

**American University of Beirut**

Faculty of Engineering & Architecture

Mechanical Engineering

**Tensile Testing for Metallic Materials**

**(Lab01)**

MECH 341 – Engineering Materials Lab

Section 4 (5:00 pm)

Due Date: 03/03/2010

Professor: Mr. Charbel Seif

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**I. Objective:**

The main objective of this lab experiment is to perform a tensile test on a low carbon steel dog-bone specimen by applying to it a constant continuous load rate, in order to study its mechanical properties. From the tensile test results, we extract the force vs. elongation curve which we transform into a stress vs. strain curve (engineering or true). This curve enables us to determine the elastic region, the yield point, the plastic region, the ultimate tensile strength and the fracture point. From these characteristics, we can determine the needed mechanical properties such as: modulus of elasticity, modulus of resilience, modulus of toughness, yield strength, tensile strength, ductility, yield point and break point energies.

**II. Problem Approach:**

The performance of the tensile test on the low carbon steel specimen requires the following steps:

1. A dog-bone specimen is prepared (Appendix A, figure 1), having a length of 200 mm, a cross-section diameter of 11 mm and a gage length of 25 mm.
2. The Hounsfield UTM testing machine is set to a strain rate of 3 mm/min.
3. The specimen is fixed tightly between the grips in a manner that ensures a pure axial force.
4. The force is applied until fracture occurs. During this step, the elongation is calculated by the extensometer equipped within the UTM machine and then displayed on its screen along with the corresponding force. At the same time, the force vs. elongation curve is sketched on the screen of the computer connected to the machine.

**III. Analysis & Calculations:**

**a. Engineering Stress:**

Where:

* is the engineering stress
* F is the force applied (the data were given)
* Ao is the initial cross sectional area (Ao = 9.5 x 10-5 m2)

In order to check the results, please refer to Appendix C column IV

**b. Engineering Strain:**

Where:

* is the engineering strain
* is the extension (the data were given)
* is the initial gage length (25 mm)

In order to check the results, please refer to Appendix C column III

**c. True Stress:**

Where:

* is the true stress
* is the instantaneous cross sectional area at which deformation is occurring

In order to check the results, please refer to Appendix C column VI

**d. True Strain:**

Where:

* is the true strain
* is the instantaneous gage length which deformation is occurring

In order to check the results, please refer to Appendix C column V

**e.** **Proportional Limit Stress:**

= 490 MPa; it is determined from the stress-strain curve at the point where it become non-linear. (Appendix B, Figure 4b; point A)

**f. Yield Point Stress:**

= 500.35 MPa; it is determined from the stress-strain curve at the point where the curve goes horizontal. (Appendix B, Figure 4b; point B)

**g. Modulus of Elasticity:**

E= 416.67 GPa; it is determined by the slope of the initial linear elastic part of the stress-strain curve. (Appendix B, Figure 3)

**h. 0.2% Offset Yield Stress:**

= 496.14 MPa; it is determined by the stress value at which a line drawn with slope E starting at 0.2% (0.002) strain intersects the curve. (Appendix B figure 4a, or the enlarged scale on figure 4b point C)

**i. Ultimate Tensile Stress:**

MPa; it is determined by the largest value of stress on the curve. (Appendix B Figure 2; point B)

**j. Engineering Fracture Stress:**

= 470.36 MPa

(Appendix B figure 2; point C)

**k. True Fracture Stress:**

= 663.73 MPa

(Appendix B figure 5; point A)

**l. Modulus of Resilience:**

; It is defined as the area under elastic portion of the stress strain curve.

Also,

= 3004.17 Pa

**m. Modulus of toughness**

is defined by the area under the entire stress strain curve, since the difference between two consecutive values are an ε (too small), we can assume a linear relation between those values and the area under the corresponding curve is equal to the trapezoid area. Then Ut is the sum of all the areas under the stress strain curve and is defined by:

73.62 MPa, (refer to Appendix C Column VII)

**n. Energy at yield**

It is area under the elastic portion of the load-deformation curve;

Energyyield= 633.15 N.mm

**o. Energy at break**

It is area under the entire load-deformation curve;

Energybreak= 174919.5 N.mm

(Refer to Appendix C Column VIII)

**p. Percent Elongation**

**q. Percent Elongation L” Gage length**

**r. Percent reduction of Area:**

**IV. Observation:**

The observations made during this experiment are as follows:

1. At the beginning of the experiment, there are no noticeable changes in the specimen. The graph appears to be linear and almost vertical with infinite slope.
2. After a certain point, the yield point, the graph begins to take a horizontal shape but still there are no observable deformations. Until this point the force applied continues to increase.
3. At the ultimate point, we notice that the force starts to decrease, and a neck starts to appear at the center of the gage length. This is due to the fact that when the surface area decreases due to necking, the force required to maintain the constant strain rate decreases.
4. The force applied continues to decrease and the necking becomes more perceptible until the fracture point where the whole specimen breaks at the point where the neck became too accentuated emitting a loud sound and forming a cup-and-cone shape on the fracture surfaces.
5. The energy transferred to the specimen by the applied load is transformed into thermal energy. This energy appears as the surface close to the fracture point is slightly heated.

**V. Conclusion:**

* All the calculations, analysis and observations made earlier show that low-carbon steel experiences considerable plastic deformation subsequent to the elastic deformation and this characterizes it as a relatively ductile material. It is also shown that low-carbon steel is relatively strong and tough considering the maximum elongation it endures is 14.67% (gage elongation).
* Conducting a tensile test is of big importance when it comes to determining mechanical properties of a metal and therefore helps us to construct the specific design criteria necessary for all applications where this metal is utilized.

**VI. Appendix A:**

***Given Data***

|  |  |
| --- | --- |
| Specimen Number | 7 |
| Gage length | http://www.sckcen.be/var/plain_site/storage/images/media/images/philippe_gouat/tensile_specimen/19376-1-eng-GB/tensile_specimen.jpg25 mm |
| Cross Section Diameter (Initial) | 11 mm |
| Uniform Elongation Diameter | 10.5 mm |
| Diameter at Fracture | 9.26 mm |

|  |  |
| --- | --- |
| Dimension | Drawing1-ModelValue (mm) |
| A- Length of narrow section | 80 |
| D- Diameter | 11 |
| C- Outer Diameter | 17 |
| R- Radius of fillet | 2 |
| L- Length overall | 200 |
| G- Gage Length | 25 |

Table 1: Specimen’s dimensions

Figure 1: Dog bone tensile test specimen

***Note:*** Elongation (Extension) and force applied data are found in Appendix C, Table 1.1, Column I & II respectively.

**VII. Appendix B:**

***Figures & Graphs***

B

Figure 2: Engineering Stress vs. engineering Strain curve, where:

A: Yield Stress

B: Ultimate Tensile Stress

C: Engineering Fracture stress

A

C

Figure 3: Plot of the elastic linear region on an enlarged scale, with the best fit slope.

Figure 4:

(a) Plot of the 0.2% yield offset line on the stress strain curve.

(b) Enlarged scale of the 0.2% yield offset line on the stress strain curve.

A: Proportional Limit Stress

B: Yield Stress

C: 0.2% Yield Stress

(a)

A

C

B

(b)

A

Figure 5:

True stress vs. true

strain curve.

A: True fracture stress

Figure 6:

Load deformation curve, plot of Force vs. Elongation.

**VIII. Appendix C:**

***Calculation Table***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **I** | **II** | **III** | **IV** | **V** | **VI** | **VII** | **VIII** |
| **Extension**  **(Elongation)** | **Force** | **Engineering Stain** | **Engineering**  **Stress** | **True**  **Stain** | **True**  **Stress** | **Trapezoid area Under Stress Strain Curve** | **Trapezoid area Under Load def. Curve** |
| **(mm)** | **(N)** | **(mm/mm)** | **(Pa)** | **(mm/mm)** | **(Pa)** | **(Pa)** | **(N.mm)** |
| 0 | 11550 | 0 | 121536502 | 0 | 121536502 | - | - |
| 0.008 | 19400 | 0.00032 | 204139232.8 | 0.000319949 | 204204557.3 | 52108.12 | 123.8 |
| 0.015 | 33500 | 0.0006 | 352508469 | 0.00059982 | 352719974 | 77930.68 | 185.15 |
| 0.023 | 47550 | 0.00092 | 500351573.1 | 0.000919577 | 500811896.5 | 136457.6 | 324.2 |
| 0.03 | 47400 | 0.0012 | 498773177 | 0.001199281 | 499371704.8 | 139877.5 | 332.325 |
| 0.038 | 47250 | 0.00152 | 497194780.8 | 0.001518846 | 497950516.9 | 159354.9 | 378.6 |
| 0.045 | 47200 | 0.0018 | 496668648.8 | 0.001798382 | 497562652.4 | 139140.9 | 330.575 |
| 0.053 | 47200 | 0.00212 | 496668648.8 | 0.002117756 | 497721586.3 | 158934 | 377.6 |
| 0.06 | 47150 | 0.0024 | 496142516.7 | 0.002397125 | 497333258.8 | 138993.6 | 330.225 |
| 0.068 | 47150 | 0.00272 | 496142516.7 | 0.002716307 | 497492024.4 | 158765.6 | 377.2 |
| 0.075 | 47150 | 0.003 | 496142516.7 | 0.002995509 | 497630944.3 | 138919.9 | 330.05 |
| 0.083 | 47150 | 0.00332 | 496142516.7 | 0.003314501 | 497789709.9 | 158765.6 | 377.2 |
| 0.09 | 47100 | 0.0036 | 495616384.7 | 0.003593536 | 497400603.7 | 138846.2 | 329.875 |
| 0.098 | 47100 | 0.00392 | 495616384.7 | 0.003912337 | 497559200.9 | 158597.2 | 376.8 |
| 0.105 | 47100 | 0.0042 | 495616384.7 | 0.004191205 | 497697973.5 | 138772.6 | 329.7 |
| 0.113 | 47150 | 0.00452 | 496142516.7 | 0.004509815 | 498385080.9 | 158681.4 | 377 |
| 0.12 | 47150 | 0.0048 | 496142516.7 | 0.004788517 | 498524000.8 | 138919.9 | 330.05 |
| 0.128 | 47150 | 0.00512 | 496142516.7 | 0.005106937 | 498682766.4 | 158765.6 | 377.2 |
| 0.135 | 47150 | 0.0054 | 496142516.7 | 0.005385472 | 498821686.3 | 138919.9 | 330.05 |
| 0.143 | 47150 | 0.00572 | 496142516.7 | 0.005703703 | 498980451.9 | 158765.6 | 377.2 |
| 0.15 | 47200 | 0.006 | 496668648.8 | 0.005982072 | 499648660.7 | 138993.6 | 330.225 |
| 0.158 | 47200 | 0.00632 | 496668648.8 | 0.006300113 | 499807594.7 | 158934 | 377.6 |
| 0.165 | 47200 | 0.0066 | 496668648.8 | 0.006578315 | 499946661.9 | 139067.2 | 330.4 |
| 0.173 | 47200 | 0.00692 | 496668648.8 | 0.006896167 | 500105595.8 | 158934 | 377.6 |
| 0.18 | 47200 | 0.0072 | 496668648.8 | 0.007174204 | 500244663.1 | 139067.2 | 330.4 |
| 0.188 | 47250 | 0.00752 | 497194780.8 | 0.007491866 | 500933685.6 | 159018.1 | 377.8 |
| 0.195 | 47250 | 0.0078 | 497194780.8 | 0.007769737 | 501072900.1 | 139214.5 | 330.75 |
| 0.203 | 47250 | 0.00812 | 497194780.8 | 0.00808721 | 501232002.5 | 159102.3 | 378 |
| 0.21 | 47250 | 0.0084 | 497194780.8 | 0.008364916 | 501371217 | 139214.5 | 330.75 |
| 0.218 | 47250 | 0.00872 | 497194780.8 | 0.0086822 | 501530319.3 | 159102.3 | 378 |
| 0.225 | 47250 | 0.009 | 497194780.8 | 0.008959741 | 501669533.9 | 139214.5 | 330.75 |
| 0.233 | 47250 | 0.00932 | 497194780.8 | 0.009276837 | 501828636.2 | 159102.3 | 378 |
| 0.24 | 47250 | 0.0096 | 497194780.8 | 0.009554213 | 501967850.7 | 139214.5 | 330.75 |
| 0.248 | 47250 | 0.00992 | 497194780.8 | 0.00987112 | 502126953.1 | 159102.3 | 378 |
| 0.255 | 47250 | 0.0102 | 497194780.8 | 0.010148331 | 502266167.6 | 139214.5 | 330.75 |
| 0.263 | 47250 | 0.01052 | 497194780.8 | 0.01046505 | 502425269.9 | 159102.3 | 378 |
| 0.27 | 47250 | 0.0108 | 497194780.8 | 0.010742097 | 502564484.5 | 139214.5 | 330.75 |
| 0.278 | 47200 | 0.01112 | 496668648.8 | 0.011058627 | 502191604.2 | 159018.1 | 377.8 |
| 0.285 | 47200 | 0.0114 | 496668648.8 | 0.01133551 | 502330671.4 | 139067.2 | 330.4 |
| 0.293 | 47150 | 0.01172 | 496142516.7 | 0.011651853 | 501957307 | 158849.8 | 377.4 |
| 0.3 | 47200 | 0.012 | 496668648.8 | 0.011928571 | 502628672.6 | 138993.6 | 330.225 |
| 0.308 | 47300 | 0.01232 | 497720912.9 | 0.012244726 | 503852834.5 | 159102.3 | 378 |
| 0.315 | 47350 | 0.0126 | 498247044.9 | 0.012521281 | 504524957.7 | 139435.5 | 331.275 |
| 0.323 | 47400 | 0.01292 | 498773177 | 0.012837249 | 505217326.4 | 159523.2 | 379 |
| 0.33 | 47450 | 0.0132 | 499299309 | 0.013113639 | 505890059.9 | 139730.1 | 331.975 |
| 0.338 | 47450 | 0.01352 | 499299309 | 0.01342942 | 506049835.7 | 159775.8 | 379.6 |
| 0.345 | 47400 | 0.0138 | 498773177 | 0.013705647 | 505656246.8 | 139730.1 | 331.975 |
| 0.353 | 47400 | 0.01412 | 498773177 | 0.014021241 | 505815854.2 | 159607.4 | 379.2 |
| 0.36 | 47450 | 0.0144 | 499299309 | 0.014297305 | 506489219.1 | 139730.1 | 331.975 |
| 0.368 | 47450 | 0.01472 | 499299309 | 0.014612712 | 506648994.8 | 159775.8 | 379.6 |
| 0.375 | 47450 | 0.015 | 499299309 | 0.014888612 | 506788798.6 | 139803.8 | 332.15 |
| 0.383 | 47450 | 0.01532 | 499299309 | 0.015203834 | 506948574.4 | 159775.8 | 379.6 |
| 0.39 | 47450 | 0.0156 | 499299309 | 0.015479571 | 507088378.2 | 139803.8 | 332.15 |
| 0.398 | 47550 | 0.01592 | 500351573.1 | 0.015794606 | 508317170.1 | 159944.1 | 380 |
| 0.405 | 47550 | 0.0162 | 500351573.1 | 0.01607018 | 508457268.6 | 140098.4 | 332.85 |
| 0.413 | 47550 | 0.01652 | 500351573.1 | 0.016385029 | 508617381.1 | 160112.5 | 380.4 |
| 0.42 | 47600 | 0.0168 | 500877705.1 | 0.016660441 | 509292450.6 | 140172.1 | 333.025 |
| 0.428 | 47650 | 0.01712 | 501403837.2 | 0.016975104 | 509987870.9 | 160365 | 381 |
| 0.435 | 47650 | 0.0174 | 501403837.2 | 0.017250353 | 510128263.9 | 140393.1 | 333.55 |
| 0.443 | 47650 | 0.01772 | 501403837.2 | 0.017564831 | 510288713.2 | 160449.2 | 381.2 |
| 0.45 | 47700 | 0.018 | 501929969.2 | 0.017839918 | 510964708.7 | 140466.7 | 333.725 |
| 0.458 | 47750 | 0.01832 | 502456101.3 | 0.018154211 | 511661097 | 160701.8 | 381.8 |
| 0.465 | 47750 | 0.0186 | 502456101.3 | 0.018429135 | 511801784.7 | 140687.7 | 334.25 |
| 0.473 | 47750 | 0.01892 | 502456101.3 | 0.018743243 | 511962570.7 | 160786 | 382 |
| 0.48 | 47800 | 0.0192 | 502982233.3 | 0.019018006 | 512639492.2 | 140761.4 | 334.425 |
| 0.488 | 47850 | 0.01952 | 503508365.4 | 0.019331928 | 513336848.6 | 161038.5 | 382.6 |
| 0.495 | 47850 | 0.0198 | 503508365.4 | 0.01960653 | 513477831 | 140982.3 | 334.95 |
| 0.503 | 47850 | 0.02012 | 503508365.4 | 0.019920267 | 513638953.7 | 161122.7 | 382.8 |
| 0.51 | 47900 | 0.0204 | 504034497.4 | 0.020194707 | 514316801.1 | 141056 | 335.125 |
| 0.518 | 47900 | 0.02072 | 504034497.4 | 0.020508261 | 514478092.2 | 161291 | 383.2 |
| 0.525 | 47900 | 0.021 | 504034497.4 | 0.020782539 | 514619221.8 | 141129.7 | 335.3 |
| 0.533 | 47950 | 0.02132 | 504560629.4 | 0.021095908 | 515317862.1 | 161375.2 | 383.4 |
| 0.54 | 47950 | 0.0216 | 504560629.4 | 0.021370026 | 515459139 | 141277 | 335.65 |
| 0.548 | 48000 | 0.02192 | 505086761.5 | 0.021683211 | 516158263.3 | 161543.6 | 383.8 |
| 0.555 | 48000 | 0.0222 | 505086761.5 | 0.021957167 | 516299687.6 | 141424.3 | 336 |
| 0.563 | 48050 | 0.02252 | 505612893.5 | 0.022270169 | 516999295.9 | 161711.9 | 384.2 |
| 0.57 | 48100 | 0.0228 | 506139025.6 | 0.022543964 | 517678995.4 | 141645.3 | 336.525 |
| 0.578 | 48100 | 0.02312 | 506139025.6 | 0.022856782 | 517840959.8 | 161964.5 | 384.8 |
| 0.585 | 48100 | 0.0234 | 506139025.6 | 0.023130417 | 517982678.8 | 141718.9 | 336.7 |
| 0.593 | 48100 | 0.02372 | 506139025.6 | 0.023443052 | 518144643.3 | 161964.5 | 384.8 |
| 0.6 | 48150 | 0.024 | 506665157.6 | 0.023716527 | 518825121.4 | 141792.6 | 336.875 |
| 0.608 | 48200 | 0.02432 | 507191289.7 | 0.024028978 | 519526181.8 | 162217 | 385.4 |
| 0.615 | 48200 | 0.0246 | 507191289.7 | 0.024302293 | 519668195.4 | 142013.6 | 337.4 |
| 0.623 | 48250 | 0.02492 | 507717421.7 | 0.024614561 | 520369739.8 | 162385.4 | 385.8 |
| 0.63 | 48250 | 0.0252 | 507717421.7 | 0.024887716 | 520511900.7 | 142160.9 | 337.75 |
| 0.638 | 48300 | 0.02552 | 508243553.7 | 0.025199801 | 521213929.2 | 162553.8 | 386.2 |
| 0.645 | 48300 | 0.0258 | 508243553.7 | 0.025472796 | 521356237.4 | 142308.2 | 338.1 |
| 0.653 | 48300 | 0.02612 | 508243553.7 | 0.025784699 | 521518875.4 | 162637.9 | 386.4 |
| 0.66 | 48350 | 0.0264 | 508769685.8 | 0.026057534 | 522201205.5 | 142381.9 | 338.275 |
| 0.668 | 48350 | 0.02672 | 508769685.8 | 0.026369255 | 522364011.8 | 162806.3 | 386.8 |
| 0.675 | 48400 | 0.027 | 509295817.8 | 0.026641931 | 523046804.9 | 142529.2 | 338.625 |
| 0.683 | 48400 | 0.02732 | 509295817.8 | 0.02695347 | 523209779.6 | 162974.7 | 387.2 |
| 0.69 | 48400 | 0.0276 | 509295817.8 | 0.027225986 | 523352382.4 | 142602.8 | 338.8 |
| 0.698 | 48450 | 0.02792 | 509821949.9 | 0.027537343 | 524056178.7 | 163058.8 | 387.4 |
| 0.705 | 48450 | 0.0282 | 509821949.9 | 0.027809701 | 524198928.9 | 142750.1 | 339.15 |
| 0.713 | 48450 | 0.02852 | 509821949.9 | 0.028120876 | 524362071.9 | 163143 | 387.6 |
| 0.72 | 48500 | 0.0288 | 510348081.9 | 0.028393075 | 525046106.7 | 142823.8 | 339.325 |
| 0.728 | 48500 | 0.02912 | 510348081.9 | 0.028704068 | 525209418.1 | 163311.4 | 388 |
| 0.735 | 48500 | 0.0294 | 510348081.9 | 0.028976108 | 525352315.5 | 142897.5 | 339.5 |
| 0.743 | 48550 | 0.02972 | 510874214 | 0.029286921 | 526057395.6 | 163395.6 | 388.2 |
| 0.75 | 48600 | 0.03 | 511400346 | 0.029558802 | 526742356.4 | 143118.4 | 340.025 |
| 0.758 | 48600 | 0.03032 | 511400346 | 0.029869434 | 526906004.5 | 163648.1 | 388.8 |
| 0.765 | 48600 | 0.0306 | 511400346 | 0.030141157 | 527049196.6 | 143192.1 | 340.2 |
| 0.773 | 48600 | 0.03092 | 511400346 | 0.030451607 | 527212844.7 | 163648.1 | 388.8 |
| 0.78 | 48650 | 0.0312 | 511926478 | 0.030723173 | 527898584.2 | 143265.8 | 340.375 |
| 0.788 | 48650 | 0.03152 | 511926478 | 0.031033443 | 528062400.6 | 163816.5 | 389.2 |
| 0.795 | 48700 | 0.0318 | 512452610.1 | 0.03130485 | 528748603.1 | 143413.1 | 340.725 |
| 0.803 | 48700 | 0.03212 | 512452610.1 | 0.031614939 | 528912587.9 | 163984.8 | 389.6 |
| 0.81 | 48700 | 0.0324 | 512452610.1 | 0.031886189 | 529056074.7 | 143486.7 | 340.9 |
| 0.818 | 48750 | 0.03272 | 512978742.1 | 0.032196098 | 529763406.6 | 164069 | 389.8 |
| 0.825 | 48750 | 0.033 | 512978742.1 | 0.03246719 | 529907040.6 | 143634 | 341.25 |
| 0.833 | 48750 | 0.03332 | 512978742.1 | 0.03277692 | 530071193.8 | 164153.2 | 390 |
| 0.84 | 48750 | 0.0336 | 512978742.1 | 0.033047854 | 530214827.9 | 143634 | 341.25 |
| 0.848 | 48800 | 0.03392 | 513504874.2 | 0.033357404 | 530922959.5 | 164237.4 | 390.2 |
| 0.855 | 48800 | 0.0342 | 513504874.2 | 0.033628181 | 531066740.9 | 143781.4 | 341.6 |
| 0.863 | 48800 | 0.03452 | 513504874.2 | 0.033937551 | 531231062.4 | 164321.6 | 390.4 |
| 0.87 | 48850 | 0.0348 | 514031006.2 | 0.034208171 | 531919285.2 | 143855 | 341.775 |
| 0.878 | 48850 | 0.03512 | 514031006.2 | 0.034517362 | 532083775.2 | 164489.9 | 390.8 |
| 0.885 | 48850 | 0.0354 | 514031006.2 | 0.034787825 | 532227703.8 | 143928.7 | 341.95 |
| 0.893 | 48900 | 0.03572 | 514557138.3 | 0.035096837 | 532937119.2 | 164574.1 | 391 |
| 0.9 | 48900 | 0.036 | 514557138.3 | 0.035367144 | 533081195.2 | 144076 | 342.3 |
| 0.908 | 48900 | 0.03632 | 514557138.3 | 0.035675976 | 533245853.5 | 164658.3 | 391.2 |
| 0.915 | 48900 | 0.0366 | 514557138.3 | 0.035946127 | 533389929.5 | 144076 | 342.3 |
| 0.923 | 48900 | 0.03692 | 514557138.3 | 0.036254781 | 533554587.8 | 164658.3 | 391.2 |
| 0.93 | 48950 | 0.0372 | 515083270.3 | 0.036524775 | 534244368 | 144149.7 | 342.475 |
| 0.938 | 48950 | 0.03752 | 515083270.3 | 0.03683325 | 534409194.6 | 164826.6 | 391.6 |
| 0.945 | 48950 | 0.0378 | 515083270.3 | 0.037103088 | 534553417.9 | 144223.3 | 342.65 |
| 0.953 | 48950 | 0.03812 | 515083270.3 | 0.037411385 | 534718244.6 | 164826.6 | 391.6 |
| 0.96 | 49000 | 0.0384 | 515609402.3 | 0.037681067 | 535408803.4 | 144297 | 342.825 |
| 0.968 | 49000 | 0.03872 | 515609402.3 | 0.037989186 | 535573798.4 | 164995 | 392 |
| 0.975 | 49000 | 0.039 | 515609402.3 | 0.038258712 | 535718169 | 144370.6 | 343 |
| 0.983 | 49000 | 0.03932 | 515609402.3 | 0.038566653 | 535883164 | 164995 | 392 |
| 0.99 | 49000 | 0.0396 | 515609402.3 | 0.038836024 | 536027534.7 | 144370.6 | 343 |
| 0.998 | 49050 | 0.03992 | 516135534.4 | 0.039143787 | 536739664.9 | 165079.2 | 392.2 |
| 1.005 | 49050 | 0.0402 | 516135534.4 | 0.039413002 | 536884182.9 | 144517.9 | 343.35 |
| 1.013 | 49050 | 0.04052 | 516135534.4 | 0.039720588 | 537049346.2 | 165163.4 | 392.4 |
| 1.02 | 49050 | 0.0408 | 516135534.4 | 0.039989648 | 537193864.2 | 144517.9 | 343.35 |
| 1.028 | 49100 | 0.04112 | 516661666.4 | 0.040297057 | 537906794.2 | 165247.6 | 392.6 |
| 1.035 | 49100 | 0.0414 | 516661666.4 | 0.040565962 | 538051459.4 | 144665.3 | 343.7 |
| 1.043 | 49100 | 0.04172 | 516661666.4 | 0.040873193 | 538216791.2 | 165331.7 | 392.8 |
| 1.05 | 49100 | 0.042 | 516661666.4 | 0.041141943 | 538361456.4 | 144665.3 | 343.7 |
| 1.058 | 49100 | 0.04232 | 516661666.4 | 0.041448998 | 538526788.2 | 165331.7 | 392.8 |
| 1.065 | 49100 | 0.0426 | 516661666.4 | 0.041717593 | 538671453.4 | 144665.3 | 343.7 |
| 1.073 | 49100 | 0.04292 | 516661666.4 | 0.042024471 | 538836785.2 | 165331.7 | 392.8 |
| 1.08 | 49150 | 0.0432 | 517187798.5 | 0.042292912 | 539530311.4 | 144738.9 | 343.875 |
| 1.088 | 49150 | 0.04352 | 517187798.5 | 0.042599614 | 539695811.5 | 165500.1 | 393.2 |
| 1.095 | 49150 | 0.0438 | 517187798.5 | 0.0428679 | 539840624 | 144812.6 | 344.05 |
| 1.103 | 49150 | 0.04412 | 517187798.5 | 0.043174425 | 540006124.1 | 165500.1 | 393.2 |
| 1.11 | 49150 | 0.0444 | 517187798.5 | 0.043442558 | 540150936.7 | 144812.6 | 344.05 |
| 1.118 | 49150 | 0.04472 | 517187798.5 | 0.043748907 | 540316436.8 | 165500.1 | 393.2 |
| 1.125 | 49200 | 0.045 | 517713930.5 | 0.044016885 | 541011057.4 | 144886.2 | 344.225 |
| 1.133 | 49200 | 0.04532 | 517713930.5 | 0.044323059 | 541176725.9 | 165668.5 | 393.6 |
| 1.14 | 49200 | 0.0456 | 517713930.5 | 0.044590883 | 541321685.8 | 144959.9 | 344.4 |
| 1.148 | 49200 | 0.04592 | 517713930.5 | 0.044896881 | 541487354.2 | 165668.5 | 393.6 |
| 1.155 | 49200 | 0.0462 | 517713930.5 | 0.045164552 | 541632314.1 | 144959.9 | 344.4 |
| 1.163 | 49200 | 0.04652 | 517713930.5 | 0.045470374 | 541797982.6 | 165668.5 | 393.6 |
| 1.17 | 49200 | 0.0468 | 517713930.5 | 0.045737892 | 541942942.5 | 144959.9 | 344.4 |
| 1.178 | 49200 | 0.04712 | 517713930.5 | 0.046043539 | 542108610.9 | 165668.5 | 393.6 |
| 1.185 | 49200 | 0.0474 | 517713930.5 | 0.046310903 | 542253570.8 | 144959.9 | 344.4 |
| 1.193 | 49200 | 0.04772 | 517713930.5 | 0.046616375 | 542419239.3 | 165668.5 | 393.6 |
| 1.2 | 49200 | 0.048 | 517713930.5 | 0.046883586 | 542564199.2 | 144959.9 | 344.4 |
| 1.208 | 49250 | 0.04832 | 518240062.6 | 0.047188883 | 543281422.4 | 165752.6 | 393.8 |
| 1.215 | 49250 | 0.0486 | 518240062.6 | 0.047455941 | 543426529.6 | 145107.2 | 344.75 |
| 1.223 | 49250 | 0.04892 | 518240062.6 | 0.047761063 | 543592366.4 | 165836.8 | 394 |
| 1.23 | 49250 | 0.0492 | 518240062.6 | 0.048027969 | 543737473.6 | 145107.2 | 344.75 |
| 1.238 | 49250 | 0.04952 | 518240062.6 | 0.048332917 | 543903310.5 | 165836.8 | 394 |
| 1.245 | 49250 | 0.0498 | 518240062.6 | 0.04859967 | 544048417.7 | 145107.2 | 344.75 |
| 1.253 | 49250 | 0.05012 | 518240062.6 | 0.048904443 | 544214254.5 | 165836.8 | 394 |
| 1.26 | 49250 | 0.0504 | 518240062.6 | 0.049171044 | 544359361.7 | 145107.2 | 344.75 |
| 1.268 | 49250 | 0.05072 | 518240062.6 | 0.049475643 | 544525198.5 | 165836.8 | 394 |
| 1.275 | 49250 | 0.051 | 518240062.6 | 0.049742092 | 544670305.8 | 145107.2 | 344.75 |
| 1.283 | 49250 | 0.05132 | 518240062.6 | 0.050046517 | 544836142.6 | 165836.8 | 394 |
| 1.29 | 49250 | 0.0516 | 518240062.6 | 0.050312814 | 544981249.8 | 145107.2 | 344.75 |
| 1.298 | 49250 | 0.05192 | 518240062.6 | 0.050617066 | 545147086.6 | 165836.8 | 394 |
| 1.305 | 49250 | 0.0522 | 518240062.6 | 0.05088321 | 545292193.8 | 145107.2 | 344.75 |
| 1.313 | 49250 | 0.05252 | 518240062.6 | 0.051187289 | 545458030.6 | 165836.8 | 394 |
| 1.32 | 49250 | 0.0528 | 518240062.6 | 0.051453282 | 545603137.9 | 145107.2 | 344.75 |
| 1.328 | 49250 | 0.05312 | 518240062.6 | 0.051757187 | 545768974.7 | 165836.8 | 394 |
| 1.335 | 49250 | 0.0534 | 518240062.6 | 0.052023028 | 545914081.9 | 145107.2 | 344.75 |
| 1.343 | 49250 | 0.05372 | 518240062.6 | 0.05232676 | 546079918.7 | 165836.8 | 394 |
| 1.35 | 49250 | 0.054 | 518240062.6 | 0.05259245 | 546225025.9 | 145107.2 | 344.75 |
| 1.358 | 49250 | 0.05432 | 518240062.6 | 0.052896009 | 546390862.8 | 165836.8 | 394 |
| 1.365 | 49250 | 0.0546 | 518240062.6 | 0.053161548 | 546535970 | 145107.2 | 344.75 |
| 1.373 | 49250 | 0.05492 | 518240062.6 | 0.053464935 | 546701806.8 | 165836.8 | 394 |
| 1.38 | 49250 | 0.0552 | 518240062.6 | 0.053730322 | 546846914 | 145107.2 | 344.75 |
| 1.388 | 49250 | 0.05552 | 518240062.6 | 0.054033536 | 547012750.8 | 165836.8 | 394 |
| 1.395 | 49250 | 0.0558 | 518240062.6 | 0.054298773 | 547157858.1 | 145107.2 | 344.75 |
| 1.403 | 49250 | 0.05612 | 518240062.6 | 0.054601815 | 547323694.9 | 165836.8 | 394 |
| 1.41 | 49250 | 0.0564 | 518240062.6 | 0.054866901 | 547468802.1 | 145107.2 | 344.75 |
| 1.418 | 49250 | 0.05672 | 518240062.6 | 0.055169771 | 547634638.9 | 165836.8 | 394 |
| 1.425 | 49250 | 0.057 | 518240062.6 | 0.055434707 | 547779746.1 | 145107.2 | 344.75 |
| 1.433 | 49250 | 0.05732 | 518240062.6 | 0.055737405 | 547945582.9 | 165836.8 | 394 |
| 1.44 | 49250 | 0.0576 | 518240062.6 | 0.05600219 | 548090690.2 | 145107.2 | 344.75 |
| 1.448 | 49250 | 0.05792 | 518240062.6 | 0.056304716 | 548256527 | 165836.8 | 394 |
| 1.455 | 49250 | 0.0582 | 518240062.6 | 0.056569351 | 548401634.2 | 145107.2 | 344.75 |
| 1.463 | 49250 | 0.05852 | 518240062.6 | 0.056871706 | 548567471 | 165836.8 | 394 |
| 1.47 | 49250 | 0.0588 | 518240062.6 | 0.057136191 | 548712578.2 | 145107.2 | 344.75 |
| 1.478 | 49250 | 0.05912 | 518240062.6 | 0.057438375 | 548878415.1 | 165836.8 | 394 |
| 1.485 | 49250 | 0.0594 | 518240062.6 | 0.05770271 | 549023522.3 | 145107.2 | 344.75 |
| 1.493 | 49250 | 0.05972 | 518240062.6 | 0.058004722 | 549189359.1 | 165836.8 | 394 |
| 1.5 | 49200 | 0.06 | 517713930.5 | 0.058268908 | 548776766.4 | 145033.6 | 344.575 |
| 1.508 | 49200 | 0.06032 | 517713930.5 | 0.058570749 | 548942434.8 | 165668.5 | 393.6 |
| 1.515 | 49200 | 0.0606 | 517713930.5 | 0.058834786 | 549087394.7 | 144959.9 | 344.4 |
| 1.523 | 49200 | 0.06092 | 517713930.5 | 0.059136456 | 549253063.2 | 165668.5 | 393.6 |
| 1.53 | 49200 | 0.0612 | 517713930.5 | 0.059400343 | 549398023.1 | 144959.9 | 344.4 |
| 1.538 | 49200 | 0.06152 | 517713930.5 | 0.059701843 | 549563691.5 | 165668.5 | 393.6 |
| 1.545 | 49200 | 0.0618 | 517713930.5 | 0.059965581 | 549708651.4 | 144959.9 | 344.4 |
| 1.553 | 49200 | 0.06212 | 517713930.5 | 0.060266911 | 549874319.9 | 165668.5 | 393.6 |
| 1.56 | 49200 | 0.0624 | 517713930.5 | 0.0605305 | 550019279.8 | 144959.9 | 344.4 |
| 1.568 | 49200 | 0.06272 | 517713930.5 | 0.060831659 | 550184948.2 | 165668.5 | 393.6 |
| 1.575 | 49150 | 0.063 | 517187798.5 | 0.061095099 | 549770629.8 | 144886.2 | 344.225 |
| 1.583 | 49150 | 0.06332 | 517187798.5 | 0.061396089 | 549936129.9 | 165500.1 | 393.2 |
| 1.59 | 49150 | 0.0636 | 517187798.5 | 0.06165938 | 550080942.5 | 144812.6 | 344.05 |
| 1.598 | 49150 | 0.06392 | 517187798.5 | 0.0619602 | 550246442.6 | 165500.1 | 393.2 |
| 1.605 | 49150 | 0.0642 | 517187798.5 | 0.062223343 | 550391255.1 | 144812.6 | 344.05 |
| 1.613 | 49150 | 0.06452 | 517187798.5 | 0.062523993 | 550556755.2 | 165500.1 | 393.2 |
| 1.62 | 49150 | 0.0648 | 517187798.5 | 0.062786988 | 550701567.8 | 144812.6 | 344.05 |
| 1.628 | 49150 | 0.06512 | 517187798.5 | 0.063087469 | 550867067.9 | 165500.1 | 393.2 |
| 1.635 | 49150 | 0.0654 | 517187798.5 | 0.063350316 | 551011880.5 | 144812.6 | 344.05 |
| 1.643 | 49100 | 0.06572 | 516661666.4 | 0.063650627 | 550616671.2 | 165415.9 | 393 |
| 1.65 | 49100 | 0.066 | 516661666.4 | 0.063913326 | 550761336.4 | 144665.3 | 343.7 |
| 1.658 | 49100 | 0.06632 | 516661666.4 | 0.064213468 | 550926668.2 | 165331.7 | 392.8 |
| 1.665 | 49100 | 0.0666 | 516661666.4 | 0.064476019 | 551071333.4 | 144665.3 | 343.7 |
| 1.673 | 49050 | 0.06692 | 516135534.4 | 0.064775993 | 550675324.4 | 165247.6 | 392.6 |
| 1.68 | 49050 | 0.0672 | 516135534.4 | 0.065038396 | 550819842.3 | 144517.9 | 343.35 |
| 1.688 | 49050 | 0.06752 | 516135534.4 | 0.065338201 | 550985005.7 | 165163.4 | 392.4 |
| 1.695 | 49050 | 0.0678 | 516135534.4 | 0.065600457 | 551129523.6 | 144517.9 | 343.35 |
| 1.703 | 49050 | 0.06812 | 516135534.4 | 0.065900094 | 551294687 | 165163.4 | 392.4 |
| 1.71 | 49050 | 0.0684 | 516135534.4 | 0.066162202 | 551439204.9 | 144517.9 | 343.35 |
| 1.718 | 49050 | 0.06872 | 516135534.4 | 0.066461671 | 551604368.3 | 165163.4 | 392.4 |
| 1.725 | 49050 | 0.069 | 516135534.4 | 0.066723632 | 551748886.3 | 144517.9 | 343.35 |
| 1.733 | 49000 | 0.06932 | 515609402.3 | 0.067022932 | 551351446.1 | 165079.2 | 392.2 |
| 1.74 | 49000 | 0.0696 | 515609402.3 | 0.067284747 | 551495816.7 | 144370.6 | 343 |
| 1.748 | 49000 | 0.06992 | 515609402.3 | 0.067583879 | 551660811.8 | 164995 | 392 |
| 1.755 | 49000 | 0.0702 | 515609402.3 | 0.067845547 | 551805182.4 | 144370.6 | 343 |
| 1.763 | 49000 | 0.07052 | 515609402.3 | 0.068144512 | 551970177.4 | 164995 | 392 |
| 1.77 | 49000 | 0.0708 | 515609402.3 | 0.068406033 | 552114548 | 144370.6 | 343 |
| 1.778 | 48950 | 0.07112 | 515083270.3 | 0.06870483 | 551715992.5 | 164910.8 | 391.8 |
| 1.785 | 48950 | 0.0714 | 515083270.3 | 0.068966204 | 551860215.8 | 144223.3 | 342.65 |
| 1.793 | 48900 | 0.07172 | 514557138.3 | 0.069264835 | 551461176.2 | 164742.5 | 391.4 |
| 1.8 | 48900 | 0.072 | 514557138.3 | 0.069526063 | 551605252.2 | 144076 | 342.3 |
| 1.808 | 48900 | 0.07232 | 514557138.3 | 0.069824526 | 551769910.5 | 164658.3 | 391.2 |
| 1.815 | 48900 | 0.0726 | 514557138.3 | 0.070085608 | 551913986.5 | 144076 | 342.3 |
| 1.823 | 48900 | 0.07292 | 514557138.3 | 0.070383904 | 552078644.8 | 164658.3 | 391.2 |
| 1.83 | 48900 | 0.0732 | 514557138.3 | 0.07064484 | 552222720.8 | 144076 | 342.3 |
| 1.838 | 48850 | 0.07352 | 514031006.2 | 0.070942969 | 551822565.8 | 164574.1 | 391 |
| 1.845 | 48850 | 0.0738 | 514031006.2 | 0.071203759 | 551966494.5 | 143928.7 | 341.95 |
| 1.853 | 48800 | 0.07412 | 513504874.2 | 0.071501722 | 551565855.4 | 164405.7 | 390.6 |
| 1.86 | 48800 | 0.0744 | 513504874.2 | 0.071762366 | 551709636.8 | 143781.4 | 341.6 |
| 1.868 | 48800 | 0.07472 | 513504874.2 | 0.072060163 | 551873958.4 | 164321.6 | 390.4 |
| 1.875 | 48800 | 0.075 | 513504874.2 | 0.072320662 | 552017739.7 | 143781.4 | 341.6 |
| 1.883 | 48750 | 0.07532 | 512978742.1 | 0.072618292 | 551616301 | 164237.4 | 390.2 |
| 1.89 | 48750 | 0.0756 | 512978742.1 | 0.072878645 | 551759935 | 143634 | 341.25 |
| 1.898 | 48750 | 0.07592 | 512978742.1 | 0.07317611 | 551924088.2 | 164153.2 | 390 |
| 1.905 | 48750 | 0.0762 | 512978742.1 | 0.073436318 | 552067722.3 | 143634 | 341.25 |
| 1.913 | 48750 | 0.07652 | 512978742.1 | 0.073733616 | 552231875.5 | 164153.2 | 390 |
| 1.92 | 48700 | 0.0768 | 512452610.1 | 0.07399368 | 551808970.5 | 143560.4 | 341.075 |
| 1.928 | 48700 | 0.07712 | 512452610.1 | 0.074290813 | 551972955.4 | 163984.8 | 389.6 |
| 1.935 | 48700 | 0.0774 | 512452610.1 | 0.074550731 | 552116442.1 | 143486.7 | 340.9 |
| 1.943 | 48650 | 0.07772 | 511926478 | 0.074847698 | 551713403.9 | 163900.7 | 389.4 |
| 1.95 | 48650 | 0.078 | 511926478 | 0.075107472 | 551856743.3 | 143339.4 | 340.55 |
| 1.958 | 48650 | 0.07832 | 511926478 | 0.075404274 | 552020559.8 | 163816.5 | 389.2 |
| 1.965 | 48600 | 0.0786 | 511400346 | 0.075663904 | 551596413.2 | 143265.8 | 340.375 |
| 1.973 | 48600 | 0.07892 | 511400346 | 0.075960541 | 551760061.3 | 163648.1 | 388.8 |
| 1.98 | 48600 | 0.0792 | 511400346 | 0.076220026 | 551903253.4 | 143192.1 | 340.2 |
| 1.988 | 48600 | 0.07952 | 511400346 | 0.076516498 | 552066901.5 | 163648.1 | 388.8 |
| 1.995 | 48550 | 0.0798 | 510874214 | 0.076775839 | 551641976.2 | 143118.4 | 340.025 |
| 2.003 | 48550 | 0.08012 | 510874214 | 0.077072146 | 551805456 | 163479.7 | 388.4 |
| 2.01 | 48500 | 0.0804 | 510348081.9 | 0.077331343 | 551380067.7 | 142971.1 | 339.675 |
| 2.018 | 48500 | 0.08072 | 510348081.9 | 0.077627486 | 551543379.1 | 163311.4 | 388 |
| 2.025 | 48500 | 0.081 | 510348081.9 | 0.077886539 | 551686276.5 | 142897.5 | 339.5 |
| 2.033 | 48500 | 0.08132 | 510348081.9 | 0.078182517 | 551849587.9 | 163311.4 | 388 |
| 2.04 | 48450 | 0.0816 | 509821949.9 | 0.078441426 | 551423421 | 142823.8 | 339.325 |
| 2.048 | 48450 | 0.08192 | 509821949.9 | 0.078737241 | 551586564 | 163143 | 387.6 |
| 2.055 | 48450 | 0.0822 | 509821949.9 | 0.078996006 | 551729314.2 | 142750.1 | 339.15 |
| 2.063 | 48400 | 0.08252 | 509295817.8 | 0.079291656 | 551322908.7 | 163058.8 | 387.4 |
| 2.07 | 48400 | 0.0828 | 509295817.8 | 0.079550279 | 551465511.5 | 142602.8 | 338.8 |
| 2.078 | 48400 | 0.08312 | 509295817.8 | 0.079845765 | 551628486.2 | 162974.7 | 387.2 |
| 2.085 | 48350 | 0.0834 | 508769685.8 | 0.080104244 | 551201077.6 | 142529.2 | 338.625 |
| 2.093 | 48350 | 0.08372 | 508769685.8 | 0.080399567 | 551363883.9 | 162806.3 | 386.8 |
| 2.1 | 48350 | 0.084 | 508769685.8 | 0.080657903 | 551506339.4 | 142455.5 | 338.45 |
| 2.108 | 48300 | 0.08432 | 508243553.7 | 0.080953062 | 551098650.2 | 162722.1 | 386.6 |
| 2.115 | 48300 | 0.0846 | 508243553.7 | 0.081211255 | 551240958.4 | 142308.2 | 338.1 |
| 2.123 | 48300 | 0.08492 | 508243553.7 | 0.081506252 | 551403596.3 | 162637.9 | 386.4 |
| 2.13 | 48300 | 0.0852 | 508243553.7 | 0.081764302 | 551545904.5 | 142308.2 | 338.1 |
| 2.138 | 48250 | 0.08552 | 507717421.7 | 0.082059135 | 551137415.6 | 162553.8 | 386.2 |
| 2.145 | 48250 | 0.0858 | 507717421.7 | 0.082317042 | 551279576.5 | 142160.9 | 337.75 |
| 2.153 | 48200 | 0.08612 | 507191289.7 | 0.082611713 | 550870603.5 | 162385.4 | 385.8 |
| 2.16 | 48200 | 0.0864 | 507191289.7 | 0.082869478 | 551012617.1 | 142013.6 | 337.4 |
| 2.168 | 48200 | 0.08672 | 507191289.7 | 0.083163985 | 551174918.3 | 162301.2 | 385.6 |
| 2.175 | 48200 | 0.087 | 507191289.7 | 0.083421608 | 551316931.9 | 142013.6 | 337.4 |
| 2.183 | 48150 | 0.08732 | 506665157.6 | 0.083715953 | 550907159.2 | 162217 | 385.4 |
| 2.19 | 48150 | 0.0876 | 506665157.6 | 0.083973434 | 551049025.4 | 141866.2 | 337.05 |
| 2.198 | 48150 | 0.08792 | 506665157.6 | 0.084267616 | 551211158.3 | 162132.9 | 385.2 |
| 2.205 | 48100 | 0.0882 | 506139025.6 | 0.084524955 | 550780487.6 | 141792.6 | 336.875 |
| 2.213 | 48100 | 0.08852 | 506139025.6 | 0.084818975 | 550942452.1 | 161964.5 | 384.8 |
| 2.22 | 48100 | 0.0888 | 506139025.6 | 0.085076172 | 551084171 | 141718.9 | 336.7 |
| 2.228 | 48050 | 0.08912 | 505612893.5 | 0.085370031 | 550673114.6 | 161880.3 | 384.6 |
| 2.235 | 48000 | 0.0894 | 505086761.5 | 0.085627086 | 550241518 | 141498 | 336.175 |
| 2.243 | 48000 | 0.08972 | 505086761.5 | 0.085920783 | 550403145.7 | 161627.8 | 384 |
| 2.25 | 48000 | 0.09 | 505086761.5 | 0.086177696 | 550544570 | 141424.3 | 336 |
| 2.258 | 47950 | 0.09032 | 504560629.4 | 0.086471231 | 550132545.5 | 161543.6 | 383.8 |
| 2.265 | 47950 | 0.0906 | 504560629.4 | 0.086728004 | 550273822.5 | 141277 | 335.65 |
| 2.273 | 47900 | 0.09092 | 504034497.4 | 0.087021377 | 549861313.9 | 161375.2 | 383.4 |
| 2.28 | 47900 | 0.0912 | 504034497.4 | 0.087278008 | 550002443.6 | 141129.7 | 335.3 |
| 2.288 | 47900 | 0.09152 | 504034497.4 | 0.08757122 | 550163734.6 | 161291 | 383.2 |
| 2.295 | 47900 | 0.0918 | 504034497.4 | 0.08782771 | 550304864.3 | 141129.7 | 335.3 |
| 2.303 | 47850 | 0.09212 | 503508365.4 | 0.088120761 | 549891556 | 161206.9 | 383 |
| 2.31 | 47850 | 0.0924 | 503508365.4 | 0.088377111 | 550032538.3 | 140982.3 | 334.95 |
| 2.318 | 47800 | 0.09272 | 502982233.3 | 0.088670001 | 549618746 | 161038.5 | 382.6 |
| 2.325 | 47800 | 0.093 | 502982233.3 | 0.088926209 | 549759581 | 140835 | 334.6 |
| 2.333 | 47800 | 0.09332 | 502982233.3 | 0.089218939 | 549920535.3 | 160954.3 | 382.4 |
| 2.34 | 47750 | 0.0936 | 502456101.3 | 0.089475006 | 549485992.3 | 140761.4 | 334.425 |
| 2.348 | 47750 | 0.09392 | 502456101.3 | 0.089767575 | 549646778.3 | 160786 | 382 |
| 2.355 | 47700 | 0.0942 | 501929969.2 | 0.090023503 | 549211772.3 | 140614 | 334.075 |
| 2.363 | 47700 | 0.09452 | 501929969.2 | 0.090315911 | 549372389.9 | 160617.6 | 381.6 |
| 2.37 | 47700 | 0.0948 | 501929969.2 | 0.090571698 | 549512930.3 | 140540.4 | 333.9 |
| 2.378 | 47650 | 0.09512 | 501403837.2 | 0.090863946 | 549097370.2 | 160533.4 | 381.4 |
| 2.385 | 47650 | 0.0954 | 501403837.2 | 0.091119593 | 549237763.2 | 140393.1 | 333.55 |
| 2.393 | 47600 | 0.09572 | 500877705.1 | 0.091411681 | 548821719.1 | 160365 | 381 |
| 2.4 | 47600 | 0.096 | 500877705.1 | 0.091667189 | 548961964.8 | 140245.8 | 333.2 |
| 2.408 | 47600 | 0.09632 | 500877705.1 | 0.091959117 | 549122245.7 | 160280.9 | 380.8 |
| 2.415 | 47550 | 0.0966 | 500351573.1 | 0.092214484 | 548685535.1 | 140172.1 | 333.025 |
| 2.423 | 47550 | 0.09692 | 500351573.1 | 0.092506252 | 548845647.6 | 160112.5 | 380.4 |
| 2.43 | 47500 | 0.0972 | 499825441 | 0.09276148 | 548408473.9 | 140024.8 | 332.675 |
| 2.438 | 47500 | 0.09752 | 499825441 | 0.093053089 | 548568418.1 | 159944.1 | 380 |
| 2.445 | 47500 | 0.0978 | 499825441 | 0.093308177 | 548708369.2 | 139951.1 | 332.5 |
| 2.453 | 47450 | 0.09812 | 499299309 | 0.093599627 | 548290557.2 | 159860 | 379.8 |
| 2.46 | 47450 | 0.0984 | 499299309 | 0.093854575 | 548430361 | 139803.8 | 332.15 |
| 2.468 | 47450 | 0.09872 | 499299309 | 0.094145866 | 548590136.8 | 159775.8 | 379.6 |
| 2.475 | 47450 | 0.099 | 499299309 | 0.094400675 | 548729940.6 | 139803.8 | 332.15 |
| 2.483 | 47450 | 0.09932 | 499299309 | 0.094691807 | 548889716.4 | 159775.8 | 379.6 |
| 2.49 | 47450 | 0.0996 | 499299309 | 0.094946477 | 549029520.2 | 139803.8 | 332.15 |
| 2.498 | 47450 | 0.09992 | 499299309 | 0.09523745 | 549189296 | 159775.8 | 379.6 |
| 2.505 | 47450 | 0.1002 | 499299309 | 0.095491981 | 549329099.8 | 139803.8 | 332.15 |
| 2.513 | 47450 | 0.10052 | 499299309 | 0.095782795 | 549488875.5 | 159775.8 | 379.6 |
| 2.52 | 47450 | 0.1008 | 499299309 | 0.096037188 | 549628679.4 | 139803.8 | 332.15 |
| 2.528 | 47450 | 0.10112 | 499299309 | 0.096327844 | 549788455.1 | 159775.8 | 379.6 |
| 2.535 | 47450 | 0.1014 | 499299309 | 0.096582098 | 549928258.9 | 139803.8 | 332.15 |
| 2.543 | 47450 | 0.10172 | 499299309 | 0.096872595 | 550088034.7 | 159775.8 | 379.6 |
| 2.55 | 47450 | 0.102 | 499299309 | 0.097126711 | 550227838.5 | 139803.8 | 332.15 |
| 2.558 | 47450 | 0.10232 | 499299309 | 0.09741705 | 550387614.3 | 159775.8 | 379.6 |
| 2.565 | 47450 | 0.1026 | 499299309 | 0.097671027 | 550527418.1 | 139803.8 | 332.15 |
| 2.573 | 47450 | 0.10292 | 499299309 | 0.097961208 | 550687193.9 | 159775.8 | 379.6 |
| 2.58 | 47450 | 0.1032 | 499299309 | 0.098215047 | 550826997.7 | 139803.8 | 332.15 |
| 2.588 | 47450 | 0.10352 | 499299309 | 0.098505071 | 550986773.5 | 159775.8 | 379.6 |
| 2.595 | 47450 | 0.1038 | 499299309 | 0.098758772 | 551126577.3 | 139803.8 | 332.15 |
| 2.603 | 47450 | 0.10412 | 499299309 | 0.099048638 | 551286353.1 | 159775.8 | 379.6 |
| 2.61 | 47450 | 0.1044 | 499299309 | 0.099302201 | 551426156.9 | 139803.8 | 332.15 |
| 2.618 | 47450 | 0.10472 | 499299309 | 0.099591909 | 551585932.6 | 159775.8 | 379.6 |
| 2.625 | 47450 | 0.105 | 499299309 | 0.099845335 | 551725736.5 | 139803.8 | 332.15 |
| 2.633 | 47450 | 0.10532 | 499299309 | 0.100134886 | 551885512.2 | 159775.8 | 379.6 |
| 2.64 | 47450 | 0.1056 | 499299309 | 0.100388174 | 552025316 | 139803.8 | 332.15 |
| 2.648 | 47450 | 0.10592 | 499299309 | 0.100677568 | 552185091.8 | 159775.8 | 379.6 |
| 2.655 | 47400 | 0.1062 | 498773177 | 0.100930719 | 551742888.4 | 139730.1 | 331.975 |
| 2.663 | 47400 | 0.10652 | 498773177 | 0.101219955 | 551902495.8 | 159607.4 | 379.2 |
| 2.67 | 47400 | 0.1068 | 498773177 | 0.101472969 | 552042152.3 | 139656.5 | 331.8 |
| 2.678 | 47400 | 0.10712 | 498773177 | 0.101762049 | 552201759.7 | 159607.4 | 379.2 |
| 2.685 | 47400 | 0.1074 | 498773177 | 0.102014925 | 552341416.2 | 139656.5 | 331.8 |
| 2.693 | 47400 | 0.10772 | 498773177 | 0.102303849 | 552501023.6 | 159607.4 | 379.2 |
| 2.7 | 47400 | 0.108 | 498773177 | 0.102556588 | 552640680.1 | 139656.5 | 331.8 |
| 2.708 | 47400 | 0.10832 | 498773177 | 0.102845355 | 552800287.5 | 159607.4 | 379.2 |
| 2.715 | 47400 | 0.1086 | 498773177 | 0.103097958 | 552939944 | 139656.5 | 331.8 |
| 2.723 | 47400 | 0.10892 | 498773177 | 0.103386569 | 553099551.4 | 159607.4 | 379.2 |
| 2.73 | 47400 | 0.1092 | 498773177 | 0.103639035 | 553239207.9 | 139656.5 | 331.8 |
| 2.738 | 47400 | 0.10952 | 498773177 | 0.103927489 | 553398815.3 | 159607.4 | 379.2 |
| 2.745 | 47400 | 0.1098 | 498773177 | 0.104179819 | 553538471.8 | 139656.5 | 331.8 |
| 2.753 | 47400 | 0.11012 | 498773177 | 0.104468118 | 553698079.2 | 159607.4 | 379.2 |
| 2.76 | 47400 | 0.1104 | 498773177 | 0.104720311 | 553837735.7 | 139656.5 | 331.8 |
| 2.768 | 47400 | 0.11072 | 498773177 | 0.105008454 | 553997343.1 | 159607.4 | 379.2 |
| 2.775 | 47400 | 0.111 | 498773177 | 0.105260511 | 554136999.6 | 139656.5 | 331.8 |
| 2.783 | 47400 | 0.11132 | 498773177 | 0.105548498 | 554296607 | 159607.4 | 379.2 |
| 2.79 | 47400 | 0.1116 | 498773177 | 0.105800419 | 554436263.5 | 139656.5 | 331.8 |
| 2.798 | 47400 | 0.11192 | 498773177 | 0.106088251 | 554595870.9 | 159607.4 | 379.2 |
| 2.805 | 47400 | 0.1122 | 498773177 | 0.106340036 | 554735527.4 | 139656.5 | 331.8 |
| 2.813 | 47400 | 0.11252 | 498773177 | 0.106627712 | 554895134.8 | 159607.4 | 379.2 |
| 2.82 | 47400 | 0.1128 | 498773177 | 0.106879362 | 555034791.3 | 139656.5 | 331.8 |
| 2.828 | 47400 | 0.11312 | 498773177 | 0.107166883 | 555194398.7 | 159607.4 | 379.2 |
| 2.835 | 47400 | 0.1134 | 498773177 | 0.107418397 | 555334055.2 | 139656.5 | 331.8 |
| 2.843 | 47400 | 0.11372 | 498773177 | 0.107705763 | 555493662.6 | 159607.4 | 379.2 |
| 2.85 | 47400 | 0.114 | 498773177 | 0.107957142 | 555633319.1 | 139656.5 | 331.8 |
| 2.858 | 47400 | 0.11432 | 498773177 | 0.108244353 | 555792926.6 | 159607.4 | 379.2 |
| 2.865 | 47350 | 0.1146 | 498247044.9 | 0.108495596 | 555346156.3 | 139582.8 | 331.625 |
| 2.873 | 47350 | 0.11492 | 498247044.9 | 0.108782653 | 555505595.3 | 159439.1 | 378.8 |
| 2.88 | 47300 | 0.1152 | 497720912.9 | 0.109033761 | 555058362 | 139435.5 | 331.275 |
| 2.888 | 47300 | 0.11552 | 497720912.9 | 0.109320664 | 555217632.7 | 159270.7 | 378.4 |
| 2.895 | 47300 | 0.1158 | 497720912.9 | 0.109571636 | 555356994.6 | 139361.9 | 331.1 |
| 2.903 | 47250 | 0.11612 | 497194780.8 | 0.109858385 | 554929038.8 | 159186.5 | 378.2 |
| 2.91 | 47250 | 0.1164 | 497194780.8 | 0.110109223 | 555068253.3 | 139214.5 | 330.75 |
| 2.918 | 47250 | 0.11672 | 497194780.8 | 0.110395817 | 555227355.7 | 159102.3 | 378 |
| 2.925 | 47200 | 0.117 | 496668648.8 | 0.11064652 | 554778880.7 | 139140.9 | 330.575 |
| 2.933 | 47200 | 0.11732 | 496668648.8 | 0.110932961 | 554937814.7 | 158934 | 377.6 |
| 2.94 | 47200 | 0.1176 | 496668648.8 | 0.111183529 | 555076881.9 | 139067.2 | 330.4 |
| 2.948 | 47150 | 0.11792 | 496142516.7 | 0.111469816 | 554647642.3 | 158849.8 | 377.4 |
| 2.955 | 47150 | 0.1182 | 496142516.7 | 0.11172025 | 554786562.2 | 138919.9 | 330.05 |
| 2.963 | 47100 | 0.11852 | 495616384.7 | 0.112006383 | 554356838.6 | 158681.4 | 377 |
| 2.97 | 47100 | 0.1188 | 495616384.7 | 0.112256682 | 554495611.2 | 138772.6 | 329.7 |
| 2.978 | 47050 | 0.11912 | 495090252.7 | 0.112542662 | 554065403.6 | 158513.1 | 376.6 |
| 2.985 | 47050 | 0.1194 | 495090252.7 | 0.112792827 | 554204028.8 | 138625.3 | 329.35 |
| 2.993 | 47000 | 0.11972 | 494564120.6 | 0.113078654 | 553773337.1 | 158344.7 | 376.2 |
| 3 | 47000 | 0.12 | 494564120.6 | 0.113328685 | 553911815.1 | 138478 | 329 |
| 3.008 | 47000 | 0.12032 | 494564120.6 | 0.113614359 | 554070075.6 | 158260.5 | 376 |
| 3.015 | 46950 | 0.1206 | 494037988.6 | 0.113864256 | 553618970 | 138404.3 | 328.825 |
| 3.023 | 46900 | 0.12092 | 493511856.5 | 0.114149777 | 553187310.2 | 158008 | 375.4 |
| 3.03 | 46900 | 0.1212 | 493511856.5 | 0.11439954 | 553325493.5 | 138183.3 | 328.3 |
| 3.038 | 46900 | 0.12152 | 493511856.5 | 0.114684908 | 553483417.3 | 157923.8 | 375.2 |
| 3.045 | 46850 | 0.1218 | 492985724.5 | 0.114934538 | 553031385.7 | 138109.7 | 328.125 |
| 3.053 | 46850 | 0.12212 | 492985724.5 | 0.115219753 | 553189141.2 | 157755.4 | 374.8 |
| 3.06 | 46800 | 0.1224 | 492459592.4 | 0.11546925 | 552736646.6 | 137962.3 | 327.775 |
| 3.068 | 46800 | 0.12272 | 492459592.4 | 0.115754313 | 552894233.6 | 157587.1 | 374.4 |
| 3.075 | 46750 | 0.123 | 491933460.4 | 0.116003676 | 552441276 | 137815 | 327.425 |
| 3.083 | 46700 | 0.12332 | 491407328.4 | 0.116288586 | 552007680.1 | 157334.5 | 373.8 |
| 3.09 | 46700 | 0.1236 | 491407328.4 | 0.116537816 | 552145274.1 | 137594.1 | 326.9 |
| 3.098 | 46700 | 0.12392 | 491407328.4 | 0.116822575 | 552302524.5 | 157250.3 | 373.6 |
| 3.105 | 46650 | 0.1242 | 490881196.3 | 0.117071672 | 551848640.9 | 137520.4 | 326.725 |
| 3.113 | 46650 | 0.12452 | 490881196.3 | 0.117356278 | 552005722.9 | 157082 | 373.2 |
| 3.12 | 46600 | 0.1248 | 490355064.3 | 0.117605242 | 551551376.3 | 137373.1 | 326.375 |
| 3.128 | 46550 | 0.12512 | 489828932.2 | 0.117889697 | 551116328.2 | 156829.4 | 372.6 |
| 3.135 | 46500 | 0.1254 | 489302800.2 | 0.118138528 | 550661371.3 | 137078.4 | 325.675 |
| 3.143 | 46500 | 0.12572 | 489302800.2 | 0.118422831 | 550817948.2 | 156576.9 | 372 |
| 3.15 | 46500 | 0.126 | 489302800.2 | 0.11867153 | 550954953 | 137004.8 | 325.5 |
| 3.158 | 46450 | 0.12632 | 488776668.1 | 0.118955681 | 550518936.9 | 156492.7 | 371.8 |
| 3.165 | 46450 | 0.1266 | 488776668.1 | 0.119204247 | 550655794.3 | 136857.5 | 325.15 |
| 3.173 | 46400 | 0.12692 | 488250536.1 | 0.119488248 | 550219294.1 | 156324.4 | 371.4 |
| 3.18 | 46400 | 0.1272 | 488250536.1 | 0.119736682 | 550356004.3 | 136710.2 | 324.8 |
| 3.188 | 46400 | 0.12752 | 488250536.1 | 0.120020531 | 550512244.5 | 156240.2 | 371.2 |
| 3.195 | 46350 | 0.1278 | 487724404.1 | 0.120268832 | 550055582.9 | 136636.5 | 324.625 |
| 3.203 | 46350 | 0.12812 | 487724404.1 | 0.12055253 | 550211654.7 | 156071.8 | 370.8 |
| 3.21 | 46350 | 0.1284 | 487724404.1 | 0.1208007 | 550348217.5 | 136562.8 | 324.45 |
| 3.218 | 46350 | 0.12872 | 487724404.1 | 0.121084247 | 550504289.3 | 156071.8 | 370.8 |
| 3.225 | 46300 | 0.129 | 487198272 | 0.121332285 | 550046849.1 | 136489.2 | 324.275 |
| 3.233 | 46300 | 0.12932 | 487198272 | 0.121615682 | 550202752.5 | 155903.4 | 370.4 |
| 3.24 | 46300 | 0.1296 | 487198272 | 0.121863588 | 550339168.1 | 136415.5 | 324.1 |
| 3.248 | 46250 | 0.12992 | 486672140 | 0.122146834 | 549900584.4 | 155819.3 | 370.2 |
| 3.255 | 46250 | 0.1302 | 486672140 | 0.122394608 | 550036852.6 | 136268.2 | 323.75 |
| 3.263 | 46200 | 0.13052 | 486146007.9 | 0.122677704 | 549597784.9 | 155650.9 | 369.8 |
| 3.27 | 46150 | 0.1308 | 485619875.9 | 0.122925347 | 549138955.6 | 136047.2 | 323.225 |
| 3.278 | 46100 | 0.13112 | 485093743.8 | 0.123208292 | 548699235.5 | 155314.2 | 369 |
| 3.285 | 46100 | 0.1314 | 485093743.8 | 0.123455804 | 548835061.8 | 135826.2 | 322.7 |
| 3.293 | 46050 | 0.13172 | 484567611.8 | 0.123738599 | 548394857.6 | 155145.8 | 368.6 |
| 3.3 | 46000 | 0.132 | 484041479.8 | 0.12398598 | 547934955.1 | 135605.3 | 322.175 |
| 3.308 | 45950 | 0.13232 | 483515347.7 | 0.124268625 | 547494098.5 | 154809.1 | 367.8 |
| 3.315 | 45950 | 0.1326 | 483515347.7 | 0.124515875 | 547629482.8 | 135384.3 | 321.65 |
| 3.323 | 45950 | 0.13292 | 483515347.7 | 0.124798371 | 547784207.7 | 154724.9 | 367.6 |
| 3.33 | 45950 | 0.1332 | 483515347.7 | 0.125045489 | 547919592 | 135384.3 | 321.65 |
| 3.338 | 45900 | 0.13352 | 482989215.7 | 0.125327835 | 547477935.7 | 154640.7 | 367.4 |
| 3.345 | 45900 | 0.1338 | 482989215.7 | 0.125574823 | 547613172.7 | 135237 | 321.3 |
| 3.353 | 45900 | 0.13412 | 482989215.7 | 0.12585702 | 547767729.3 | 154556.5 | 367.2 |
| 3.36 | 45900 | 0.1344 | 482989215.7 | 0.126103877 | 547902966.3 | 135237 | 321.3 |
| 3.368 | 45850 | 0.13472 | 482463083.6 | 0.126385924 | 547460510.2 | 154472.4 | 367 |
| 3.375 | 45850 | 0.135 | 482463083.6 | 0.126632651 | 547595599.9 | 135089.7 | 320.95 |
| 3.383 | 45800 | 0.13532 | 481936951.6 | 0.12691455 | 547152659.9 | 154304 | 366.6 |
| 3.39 | 45800 | 0.1356 | 481936951.6 | 0.127161146 | 547287602.2 | 134942.3 | 320.6 |
| 3.398 | 45750 | 0.13592 | 481410819.5 | 0.127442895 | 546844178.1 | 154135.6 | 366.2 |
| 3.405 | 45750 | 0.1362 | 481410819.5 | 0.127689361 | 546978973.2 | 134795 | 320.25 |
| 3.413 | 45700 | 0.13652 | 480884687.5 | 0.127970962 | 546535065 | 153967.3 | 365.8 |
| 3.42 | 45700 | 0.1368 | 480884687.5 | 0.128217298 | 546669712.7 | 134647.7 | 319.9 |
| 3.428 | 45700 | 0.13712 | 480884687.5 | 0.12849875 | 546823595.8 | 153883.1 | 365.6 |
| 3.435 | 45650 | 0.1374 | 480358555.5 | 0.128744956 | 546359821 | 134574.1 | 319.725 |
| 3.443 | 45600 | 0.13772 | 479832423.4 | 0.12902626 | 545914944.8 | 153630.6 | 365 |
| 3.45 | 45600 | 0.138 | 479832423.4 | 0.129272336 | 546049297.8 | 134353.1 | 319.2 |
| 3.458 | 45600 | 0.13832 | 479832423.4 | 0.129553491 | 546202844.2 | 153546.4 | 364.8 |
| 3.465 | 45600 | 0.1386 | 479832423.4 | 0.129799438 | 546337197.3 | 134353.1 | 319.2 |
| 3.473 | 45550 | 0.13892 | 479306291.4 | 0.130080445 | 545891521.4 | 153462.2 | 364.6 |
| 3.48 | 45550 | 0.1392 | 479306291.4 | 0.130326262 | 546025727.1 | 134205.8 | 318.85 |
| 3.488 | 45550 | 0.13952 | 479306291.4 | 0.130607121 | 546179105.1 | 153378 | 364.4 |
| 3.495 | 45500 | 0.1398 | 478780159.3 | 0.130852808 | 545713625.6 | 134132.1 | 318.675 |
| 3.503 | 45500 | 0.14012 | 478780159.3 | 0.13113352 | 545866835.2 | 153209.7 | 364 |
| 3.51 | 45450 | 0.1404 | 478254027.3 | 0.131379078 | 545400892.7 | 133984.8 | 318.325 |
| 3.518 | 45450 | 0.14072 | 478254027.3 | 0.131659642 | 545553934 | 153041.3 | 363.6 |
| 3.525 | 45400 | 0.141 | 477727895.2 | 0.131905071 | 545087528.5 | 133837.5 | 317.975 |
| 3.533 | 45350 | 0.14132 | 477201763.2 | 0.132185487 | 544639916.4 | 152788.7 | 363 |
| 3.54 | 45300 | 0.1416 | 476675631.1 | 0.132430787 | 544172900.5 | 133542.8 | 317.275 |
| 3.548 | 45300 | 0.14192 | 476675631.1 | 0.132711056 | 544325436.7 | 152536.2 | 362.4 |
| 3.555 | 45250 | 0.1422 | 476149499.1 | 0.132956227 | 543857957.9 | 133395.5 | 316.925 |
| 3.563 | 45250 | 0.14252 | 476149499.1 | 0.133236349 | 544010325.7 | 152367.8 | 362 |
| 3.57 | 45200 | 0.1428 | 475623367.1 | 0.133481391 | 543542383.9 | 133248.2 | 316.575 |
| 3.578 | 45200 | 0.14312 | 475623367.1 | 0.133761366 | 543694583.4 | 152199.5 | 361.6 |
| 3.585 | 45150 | 0.1434 | 475097235 | 0.13400628 | 543226178.5 | 133100.9 | 316.225 |
| 3.593 | 45100 | 0.14372 | 474571103 | 0.134286108 | 542776461.9 | 151946.9 | 361 |
| 3.6 | 45050 | 0.144 | 474044970.9 | 0.134530893 | 542307446.7 | 132806.3 | 315.525 |
| 3.608 | 45000 | 0.14432 | 473518838.9 | 0.134810574 | 541857077.7 | 151610.2 | 360.2 |
| 3.615 | 45000 | 0.1446 | 473518838.9 | 0.135055231 | 541989663 | 132585.3 | 315 |
| 3.623 | 44950 | 0.14492 | 472992706.8 | 0.135334766 | 541538809.9 | 151441.8 | 359.8 |
| 3.63 | 44900 | 0.1452 | 472466574.8 | 0.135579294 | 541068721.5 | 132364.3 | 314.475 |
| 3.638 | 44850 | 0.14552 | 471940442.8 | 0.135858682 | 540617216 | 151105.1 | 359 |
| 3.645 | 44800 | 0.1458 | 471414310.7 | 0.136103083 | 540146517.2 | 132069.7 | 313.775 |
| 3.653 | 44800 | 0.14612 | 471414310.7 | 0.136382325 | 540297369.8 | 150852.6 | 358.4 |
| 3.66 | 44750 | 0.1464 | 470888178.7 | 0.136626598 | 539826208 | 131922.3 | 313.425 |
| 3.668 | 44700 | 0.14672 | 470362046.6 | 0.136905693 | 539373566.1 | 150600 | 357.8 |
| **Total Sum:** | | | | | | **73624603** | **174919.5** |