

# Summary

On the base of the above considerations, one can draw the following most important conclusions regarding utilisation of formulae for properties reconstruction of elasto-plastic materials:

1. The formula derived by Bridgman for the flow curve determination demonstrates the worst results among all the classical formulae but it is still the most often used and disseminated especially in the English literature.
2. The formulae by Malinin–Petrosjan, Siebel–Davidenkov–Spiridonova and Szczepiński always characterise a greater accuracy compared to Bridgman. However, the smallest error among all the classical formulae generates the Malinin–Petrosjan formula. At small strains, the Szczepiński formula can be applied but at greater strains the Siebel–Davidenkov–Spiridonova should be used, because the curve determined from the Szczepiński formula begins to differ more from the real solution. However, the Siebel–Davidenkov–Spiridonova formula is still better in comparison with the results obtained from the Bridgman formula.
3. However, the most justified seems to be the application of the new formula which depends on two parameters. As it was presented, the new approximation always exhibits greater accuracy in comparison with the classical expressions.
4. If we are still interested in a formula taking into account only one parameter, it is worth taking advantage of the empirical formula (3.15) which reconstructs better the material properties. On the other hand, one may use the single-parameter formula (3.16) which reveals an acceptable accuracy but limits the real solution from below.
5. In the case of estimation of the flow curve of materials at small deformations and neck presence, it does not make sense to distinguish between the formulas because the difference for small strains is very small.

# Index

## A

Analytical analysis, 74  
Associated flow law, 33  
Associated flow rule, 23  
Assumption, 74  
Axial symmetry, 17, 67  
Axisymmetrical sample, 2

## B

Bessel differential equation, 45  
Bessel function, 45, 46  
Boundary condition, 29  
Boundary conditions, 68  
Bridgman, 11, 23, 82

## C

Classical approaches, 69  
Classical formula, 11  
Condition of material incompressibility, 54  
Considère criterion, 8  
Constitutive equation, 21  
Conventional elastic limit, 4  
Conventional yield limit, 4  
Correction coefficient, 8  
Curvature radius of the neck contour, 12  
Cylindrical coordinate system, 2

## D

Davidenkov–Spiridonova, 11, 34  
Differential equation, 56

## E

Elastic bulk modulus, 6  
Elastic limit, 4  
Empirical expression, 82  
Empirical formulae, 83  
*Engineering* stress–strain  
curve, 3, 4  
Equilibrium equation, 36  
Equilibrium equations, 18  
Euler coordinates, 21

## F

Factor of proportionality, 23  
Finite element method, 12  
Flow curves, 84

## H

Hardening coefficient, 5, 9  
Hooke's law, 8

## I

Initial cross section area, 7  
Initial measuring length, 2

## L

Lamé's elasticity  
coefficients, 22  
Limit of proportionality, 4  
Lower yield point, 5

**M**

Malinin and Petrosjan, 11, 43, 83  
 Material  
   ideal plastic material, 68  
   linear hardening material, 68  
   nonlinear hardening material, 68  
 Material incompressibility, 7  
 Material volume, 9  
 Mechanical materials properties, 2  
 Mechanical properties, 1  
 Meridian surface, 26  
 Mesh, 67  
 MSC.Marc Mentat, 67, 69

**N**

Natural boundary conditions, 54  
 Neck  
   neck contour, 57  
   onset of neck creation, 8, 9  
 Necking, 5  
 New formula, 83  
 Numerical simulation, 12, 67  
   numerical simulation procedure, 68

**O**

Ordinary differential equation, 58

**P**

Plastic potential, 33  
 Poisson's ratio, 7, 22, 68  
 Present cross section area, 7

**S**

Sample  
   initial cross section area of the sample, 3  
   initial radius of sample, 7  
   radius of sample after deformation, 7  
   sample elongation, 2  
 Siebel, 11, 35  
 Siebel–Davidenkova–Spiridonova, 83  
 Simplifying assumption, 75  
 Simplifying assumptions, 71  
 Standard, 2  
 Strain  
   axial strain, 7  
   circumferential strain, 24  
   engineering strain, 2  
   logarithmic strain, 2  
   plastic strain, 4  
   plastic true strain, 6

radial strain, 24  
 strain deviator, 20  
 strain intensity, 7, 20, 79  
 strain tensor, 21, 55  
 true (logarithmic) plastic strain, 7, 79  
 true plastic strain, 11, 68

**Stress**

average axial stress, 30, 60  
 average normalised axial stress, 8, 11, 30, 41, 49, 80  
 engineering stress, 3, 5  
 normalised axial stress, 63  
 normalised circumferential stress, 30, 42, 64  
 normalised radial stress, 30, 42, 63  
 stress intensity, 7  
 stress tensor, 32  
 true stress, 5, 7, 83  
 yield stress, 11, 20, 25, 68, 74  
 Szczepiński, 11, 36, 82

**T**

Taylor series, 76  
 Tensile force, 2, 8  
 Tensile test, 1  
 Tension curve, 2  
 Theory of plasticity  
   deformation theory  
     of plasticity, 7, 17, 24, 54  
   plastic flow theory, 8, 22, 30  
   theory of small deformations, 8  
 Trajectory  
   longitudinal trajectory of the principal stress, 29  
   transverse trajectory of the principal stress, 29  
 True stress–strain curve, 6, 7

**U**

Ultimate strength, 5  
 Upper yield point, 5

**Y**

Yield condition  
   Huber-Mises yield condition, 21, 25, 31, 54, 68  
   Tresca yield condition, 21, 25, 31  
 Yield conditions, 20  
 Yield limit, 4  
 Young's modulus, 6, 7, 68