



LAMPIRAN 1

CHECK SHEET LPDC

Check Sheet I

| | | | | |
|--------------------------------|---|-------------|-------|--|
| Temp. melting | : | 823 | °C | |
| Komposisi grain refiner | : | 0.081 | wt. % | |
| Temp. penambahan grain refiner | : | 763 | °C | |
| Jenis grain refiner | : | AlTiB (Rod) | | |
| Waktu GBF | : | 8 | Menit | |

| No Shot | No Dies | Temp. Dies (°C) | | Temp. Molten (°C) | Tekanan | | Jenis Cacat LPDC | Jenis Cacat Machining |
|------------------------------|------------|-----------------|-------|-------------------------|----------------|-------|---------------------|-----------------------------|
| | | Upper | Lower | | mesin (kPa) | Jam | | |
| 1 | Trial | Trial | Trial | Trial | Trial | Trial | Trial | Trial |
| 2 | Trial | Trial | Trial | Trial | Trial | Trial | Trial | Trial |
| 3 | 39 | 238 | 341 | 701 | 25 | 0 | - | - |
| | 40 | 230 | 275 | | | | | |
| 4 | 39 | 248 | 357 | 703 | 25 | 0 | - | - |
| | 40 | 240 | 288 | | | | | |
| 5 | 39 | 279 | 372 | 705 | 25 | 0 | - | - |
| | 40 | 247 | 300 | | | | | |
| 6 | 39 | 236 | 371 | 706 | 25 | 0 | - | - |
| | 40 | 248 | 302 | | | | | |
| - Rehat 30 menit ganti shift | | | | | | | | |
| 7 | Trial | Trial | Trial | Trial | Trial | Trial | Trial | Trial |
| 8 | Trial | Trial | Trial | Trial | Trial | Trial | Trial | Trial |
| 9 | 39 | 249 | 361 | 715 | 25 | 1 | - | - |
| | 40 | 239 | 293 | | | | | |
| 10 | 39 | 260 | 382 | 715 | 25 | 1 | - | - |
| | 40 | 251 | 304 | | | | | |
| 11 | 39 | 264 | 381 | 714 | 25 | 1 | - | - |
| | 40 | 256 | 311 | | | | | |
| 12 | 39 | 267 | 382 | 714 | 25 | 1 | - | - |
| | 40 | 260 | 322 | | | | | |
| 13 | 39 | 269 | 384 | 713 | 25 | 1 | - | - |
| | 40 | 261 | 318 | | | | | |
| 14 | 39 | 274 | 392 | 712 | 25.6 | 1 | - | - |
| | 40 | 266 | 323 | | | | | |
| 15 | 39 | 278 | 399 | 712 | 25.6 | 1 | - | - |
| | 40 | 271 | 330 | | | | | |
| 16 | 39 | 279 | 391 | 711 | 25.6 | 1 | - | - |
| | 40 | 271 | 328 | | | | | |
| 17 | 39 | 278 | 388 | 711 | 25.6 | 1 | - | - |
| | 40 | 272 | 321 | | | | | |
| 18 | 39 | 281 | 398 | 711 | 25.6 | 2 | - | - |
| | 40 | 276 | 334 | | | | | |
| 19 | 39 | 283 | 401 | 711 | 25.6 | 2 | - | - |
| | 40 | 278 | 337 | | | | | |
| 20 | Trial | Trial | Trial | Trial | Trial | Trial | Trial | Trial |
| 21 | 39 | 269 | 384 | 712 | 25.6 | 2 | - | - |
| | 40 | 263 | 321 | | | | | |
| 22 | 39 | 279 | 395 | 713 | 25.6 | 2 | - | - |
| | 40 | 270 | 326 | | | | | |
| 23 | 39 | 284 | 395 | 715 | 25.6 | 2 | - | - |
| | 40 | 274 | 330 | | | | | |
| 24 | 39 | 287 | 400 | 712 | 25.6 | 2 | - | - |
| | 40 | 278 | 333 | | | | | |
| 25 | 39 | 291 | 404 | 712 | 25.6 | 2 | - | - |
| | 40 | 280 | 337 | | | | | |

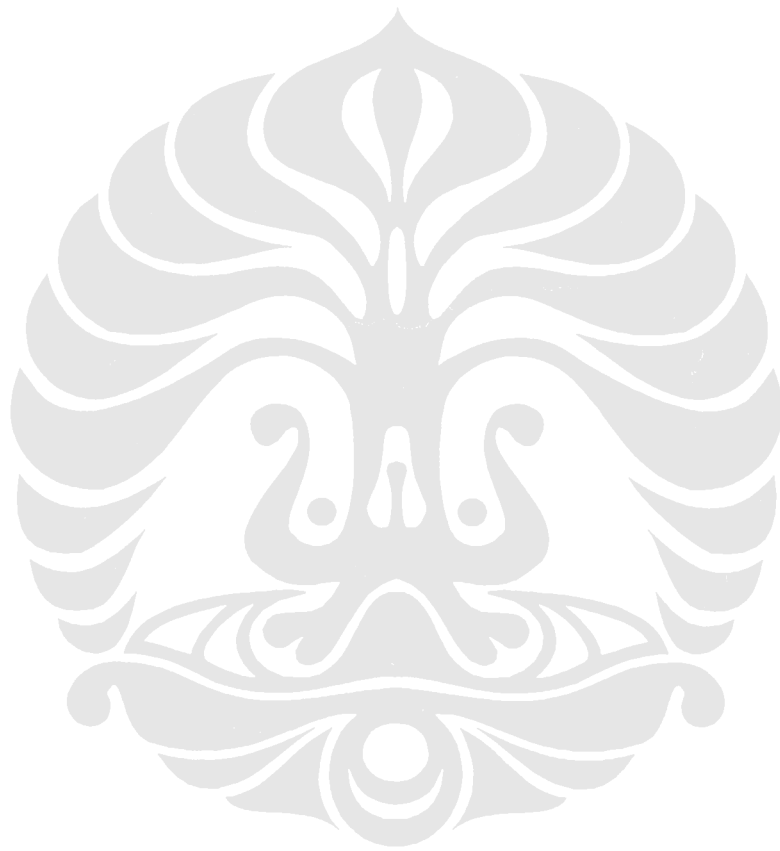
| | | | | | | | | |
|----|----|-----|-----|-----|------|---|-----------------|---------|
| 26 | 39 | 292 | 406 | 711 | 25.6 | 2 | - | - |
| | 40 | 283 | 340 | | | | - | - |
| 27 | 39 | 292 | 403 | 711 | 26.2 | 2 | - | - |
| | 40 | 285 | 341 | | | | Misrun (IN) | - |
| 28 | 39 | 294 | 410 | 711 | 26.2 | 2 | - | - |
| | 40 | 287 | 346 | | | | - | - |
| 29 | 39 | 298 | 412 | 710 | 26.2 | 2 | - | - |
| | 40 | 289 | 345 | | | | - | - |
| 30 | 39 | 295 | 406 | 710 | 26.2 | 2 | Misrun (PL) | - |
| | 40 | 288 | 343 | | | | - | - |
| 31 | 39 | 294 | 420 | 711 | 26.2 | 3 | Misrun (IN) | - |
| | 40 | 284 | 344 | | | | - | - |
| 32 | 39 | 292 | 400 | 710 | 26.2 | 3 | Misrun (IN) | Bocor |
| | 40 | 284 | 341 | | | | - | - |
| 33 | 39 | 291 | 400 | 711 | 26.2 | 3 | Keropos (chain) | - |
| | 40 | 284 | 340 | | | | - | - |
| 34 | 39 | 289 | 411 | 711 | 26.2 | 3 | Keropos (chain) | - |
| | 40 | 283 | 343 | | | | - | - |
| 35 | 39 | 296 | 408 | 710 | 26.2 | 3 | - | - |
| | 40 | 286 | 345 | | | | - | - |
| 36 | 39 | 293 | 404 | 710 | 26.2 | 3 | - | - |
| | 40 | 285 | 343 | | | | - | Keropos |
| 37 | 39 | 298 | 412 | 710 | 26.2 | 3 | - | - |
| | 40 | 288 | 344 | | | | - | - |
| 38 | 39 | 296 | 414 | 710 | 26.2 | 3 | - | - |
| | 40 | 288 | 344 | | | | - | - |
| 39 | 39 | 297 | 410 | 711 | 26.2 | 3 | - | - |
| | 40 | 288 | 351 | | | | - | - |
| 40 | 39 | 299 | 412 | 711 | 26.8 | 3 | - | - |
| | 40 | 288 | 344 | | | | Misrun (IN) | - |
| 41 | 39 | 296 | 414 | 710 | 26.8 | 3 | - | - |
| | 40 | 288 | 345 | | | | - | - |
| 42 | 39 | 297 | 417 | 710 | 26.8 | 3 | - | - |
| | 40 | 289 | 347 | | | | Misrun (PL,IN) | - |
| 43 | 39 | 295 | 415 | 710 | 26.8 | 3 | - | - |
| | 40 | 288 | 347 | | | | - | Keropos |
| 44 | 39 | 297 | 416 | 709 | 26.8 | 4 | - | - |
| | 40 | 291 | 346 | | | | - | - |
| 45 | 39 | 297 | 417 | 709 | 26.8 | 4 | - | - |
| | 40 | 294 | 347 | | | | Misrun (PL) | - |

Check Sheet II

| | | | | |
|--------------------------------|---|-------------|-------|---|
| Temp. melting | : | 809 | °C | |
| Komposisi grain refiner | : | 0.114 | wt. | % |
| Temp. penambahan grain refiner | : | 737 | °C | |
| Jenis grain refiner | : | AlTiB (Rod) | | |
| Waktu GBF | : | 6 | Menit | |

| No Shot | No Dies | Temp. Dies (oC) | | Temp. Molten (oC) | Tekanan mesin (kPa) | Jam ke | Jenis Cacat LPDC | Jenis Cacat Machining |
|---------|---------|-----------------|-------|-------------------|---------------------|--------|-------------------|-----------------------|
| | | Upper | Lower | | | | | |
| 1 | Trial | Trial | Trial | Trial | Trial | Trial | Trial | Trial |
| 2 | Trial | Trial | Trial | Trial | Trial | Trial | Trial | Trial |
| 3 | 39 | 288 | 376 | 702 | 25 | 0 | Misrun (PL,IN) | - |
| | 40 | 290 | 300 | | | | Misrun (IN) | - |
| 4 | 39 | 282 | 390 | 701 | 25 | 0 | Misrun (PL,IN) | - |
| | 40 | 285 | 315 | | | | Misrun (PL,IN) | - |
| 5 | 39 | 279 | 388 | 702 | 25 | 0 | Misrun (IN) | - |
| | 40 | 282 | 317 | | | | Misrun (PL,IN,EX) | - |
| 6 | 39 | 277 | 395 | 704 | 25 | 0 | Misrun (PL) | - |
| | 40 | 278 | 321 | | | | Misrun (PL,EX) | - |
| 7 | 39 | 282 | 406 | 705 | 25 | 0 | - | - |
| | 40 | 280 | 327 | | | | Misrun (PL) | - |
| 8 | 39 | 283 | 409 | 706 | 25 | 1 | Pasir gugur | - |
| | 40 | 281 | 331 | | | | Misrun (PL) | - |
| 9 | 39 | 277 | 406 | 707 | 25 | 1 | Misrun (IN) | - |
| | 40 | 278 | 333 | | | | Misrun (IN,EX) | - |
| 10 | 39 | 271 | 387 | 708 | 25 | 1 | Misrun (IN) | - |
| | 40 | 282 | 330 | | | | Misrun (PL,EX) | - |
| 11 | 39 | 285 | 415 | 708 | 25 | 1 | - | - |
| | 40 | 281 | 341 | | | | - | - |
| 12 | 39 | 285 | 415 | 708 | 25 | 1 | Misrun (IN) | - |
| | 40 | 280 | 340 | | | | Misrun (EX) | - |
| 13 | 39 | 285 | 392 | 710 | 25.6 | 1 | - | - |
| | 40 | 278 | 330 | | | | Misrun (EX) | - |
| 14 | 39 | 284 | 397 | 711 | 25.6 | 1 | Misrun (PL) | - |
| | 40 | 279 | 334 | | | | Misrun (EX) | - |
| 15 | 39 | 284 | 399 | 711 | 25.6 | 1 | Misrun (IN) | - |
| | 40 | 280 | 337 | | | | - | - |
| 16 | 39 | 284 | 399 | 712 | 25.6 | 1 | Misrun (PL) | - |
| | 40 | 281 | 342 | | | | Misrun (EX) | - |
| 17 | 39 | 285 | 395 | 713 | 25.6 | 1 | - | - |
| | 40 | 282 | 343 | | | | Misrun (EX) | - |
| 18 | 39 | 290 | 394 | 712 | 25.6 | 1 | Misrun (PL) | - |
| | 40 | 282 | 334 | | | | - | - |
| 19 | 39 | 291 | 410 | 713 | 25.6 | 1 | - | - |
| | 40 | 284 | 346 | | | | - | - |
| 20 | 39 | 296 | 408 | 713 | 25.6 | 2 | - | - |
| | 40 | 286 | 341 | | | | - | - |
| 21 | 39 | 294 | 407 | 713 | 25.6 | 2 | - | - |
| | 40 | 287 | 342 | | | | - | - |
| 22 | 39 | 292 | 405 | 713 | 25.6 | 2 | - | - |
| | 40 | 288 | 344 | | | | Misrun (EX) | - |
| 23 | 39 | 292 | 410 | 713 | 25.6 | 2 | - | - |
| | 40 | 288 | 347 | | | | - | - |
| 24 | 39 | 281 | 377 | 712 | 25.6 | 2 | - | - |
| | 40 | 275 | 329 | | | | Misrun (EX) | - |
| 25 | 39 | 277 | 378 | 713 | 25.6 | 2 | - | - |
| | 40 | 273 | 329 | | | | Misrun (PL,IN,EX) | - |
| 26 | 39 | 282 | 395 | 713 | 25.6 | 2 | - | - |
| | 40 | 278 | 333 | | | | - | - |
| 27 | 39 | 290 | 405 | 713 | 262 | 2 | - | - |

| | | | | | | | | |
|----|----|-----|-----|-----|-----|---|-------------|---|
| | 40 | 282 | 337 | | | | Misrun (EX) | - |
| 28 | 39 | 294 | 406 | 713 | 262 | 2 | - | - |
| | 40 | 284 | 340 | | | | - | - |
| 29 | 39 | 290 | 408 | 712 | 262 | 2 | Misrun (EX) | - |
| | 40 | 281 | 342 | | | | - | - |
| 30 | 39 | 288 | 409 | 712 | 262 | 2 | - | - |
| | 40 | 282 | 342 | | | | Misrun (EX) | - |
| 31 | 39 | 291 | 406 | 712 | 262 | 2 | - | - |
| | 40 | 286 | 342 | | | | Misrun (EX) | - |
| 32 | 39 | 290 | 403 | 712 | 262 | 2 | - | - |
| | 40 | 286 | 343 | | | | - | - |
| 33 | 39 | 290 | 400 | 712 | 262 | 3 | - | - |
| | 40 | 286 | 343 | | | | - | - |
| 34 | 39 | 292 | 406 | 712 | 262 | 3 | - | - |
| | 40 | 288 | 344 | | | | - | - |





Pengukuran Kekerasan

Diketahui : $P = 31,25 \text{ kg}$

$D = 2,5 \text{ mm}$

A. Paduan AC4B dengan 0,081 wt. % Ti

A.1 Bagian Tebal

A.1.1 Jam ke 1

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|--------------------|
| 0.696 | 0.727 | 0.709 | 0.715 | 0.717 | 0.728 | 0.700 | d rata-rata |
| 0.099 | 0.108 | 0.102 | 0.104 | 0.105 | 0.108 | 0.100 | $D-\sqrt{D^2-d^2}$ |
| 80.555 | 73.796 | 77.679 | 76.352 | 75.917 | 73.486 | 79.618 | BHN |

Kekerasan rata-rata = 76.8 BHN

A.1.2 Jam ke 2

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|--------------------|
| 0.706 | 0.708 | 0.712 | 0.716 | 0.711 | 0.707 | 0.700 | d rata-rata |
| 0.102 | 0.102 | 0.104 | 0.105 | 0.103 | 0.102 | 0.100 | $D-\sqrt{D^2-d^2}$ |
| 78.356 | 77.791 | 76.901 | 76.026 | 77.233 | 78.016 | 79.618 | BHN |

Kekerasan rata-rata = 77.7 BHN

A.1.3 Jam ke 3

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|--------------------|
| 0.716 | 0.713 | 0.695 | 0.707 | 0.712 | 0.718 | 0.716 | d rata-rata |
| 0.105 | 0.104 | 0.099 | 0.102 | 0.104 | 0.105 | 0.105 | $D-\sqrt{D^2-d^2}$ |
| 76.026 | 76.681 | 80.791 | 78.129 | 76.901 | 75.594 | 76.026 | BHN |

Kekerasan rata-rata = 77.2 BHN

A.1.4 Jam ke 4

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|--------------------|
| 0.721 | 0.714 | 0.704 | 0.714 | 0.713 | 0.711 | 0.713 | d rata-rata |
| 0.106 | 0.104 | 0.101 | 0.104 | 0.104 | 0.103 | 0.104 | $D-\sqrt{D^2-d^2}$ |
| 75.058 | 76.462 | 78.697 | 76.462 | 76.681 | 77.233 | 76.681 | BHN |

Kekerasan rata-rata = 76.8 BHN

A.2 Bagian Tipis

A.2.1 Jam ke 1

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|--------------------|
| 0.705 | 0.708 | 0.705 | 0.702 | 0.699 | 0.705 | 0.708 | d rata-rata |
| 0.101 | 0.102 | 0.101 | 0.101 | 0.100 | 0.101 | 0.102 | $D-\sqrt{D^2-d^2}$ |
| 78.469 | 77.791 | 78.583 | 79.155 | 79.967 | 78.469 | 77.791 | BHN |

Kekerasan rata-rata = 78.6 BHN

A.2.2 Jam ke 2

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|-------------------|
| 0.709 | 0.710 | 0.707 | 0.713 | 0.699 | 0.707 | 0.699 | d rata-rata |
| 0.102 | 0.103 | 0.102 | 0.104 | 0.100 | 0.102 | 0.100 | D- $\sqrt{D2-d2}$ |
| 77.679 | 77.344 | 78.129 | 76.681 | 79.967 | 78.016 | 79.967 | BHN |

Kekerasan rata-rata = 78.3 BHN

A.2.3 Jam ke 3

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|-------------------|
| 0.711 | 0.713 | 0.712 | 0.722 | 0.704 | 0.706 | 0.706 | d rata-rata |
| 0.103 | 0.104 | 0.104 | 0.106 | 0.101 | 0.102 | 0.102 | D- $\sqrt{D2-d2}$ |
| 77.233 | 76.791 | 76.901 | 74.846 | 78.697 | 78.242 | 78.356 | BHN |

Kekerasan rata-rata = 77.3 BHN

A.2.4 Jam ke 4

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|-------------------|
| 0.710 | 0.666 | 0.698 | 0.713 | 0.707 | 0.700 | 0.796 | d rata-rata |
| 0.103 | 0.090 | 0.099 | 0.104 | 0.102 | 0.100 | 0.130 | D- $\sqrt{D2-d2}$ |
| 77.344 | 88.128 | 80.202 | 76.791 | 78.129 | 79.618 | 61.272 | BHN |

Kekerasan rata-rata = 77.4 BHN

B. Paduan AC4B dengan 0,115 wt. % Ti

B.1 Bagian Tebal

B.1.1 Jam ke 1

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|-------------------|
| 0.701 | 0.712 | 0.718 | 0.700 | 0.714 | 0.705 | 0.709 | d rata-rata |
| 0.100 | 0.104 | 0.105 | 0.100 | 0.104 | 0.101 | 0.103 | D- $\sqrt{D2-d2}$ |
| 79.386 | 76.901 | 75.701 | 79.734 | 76.571 | 78.469 | 77.567 | BHN |

Kekerasan rata-rata = 77.8 BHN

B.1.2 Jam ke 2

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|-------------------|
| 0.709 | 0.703 | 0.700 | 0.707 | 0.704 | 0.709 | 0.710 | d rata-rata |
| 0.103 | 0.101 | 0.100 | 0.102 | 0.101 | 0.103 | 0.103 | D- $\sqrt{D2-d2}$ |
| 77.567 | 79.040 | 79.618 | 78.016 | 78.811 | 77.567 | 77.456 | BHN |

Kekerasan rata-rata = 78.3 BHN

B.1.3 Jam ke 3

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|-------------------|
| 0.719 | 0.720 | 0.715 | 0.713 | 0.711 | 0.719 | 0.710 | d rata-rata |
| 0.105 | 0.106 | 0.104 | 0.104 | 0.103 | 0.106 | 0.103 | D- $\sqrt{D2-d2}$ |
| 75.486 | 75.272 | 76.352 | 76.681 | 77.233 | 75.379 | 77.344 | BHN |

Kekerasan rata-rata = 76.3 BHN

B.1.4 Jam ke 4

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|------------------|
| 0.712 | 0.711 | 0.730 | 0.716 | 0.706 | 0.722 | 0.721 | d rata-rata |
| 0.103 | 0.103 | 0.109 | 0.105 | 0.102 | 0.106 | 0.106 | $D-\sqrt{D2-d2}$ |
| 77.012 | 77.233 | 73.075 | 76.026 | 78.242 | 74.846 | 75.058 | BHN |

Kekerasan rata-rata = 75.9 BHN

B.2 Bagian Tipis

B.2.1 Jam ke 1

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|------------------|
| 0.694 | 0.703 | 0.706 | 0.706 | 0.701 | 0.698 | 0.697 | d rata-rata |
| 0.098 | 0.101 | 0.102 | 0.102 | 0.100 | 0.099 | 0.099 | $D-\sqrt{D2-d2}$ |
| 81.029 | 79.040 | 78.356 | 78.242 | 79.386 | 80.202 | 80.437 | BHN |

Kekerasan rata-rata = 79.5 BHN

B.2.2 Jam ke 2

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|------------------|
| 0.729 | 0.696 | 0.700 | 0.704 | 0.703 | 0.703 | 0.702 | d rata-rata |
| 0.108 | 0.099 | 0.100 | 0.101 | 0.101 | 0.101 | 0.100 | $D-\sqrt{D2-d2}$ |
| 73.383 | 80.673 | 79.734 | 78.697 | 78.926 | 79.040 | 79.271 | BHN |

Kekerasan rata-rata = 78.5 BHN

B.2.3 Jam ke 3

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|------------------|
| 0.711 | 0.704 | 0.715 | 0.714 | 0.706 | 0.712 | 0.703 | d rata-rata |
| 0.103 | 0.101 | 0.104 | 0.104 | 0.102 | 0.103 | 0.101 | $D-\sqrt{D2-d2}$ |
| 77.122 | 78.697 | 76.352 | 76.571 | 78.356 | 77.012 | 78.926 | BHN |

Kekerasan rata-rata = 77.6 BHN

B.2.4 Jam ke 4

| Jejak 1 | Jejak 2 | Jejak 3 | Jejak 4 | Jejak 5 | Jejak 6 | Jejak 7 | besaran |
|---------|---------|---------|---------|---------|---------|---------|------------------|
| 0.708 | 0.710 | 0.705 | 0.706 | 0.704 | 0.710 | 0.709 | d rata-rata |
| 0.102 | 0.103 | 0.101 | 0.102 | 0.101 | 0.103 | 0.103 | $D-\sqrt{D2-d2}$ |
| 77.904 | 77.456 | 78.583 | 78.242 | 78.811 | 77.344 | 77.567 | BHN |

Kekerasan rata-rata = 78.0 BHN



Pengukuran Lebar SDAS

A. Paduan AC4B dengan 0,081 wt. % Ti

A.1 Bagian Tebal

| Jam | SDAS (μm) | | | | | | | SDAS rata-rata |
|-----|------------------------|----|----|----|----|----|----|-------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 0 | 15 | 20 | 12 | 15 | 20 | 15 | 40 | 19.571 |
| 1 | 22 | 22 | 20 | 20 | 28 | 22 | 26 | 22.857 |
| 2 | 27 | 18 | 21 | 12 | 20 | 29 | 20 | 21.000 |
| 3 | 26 | 22 | 20 | 22 | 23 | 20 | 29 | 23.143 |
| 4 | 31 | 29 | 28 | 30 | 40 | 39 | 29 | 32.286 |

A.2 Bagian Tipis

| Jam | SDAS (μm) | | | | | | | SDAS rata-rata |
|-----|------------------------|----|----|----|----|----|----|-------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 0 | 11 | 15 | 15 | 10 | 20 | 10 | 12 | 13.286 |
| 1 | 12 | 18 | 21 | 13 | 20 | 15 | 12 | 15.857 |
| 2 | 19 | 22 | 15 | 20 | 21 | 21 | 20 | 19.714 |
| 3 | 18 | 18 | 21 | 19 | 14 | 19 | 15 | 17.714 |
| 4 | 22 | 15 | 16 | 14 | 21 | 21 | 22 | 18.714 |

B. Paduan AC4B dengan 0,115 wt. % Ti

B.1 Bagian Tebal

| Jam | SDAS (μm) | | | | | | | SDAS rata-rata |
|-----|------------------------|----|----|----|----|----|----|-------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 0 | 20 | 20 | 25 | 15 | 11 | 10 | 10 | 15.857 |
| 1 | 21 | 21 | 19 | 21 | 22 | 22 | 24 | 21.429 |
| 2 | 14 | 16 | 19 | 18 | 20 | 29 | 19 | 19.286 |
| 3 | 26 | 25 | 25 | 21 | 22 | 20 | 21 | 22.857 |
| 4 | 41 | 29 | 28 | 29 | 30 | 25 | 27 | 29.857 |

B.2 Bagian Tipis

| Jam | SDAS (μm) | | | | | | | SDAS rata-rata |
|-----|------------------------|----|----|----|----|----|----|-------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 0 | 10 | 10 | 10 | 11 | 10 | 13 | 10 | 10.571 |
| 1 | 19 | 14 | 13 | 19 | 12 | 11 | 16 | 14.857 |
| 2 | 13 | 12 | 18 | 15 | 13 | 13 | 16 | 14.286 |
| 3 | 19 | 15 | 16 | 17 | 17 | 20 | 18 | 17.429 |
| 4 | 21 | 14 | 19 | 15 | 19 | 21 | 19 | 18.286 |



LAMPIRAN 4

PENGHITUNGAN KEKUATAN TARIK DAN KEULETAN

A. Penghitungan Kekuatan Tarik

A.1 Paduan AC4B dengan 0,081 wt. % Ti

| Diameter (mm) | Luas Penampang (mm ²) | Beban Total (kg) | F (N) | UTS (MPa) | UTS jam ke 0 (MPa) | UTS jam ke 4 (MPa) |
|---------------|-----------------------------------|------------------|---------|-----------|--------------------|--------------------|
| 11.9 | 111.2 | 2275.0 | 22295.0 | 200.6 | | |
| 12.5 | 122.7 | 2300.0 | 22540.0 | 183.8 | 193.5 | 188.0 |
| 12.7 | 126.6 | 2320.0 | 22736.0 | 179.6 | | |

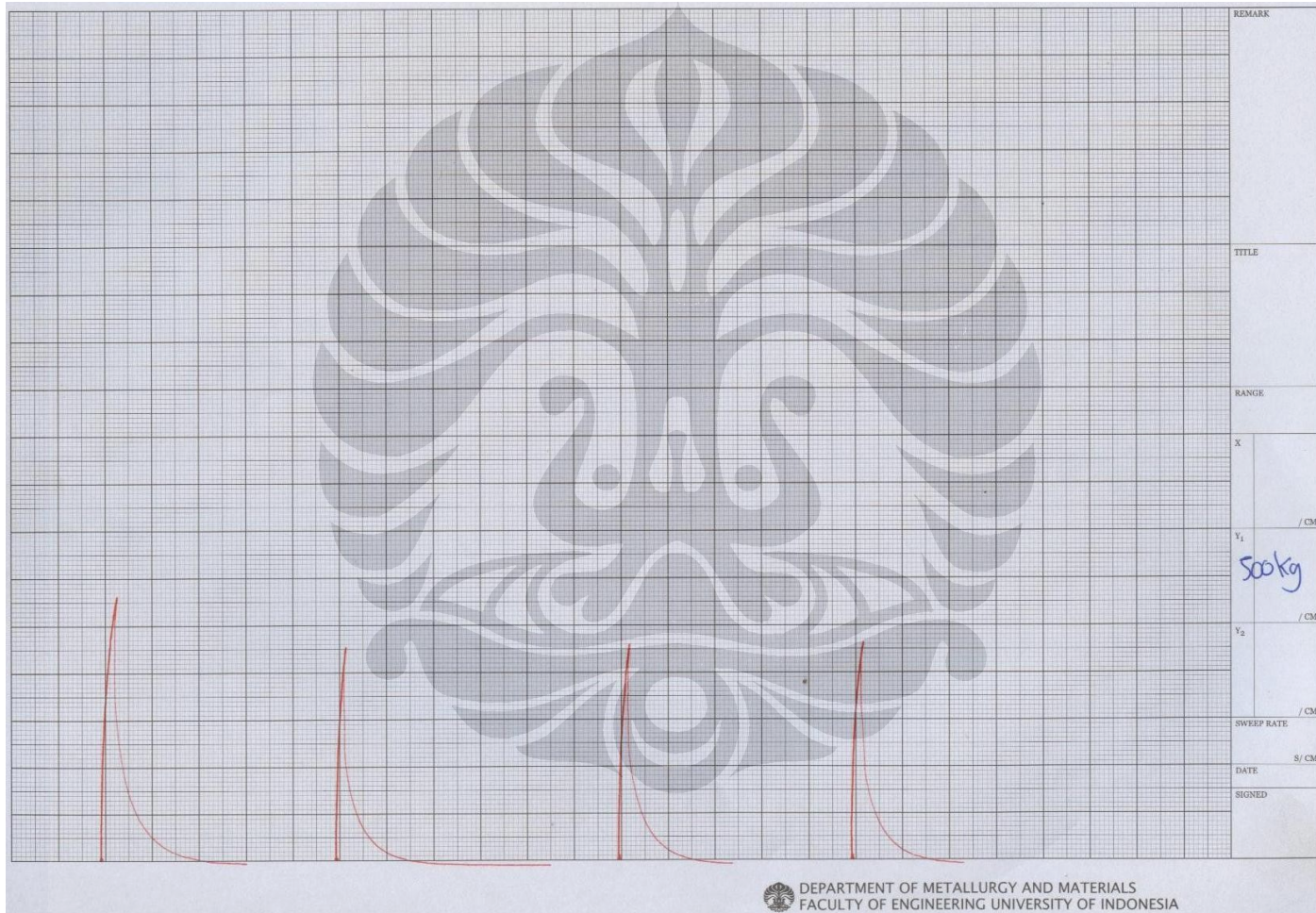
A.2 Paduan AC4B dengan 0,115 wt. % Ti

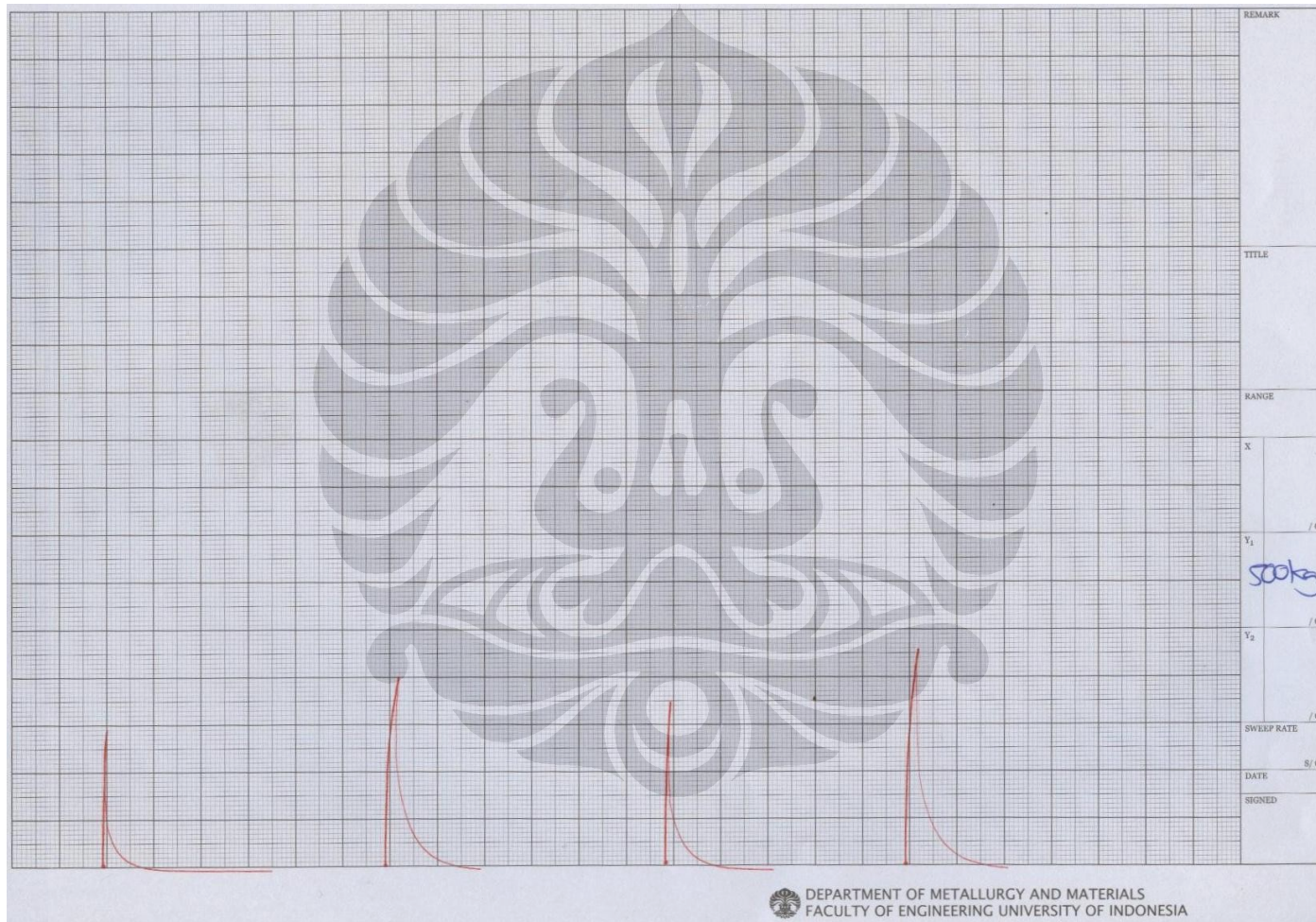
| Diameter (mm) | Luas Penampang (mm ²) | Beban Total (kg) | F (N) | UTS (MPa) | UTS jam ke 0 (MPa) | UTS jam ke 4 (MPa) |
|---------------|-----------------------------------|------------------|---------|-----------|--------------------|--------------------|
| 13.1 | 134.7 | 1450.0 | 14210.0 | 105.5 | | |
| 13.0 | 132.7 | 2000.0 | 19600.0 | 147.7 | 194.4 | 140.3 |
| 12.9 | 130.6 | 1750.0 | 17150.0 | 131.3 | | |

B. Penghitungan Keuletan

| Komposisi (wt. % Ti) | Pertambahan panjang (mm) | | | | | Panjang Awal (mm) | Elongasi (%) |
|----------------------|--------------------------|-----|-----|---|-----------|-------------------|--------------|
| | 1 | 2 | 3 | 4 | Rata-rata | | |
| 0,08 | 2.2 | 2.3 | 2.5 | - | 2.3 | 50 | 4.7 |
| 0,1 | 1 | 3 | 1 | 3 | 2 | 50 | 4 |

C. Kurva uji Tarik AC4B dengan 0,08 wt. % Ti



D. Kurva uji Tarik AC4B dengan 0,115 wt. % Ti



HOESCH METALS AND ALLOYS GMBH



Product Data Sheet

Product:
AlTi5B1 (Sticks 500 mm)

Aluminium Titanium Boron Master Alloy with 5 % Titanium and 1 % Boron for the grain refining of aluminium and aluminium alloys.

Typical chemical analysis:

| Element | Composition [%] |
|--------------|-----------------|
| Ti | 4.5 – 5.5 |
| B | 0.9 – 1.1 |
| Si | ≤ 0.30 |
| Fe | ≤ 0.30 |
| V | ≤ 0.20 |
| Others each | ≤ 0.04 |
| Others total | ≤ 0.10 |
| Al | Remainder |

Specification:

EN AM-92256, EN AM-AlTi5B1 (A)

Customer specification will be considered in accordance to requirements.

Typical physical data:

| Appearance | Dimension | Weight [net] |
|------------|--------------------|--------------|
| Sticks | ≈ 500 mm, Ø ≈ 9 mm | ≈ 100 g |

Application:

Close control of the cast structure is a major requirement of high quality aluminium alloy products. The most effective way to provide a fine and uniform as-cast grain structure is to add nucleating agents to the melt to control crystal formation during solidification.

Grain refiners with a number of different titanium-to-boron ratios are available to accommodate special conditions which may exist in the user's plant. In selecting the correct grain refiner alloy, the user must take into consideration conditions such as the alloy to be treated, the quantity of recycle or secondary aluminium used, the desired grain size in the product, and the melting and casting practice used.

Recommended titanium content: 100 – 250 ppm
Application temperature: 700 – 750°C

For more information about the application don't hesitate to contact our sales department.

Storage:

AlTi5B1 has to be stored in a dry warehouse. Shelf life 3 - 6 months in tightly closed original packaging.

Packaging:

AlTi5B1 sticks are packed in wooden crates of ≈ 1.000 Kg net each. The crates are shrink-wrapped and suitable for forklift-truck handling.

Supplier:

HOESCH Metals and Alloys GmbH ☎ + 49 2428 90476-10
P.O. Box 10 09 43 ☎ + 49 2428 90476-00
52353 Dueren, Germany E-Mail: Sales@Hoesch-MetalsAlloys.com


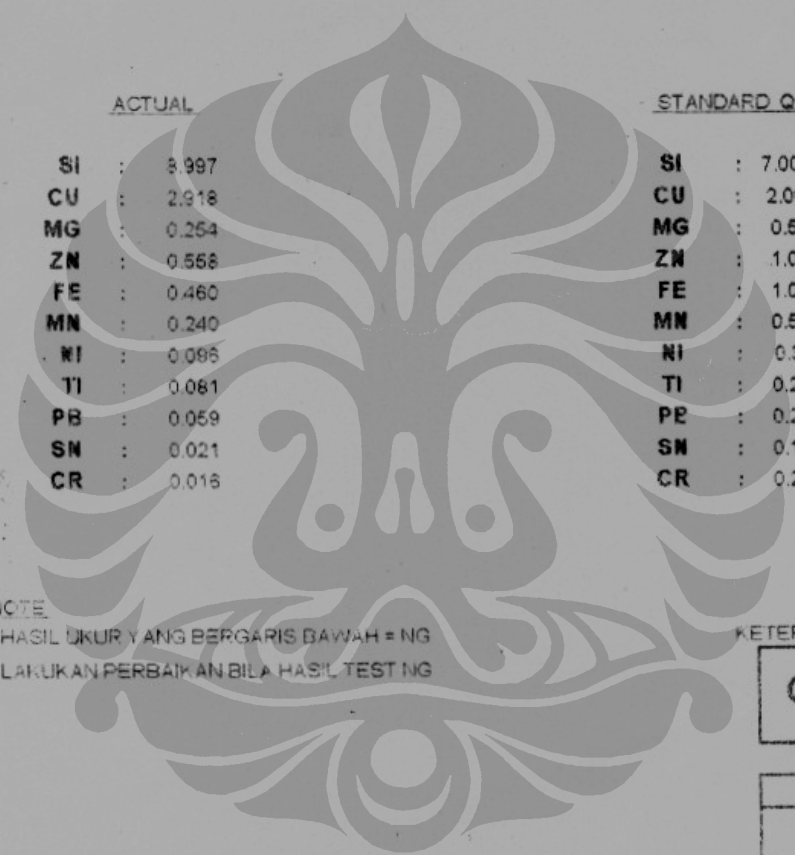
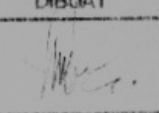
Date:

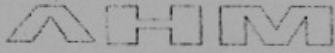
April 4, 2006/ Rev. #1/QUS



LAMPIRAN 6

KOMPOSISI KIMIA PADUAN AC4B

|  PT Astra Honda Motor Measurement & Laboratory Section Quality Assurance Support Department | |
|---|--|
| LAPORAN PENGUJIAN KOMPOSISI KIMIA | |
| NAMA PART : SAMPLE MELTING | TGL PENGUJIAN : 06-Aug-08 20:45:04 |
| NO PART / TYPE : Sample No: [06/08/2008 ALTIB M3 | STANDARD UJI : HES C-101-99 |
| MATERIAL : AC 43 | MESIN UJI : SPECTRO SHIMADZHU |
| SEKSI / SUB CON : LPDC | KETERANGAN : SHIFT 2 |
| TEST KE : 1 | |
|  | |
| <u>ACTUAL</u> | <u>STANDARD QA AHM</u> |
| SI : 8.997 | SI : 7.00 ~ 10.00 |
| CU : 2.918 | CU : 2.00 ~ 4.00 |
| MG : 0.254 | MG : 0.50 MAX |
| ZN : 0.558 | ZN : 1.00 MAX |
| FE : 0.460 | FE : 1.00 MAX |
| MN : 0.240 | MN : 0.50 MAX |
| NI : 0.095 | NI : 0.35 MAX |
| TI : 0.081 | TI : 0.20 MAX |
| PB : 0.059 | PE : 0.20 MAX |
| SN : 0.021 | SN : 0.10 MAX |
| CR : 0.016 | CR : 0.20 MAX |
| NOTE | KETERANGAN |
| - HASIL UKUR YANG BERGARIS BAWAH = NG | <div style="border: 1px solid black; padding: 5px; display: inline-block;">OK</div> |
| - LAKUKAN PERBAIKAN BILA HASIL TEST NG | <div style="border: 1px solid black; padding: 5px; display: inline-block;">DIBUAT</div>  DIBUAT |

|  PT Asira Honda Motor Measurement & Laboratory Section Quality Assurance Support Department | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--------|-----------------|------------|-------------------|------------|------------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|
| LAPORAN PENGUJIAN KOMPOSISI KIMIA | | | | | | | | | | | | | | | | | | | | | | | | | |
| NAMA PART : SAMPLE MELTING | TGL PENGUJIAN : 07-Aug-08 14:38:08 | | | | | | | | | | | | | | | | | | | | | | | | |
| NO PART / TYPE : Sample No. (ALTIB M3) | STANDARD UJI : HES C-101-99 | | | | | | | | | | | | | | | | | | | | | | | | |
| MATERIAL : AC 4B | MESIN UJI : SPECTRO SHIMADZHU | | | | | | | | | | | | | | | | | | | | | | | | |
| SEKSI / SUB CON : LPDC | KETERANGAN : ALTIB(07/08/08 M3) | | | | | | | | | | | | | | | | | | | | | | | | |
| TEST KE : 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th>ACTUAL</th> <th>STANDARD QA AHM</th> </tr> </thead> <tbody> <tr> <td>SI : 3.731</td> <td>SI : 7.00 ~ 10.00</td> </tr> <tr> <td>CU : 3.101</td> <td>CU : 2.00 ~ 4.00</td> </tr> <tr> <td>MG : 0.233</td> <td>MG : 0.50 MAX</td> </tr> <tr> <td>ZN : 0.454</td> <td>ZN : 1.00 MAX</td> </tr> <tr> <td>FE : 1.513</td> <td>FE : 1.00 MAX</td> </tr> <tr> <td>MN : 0.227</td> <td>MN : 0.50 MAX</td> </tr> <tr> <td>NI : 0.069</td> <td>NI : 0.35 MAX</td> </tr> <tr> <td>TI : 0.115</td> <td>TI : 0.20 MAX</td> </tr> <tr> <td>PB : 0.070</td> <td>PB : 0.20 MAX</td> </tr> <tr> <td>SN : 0.037</td> <td>SN : 0.10 MAX</td> </tr> <tr> <td>CR : 0.020</td> <td>CR : 0.20 MAX</td> </tr> </tbody> </table> | | ACTUAL | STANDARD QA AHM | SI : 3.731 | SI : 7.00 ~ 10.00 | CU : 3.101 | CU : 2.00 ~ 4.00 | MG : 0.233 | MG : 0.50 MAX | ZN : 0.454 | ZN : 1.00 MAX | FE : 1.513 | FE : 1.00 MAX | MN : 0.227 | MN : 0.50 MAX | NI : 0.069 | NI : 0.35 MAX | TI : 0.115 | TI : 0.20 MAX | PB : 0.070 | PB : 0.20 MAX | SN : 0.037 | SN : 0.10 MAX | CR : 0.020 | CR : 0.20 MAX |
| ACTUAL | STANDARD QA AHM | | | | | | | | | | | | | | | | | | | | | | | | |
| SI : 3.731 | SI : 7.00 ~ 10.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| CU : 3.101 | CU : 2.00 ~ 4.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| MG : 0.233 | MG : 0.50 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| ZN : 0.454 | ZN : 1.00 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| FE : 1.513 | FE : 1.00 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| MN : 0.227 | MN : 0.50 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| NI : 0.069 | NI : 0.35 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| TI : 0.115 | TI : 0.20 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| PB : 0.070 | PB : 0.20 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| SN : 0.037 | SN : 0.10 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| CR : 0.020 | CR : 0.20 MAX | | | | | | | | | | | | | | | | | | | | | | | | |
| NOTE - HASIL UKUR YANG BERGARIS BAWAH = NG - LAKUKAN PERBAIKAN BILA HASIL TEST NG | KETERANGAN <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 5px auto;">OK</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 5px auto;">DIBUAT</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 5px auto;">SALAH MASIH</div> | | | | | | | | | | | | | | | | | | | | | | | | |



LAMPIRAN 7
HASIL PENGUJIAN SEM DAN EDAX

| <i>Marking</i> | Komposisi AC4B | Posisi | Jam | No. titik |
|--------------------|-------------------|--------|-----|-----------|
| 0,081 – 1 – Tb – 1 | 0.081 wt. % | Tebal | 1 | 1 |
| 0,081 – 1 – Tb – 2 | 0.081 wt. % | Tebal | 1 | 2 |
| 0,081 – 1 – Tb – 3 | 0.081 wt. % | Tebal | 1 | 3 |
| 0,081 – 1 – Tp – 1 | 0.081 wt. % | Tipis | 1 | 1 |
| 0,081 – 1 – Tp – 2 | 0.081 wt. % | Tipis | 1 | 2 |
| 0,081 – 1 – Tp – 3 | 0.081 wt. % | Tipis | 1 | 3 |
| 0,081 – 2 – Tb – 1 | 0.081 wt. % | Tebal | 2 | 1 |
| 0,081 – 2 – Tb – 2 | 0.081 wt. % | Tebal | 2 | 2 |
| 0,081 – 2 – Tb – 3 | 0.081 wt. % | Tebal | 2 | 3 |
| 0,081 – 2 – Tp – 1 | 0.081 wt. % | Tipis | 2 | 1 |
| 0,081 – 2 – Tp – 2 | 0.081 wt. % | Tipis | 2 | 2 |
| 0,081 – 2 – Tp – 3 | 0.081 wt. % | Tipis | 2 | 3 |
| 0,081 – 3 – Tb – 1 | 0.081 wt. % | Tebal | 3 | 1 |
| 0,081 – 3 – Tb – 2 | 0.081 wt. % | Tebal | 3 | 2 |
| 0,081 – 3 – Tb – 3 | 0.081 wt. % | Tebal | 3 | 3 |
| 0,081 – 3 – Tp – 1 | 0.081 wt. % | Tipis | 3 | 1 |
| 0,081 – 3 – Tp – 2 | 0.081 wt. % | Tipis | 3 | 2 |
| 0,081 – 3 – Tp – 3 | 0.081 wt. % | Tipis | 3 | 3 |
| 0,081 – 4 – Tb – 1 | 0.081 wt. % | Tebal | 4 | 1 |
| 0,081 – 4 – Tb – 2 | 0.081 wt. % | Tebal | 4 | 2 |
| 0,081 – 4 – Tb – 3 | 0.081 wt. % | Tebal | 4 | 3 |
| 0,081 – 4 – Tp – 1 | 0.081 wt. % | Tipis | 4 | 1 |
| 0,081 – 4 – Tp – 2 | 0.081 wt. % | Tipis | 4 | 2 |
| 0,081 – 4 – Tp – 3 | 0.081 wt. % | Tipis | 4 | 3 |
| 0,115 – 1 – Tb – 1 | 0.115 wt. % | Tebal | 1 | 1 |
| 0,115 – 1 – Tb – 2 | 0.115 wt. % | Tebal | 1 | 2 |
| 0,115 – 1 – Tb – 3 | 0.115 wt. % | Tebal | 1 | 3 |
| 0,115 – 1 – Tp – 1 | 0.115 wt. % | Tipis | 1 | 1 |
| 0,115 – 1 – Tp – 2 | 0.115 wt. % | Tipis | 1 | 2 |
| 0,115 – 1 – Tp – 3 | 0.115 wt. % | Tipis | 1 | 3 |
| 0,115 – 2 – Tb – 1 | 0.115 wt. % | Tebal | 2 | 1 |
| 0,115 – 2 – Tb – 2 | 0.115 wt. % | Tebal | 2 | 2 |
| 0,115 – 2 – Tb – 3 | 0.115 wt. % | Tebal | 2 | 3 |
| 0,115 – 2 – Tp – 1 | 0.115 wt. % | Tipis | 2 | 1 |
| 0,115 – 2 – Tp – 2 | 0.115 wt. % | Tipis | 2 | 2 |
| 0,115 – 2 – Tp – 3 | 0.115 wt. % | Tipis | 2 | 3 |
| 0,115 – 3 – Tb – 1 | 0.115 wt. % | Tebal | 3 | 1 |
| 0,115 – 3 – Tb – 2 | 0.115 wt. % | Tebal | 3 | 2 |
| 0,115 – 3 – Tb – 3 | 0.115 wt. % | Tebal | 3 | 3 |
| 0,115 – 3 – Tp – 1 | 0.115 wt. % | Tipis | 3 | 1 |
| 0,115 – 3 – Tp – 2 | 0.115 wt. % | Tipis | 3 | 2 |
| 0,115 – 3 – Tp – 3 | 0.115 wt. % | Tipis | 3 | 3 |
| 0,115 – 4 – Tb – 1 | 0.115 wt. % | Tebal | 4 | 1 |
| 0,115 – 4 – Tb – 2 | 0.115 wt. % | Tebal | 4 | 2 |
| 0,115 – 4 – Tb – 3 | 0.115 wt. % | Tebal | 4 | 3 |
| 0,115 – 4 – Tp – 1 | 0.115 wt. % | Tipis | 4 | 1 |
| 0,115 – 4 – Tp – 2 | 0.115 wt. % | Tipis | 4 | 2 |
| 0,115 – 4 – Tp – 3 | 0.115 wt. % | Tipis | 4 | 3 |

| <i>Marking</i> | Komposisi AC4B | Posisi | Jam | No. titik |
|----------------------|-------------------|--------------|-----|-----------|
| 0,081 Tebal – 1 | 0.081 wt. % | Tebal | 0 | 1 |
| 0,081 Tebal – 2 | 0.081 wt. % | Tebal | 0 | 2 |
| 0,081 Tebal – 3 | 0.081 wt. % | Tebal | 0 | 3 |
| 0,081 Tebal – 4 | 0.081 wt. % | Tebal | 0 | 4 |
| 0,081 Tebal – 5 | 0.081 wt. % | Tebal | 0 | 5 |
| 0,081 Tipis – 1 | 0.081 wt. % | Tipis | 0 | 1 |
| 0,081 Tipis – 2 | 0.081 wt. % | Tipis | 0 | 2 |
| 0,081 Tipis – 3 | 0.081 wt. % | Tipis | 0 | 3 |
| 0,081 Tipis – 4 | 0.081 wt. % | Tipis | 0 | 4 |
| 0,115 Tebal – 1 | 0.115 wt. % | Tebal | 0 | 1 |
| 0,115 Tebal – 2 | 0.115 wt. % | Tebal | 0 | 2 |
| 0,115 Tebal – 3 | 0.115 wt. % | Tebal | 0 | 3 |
| 0,115 Tebal – 4 | 0.115 wt. % | Tebal | 0 | 4 |
| 0,115 Tipis – 1 | 0.115 wt. % | Tipis | 0 | 1 |
| 0,115 Tipis – 2 | 0.115 wt. % | Tipis | 0 | 2 |
| 0,115 Tipis – 3 | 0.115 wt. % | Tipis | 0 | 3 |
| 0,115 Tipis – 4 | 0.115 wt. % | Tipis | 0 | 4 |
| AlTiB – 1 | AlTiB | - | - | 1 |
| AlTiB – 2 | AlTiB | - | - | 2 |
| AlTiB – 3 | AlTiB | - | - | 3 |
| 0,081 – jam ke 0 – 1 | 0.081 wt. % | Sampel tarik | 0 | 1 |
| 0,081 – jam ke 0 – 2 | 0.081 wt. % | Sampel tarik | 0 | 2 |
| 0,081 – jam ke 0 – 3 | 0.081 wt. % | Sampel tarik | 0 | 3 |
| 0,115 – jam ke 0 – 1 | 0.115 wt. % | Sampel tarik | 0 | 1 |
| 0,115 – jam ke 0 – 2 | 0.115 wt. % | Sampel tarik | 0 | 2 |
| 0,115 – jam ke 0 – 3 | 0.115 wt. % | Sampel tarik | 0 | 3 |
| 0,081 – jam ke 4 – 1 | 0.081 wt. % | Sampel tarik | 4 | 1 |
| 0,081 – jam ke 4 – 2 | 0.081 wt. % | Sampel tarik | 4 | 2 |
| 0,081 – jam ke 4 – 3 | 0.081 wt. % | Sampel tarik | 4 | 3 |
| 0,081 – jam ke 4 – 4 | 0.081 wt. % | Sampel tarik | 4 | 4 |
| 0,081 – jam ke 4 – 5 | 0.081 wt. % | Sampel tarik | 4 | 5 |
| 0,115 – jam ke 4 – 1 | 0.115 wt. % | Sampel tarik | 4 | 1 |
| 0,115 – jam ke 4 – 2 | 0.115 wt. % | Sampel tarik | 4 | 2 |
| 0,115 – jam ke 4 – 3 | 0.115 wt. % | Sampel tarik | 4 | 3 |
| 0,115 – jam ke 4 – 4 | 0.115 wt. % | Sampel tarik | 4 | 4 |
| 0,115 – jam ke 4 – 5 | 0.115 wt. % | Sampel tarik | 4 | 5 |



