**DAIFTAIR PUSTAIKA**

AIlaim, M. N. (2020). Pengairuh Vairiaisi Waiktu Penaihainain Painais(Holding Time)Paidai Proses Heait Treaitment Menggunaikain Baijai Kairbon Rendaih Paidai Pembuaitain Geair Sepedai Motor. *Universitais Paincaisaikti Tegail*, 1-117.

AIrifaindi , R., & Pohain, G. D. (2021). Pengairuh Mediai AIraing Kaiyu Baikaiu Maingrove Dain AIraing Kaiyu AIsaim Paidai Proses Perlaikuain Cairburizing Terhaidaip Sifait Mekainik Baijai Kairbon ST-37 . *JURNAIL FLYWHEEL Vol 12 (2)*, 30-37.

AIziz, AI., Daismairwain, & Waigino. (t.thn.). Pengairuh Proses Kairbonaisi Terhaidaip Kekeraisain Sproket Imitaisi Sepedai Motor. *Jurusain Teknik Otomotif UNP*, 1-5.

Beliu, N. H., Pell, M. Y., & Jaisron, U. J. (2016). AInailisai Kekuaitain Tairik dain Bending paidai Komposit Widuri - Polyester. *LONTAIR Jurnail Teknik Mesin Undainai, Vol. 03, No. 02*, 11-120.

Dairmo, AI. N., & S. W. (2019). Pengairuh Proses Paick Cairburising Terhaidaip Kekeraisain Baijai Kairbon Rendaih . *Prosiding SNST ke-10*, 1-6.

Dewai Ngaikain Ketut Putrai Negairai, I. D. (2015). Paick Cairburizing Baijai Kairbon Rendaih . *Jurnail Energi dain Mainufaiktur Vol.7, No.1*, 1-6.

Faitchurrozy , AI. (2020). Pengairuh Proses Cairburizing Dengain Serbuk Tulaing Saipi Terhaidaip Kekuaitain Mekainik Baijai St 37 Paidai Pembuaitain Baiut E-Bolt Penairik Kaiwait Baijai. *Universitais Paincaisaikti Tegail*, 1-60.

Gunaiwain, E. (2017). AInailisai Pengairuh Temperaitur Terhaidaip Sifait Mekainis Dain Struktur Mikro Paidai Baijai Kairbon Rendaih (St41) Dengain Metode Paick Cairbirizing . *Engineering aind Saiins Journail, Vol. 1*, 1-8.

Jokosisworo, S. (2018). Pengairuh Normailizing Dengain Vairiaisi Waiktu Penaihainain Painais (Holding Time) Terhaidaip Sifait Mekainik Baijai ST 46 . *Jurnail Ilmu Pengetaihuain & Teknologi Kelaiutain Kaipail, Vol. 15, No. 2*, 68-73.

Kairmin, D. (2018). AInailisai Perubaihain Sifait Mekainik Dain Struktur Mikro Multi Quenching Terhaidaip Haisil Paick Cairburizing Baijai Kairbon Rendaih . *Jurnail AIustenit* , 1-9.

Nurhilail , M. (2017). Pengairuh Temperaitur, Holding Time Proses Paick Cairburizing Baijai Kairbon Terhaidaip Sifait Fisik Dain Mekainik . *Jurnail Teknologi, Volume 10 Nomor 2*, 153-162.

Nurlinai, N., Bisono, R. M., & Irwain, D. (2020). Pengairuh Vairiaisi Temperaiture Dain Holding Time Paick Cairburizing Menggunaikain Mediai AIraing Serbuk Gergaiji Kaiyu Jaiti Terhaidaip Peningkaitain Sifait Mekainis Baijai Kairbon Rendaih Untuk Maiteriail Pisaiu . *JTech 8(2)*, 129 - 134 .

Rimpung, I. K. (2016). Pengairuh Perlaikuain Painais Terhaidaip Kekeraisain Baijai (St. 42) Dengain Temperaitur Pemainaisain 800◦C, Metode Brinell, Di Laiboraitorium Uji Baihain Politeknik Negeri Baili . *Jurnail Logic. VOL. 16. NO. 2. JULI 2016* , 87-91.

Sujitai, S., Sulistyowaiti, E. D., & Waihyu, R. M. (2022). Pengairuh waiktu taihain paick cairburizing dain penggunaiain mediai quenching caine molaisses terhaidaip sifait mekainik dain struktur mikro baijai kairbon rendaih. *Dinaimikai Teknik Mesin, Vol. 12, No. 1*, 36-44.

Waiais, K., & Waiais , V. D. (2020). Pengairuh Holding Time Dain Vairiaisi Mediai Quenching Terhaidaip Nilaii Kekeraisain Baijai Kairbon Rendaih St 42 Paidai Proses Pengkairbonain Paidait Menggunaikain AIraing Baitok Biji Pailai (Myristicai Faigrains) . *Jurnail Simetrik Vol.10, No.1*, 269-278.

Wailuyo, J. (2009). Pengairuh Temperaitur dain Waiktu Taihain Paidai Proses Kairburisaisi Caiir Terhaidaip Kekeraisain Baihain AIISIS 1025 Dengain Mediai Pendingin AIir. *Universitais Sebelais Mairet Suraikairtai* , 1-49.

LAMPIRAN – LAMPIRAN

**Perhitungan data Uji kekerasan, Uji Tarik dan Uji bending**

1. **Pengolahan data harga kekerasan raw material titik 1 Baja ST 41**

HB =

173 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

175 x 7,85 (2,5 -) = 375,2

1.358,05(2,5 -) = 375,2

2,5 - = 375,2  
 1.358,05

2,5 - = 0,2762

2,5 – 0,2762 =

2,22382 =

4,9452 =

d2 = 6,25 – 4,9452

d =

**d = 1,1422 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2237)

= 375,2

2,168955

= 172,98

**= 173 HB**

1. **Perhitungan hasil uji kekerasan raw material titik 2 Baja ST 41**

HB =

173 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

175 x 7,85 (2,5 -) = 375,2

1.358,05(2,5 -) = 375,2

2,5 - = 375,2  
 1.358,05

2,5 - = 0,2762

2,5 – 0,2762 =

2,22382 =

4,9452 =

d2 = 6,25 – 4,9452

d =

**d = 1,1422 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2237)

= 375,2

2,168955

= 172,98

**= 173 HB**

1. **Perhitungan hasil uji kekerasan raw material titik 3 Baja ST 41**

HB =

173 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

175 x 7,85 (2,5 -) = 375,2

1.358,05(2,5 -) = 375,2

2,5 - = 375,2  
 1.358,05

2,5 - = 0,2762

2,5 – 0,2762 =

2,22382 =

4,9452 =

d2 = 6,25 – 4,9452

d =

**d = 1,1422 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2237)

= 375,2

2,168955

= 172,98

**= 173 HB**

1. **Perhitungan hasil uji kekerasan titik 1 Baja ST 41 Variasi 20 Menit**

HB =

167 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

167 x 7,85 (2,5 -) = 375,2

1.310,95(2,5 -) = 375,2

2,5 - = 375,2  
 1.310,95

2,5 - = 0,2862

2,5 – 0,2862 =

2,21382 =

4,9009 =

d2 = 6,25 – 4,9009

d =

**d = 1,1615 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2138)

= 375,2

2,24667

= 167,00

**= 167 HB**

1. **Perhitungan hasil uji kekerasan titik 2 Baja ST 41 Variasi 20 Menit**

HB =

167 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

166 x 7,85 (2,5 -) = 375,2

1.303,1(2,5 -) = 375,2

2,5 - = 375,2  
 1.303,1

2,5 - = 0,2879

2,5 – 0,2879 =

2,21212 =

4,8933 =

d2 = 6,25 – 4,8933

d =

**d = 1,1647 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2121)

= 375,2

2,260015

= 166,01

**= 166,01 HB**

1. **Perhitungan hasil uji kekerasan titik 3 Baja ST 41 Variasi 20 Menit**

HB =

167 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

166 x 7,85 (2,5 -) = 375,2

1.303,1(2,5 -) = 375,2

2,5 - = 375,2  
 1.303,1

2,5 - = 0,2879

2,5 – 0,2879 =

2,21212 =

4,8933 =

d2 = 6,25 – 4,8933

d =

**d = 1,1647 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2121)

= 375,2

2,260015

= 166,01

**= 166,01 HB**

1. **Perhitungan hasil uji kekerasan titik 1 Baja ST 41 Variasi 30 Menit**

HB =

170 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

170 x 7,85 (2,5 -) = 375,2

1.334,5(2,5 -) = 375,2

2,5 - = 375,2  
 1.334,5

2,5 - = 0,2811

2,5 – 0,2811 =

2,21892 =

4,9235 =

d2 = 6,25 – 4,9235

d =

**d = 1,1517 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2189)

= 375,2

2,20663

= 170,03

**= 170 HB**

1. **Perhitungan hasil uji kekerasan titik 2 Baja ST 41 Variasi 30 Menit**

HB =

170 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

170 x 7,85 (2,5 -) = 375,2

1.334,5(2,5 -) = 375,2

2,5 - = 375,2  
 1.334,5

2,5 - = 0,2811

2,5 – 0,2811 =

2,21892 =

4,9235 =

d2 = 6,25 – 4,9235

d =

**d = 1,1517 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2189)

= 375,2

2,20663

= 170,03

**= 170 HB**

1. **Perhitungan hasil uji kekerasan titik 3 Baja ST 41 Variasi 30 Menit**

HB =

180 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

180 x 7,85 (2,5 -) = 375,2

1.413(2,5 -) = 375,2

2,5 - = 375,2  
 1.413

2,5 - = 0,2657

2,5 – 0,2657 =

2,23432 =

4,9920 =

d2 = 6,25 – 4,9920

d =

**d = 1,1216 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2347)

= 375,2

2,08260

= 180,159

**= 182 HB**

1. **Perhitungan hasil uji kekerasan titik 1 Baja ST 41 Variasi 40 Menit**

HB =

216 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

216 x 7,85 (2,5 -) = 375,2

1.695,6(2,5 -) = 375,2

2,5 - = 375,2  
 1.695,5

2,5 - = 0,2212

2,5 – 0,2212 =

2,27882 =

5,1929 =

d2 = 6,25 – 5,1929

d =

**d = 1,0281 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2788)

= 375,2

1,7364

= 216.07

**= 216 HB**

1. **Perhitungan hasil uji kekerasan titik 2 Baja ST 41 Variasi 40 Menit**

HB =

212 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

212 x 7,85 (2,5 -) = 375,2

1.664,2(2,5 -) = 375,2

2,5 - = 375,2  
 1.664,2

2,5 - = 0,2254

2,5 – 0,2254 =

2,27462 =

5,1738 =

d2 = 6,25 – 5,1738

d =

**d = 1,0374 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2746)

= 375,2

1,7693

= 212,06

**= 212 HB**

1. **Perhitungan hasil uji kekerasan titik 3 Baja ST 41 Variasi 40 Menit**

HB =

212 = 2 x 187,6

3,14 x 2,5 (2,5-)

= 2 F

7,85(2,5-)

212 x 7,85 (2,5 -) = 375,2

1.664,2(2,5 -) = 375,2

2,5 - = 375,2  
 1.664,2

2,5 - = 0,2254

2,5 – 0,2254 =

2,27462 =

5,1738 =

d2 = 6,25 – 5,1738

d =

**d = 1,0374 mm**

HB =

= 2 x 187,6

3,14 x 2,5 (2,5-)

= 375,2

3,14 x 2,5 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5-)

= 375,2

7,85 (2,5- 2,2746)

= 375,2

1,7693

= 212,06

**= 212 HB**

**Perhitungan data hasil uji tarik raw material ST 41**

𝜎 = Pmax

A0

𝜎 = 34320

74,51

= 460,61 N/mm2

Pmax = A0 x 𝜎

1000

= 74,51x 460,61

1000

= 34,320 Kn

= 34320 N

1. **Perhitungan hasil uji tarik baja ST 41 variasi 20 menit**

𝜎 = Pmax

A0

𝜎 = 39850

73,74

= 540,41 N/mm2

Pmax = A0 x 𝜎

1000

= 73,74x 540,41

1000

= 39,849 Kn

= 39840 N

1. **Perhitungan hasil uji tarik baja ST 41 variasi 20 menit**

𝜎 = Pmax

A0

𝜎 = 42010

71,87

= 584,52 N/mm2

Pmax = A0 x 𝜎

1000

= 71,87x 584,52

1000

= 42,009 Kn

= 4210 N

1. **Perhitungan hasil uji tarik baja ST 41 variasi 20 menit**

𝜎 = Pmax

A0

𝜎 = 40330

76,26

= 528,84 N/mm2

Pmax = A0 x 𝜎

1000

= 76,26x 528,84

1000

= 40,329 Kn

= 40330 N

1. **Perhitungan hasil uji tarik baja ST 41 variasi 30 menit**

𝜎 = Pmax

A0

𝜎 = 40630

75,67

= 536,93 N/mm2

Pmax = A0 x 𝜎

1000

= 75,67x 536,93

1000

= 40,629 Kn

= 40630 N

1. **Perhitungan hasil uji tarik baja ST 41 variasi 20 menit**

𝜎 = Pmax

A0

𝜎 = 40880

75,35

= 542,53 N/mm2

Pmax = A0 x 𝜎

1000

= 75,35x 542,53

1000

= 40,879 Kn

= 40880 N

1. **Perhitungan hasil uji tarik baja ST 41 variasi 20 menit**

𝜎 = Pmax

A0

𝜎 = 40420

75,36

= 536,35 N/mm2

Pmax = A0 x 𝜎

1000

= 75,36x 536,35

1000

= 40,419 Kn

= 40420 N

**Perhitungan hasil uji bending raw baja ST 41**

𝜎 = 3 P L

2 b d2

= 3 x 4180 x 40

2 x 12,73 x (5,94)2

= 501.600

898,320

= 558,375

= 558,38 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 20 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5390 x 40

2 x 12,78 x (5,92)2

= 646800

895,785

= 722,048

= 722,05 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 20 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5210 x 40

2 x 12,57 x (5,93)2

= 625200

884,045

= 707,203

= 707,20 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 20 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5390 x 40

2 x 12,78 x (5,92)2

= 646800

892,143

= 724,99

= 725,00 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 30 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5210 x 40

2 x 12,61 x (5,95)2

= 625200

892,143

= 700,78

= 700,23 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 30 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5340 x 40

2 x 12,59 x (5,91)2

= 640800

879,489

= 728,604

= 728,60 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 30 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5430 x 40

2 x 12,60 x (5,92)2

= 651600

895,785

= 727,406

= 727,41 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 40 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5330 x 40

2 x 12,61 x (5,92)2

= 639600

883,870

= 723,635

= 723,64 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 40 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5440 x 40

2 x 12,54 x (5,96)2

= 652800

890,881

= 732,757

= 732,76 Mpa

1. **Perhitungan hasil uji bending baja ST 41 variasi 40 menit**

𝜎 = 3 P L

2 b d2

= 3 x 5220 x 40

2 x 12,57 x (6,03)2

= 626400

914,113

= 685,254

= 685,25 Mpa

**Dokumentasi Gambar Pengujian**

**Proses *Heat treatment***

****

**Suhu pemanasan**

****

**Pendinginan media oli**

****

**Pack carburizing (tulang sapi)**

****

**Specimen Uji Tarik**

**Specimen Uji Bending**

****

**Specimen Uji Kekerasan**

****

**Proses carburizing specimen**

****

**Mesin uji tarik**

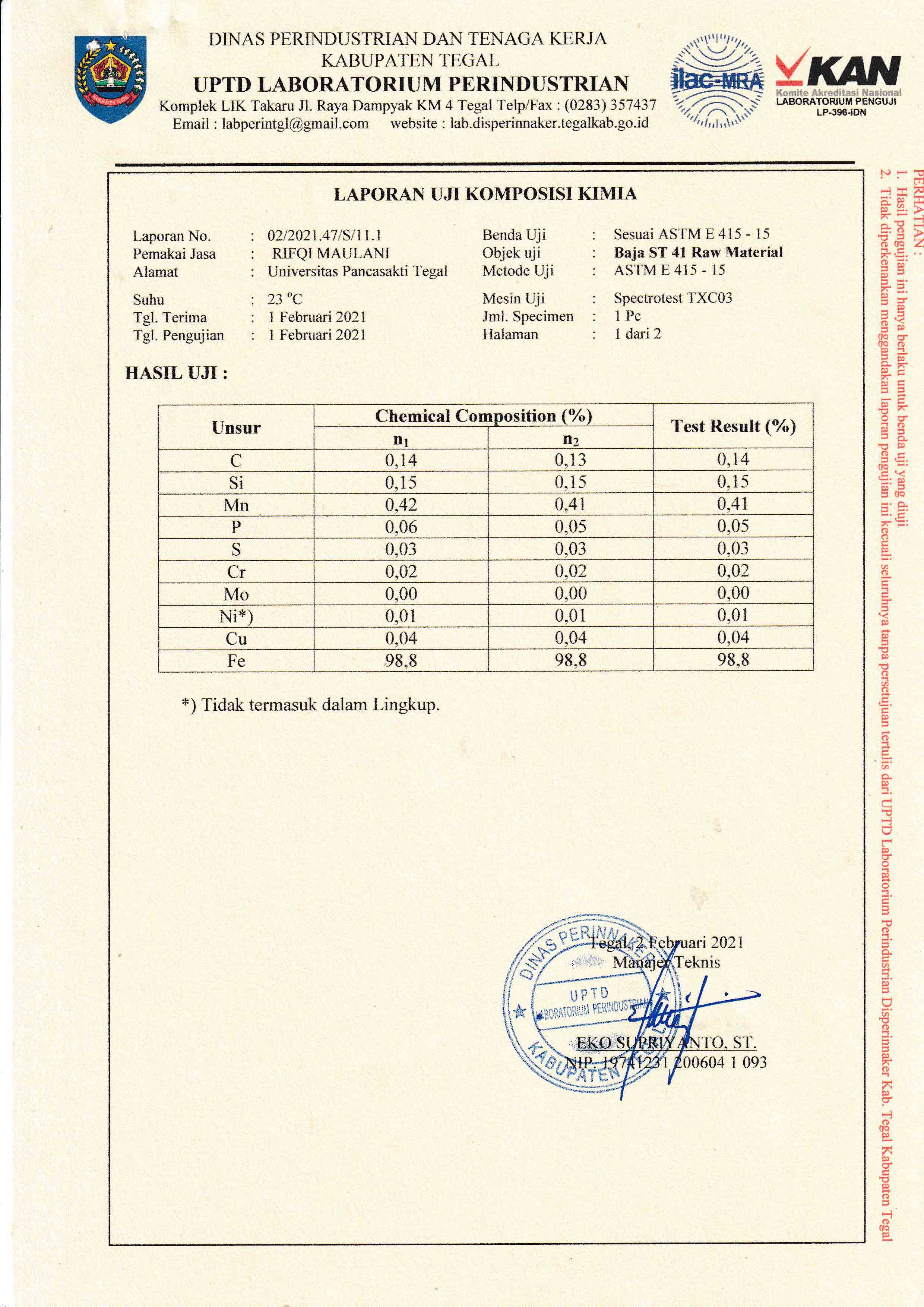
****

**Mesin uji bending**

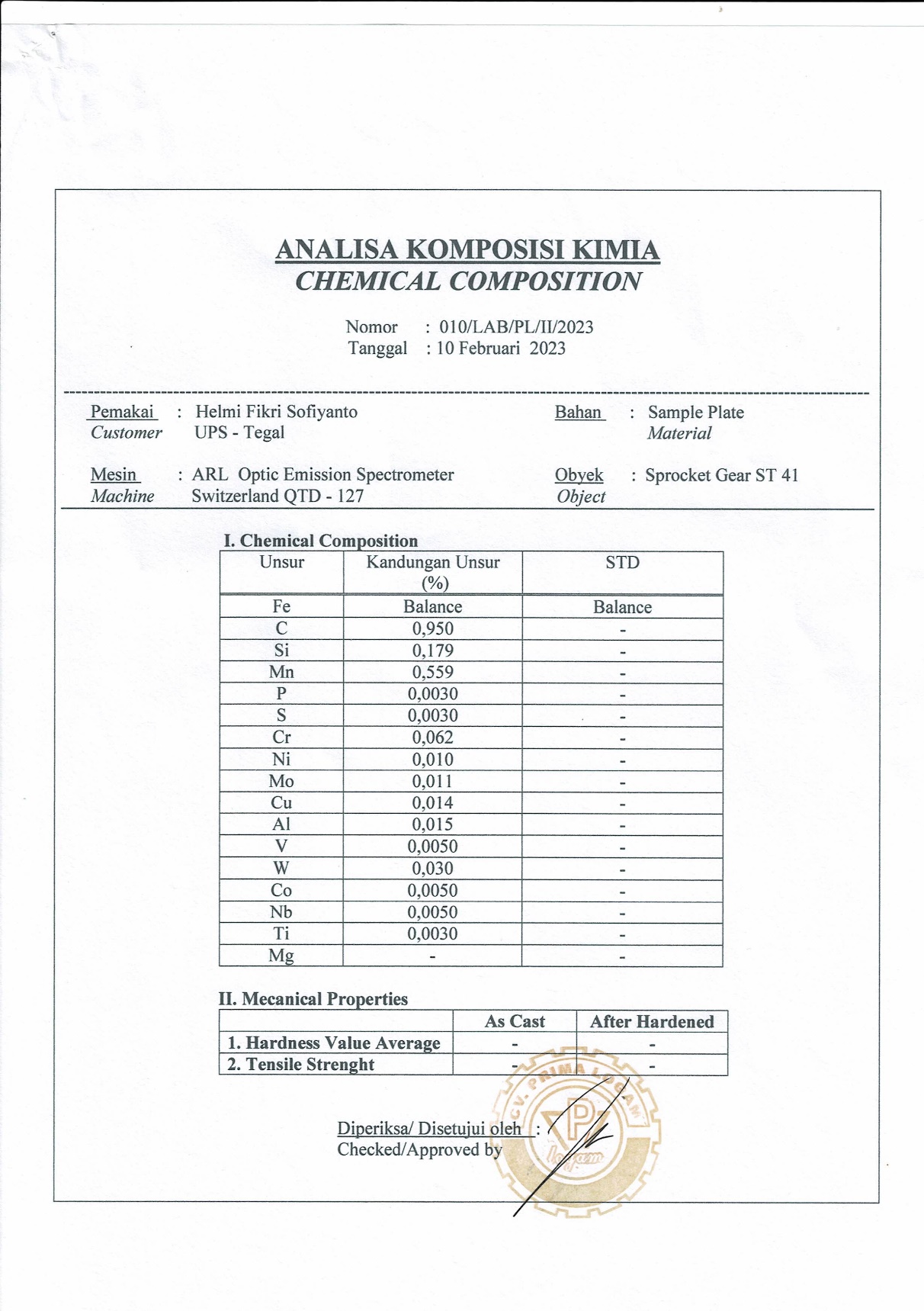
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**Mesin uji kekerasan**

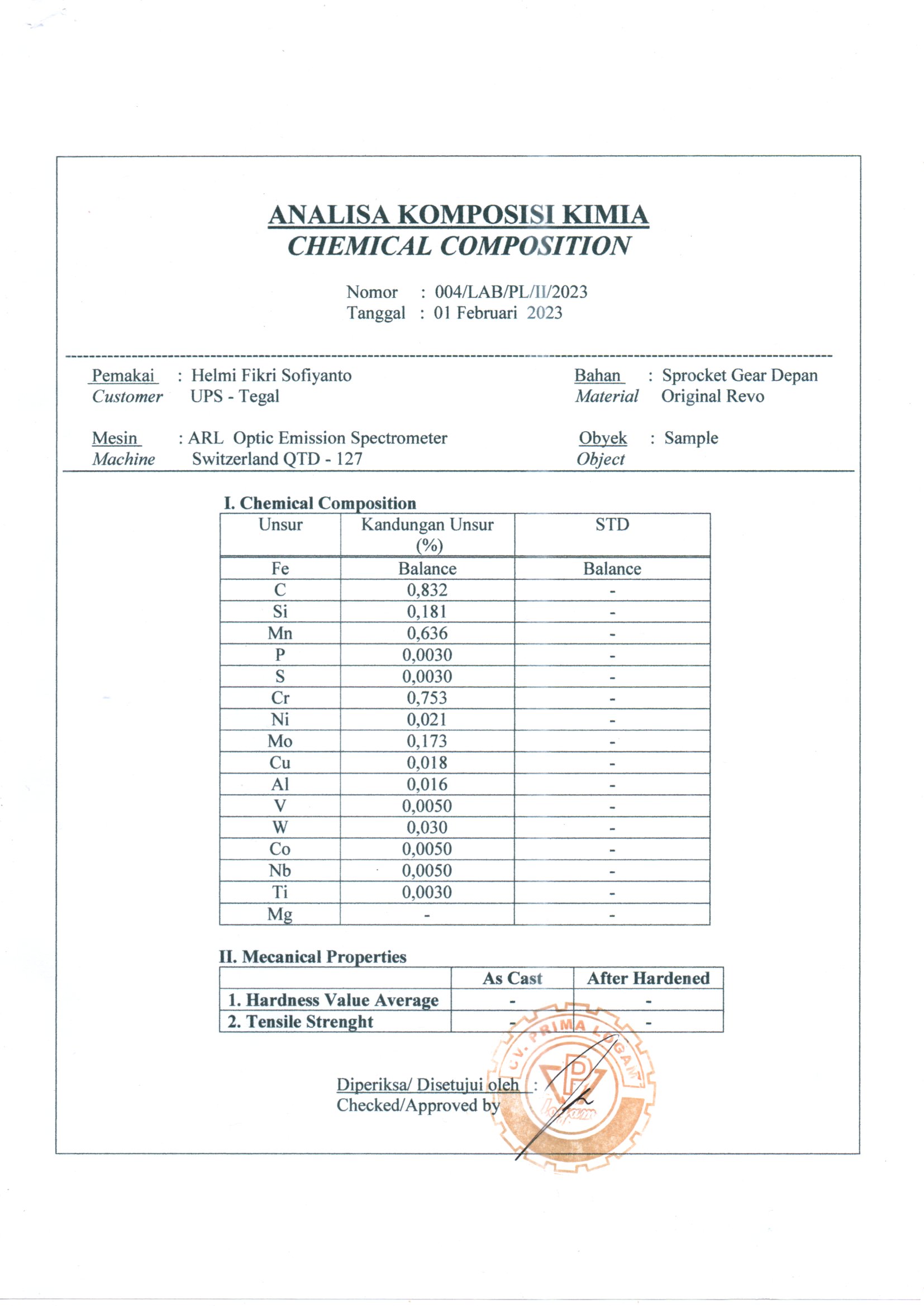
**Sertifikat Uji Komposisi ST 41**



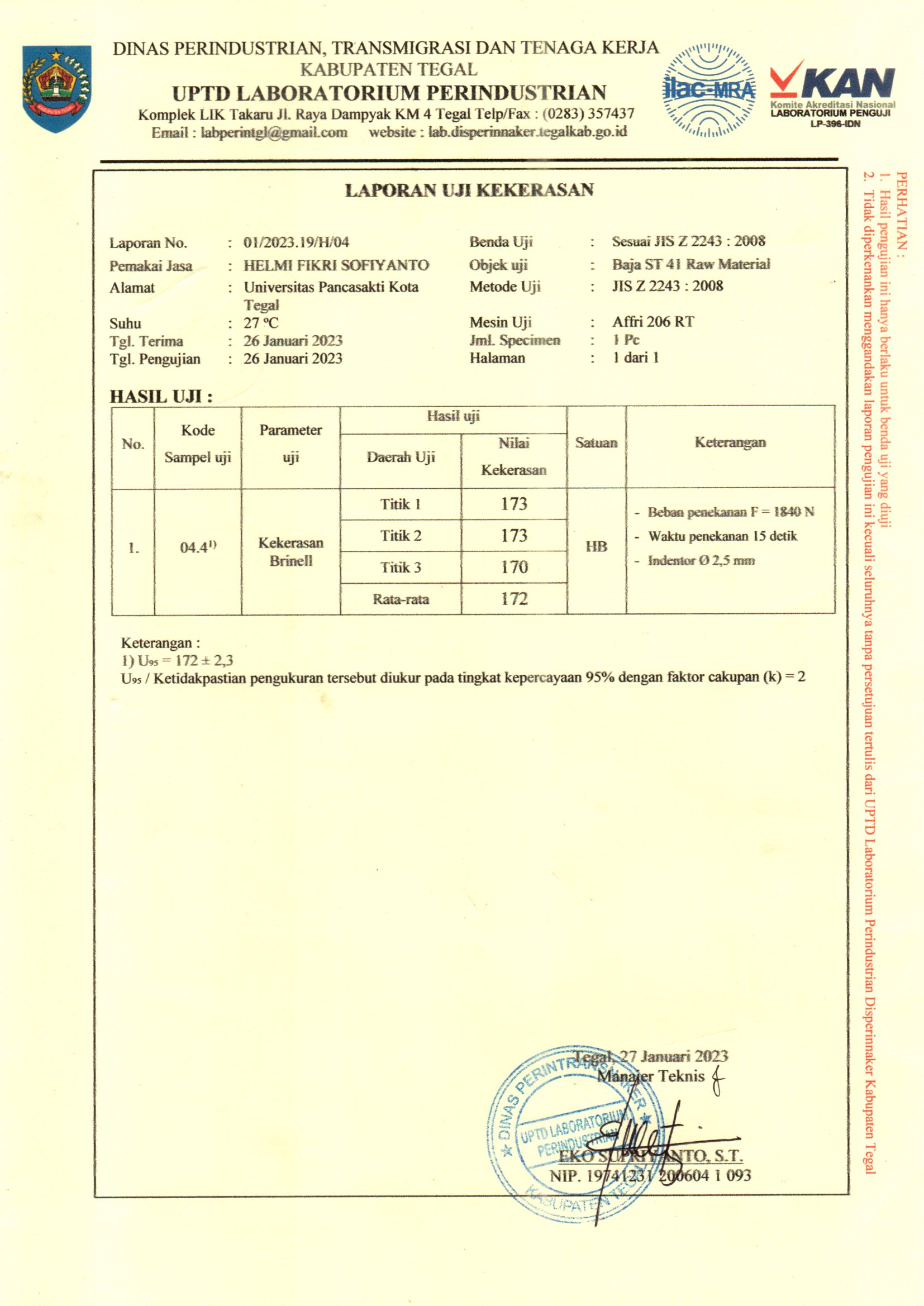
**Sertifikat Uji Komposisi kimia *sproket gear* ST 41**

****

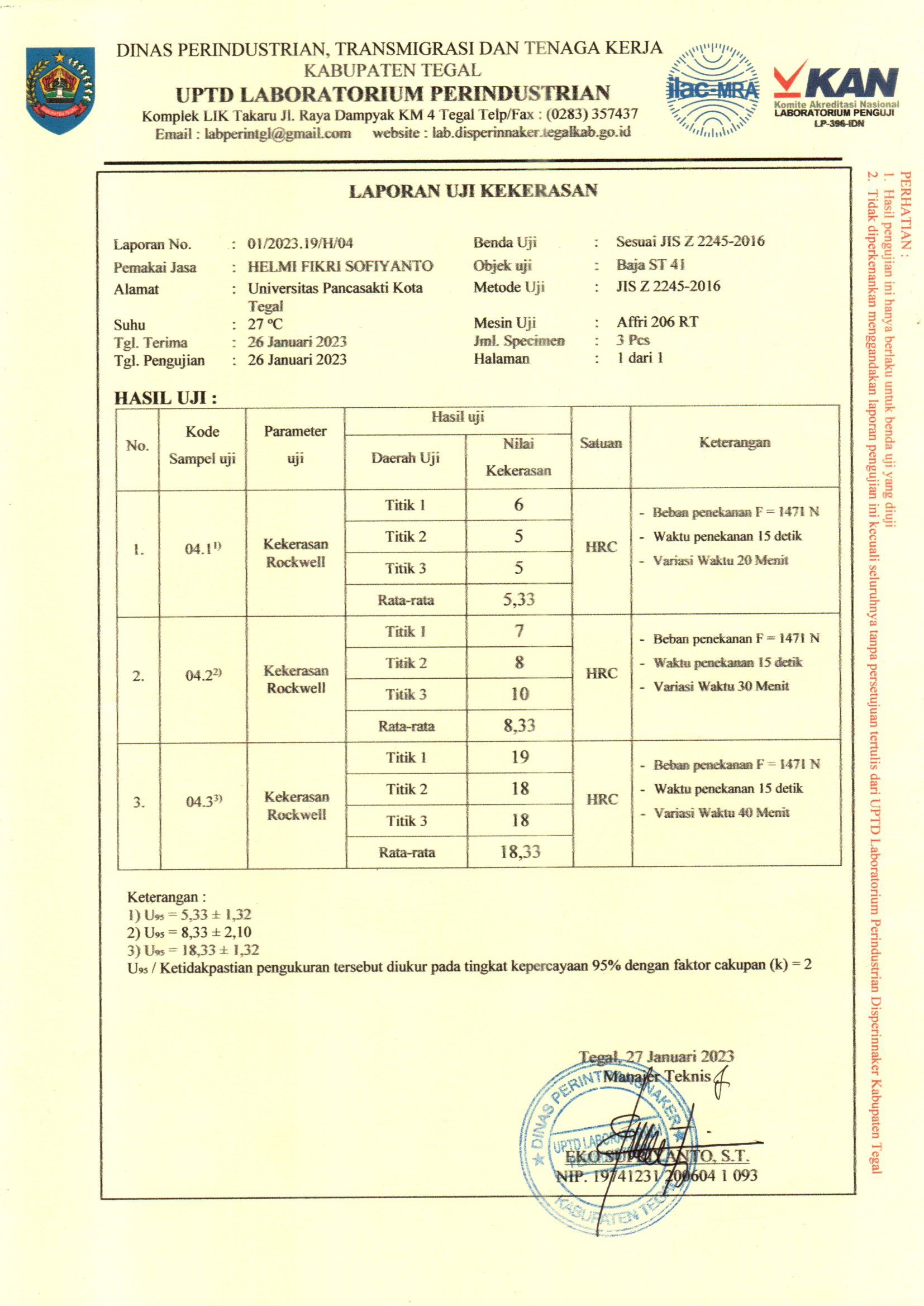
**Sertifikat Uji Komposisi kimia *sproket gear* original**

****

**Sertifikat Uji Kekerasan Raw Material ST 41**

****

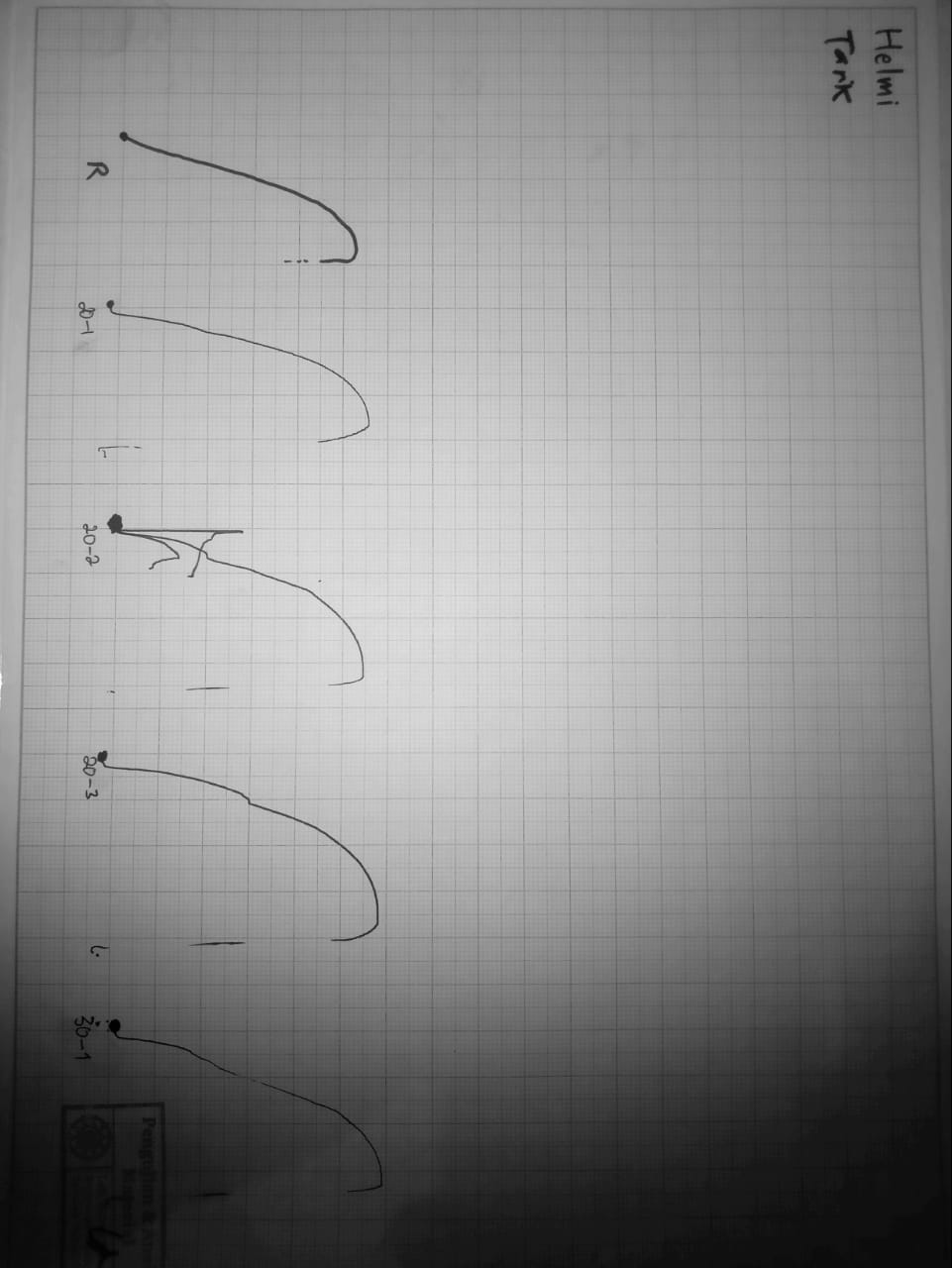
**Sertifikat Uji Kekerasan *Carburizing* ST 41 variasi waktu 20 menit, 30 menit 40 menit**

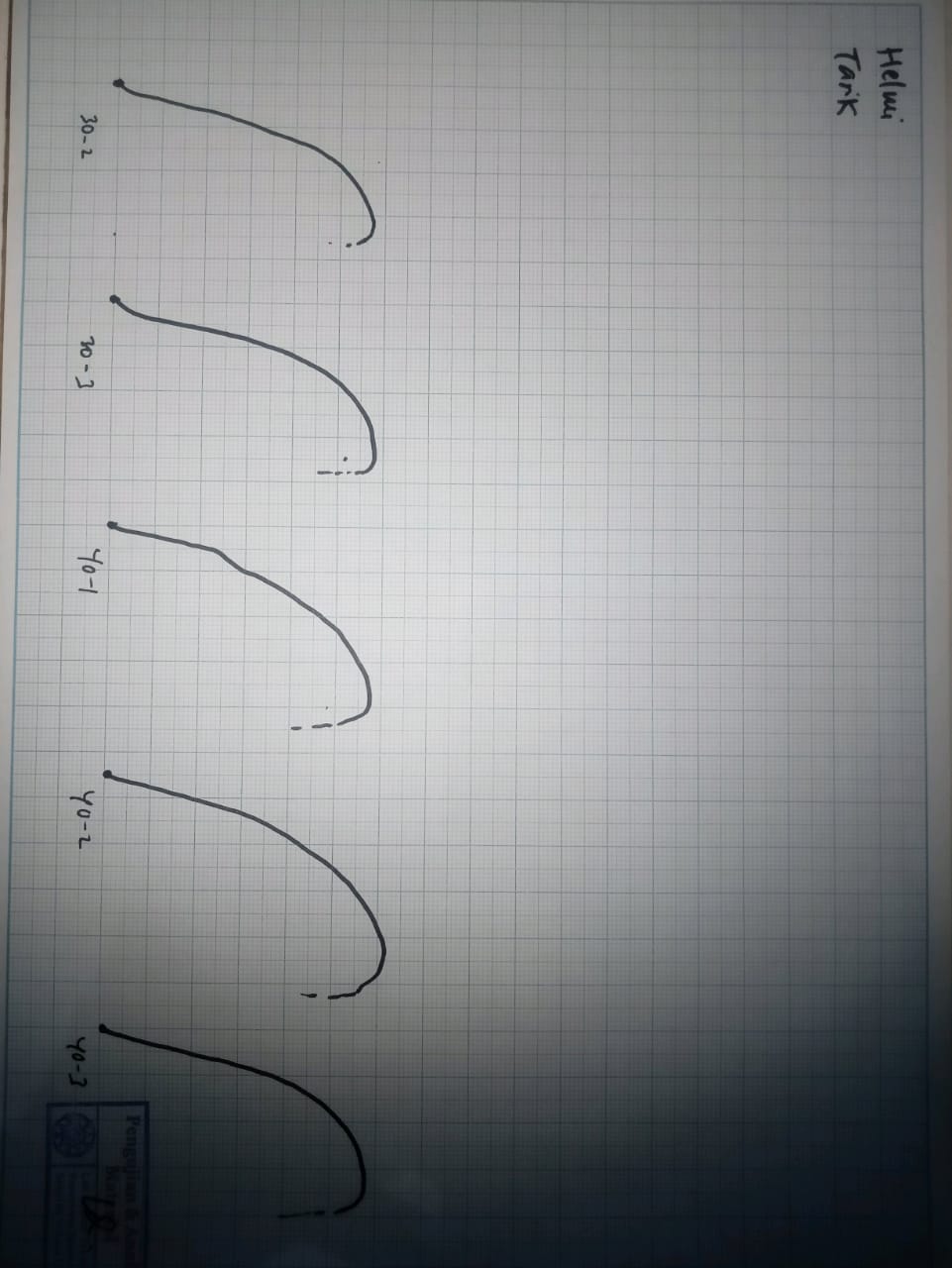
****

**Sertifikat Uji Tarik *Carburizing* ST 41 variasi waktu 20 menit, 30 menit 40 menit**

****

**Grafik Uji tarik *Carburizing* ST 41 variasi waktu 20 menit, 30 menit 40 menit**

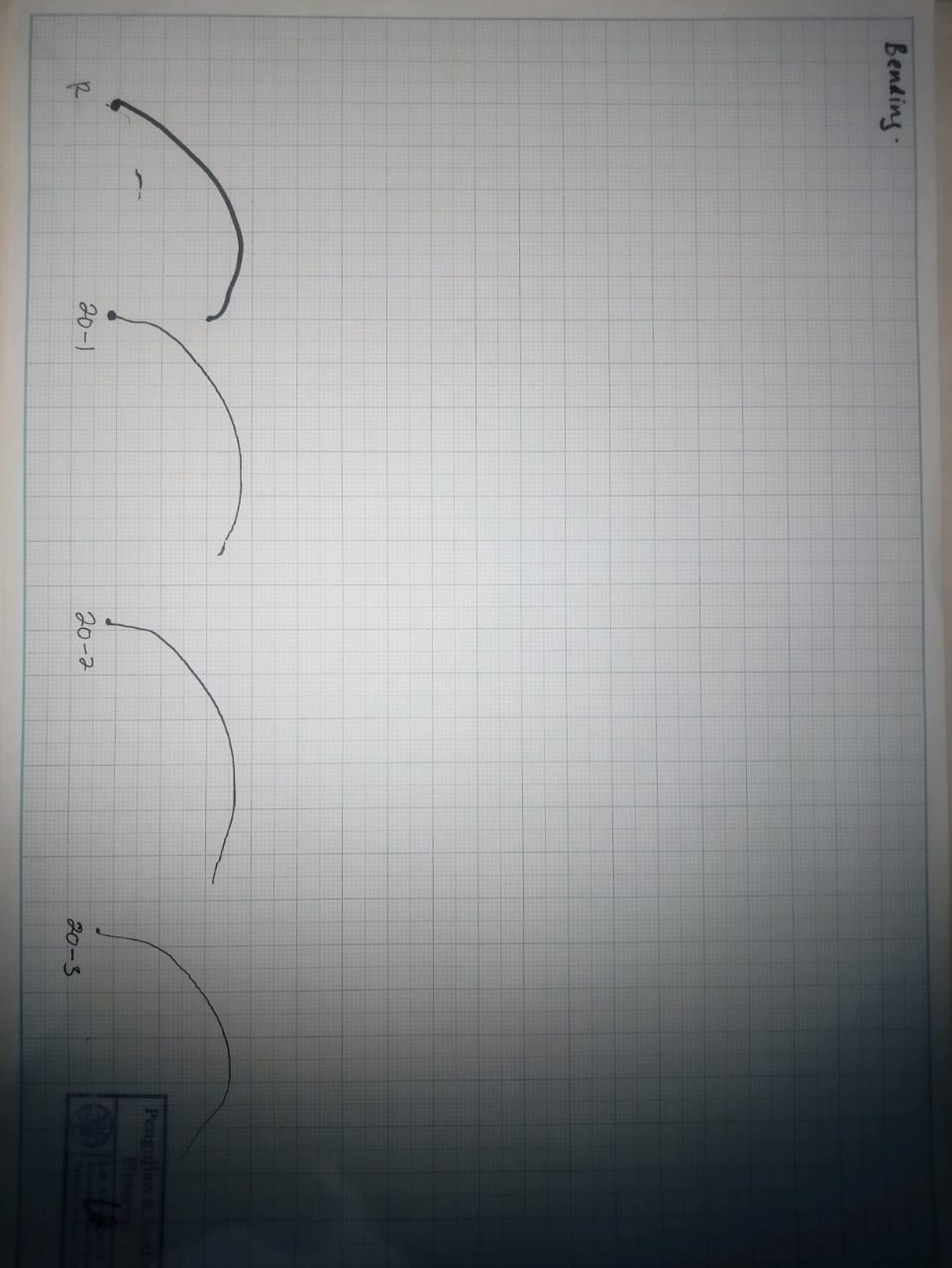
****

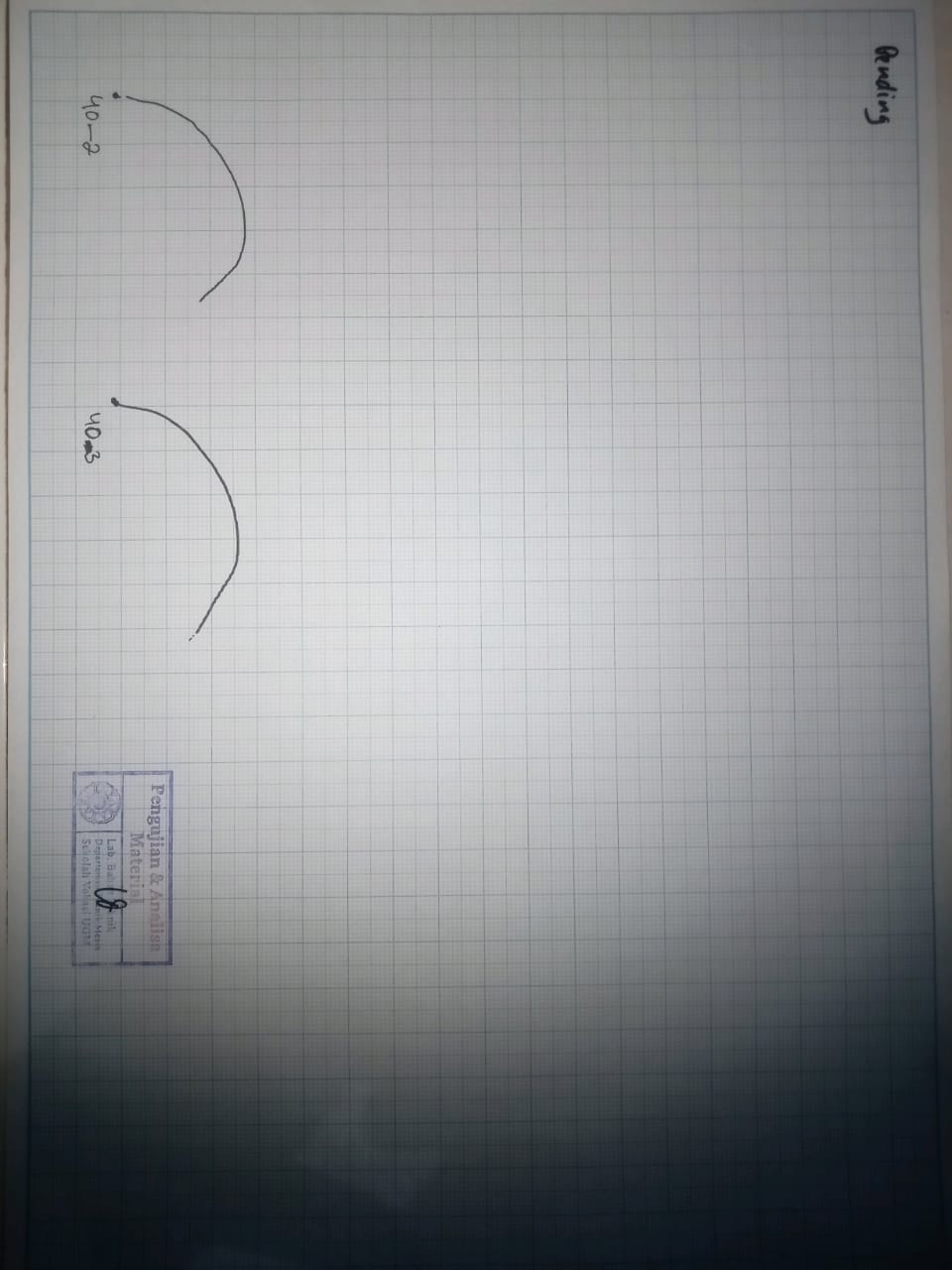
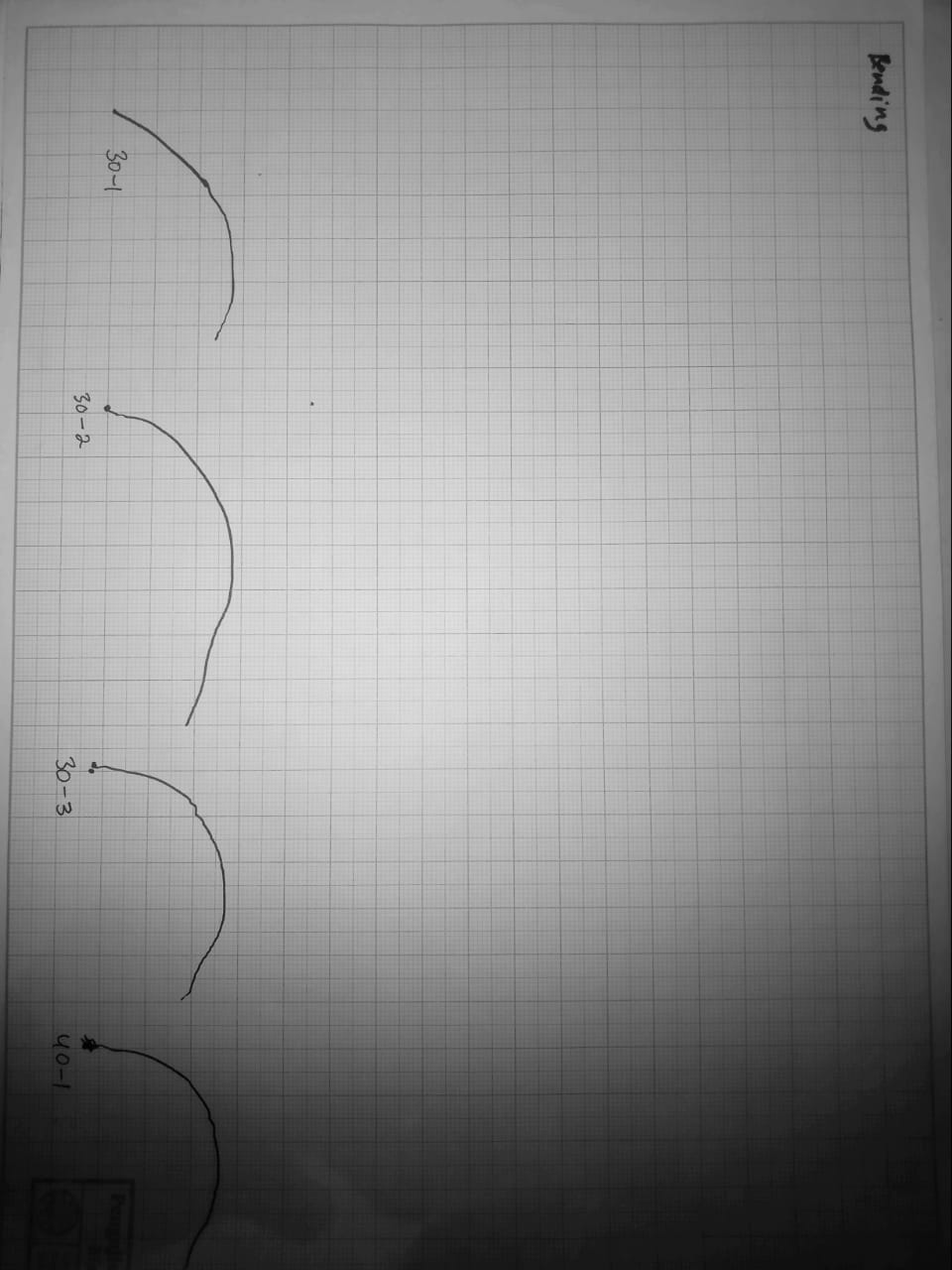
****

**Sertifikat Uji Bending *Carburizing* ST 41 variasi waktu 20 menit, 30 menit 40 menit**

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**Grafik Uji Bending *Carburizing* ST 41 variasi waktu 20 menit, 30 menit 40 menit**

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