The engineering strain and stress can be obtained by test data directly, while the true stain and stress can be calculated by following formula.



Material properties obtained from conducted tension (longitudinal) coupon tests

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample Set | Sample # | Engineering Stress-Strain Relationship | | | | | | | True Stress-Strain Relationship | | | | | | |
| Yield Stress  (Mpa) | | | | Ultimate Tensile Stress  (Mpa) | | Modulus of Elasticity  (Mpa) | Yield Stress  (Mpa) | | | | Ultimate Tensile Stress  (Mpa) | | Modulus of Elasticity  (Mpa) |
| by 0.2% Offset | at 0.5% Strain | Upper  Yield | Static | Dynamic | Static | by 0.2% Offset | at 0.5% Strain | Upper Yield | Static | Dynamic | Static |
| Base Metal | 1A | 415.0 | 420.3 | / | 412.2 | 498.8 | 474.8 | 200072 | 416.7 | 422.4 | / | 414.7 | 580.1 | / | 200371 |
| 1B | 403.7 | 407.8 | / | 401.0 | 492.2 | 467.6 | 193391 | 405.3 | 410.9 | / | 403.5 | 593.4 | 568.9 | 193680 |
| 1C | 419.1 | 418.5 | 438.4 | 410.1 | 499.8 | 473.4 | 203779 | 420.7 | 420.6 | 439.7 | 413.0 | 603.1 | 571.4 | 204086 |
| **Average** | **412.6** | **415.5** |  | **407.8** | **496.9** | **471.9** | **199081** | **414.2** | **418.0** |  | **410.4** | **592.2** | **570.2** | **199379** |
| New HAZ | 1D | 427.6 | 431.8 | 431.9 | 420.3 | 530.5 | 478.1 | 202537 | 429.4 | 433.9 | 433.0 | 422.4 | 555.4 | 528.0 | 202842 |
| 1E | 430.8 | 432.3 | 443.3 | 417.9 | 502.7 | 477.6 | 208976 | 432.6 | 434.5 | 444.4 | 421.7 | 574 | / | 209289 |
| 1F | 419.5 | 421.5 | / | 410.7 | 499.4 | 474.0 | 173903(low) | 421.4 | 423.6 | / | 412.8 | 552.5 | 524.7 | 174165(low) |
| **Average** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Material properties obtained from conducted tension (longitudinal) coupon tests

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample Set | Sample # | Original Dimension of  Reduced Section | | | Final Dimension of Necking Section | | | Reduction of  Area | Elongation at Fracture | | Character of  Failure | Location of Failure |
| Width (mm) | Thickness (mm) | Area  (mm2) | Width (mm) | Thickness (mm) | Area  (mm2) | 50mm Gauge Length | 100mm Gauge Length  (Reference) |
| Base Metal | 1A | 12.428 | 6.736 | 83.715 | 7.95 | 3.16 | 25.1 | 70.0% | (62.97-48.70)/48.70=29.3% | / | Ductile | Base |
| 1B | 12.674 | 6.778 | 85.904 | 7.96 | 3.60 | 28.7 | 66.6% | (64.75-48.70)/48.70=33.0% | / | Ductile | Base |
| 1C | 12.644 | 6.820 | 86.232 | 7.85 | 3.67 | 28.8 | 66.6% | (64.05-48.26)/48.26=32.7% | / | Ductile | Base |
| **Average** |  |  | **85.3** |  |  |  | **67.7%** | **31.7%** |  | **Ductile** | **Base** |
| New HAZ | 1D | 12.478 | 6.024 | 75.167 | 8.15 | 3.27 | 26.7 | 64.6% | Necking out of gauge mark | (113.39-100)/100=13.4% | Ductile | Base |
| 1E | 12.476 | 6.006 | 74.931 | 8.10 | 3.26 | 29.2 | 61.1% | (61.30-48.97)/48.97=25.2% | (115.16-100)/100=15.2% | Ductile | Base |
| 1F | 12.462 | 6.008 | 74.872 | 8.01 | 3.10 | 24.8 | 66.9% | Necking out of gauge mark | (113.69-100)/100=13.7% | Ductile | Base |
| **Average** |  |  | **75.0** |  |  |  | **64.2%** |  | **14.1%** | **Ductile** | **Base** |

Static Readings

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample  Set | Sample # | Stoppages  # | Load  (kN) | Engineering | | | True | | |
| Strain  (mm/m) | Stress  (Mpa) | Yield or  Ultimate? | Strain  (mm/mm) | Stress  (Mpa) | Yield or  Ultimate? |
| Base  Metal | 1A | 1 | 34.51 | 0.006057 | 412.2 | Yield | 0.006039 | 414.7 | Yield |
| 2 | 34.73 | 0.007062 | 414.9 |  | 0.007037 | 417.8 |  |
| 3 | 34.92 | 0.00807 | 417.1 |  | 0.008038 | 420.5 |  |
| 4 | 35.70 | 0.01207 | 426.4 |  | 0.011998 | 431.6 |  |
| 5 | 36.19 | 0.01607 | 432.3 |  | 0.015942 | 439.2 |  |
| 6 | 37.33 | 0.03016 | 445.9 |  | 0.029714 | 459.4 |  |
| 7 | 39.75 | 0.01341 | 474.8 | Ultimate | 0.125839 | 538.5 |  |
| 1B | 1 | 34.45 | 0.006087 | 401.0 | Yield | 0.006069 | 403.5 | Yield |
| 2 | 34.63 | 0.007092 | 403.1 |  | 0.007067 | 406.0 |  |
| 3 | 34.78 | 0.0081 | 404.9 |  | 0.008067 | 408.2 |  |
| 4 | 35.45 | 0.012 | 412.7 |  | 0.011929 | 417.6 |  |
| 5 | 36.04 | 0.02037 | 419.5 |  | 0.020165 | 428.1 |  |
| 6 | 38.08 | 0.04002 | 443.3 |  | 0.03924 | 461.0 |  |
| 7 | 39.06 | 0.0602 | 454.7 |  | 0.058458 | 482.1 |  |
| 8 | 39.94 | 0.1003 | 464.9 |  | 0.095583 | 511.6 |  |
| 9 | 40.18 | 0.1611 | 467.7 | Ultimate | 0.149368 | 543.1 |  |
| 10 | 39.8 | 0.228 | 463.3 |  | 0.205387 | 568.9 | Ultimate |
| 11 | 38.91 | 0.2488 | 452.9 |  | 0.222183 | 565.6 |  |
| 1C | 1 | 35.35 | 0.006071 | 409.9 | Yield | 0.006053 | 412.4 | Yield |
| 2 | 35.4 | 0.007076 | 410.5 | Yield | 0.007051 | 413.4 | Yield |
| 3 | 35.33 | 0.008232 | 409.7 | Yield | 0.008198 | 413.1 | Yield |
| 4 | 36.05 | 0.02019 | 418.1 |  | 0.019989 | 426.5 |  |
| 5 | 38.4 | 0.04029 | 445.3 |  | 0.0395 | 463.3 |  |
| 6 | 39.6 | 0.06028 | 459.2 |  | 0.058533 | 486.9 |  |
| 7 | 40.32 | 0.08027 | 467.6 |  | 0.077211 | 505.1 |  |
| 8 | 40.71 | 0.1003 | 472.1 |  | 0.095583 | 519.5 |  |
| 9 | 40.82 | 0.1497 | 473.4 | Ultimate | 0.139501 | 544.2 |  |
| 10 | 40.61 | 0.2004 | 470.9 |  | 0.182655 | 565.3 |  |
| 11 | 39.4 | 0.2506 | 456.9 |  | 0.223623 | 571.4 | Ultimate |
| New  HAZ | 1D | 1 | 31.59 | 0.005111 | 420.3 | Yield | 0.005098 | 422.4 | Yield |
| 2 | 31.65 | 0.008106 | 421.1 |  | 0.008073 | 424.5 |  |
| 3 | 32.04 | 0.01112 | 426.3 |  | 0.011059 | 431.0 |  |
| 4 | 31.93 | 0.01412 | 424.8 |  | 0.014021 | 430.8 |  |
| 5 | 34.99 | 0.0503 | 465.5 |  | 0.049076 | 488.9 |  |
| 6 | 35.85 | 0.08022 | 476.9 |  | 0.077165 | 515.2 |  |
| 7 | 35.94 | 0.1042 | 478.1 | Ultimate | 0.099121 | 528.0 | Ultimate |
| 1E | 1 | 31.34 | 0.00614 | 418.3 | Yield | 0.006121 | 420.8 | Yield |
| 2 | 31.62 | 0.009086 | 422.0 | Yield | 0.009045 | 425.8 | Yield |
| 3 | 30.99 | 0.01211 | 413.6 | Yield | 0.012037 | 418.6 | Yield |
| 4 | 33.24 | 0.04031 | 443.6 |  | 0.039519 | 461.5 |  |
| 5 | 35.08 | 0.07035 | 468.2 |  | 0.067986 | 501.1 |  |
| 6 | 35.69 | 0.1008 | 476.3 |  | 0.096037 | 524.3 |  |
| 7 | 35.79 | 0.1197 | 477.6 | Ultimate | 0.113061 | 534.8 |  |
| 1F | 1 | 30.75 | 0.005076 | 410.7 |  | 0.005063 | 412.8 |  |
| 2 | 31.48 | 0.008053 | 420.5 |  | 0.008021 | 423.8 |  |
| 3 | 31.91 | 0.01108 | 426.2 |  | 0.011019 | 430.9 |  |
| 4 | 34.05 | 0.05035 | 454.8 | Yield | 0.049123 | 477.7 | Yield |
| 5 | 35.06 | 0.07025 | 468.3 |  | 0.067892 | 501.2 |  |
| 6 | 35.49 | 0.1069 | 474.0 | Ultimate | 0.101563 | 524.7 | Ultimate |