{ (kotak)} = 1258,14 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1420}{28,2} = 50,53 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{887,15}{28,2} = 31,45 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1258,14}{28,2} = 44,61 \text{ kg/mm}^2$$

Spesimen 2(b) :

$$\begin{aligned} \text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2 \end{aligned}$$

$$P_{\max} = \frac{1510 \text{ kgf}}{99 \text{ (kotak)}} = 15,25 / \text{kotak}$$

$$P_{\gamma} = 15,25 \times 62 \text{ (kotak)} = 945,5 \text{ kg}$$

$$P_p = 15,25 \times 83 \text{ (kotak)} = 1265,75 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1510}{28,2} = 53,54 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{945,5}{28,2} = 33,52 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1265,75}{28,2} = 44,88 \text{ kg/mm}^2$$



LABORATORIUM MATERIAL TEKNIK  
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UNIVERSITAS 17 AGUSTUS 1945



Nama Mahasiswa : Andik Kristanto  
NBI : 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Temperatur 900°C  
Dengan Quenching Oli (B2)

Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,5	3,7	3,6
Luas Penampang $A_0$ (mm) <sup>2</sup>	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	40,2	40,4	40,3
pertambahan panjang ( $\Delta L_{max}$ )	8,2	8,4	8,3
Beban Luluh, $P_f$ (kg)	861,84	935,74	898,79
Beban Maksimum, $P_{max}$ (kg)	1240	1350	1295
Beban Putus, $P_p$ (kg)	1073,52	1196,52	1135,02
Tegangan Luluh, (kg/mm <sup>2</sup> )	30,56	33,18	31,87
Tegangan Max (kg/mm <sup>2</sup> )	43,97	47,87	45,92
Tegangan Putus (kg/mm <sup>2</sup> )	38,06	42,42	40,24

Surabaya, 1 April 2020



Lab Material

$$B_2(A) = 1200 \text{ kgf}$$



$$B_2(C) = 1350 \text{ kgf}$$



## B2

### Spesimen 1(a) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1240 \text{ kgf}}{82 \text{ (kotak)}} = 15,12/\text{kotak}$$

$$P_{\gamma} = 15,12 \times 57 \text{ (kotak)} = 861,84 \text{ kg}$$

$$P_p = 15,12 \times 71 \text{ (kotak)} = 1073,52 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1240}{28,2} = 43,97 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{861,84}{28,2} = 30,56 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1073,52}{28,2} = 38,06 \text{ kg/mm}^2$$

### Spesimen 2(b) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1350 \text{ kgf}}{88 \text{ (kotak)}} = 15,34 / \text{kotak}$$

$$P_{\gamma} = 15,34 \times 61 \text{ (kotak)} = 935,74 \text{ kg}$$

$$P_p = 15,34 \times 78 \text{ (kotak)} = 1196,52 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1350}{28,2} = 47,87 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{935,74}{28,2} = 33,18 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1196,52}{28,2} = 42,42 \text{ kg/mm}^2$$



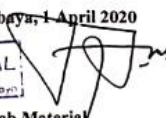
LABORATORIUM MATERIAL TEKNIK  
FAKULTAS TEKNIK MESIN  
UNIVERSITAS 17 AGUSTUS 1945



Nama Mahasiswa : Andik Kristanto  
NBI : 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Temperatur 900°C  
Dengan Quenching Larutan Garam (B3)

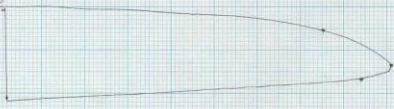
Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,2	3,3	3,25
Luas Penampang $A_0$ (mm) <sup>2</sup>	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	39,9	39,8	39,85
pertambahan panjang ( $\Delta L_{max}$ )	7,9	7,8	7,85
Beban Luluh, $P_y$ (kg)	1261,6	1153,5	1207,55
Beban Maksimum, $P_{max}$ (kg)	1520	1400	1460
Beban Putus, $P_p$ (kg)	1292	1299,2	1295,6
Tegangan Luluh, (kg/mm <sup>2</sup> )	44,73	40,90	42,81
Tegangan Max (kg/mm <sup>2</sup> )	53,90	49,64	51,77
Tegangan Putus (kg/mm <sup>2</sup> )	45,81	46,07	45,94

Surabaya, 1 April 2020  
  
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Teknik Mesin  
UNTAG Surabaya  
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$$h_2(\omega) = 1520 \text{ kJ/F}$$



$$h_3(\omega) = 1400 \text{ kJ/F}$$



11 5 14 20

1000 kJ/F

### B3

Spesimen 1(a) :

$$\begin{aligned} \text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2 \end{aligned}$$

$$P_{\max} = \frac{1520 \text{ kgf}}{100 \text{ (kotak)}} = 15,2 \text{ /kotak}$$

$$P_{\gamma} = 15,2 \times 83 \text{ (kotak)} = 1261,6 \text{ kg}$$

$$P_p = 15,2 \times 85 \text{ (kotak)} = 1292 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1520}{28,2} = 53,90 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1261,6}{28,2} = 44,73 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1292}{28,2} = 45,81 \text{ kg/mm}^2$$

Spesimen 2(b) :

$$\begin{aligned} \text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2 \end{aligned}$$

$$P_{\max} = \frac{1400 \text{ kgf}}{91 \text{ (kotak)}} = 15,38 \text{ /kotak}$$

$$P_{\gamma} = 15,38 \times 75 \text{ (kotak)} = 1153,5 \text{ kg}$$

$$P_p = 15,38 \times 84 \text{ (kotak)} = 1299,2 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1400}{28,2} = 49,64 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1153,5}{28,2} = 40,90 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1299,2}{28,2} = 46,07 \text{ kg/mm}^2$$



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UNIVERSITAS 17 AGUSTUS 1945

Nama Mahasiswa : Andik Kristanto  
NBI : 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Temperatur 950°C  
Dengan Quenching Air Mineral (C1)

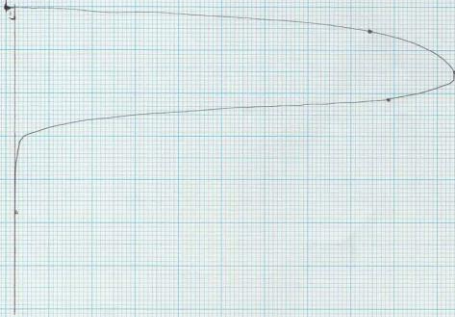
Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,7	3,5	3,6
Luas Penampang $A_0$ (mm) <sup>2</sup>	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	38,6	37,4	38
pertambahan panjang ( $\Delta L_{max}$ )	6,6	5,4	6
Beban Luluh, $P_y$ (kg)	1271,76	1132,2	1201,98
Beban Maksimum, $P_{max}$ (kg)	1575	1515	1545
Beban Putus, $P_p$ (kg)	1347,46	1208,7	1278,08
Tegangan Luluh, (kg/mm <sup>2</sup> )	45,09	40,14	42,61
Tegangan Max (kg/mm <sup>2</sup> )	55,85	53,72	54,78
Tegangan Putus (kg/mm <sup>2</sup> )	47,78	42,86	45,32

Surabaya, 1 April 2020

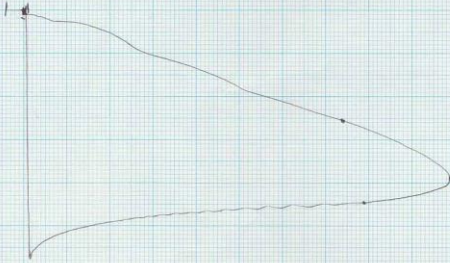
Lab MATERIAL  
FAKULTAS TEKNIK MESIN  
UNTAG SURABAYA  
Lab Material



$$C_1(z) = 1576 \text{ kgF}$$



$$C_2(z) = 1515 \text{ kgF}$$



## C1

Spesimen 1(a) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1575 \text{ kgf}}{104 \text{ (kotak)}} = 15,14/\text{kotak}$$

$$P_{\gamma} = 15,14 \times 84 \text{ (kotak)} = 1271,76 \text{ kg}$$

$$P_p = 15,14 \times 89 \text{ (kotak)} = 1347,46 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1575}{28,2} = 55,85 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1271,76}{28,2} = 45,09 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1347,46}{28,2} = 47,78 \text{ kg/mm}^2$$

Spesimen 2(b) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1515 \text{ kgf}}{99 \text{ (kotak)}} = 15,30 / \text{kotak}$$

$$P_{\gamma} = 15,30 \times 74 \text{ (kotak)} = 1132,2 \text{ kg}$$

$$P_p = 15,30 \times 79 \text{ (kotak)} = 1208,7 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1515}{28,2} = 53,72 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1132,2}{28,2} = 40,14 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1208,7}{28,2} = 42,86 \text{ kg/mm}^2$$



LABORATORIUM MATERIAL TEKNIK  
FAKULTAS TEKNIK MESIN  
UNIVERSITAS 17 AGUSTUS 1945



Nama Mahasiswa : Andik Kristanto  
NBI 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Temperatur 950°C  
Dengan Quenching Oli (C2)

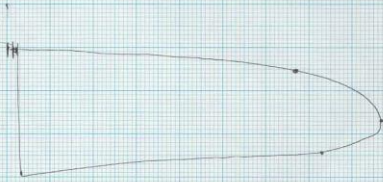
Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,9	4,0	3,95
Luas Penampang $A_0$ (mm) <sup>2</sup>	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	42,2	41,5	41,85
pertambahan panjang ( $\Delta L_{max}$ )	10,2	9,5	9,85
Beban Luluh, $P_r$ (kg)	1019,74	993,85	1006,79
Beban Maksimum, $P_{max}$ (kg)	1325	1300	1312,5
Beban Putus, $P_p$ (kg)	1111,06	1055,01	1083,03
Tegangan Luluh, (kg/mm <sup>2</sup> )	36,16	35,24	35,7
Tegangan Max (kg/mm <sup>2</sup> )	46,98	46,09	46,53
Tegangan Putus (kg/mm <sup>2</sup> )	39,39	37,41	38,4

Surabaya, 1 April 2020



Lab Matrerial

$$C_2(\lambda) = 1308 \text{ kgf}$$



$$C_2(\delta) = 1300 \text{ kgf}$$



## C2

### Spesimen 1(a) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o) &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1325 \text{ kgf}}{87 \text{ (kotak)}} = 15,22/\text{kotak}$$

$$P_{\gamma} = 15,22 \times 67 \text{ (kotak)} = 1019,74 \text{ kg}$$

$$P_p = 15,22 \times 73 \text{ (kotak)} = 1111,06 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1325}{28,2} = 46,98 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1019,74}{28,2} = 36,16 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1111,06}{28,2} = 39,39 \text{ kg/mm}^2$$

### Spesimen 2(b) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o) &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1300 \text{ kgf}}{85 \text{ (kotak)}} = 15,29 /\text{kotak}$$

$$P_{\gamma} = 15,29 \times 65 \text{ (kotak)} = 993,85 \text{ kg}$$

$$P_p = 15,29 \times 69 \text{ (kotak)} = 1055,01 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1300}{28,2} = 46,09 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{993,85}{28,2} = 35,24 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1055,01}{28,2} = 37,41 \text{ kg/mm}^2$$



LABORATORIUM MATERIAL TEKNIK  
FAKULTAS TEKNIK MESIN  
UNIVERSITAS 17 AGUSTUS 1945



Nama Mahasiswa : Andik Kristanto  
NBI : 1421600113  
Tanggal Pengujian : 1 April 2020

Data Hasil Pengujian Tarik Bahan Baja ST-41 Temperatur 950°C  
Dengan Quenching Larutan Garam (C3)

Parameter	Spesimen 1 (a)	Spesimen 2 (b)	Rata-Rata
Diameter awal $d_0$ (mm)	6	6	6
Diameter setelah Patah, $d_1$ (mm)	3,5	3,6	3,55
Luas Penampang $A_0$ (mm <sup>2</sup> )	28,2	28,2	28,2
Panjang Awal, $L_0$ (mm)	32	32	32
Panjang Akhir, $L_f$ (mm)	40,6	39,5	40,05
pertambahan panjang ( $\Delta L_{max}$ )	8,6	7,5	8,05
Beban Luluh, $P_f$ (kg)	1281,52	1148,25	1214,88
Beban Maksimum, $P_{max}$ (kg)	1560	1440	1500
Beban Putus, $P_p$ (kg)	1343,28	1194,18	1268,73
Tegangan Luluh, (kg/mm <sup>2</sup> )	45,42	40,71	43,06
Tegangan Max (kg/mm <sup>2</sup> )	55,31	51,06	53,18
Tegangan Putus (kg/mm <sup>2</sup> )	47,63	42,34	44,98

Surabaya, 1 April 2020



$$c_3(a) = 1500 \text{ kgF}$$



$$c_3(b) = 1400 \text{ kgF}$$



### C3

Spesimen 1(a) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1560 \text{ kgf}}{101 \text{ (kotak)}} = 15,44/\text{kotak}$$

$$P_{\gamma} = 15,44 \times 83 \text{ (kotak)} = 1281,52 \text{ kg}$$

$$P_p = 15,44 \times 87 \text{ (kotak)} = 1343,28 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1560}{28,2} = 55,31 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1281}{28,2} = 45,42 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1343,28}{28,2} = 47,63 \text{ kg/mm}^2$$

Spesimen 2(b) :

$$\begin{aligned}\text{Mencari Luas Penampang awal ( } A_o \text{ )} &= \frac{\pi}{4} \cdot d^2 \\ &= \frac{\pi}{4} \cdot 6^2 = 28,2\end{aligned}$$

$$P_{\max} = \frac{1440 \text{ kgf}}{94 \text{ (kotak)}} = 15,31 /\text{kotak}$$

$$P_{\gamma} = 15,31 \times 75 \text{ (kotak)} = 1148,25 \text{ kg}$$

$$P_p = 15,29 \times 78 \text{ (kotak)} = 1194,18 \text{ kg}$$

$$\sigma_{\max} = \frac{P_{\max}}{A_o} = \frac{1440}{28,2} = 51,06 \text{ kg/mm}^2$$

$$\sigma_{\gamma} = \frac{P_{\gamma}}{A_o} = \frac{1148,25}{28,2} = 40,71 \text{ kg/mm}^2$$

$$\sigma_p = \frac{P_p}{A_o} = \frac{1194,18}{28,2} = 42,34 \text{ kg/mm}^2$$



## F. Proses Uji kekerasan Rockwell



(Tampak Depan)

(Tampak Samping)

Mesin Uji kekerasan Rockwell Lab Material  
Universitas 17 Agustus Surabaya



Spesimen Uji kekerasan Rockwell



Indentor Uji kekerasan Rockwell dengan Diamond cone (Black)



Foto Dokumentasi di Lab Material Universitas 17 Agustus 1945 Surabaya



LABORATORIUM MATERIAL TEKNIK  
FAKULTAS TEKNIK MESIN  
UNIVERSITAS 17 AGUSTUS 1945



Nama Mahasiswa : Andik Kristanto  
NBI : 1421600113  
Tanggal Pengujian : 20 April 2020

Data Hasil Pengujian Kekerasan Rockwell

Benda Uji	Kondisi Indentasi	Indentasi	Spesimen	Nilai Kekerasan (HRC)			Rata-Rata
				Titik 1	Titik 2	Titik 3	
Baja ST-41	P = 150kg t = 5 Detik	Diamond Cone (Black)	A	55,5	58	57,5	57
			A1	59	57,5	60,5	59
			A2	53,5	53,5	54	53
			A3	63	59,5	60	60,8
			B1	64,5	63	64	63,8
			B2	54,5	52	51	52,5
			B3	63	59	59	55,6
			C1	71	69	70,5	70,1
			C2	62	62,5	66,5	63,6
			C3	72,5	75,5	72	73,3

Keterangan :

- A = Spesimen Uji kekerasan tanpa *Heattreatment*
- A1 = Media pendingin air mineral dengan temperatur 850<sup>0</sup>C
- B1 = Media pendingin air mineral dengan temperatur 900<sup>0</sup>C
- C1 = Media pendingin air mineral dengan temperatur 950<sup>0</sup>C
- A2 = Media pendingin Oli dengan temperatur 850<sup>0</sup>C
- B2 = Media pendingin Oli dengan temperatur 900<sup>0</sup>C
- C2 = Media pendingin Oli dengan temperatur 950<sup>0</sup>C
- A3 = Media pendingin Larutan Garam dengan temperatur 850<sup>0</sup>C
- B3 = Media pendingin Larutan Garam dengan temperatur 900<sup>0</sup>C
- C3 = Media pendingin Larutan Garam dengan temperatur 950<sup>0</sup>C

Surabaya, 20 April 2020



Lab Material