# Maleic acid

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|---|---|
| **Other names:** | (Z)-2-Butenedioic acid |
| | (Z)-Butenedioic acid |
| | 1,2-Ethylenedicarboxylic acid, (Z) |
| | 1,2-Ethylenedicarboxylic acid, cis- |
| | 2-Butenedioic acid (2Z)- |
| | 2-Butenedioic acid (Z)- |
| | 2-butenedioic acid (Z) |
| | Butenedioic acid,(Z)- |
| | CIS-1,2-ETHYLENEDICARBOXYL ACID |
| | CIS-BUTENEDIOIC ACID |
| | Kyselina maleinova |
| | Maleinic acid |
| | Malenic acid |
| | Toxilic acid |
| | cis-1,2-Ethylenedicarboxylic acid |
| | cis-1,4-butenedioic acid |
| | cis-2-butenedioic acid |
| **Inchi:** | InChI=1S/C4H4O4/c5-3(6)1-2-4(7)8/h1-2H,(H,5,6)(H,7,8)/b2-1- |
| **InchiKey:** | VZCYOOQTPOCHFL-UPHRSURJSA-N |
| **Formula:** | C4H4O4 |
| **SMILES:** | O=C(O)C=CC(=O)O |
| **Mol. weight [g/mol]:** | 116.07 |
| **CAS:** | 110-16-7 |

# Physical Properties

| Property code | Value | Unit | Source |
|---|---|---|---|
| chs | -1356.20 | kJ/mol | NIST Webbook |
| chs | -1358.00 | kJ/mol | NIST Webbook |
| chs | -1355.20 ± 0.67 | kJ/mol | NIST Webbook |
| gf | -468.46 | kJ/mol | Joback Method |
| hf | -538.29 | kJ/mol | Joback Method |
| hfl | -787.30 ± 1.70 | kJ/mol | NIST Webbook |
| hfs | -790.57 ± 0.71 | kJ/mol | NIST Webbook |
| hfs | -787.76 | kJ/mol | NIST Webbook |
| hfs | -789.52 | kJ/mol | NIST Webbook |

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|---|---|---|---|
| hfus | 27.28 | kJ/mol | Thermal analysis of phase change materials in the temperature range 120.150 .C |
| hvap | 71.31 | kJ/mol | Joback Method |
| log10ws | 0.45 | | Crippen Method |
| logp | -0.288 | | Crippen Method |
| mcvol | 77.800 | ml/mol | McGowan Method |
| nfpaf | %!d(float64=1) | | KDB |
| nfpah | %!d(float64=3) | | KDB |
| nfpas | %!d(float64=1) | | KDB |
| pc | 6503.64 | kPa | Joback Method |
| ss | 159.40 | J/mol×K | NIST Webbook |
| tb | 587.18 | K | Joback Method |
| tc | 616.00 ± 50.00 | K | NIST Webbook |
| tf | 402.90 ± 0.60 | K | NIST Webbook |
| tf | 403.80 ± 0.50 | K | NIST Webbook |
| tf | 416.65 ± 0.50 | K | NIST Webbook |
| tf | 405.00 ± 2.00 | K | NIST Webbook |
| tf | 403.40 ± 0.60 | K | NIST Webbook |
| vc | 0.289 | m3/kmol | Joback Method |

# Temperature Dependent Properties

| Property code | Value | Unit | Temperature [K] | Source |
|---|---|---|---|---|
| cpg | 191.01 | J/mol×K | 769.82 | Joback Method |
| cpg | 168.01 | J/mol×K | 587.18 | Joback Method |
| cpg | 180.57 | J/mol×K | 678.50 | Joback Method |
| cpg | 184.27 | J/mol×K | 708.94 | Joback Method |
| cpg | 187.74 | J/mol×K | 739.38 | Joback Method |
| cpg | 176.64 | J/mol×K | 648.06 | Joback Method |
| cpg | 172.46 | J/mol×K | 617.62 | Joback Method |
| cps | 135.60 | J/mol×K | 294.40 | NIST Webbook |
| dvisc | 0.0000492 | Pa×s | 587.18 | Joback Method |
| dvisc | 0.0001649 | Pa×s | 508.54 | Joback Method |
| dvisc | 0.0003515 | Pa×s | 469.22 | Joback Method |
| dvisc | 0.0008609 | Pa×s | 429.90 | Joback Method |
| dvisc | 0.0025249 | Pa×s | 390.58 | Joback Method |
| dvisc | 0.0000862 | Pa×s | 547.86 | Joback Method |
| dvisc | 0.0094225 | Pa×s | 351.26 | Joback Method |
| hfust | 26.90 | kJ/mol | 411.90 | NIST Webbook |
| hsubt | 109.00 ± 4.20 | kJ/mol | 363.50 | NIST Webbook |

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|---|---|---|---|---|
| hsubt | 110.00 ± 2.50 | kJ/mol | 362.00 | NIST Webbook |
| hsubt | 105.40 ± 1.70 | kJ/mol | 368.50 | NIST Webbook |
| hsubt | 110.00 ± 3.00 | kJ/mol | 363.00 | NIST Webbook |

# Correlations

| Information | Value |
|---|---|
| Property code | pvap |
| Equation | ln(Pvp) = A + B/T + C*ln(T) + D*T^2 |
| Coeff. A | 1.80781e+02 |
| Coeff. B | -1.91037e+04 |
| Coeff. C | -2.28200e+01 |
| Coeff. D | 7.02669e-06 |
| Temperature range (K), min. | 403.45 |
| Temperature range (K), max. | 773.00 |

# Sources

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|---|---|
| **Crippen Method:** | https://www.chemeo.com/doc/models/crippen_log10ws |
| **Solubility of Maleic Acid in Supercritical Carbon Dioxide:** | https://www.doi.org/10.1021/je9008393 |
| **Extraction of Citric Acid and Maleic Acid from Their Aqueous Solutions Using a Phosphorus-Bonded Extractant, Tri-n-octylphosphine Oxide, and a Secondary Amine, Dioctylamine:** | https://www.doi.org/10.1021/acs.jced.7b00562 |
| **The solubility of maleic acid in various inorganic salts and organic solvents:** | https://www.doi.org/10.1016/j.fluid.2017.07.012 |
| **KDB Thermodynamics model and parameters:** | https://www.cheric.org/research/kdb/hcprop/showprop.php?cmpid=962 |
| **Joback Method:** | https://en.wikipedia.org/wiki/Joback_method |
| **McGowan Method:** | http://link.springer.com/article/10.1007/BF02311772 |
| **NIST Webbook:** | http://webbook.nist.gov/cgi/cbook.cgi?ID=C110167&Units=SI |
| **Ultrasonic Velocity and Density Studies of Solutions of Maleic Acid and Tartaric Acid in Water at T = (298.15 and 308.15)K** | https://www.doi.org/10.1007/s10765-010-0736-6 |
| **Thermal analysis of phase change materials in the temperature range 120-150 °C:** | https://www.doi.org/10.1016/j.tca.2010.11.011 |
| **Crippen Method:** | http://pubs.acs.org/doi/abs/10.1021/ci990307l |
| **KDB Vapor Pressure Data:** | https://www.cheric.org/research/kdb/hcprop/showprop.php?cmpid=962 |
| **Measurement and correlation of the solubility of maleic acid in acetone-ethyl acetate mixtures:** | https://www.doi.org/10.1016/j.tca.2012.03.023 |
| **Surface Tensions and Densities of Oxalic, Malonic, Succinic, Maleic, Malic, and cis-Pinonic Acids:** | https://www.doi.org/10.1021/je050366x |

# Legend

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|---|---|
| **chs:** | Standard solid enthalpy of combustion |
| **cpg:** | Ideal gas heat capacity |
| **cps:** | Solid phase heat capacity |
| **dvisc:** | Dynamic viscosity |
| **gf:** | Standard Gibbs free energy of formation |
| **hf:** | Enthalpy of formation at standard conditions |
| **hfl:** | Liquid phase enthalpy of formation at standard conditions |
| **hfs:** | Solid phase enthalpy of formation at standard conditions |
| **hfus:** | Enthalpy of fusion at standard conditions |
| **hfust:** | Enthalpy of fusion at a given temperature |
| **hsubt:** | Enthalpy of sublimation at a given temperature |
| **hvap:** | Enthalpy of vaporization at standard conditions |
| **log10ws:** | Log10 of Water solubility in mol/l |
| **logp:** | Octanol/Water partition coefficient |
| **mcvol:** | McGowan's characteristic volume |
| **nfpaf:** | NFPA Fire Rating |
| **nfpah:** | NFPA Health Rating |
| **nfpas:** | NFPA Safety Rating |
| **pc:** | Critical Pressure |
| **pvap:** | Vapor pressure |
| **ss:** | Solid phase molar entropy at standard conditions |
| **tb:** | Normal Boiling Point Temperature |
| **tc:** | Critical Temperature |
| **tf:** | Normal melting (fusion) point |
| **vc:** | Critical Volume |