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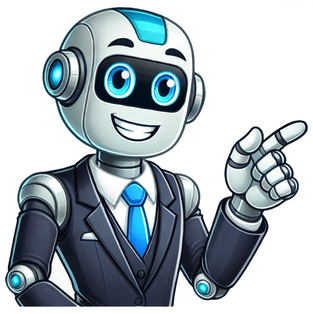

The following tables of the properties of steam are taken directly from Chapter 5.5.3 of the Heat Exchanger Design Handbook, 1986, by C. F. Beaton.The tables in this section are reprinted, with permission, from NBS/NRC Steam Tables.Symbols and Nomenclature for the TablesThe reference state for all property values is the liquid at the triple point, for which state the specific internal energy and the specific entropy have been set to zero.Figure1.Viscosity.Figure2.Thermal conductivity.Figure3.Prandtl number.Table1.Saturation (temperature)Table2.Saturation (pressure)Table3.Compressed water and superheated steamTable4.Specific heat capacity at constant pressureTable5.ViscosityTable6.Thermal conductivityTable7.Prandtl numberTable8.Properties for coexisting phases: viscosity, thermal, conductivity, Prandtl number, dielectric constant, surface tensionTable9.Thermal expansion coefficient = (1/)(/T)p of liquid water as a function of pressure and temperature. (in 103/K.)Table10.Thermal diffusivity of liquid water as a function of pressure and temperature. (k in 106 m2/sec.) Haar, L., Gallagher, J. S., and Kell, G. S. (1984) Thermodynamic and Transport Properties and Computer Programs for Vapor and Liquid States of Water in S.I. Units. NBS/NRC, Hemisphere, Washington, D.C.VDIWrmeatlas (1974) 2d edn., Verein Deutsches Ingenieure, Dsseldorf. TLV delivers products and services to keep your steam system in optimum condition, overcoming challenges together with customers for safe and reliable operation, energy saving and productivity improvements Products for use in steam, air, and water applicationsSee more Surveys and management programs for optimizing your steam-using plantSee more Contact your local TLV representative mail Free monthly email magazine on steam systems, energy efficiency, product selection, and more. Sign Up Here Units: SI SI(bar) Imperial MKS Also on TLV.com Sensible, latent and total heat in evaporated water - steam - at different gauge pressures and boiling temperatures.Saturated Steam - Properties vs. Pressure - psiGauge Pressure (psig)Temperature (oF)Specific Volume Saturated Vapor (ft3/lb)EnthalpySaturated Liquid (Btu/lb)Evaporated (Btu/lb)Saturated Vapor (Btu/lb)25(Inches Mercury Vacuum)134141021017111920(Inches Mercury Vacuum)16273.91291001113015(Inches Mercury Vacuum)17951.3147990113710(Inches Mercury Vacuum)19239.416098211425(Inches Mercury Vacuum)20331.817197611470 1)21226.81809701150121525.21839681151221923.51879661153322222.31909641154422421.41929621154522720.11959601155623019.41989591157723218.72009571157823318.42019561157923717.120595411591023916.520795311601224415.321294911611424814.321694711631625213.422094411641825612.622494111652025911.922793911662226111.323093711672426510.823393411672626810.32369331169282719.852399301169302749.462439291172322779.12469271173342798.752489251173362828.422519231174382848.0825392211754 ---1) Atmospheric pressure is used for the table except for 2)2) Critical Point - At 3206.2 psia and 705.40 oF the vapor and liquid are indistinguishable. No change of state occurs when pressure increases above the critical point or when heat is added. At the critical point it is no longer referred to water or steam and it is not possible keep the water and steam apart.1 psi (lbf/in2) = 6894.8 Pa (N/m2) = 0.06895 barProperties of Saturated Steam - SI UnitsNote! Gauge Pressure = Absolute Pressure - Atmospheric PressureNTP - Normal Temperature and Pressure - is defined as 20 oC (293.15 K, 68 oF) and 1 atm (101.325 kN/m2, 101.325 kPa, 14.7 psia, 0 psig, 30 in Hg, 760 torr)Vacuum steam is the general term used for saturated steam at temperatures below 100C. Example - Boiling Water at 212 oF and 0 psigAt atmospheric pressure - 0 psig - water boils at 212 oF. 180 Btu/lb of energy is required to heat 1 lb of water to saturation temperature 212 oF.Therefore, at 0 psig and 212 oF - the specific enthalpy of water is 180 Btu/lb. Another 970 Btu/lb of energy is required to evaporate the 1 lb of water at212 oF to steam at 212 oF. Therefore, at 0 psig - the specific enthalpy of evaporation is 970 Btu/lb.The total specific enthalpy of the steam (or heat required to evaporate water to steam) at atmospheric pressure and212 oF can be summarized tohs = (180 Btu/lb) + (970 Btu/lb) = 1150 Btu/lb Calculate flash steam generation in condensate pipe lines. Heat transfer when steam condensates. Evaporation of water from a water surface - like a swimming pool or an open tank - depends on water temperature, air temperature, air humidity and air velocity above the water surface - online calculator. Evaporative cooling tutorial. When flash steam is generated and vented to the surroundings a considerable amount of energy is lost Tutorial to the basic physics behind flash steam generation When condensate passes steam traps - flash steam is generated. When condensate leaves the steam traps - flash steam is generated. Amount of flash steam generated at different pressures - kN/m2. Water can be heated by injecting steam. Latent heat is the heat when supplied to or removed from air results in a change in moisture content - the temperature of the air is not changed. Saturated Steam Table with steam properties as specific volume, density, specific enthalpy and specific entropy. Steam table with sensible, latent and total heat, and specific volume at different gauge pressures and temperatures. Steam table with sensible, latent and total heat, and specific volume at different gauge pressures and temperatures. Steam is a compressible gas where the capacity of a pipe line depends on the size of the pipe and the steam pressure. Absolute viscosity of steam at pressure ranging 1 - 10000 psia. Vapor and steam enthalpy, specific enthalpy of saturated liquid, saturated vapor and superheated vapor. Calculate the stress in steam boiler shells caused by steam pressure. Basic steam thermodynamics - entropy diagram. Calculate steam heated air systems. Steam systems carries heat through pipes from the boiler to consumers as heat exchangers, process equipment etc. An introduction to the basic design of steam heating systems. Calculate pressure drops in steam distribution pipe lines. Steam pipes and pressure drop diagrams - imperial and metric units. Steam trap selection guide - Float & Thermostatic, Inverted Bucket, Bimetal Thermostatic, Impulse and Thermodynamic Disc steam traps. The definition of STP - Standard Temperature and Pressure and NTP - Normal Temperature and Pressure. Enthalpy of steam superheated to temperatures above it's boiling point. Saturated Steam Table with properties like boiling point, specific volume, density, specific enthalpy, specific heat and latent heat of vaporization. An introduction to vapor and steam. Figures and tables showing the enthalpy and entropy of liquid water as function of temperature - SI and Imperial Units. Vapor pressure and specific weight of water at temperatures ranging 32 to 212 oF - Imperial Units. Online calculator, figures and tables showing Specific Volume of water at temperatures ranging from 0-370 C and 32 - 700 F - Imperial and IS Units. Thermal properties of water, including density, specific heat capacity, thermal conductivity, and thermal expansion at different temperatures. Enthalpy-entropy diagram for water and steam. Wet steam, dryness fraction and enthalpy. Introduction and definition of steam quality and dryness fraction including calculating wet steam enthalpy and specific volume.BerylliumAlkaline earth metalMagnesiumAlkaline earth metalAluminiumPost-transition metalsCalciumAlkaline earth metalScandiumTransition metalsTitaniumTransition metalsVanadiumTransition metalsChromiumTransition metalsManganeseTransition metalsGalliumPost-transition metalsStrontiumAlkaline earth metalsZirconiumTransition metalsMolybdenumTransition metalsTechnetiumTransition metalsRutheniumTransition metalsPalladiumTransition metalsIndiumPost-transition metalsTinPost-transition metalsBariumAlkaline earth metalsTantalumTransition metalsTungstenTransition metalsPlatinumTransition metalsThalliumPost-transition metalsLeadPost-transition metalsBismuthPost-transition metalsPoloniumPost-transition metalsRadiumAlkaline earth metalRutherfordiumTransition metalSeaborgiumTransition metal This demo calculator provides approximate saturated or superheated steam properties at selected data points. For professional design, always use **official references** or specialized software. A Quick, Convenient Way to Estimate Steam Properties In thermodynamics and process engineering, steam tables are essential for determining the properties of water and steam under various conditions. These properties typically include: Saturation Pressure & Temperature (the boundary between liquid and vapor) Enthalpy of saturated liquid, saturated vapor, or superheated steam Entropy Specific Volume And more This Steam Table Lookup Calculator offers an illustrative, simplified way to find either saturated steam data (for given temperature or pressure) or superheated steam data (for given conditions). Its a handy reference for quick checks and educational purposes. Important: The underlying data in our demo is approximate and minimal. For rigorous design or detailed calculations, consult official steam tables or specialized software (like IAPWS IF-97 references, REFPROP, or proprietary vendor data).Boiler & Turbine Operations: Operators and engineers need to know the specific enthalpy, pressure, or temperature conditions of steam at various stages (e.g., boiler output, turbine inlet/outlet). Heat Exchanger Sizing: Accurately sizing equipment often means calculating how much heat steam can release or absorb. HVAC & Process Design: From power plants to chemical refineries, steam is a common medium for heating, cooling, and power generation. Learning Thermodynamics: Students and hobbyists can better understand phase changes and energy transfer by experimenting with steam property values. In the dropdown labeled Steam Type, choose whether youre looking up saturated steam properties (which define a phase equilibrium point) or superheated steam properties (steam at a temperature above its saturation point). Use the second dropdown to specify if youre entering a Temperature or a Pressure. For saturated steam, either temperature or pressure uniquely determines the other. For superheated steam, you typically need both temperature and pressure, but our demo approach guesses or finds a closest data point for demonstration. In the Value field, type a temperature (C) or a pressure (bar), depending on the selected parameter. Our code will attempt to interpolate or find the best matching data point in a small data table. The properties displayed can include: Temperature & Pressure (for saturated steam, one defines the other) The enthalpy of saturated liquid / vapor (kJ/kg) The entropy of saturated liquid / vapor (kJ/kg.K) The specific volume of saturated liquid / vapor (m/kg) Or, for superheated steam, approximate enthalpy (h), entropy (s), and specific volume (v). The table will appear below the Lookup button, listing the approximate properties. Note that if your input is outside the limited demonstration range, you may see an error message. Real steam tables cover a wider range of conditions. Saturated Steam by TemperatureSuppose you select Saturated and Temperature, and enter 120 C. After clicking Lookup, you might see a result around 1.985 bar pressure, with ~503 kJ/kg, ~2706 kJ/kg, etc.This helps you confirm how much heat the steam can absorb or release when condensing or evaporating at that temperature. Superheated SteamSuppose you choose Superheated and Temperature = 300 C. The calculator might find a matching or closest data point for a default pressure (e.g., 1.013 bar or 10 bar) and provide approximate enthalpy, entropy, and specific volume.The code weve used includes very few data points for each region (saturated and superheated). Interpolation in the saturated region for temperature is rudimentary, and for pressure we simply pick the closest data point. Superheated steam requires 2 variables (pressure + temperature) for a precise lookup, but this demo approach guesses or picks a nearest stored data point. For real engineering work, you must have a comprehensive data set (covering your entire operating range) and more robust interpolation (2D for superheat). IAPWS-IF97 or ASME Steam Tables are the professional standard references. This Steam Table Lookup Calculator is an educational demo that quickly illustrates how to fetch basic saturated or superheated steam properties with a minimal data set. Its excellent for: Teaching fundamental thermodynamic concepts Quick demonstration of how steam property lookups work Initial estimates for conceptual design or classroom exercises For advanced or industrial-level needslike large-scale power generation, chemical processing, or high-pressure steam linesalways rely on official steam table references and more thorough interpolation methods. Give it a try: Enter a temperature or pressure, click Lookup, and see if the approximate data matches your expectations or references. Whether youre a student learning the ropes or an engineer in the early design phase, we hope this tool offers a helpful starting point! Questions or Suggestions?Feel free to share your feedback or request additional data points. We can expand the superheated range, add more temperature/pressure increments, or implement more sophisticated interpolation if theres demand. Steam burns are more dangerous than water burns because more heat is transferred due to the additional release of latent heat of condensation. To vaporize a liquid, energy as heat must be transferred to the substance in order to break the intermolecular bonds so that the substance becomes gaseous. In the case of pure substances, the temperature remains constant until the liquid has completely vaporized. The heat added during vaporization therefore does not result in an increase in temperature, since it is used to break the intermolecular bonds (hydrogen bond). The heat to be added for the complete vaporization of a certain amount of liquid is also referred to as heat of vaporization or, more generally, as latent heat. Figure: Supply of heat of vaporization during vaporization and dissipation of heat of condensation during condensation Water requires a very large amount of heat to vaporize. For example, to vaporize 1 kg of water, a heat energy of 2257 kJ is required. If we compare this amount of heat with the heating of water from 20 C to 100 C, only 336 kJ is required. Thus, more than 6 times as much heat is needed for vaporization as was necessary for heating! The transferred heat of vaporization cannot simply have disappeared due to the conservation of energy. Rather, this enormous amount of energy is stored as internal energy in the gas phase. Water needs a multiple of the amount of heat for vaporization compared to heating up to boiling temperature! During condensation, i.e. when gaseous water liquefies on a cold object, the previously absorbed latent heat is released again. The emitted heat from the substance is absorbed by the cooler object. The (internal) energy of the water decreases and the intermolecular bonds can form again, resulting in the liquid state. In the case of condensation, one also speaks of heat of condensation, which is also a form of latent heat. The amount of heat of condensation is the same as the heat of vaporization. The energy absorbed by a substance during vaporization in the form of heat of vaporization (latent heat) is released during condensation in the form of heat of condensation (latent heat)! Figure: Energy flow diagram of vaporization and condensation This understanding now also explains why steam burns are generally much more painful and dangerous than water burns. If the relatively cool skin comes into contact with water vapor (steam), the water condenses there and heat of condensation is released and transferred to the skin. As already explained, due to the large amount of latent heat involved, there is a huge amount of thermal energy transferred. Thus, in contact with steam, significantly more heat is transferred to our skin than in contact with liquid water, although the temperature is the same in both cases (100 C). Figure: Heat of condensation released during condensation of steam (water vapor) leads to severe burns Steam burns are more dangerous compared to water burns because additional latent heat is transferred in the form of heat of condensation! Note that the human perception of warm or cold is not based on temperatures, but on heat flows (transferred heat per unit time). Thus, although the temperatures are identical at 100 C in both cases, condensation results in a much larger heat flow. This greater heat flow not only causes a psychologically warmer perception, but also leads physically to more dangerous burns. More information on the perception of warm and cold can be found in the article Why does metal feel colder than wood. We hope, this article, Density of Steam Specific Volume of Steam, helps you. If so, give us a like in the sidebar. Main purpose of this website is to help the public to learn some interesting and important information about radiation and dosimeters. Related Resources: thermodynamics Thermodynamics and Heat Transfer Saturated Steam Tables - Imperial Units Saturated steam is steam that is in equilibrium with heated water at the same pressure, i.e., it has not been heated past the boiling point for that pressure. If saturated steam is reduced in temperature (while retaining its pressure) it will condense to produce water droplets, even if it is still considerably above the boiling point of 100C at standard pressure . Related Resources: Saturated Steam Tables - Imperial Units Pressure psi Temp deg F Temp deg C Temp deg K Water (hf) Btu/lb Evap'n (hfg) Btu/lb Steam (hg) Btu/lb Sp. Vol Dry Sat cu.ft/lb absolute 15 179 81.7 354.8 147 991 1138 51.41 10 192 88.9 362.0 160 983 1143 39.4 5 203 95.0 368.2 171 976 1147 31.8 psig 0 212 100.0 373.2 180 971 1151 26.8 1 215 101.7 374.8 183 969 1152 25.2 3 221 105.0 378.2 190 964 1154 22.5 5 227 108.3 381.5 196 961 1156 20.1 7 232 111.1 384.3 201 958 1158 18.4 9 237 113.9 387.0 206 954 1160 17 11 241 116.1 389.3 210 951 1162 15.9 13 246 118.9 392.0 214 949 1163 15.1 15 250 121.1 394.3 218 946 1164 13.9 17 253 122.8 395.9 222 943 1165 13 19 257 125.0 398.2 226 941 1167 12.3 21 260 126.7 399.8 229 939 1168 11.7 23 264 128.9 402.0 233 937 1169 11.1 25 267 130.6 403.7 236 935 1170 10.6 27 270 132.2 405.4 239 932 1171 10.3 29 273 133.9 407.0 242 931 1172 9.7 31 275 135.0 408.2 244 929 1173 9.3 33 278 136.7 409.8 247 927 1174 8.9 35 281 138.3 411.5 250 925 1175 8.6 37 283 139.4 412.6 252 923 1175 8.25 39 286 141.1 414.3 255 921 1176 7.95 41 288 142.2 415.4 257 920 1177 7.7 43 290 143.3 416.5 260 918 1177 7.44 45 292 144.4 417.6 262 916 1178 7.21 47 295 146.1 419.3 264 915 1179 6.99 49 297 147.2 420.4 266 913 1179 6.78 51 299 148.3 421.5 268 912 1180 6.6 53 300 148.9 422.0 270 910 1181 6.4 55 303 150.6 423.7 272 909 1181 6.23 60 308 153.3 426.5 278 905 1183 5.84 65 312 155.6 428.7 282 902 1184 5.5 70 316 157.8 430.9 287 898 1185 5.19 75 320 160.0 433.2 290 896 1186 4.91 80 324 162.4 435.4 295 892 1187 4.67 85 327 163.9 437.0 298 890 1188 4.45 90 331 166.1 439.3 302 887 1189 4.24 95 335 168.3 441.5 305 884 1189 4.06 100 338 170.0 443.2 309 882 1190 3.89 105 341 171.7 444.8 312 879 1191 3.74 110 344 173.3 446.5 314 876 1192 3.59 115 347 175.0 448.2 319 874 1193 3.46 120 350 176.7 449.8 322 872 1193 3.34 125 353 178.3 451.5 325 869 1194 3.23 130 356 180.0 453.2 328 867 1195 3.12 135 358 181.1 454.3 330 865 1195 3.02 140 361 182.8 455.9 333 862 1196 2.93 145 363 183.9 457.0 336 860 1196 2.84 150 366 185.6 458.7 339 858 1197 2.76 155 368 186.7 459.8 341 856 1197 2.68 160 371 188.3 461.5 344 854 1198 2.61 165 373 189.4 462.6 346 852 1198 2.54 170 375 190.6 463.7 348 850 1198 2.47 175 377 191.7 464.8 351 848 1199 2.41 180 380 193.3 466.5 353 846 1199 2.35 185 382 194.4 467.6 355 844 1199 2.29 190 384 195.6 468.7 358 842 1200 2.24 195 386 196.7 469.8 360 840 1200 2.19 200 388 197.8 470.9 362 838 1200 2.14 205 390 198.9 472.0 364 837 1201 2.09 210 392 200.0 473.2 366 835 1201 2.04 215 394 201.1 474.3 368 833 1201 2 220 395 201.7 474.8 370 831 1201 1.96 225 397 202.8 475.9 372 830 1202 1.92 230 399 203.9 477.0 374 828 1202 1.88 235 401 205.0 478.2 376 826 1202 1.85 245 404 206.7 479.8 380 822 1202 1.78 255 408 208.9 482.0 383 819 1203 1.71 265 411 210.6 483.7 387 816 1203 1.65 275 414 212.2 485.4 391 813 1204 1.6 285 417 213.9 487.0 394 810 1204 1.54 295 420 215.6 488.7 397 807 1204 1.49 305 423 217.2 490.4 400 804 1204 1.45 315 426 218.9 492.0 404 801 1204 1.41 325 429 220.6 493.7 407 798 1205 1.36 335 432 222.2 495.4 410 795 1205 1.33 345 434 223.3 496.5 41 792 1205 1.29 355 437 225.0 498.2 416 790 1205 1.26 365 440 226.7 499.8 419 787 1205 1.22 375 442 227.8 500.9 421 784 1205 1.19 385 445 229.4 502.6 424 781 1205 1.16 395 447 230.6 503.7 427 779 1205 1.13 For full table - rotate the screen!Saturated Steam - Properties vs. Pressure - BarAbsolute PressureBoiling PointSpecific Volume (steam)Density (steam)Specific Enthalpy of Liquid Water (sensible heat)Specific Enthalpy of Steam (total heat)Latent heat of VaporizationSpecific Heat(bar)(oC)(m3/kg)(kg/m3)(kJ/kg)(kcal/kg)(kJ/kg)(kcal/kg)(kJ/kg)(kcal/kg)(kJ/kg K)0.0217.5167.0060.01573.4517.542533.64605.152460.19587.611.86440.0324.1045.6670.022101.0024.122545.64608.022444.65583.891.86940.0428.9834.8020.029121.4129.002554.51610.132433.10581.141.87360.0532.9028.1940.035137.7732.912561.59611.832423.82578.921.87740.0636.1823.7410.042151.5036.192567.51613.242416.01577.051.88080.0739.0220.5310.049163.3839.022572.62614.462409.24575.441.88400.0841.5318.1050.055173.8741.532577.11615.532403.25574.011.88710.0943.7916.2040.062183.2843.782581.14616.492397.85572. 1)99.631.6940.590417.5199.722675.43639.022257.92539.302.02671.1102.321.5490.645428.84102.432679.61640.012250.76537.592.03731.2104.811.4280.700439.36104.942683.44640.932244.08535.992.04761.3107.131.3250.755449.19107.292686.98641.772237.79534.492.05761.4109.321.2360.809458.42109.492690.28642.562231.86533.072.06731.5111.371.1590.863467.13111.572693.36643.302226.23531.732.07681.6113.321.0910.916475.38113.542696.25643.992220.87530.452.08601.7115.171.0310.970483.22115.422698.97644.642215.75529.222.0 1 bar abs = 0 bar gauge =0.98692 atm = 100 kPa abs = Standard Atmospheric Pressure (IUPAC system) Vacuum steam is the general term used for saturated steam at temperatures below 100C.Steam evaporators used in industrial and waste water applications operates with pressures lower that the atmospheric pressure. In steam distribution system the pressure is almost always more than 0 bar gauge. Example - Boiling Water at 100 oC, 0 bar (100 kPa) Atmospheric PressureAt atmospheric pressure (0 bar g, absolute 1 bar) water boils at 100 oC and 417.51 kJ of energy is required to heat 1 kg of water from 0 oC to evaporating temperature 100 oC.Therefore the specific enthalpy of water at 0 bar g (absolute 1 bar) and 100 oC is 417.51 kJ/kg. Another 2257.92 kJ of energy is required to evaporate 1 kg of water at 100 oC into 1 kg of steam at 100 oC. Therefore at 0 bar g (absolute 1 bar) the specific enthalpy of vaporation is 2257.19 kJ/kg.The total specific enthalpy for steam at 0 bar gauge is:hs = (417.51 kJ/kg) + (2257.92 kJ/kg) = 2675.43 kJ/kgExample - Boiling Water at 170 oC and 7 bar (700 kPa) Atmospheric PressureAt 7 bar g (absolute 8 bar) the saturation temperature of water is 170.42 oC. More heat energy is required to raise its temperature to saturation point at 7 bar g than needed when the water is at atmospheric pressure. According the table 720.94 kJ is required to raise 1 kg of water from 0 oC to saturation temperature 170 oC. The heat energy (enthalpy of evaporation) needed at 7 bar g to vaporize the water to steam is actually less than required at atmospheric pressure. The specific enthalpy of vaporization decreases with steam pressure. The evaporation heat is 2046.53 kJ/kg at 7 bar g.Note! The specific volume of steam decreases with increased pressure - and the amount of heat energy distributed by the same volume increase. With higher pressure - more energy can be transferred in a steam distribution system. Calculate flash steam generation in condensate pipe lines. Control valves and cavitation, application ratio and multi stage control valves. Tutorial to the basic physics behind flash steam generation Water can be heated by injecting steam. Latent heat is the heat when supplied to or removed from air results in a change in moisture content - the temperature of the air is not changed. Vapor and saturation pressure for some common liquids. Saturated Steam Table with steam properties as specific volume, density, specific enthalpy and specific entropy. Steam table with sensible, latent and total heat, and specific volume at different gauge pressures and temperatures. Vapor and steam enthalpy, specific enthalpy of saturated liquid, saturated vapor and superheated vapor. Basic steam thermodynamics - entropy diagram. The amount of flash steam generated depends on steam pressure and pressure in the condensate lines. Calculate steam heated air systems. Steam systems carries heat through pipes from the boiler to consumers as heat exchangers, process equipment etc. Calculate pressure drops in steam distribution pipe lines. Steam pipes and pressure drop diagrams - imperial and metric units. Enthalpy of steam superheated to temperatures above it's boiling point. The entropy of steam superheated to temperatures above saturation points. Enthalpy-entropy diagram for water and steam. Wet steam, dryness fraction and enthalpy. Wet steam and specific volume. Toggle Menu Materials Design Processes Units Formulas Math Saturated steam properties - in barSaturated steam properties - in psiProperties of steam at varying pressures and temperatures:For full table with Entropy - rotate the screen!Properties of Saturated Steam - SI UnitsAbsolute pressure (kPa, kN/m2)Evaporation Temperature (oC)Specific Volume (m3/kg)Density - - (kg/m3)Specific Enthalpy ofSpecific Entropy of Steam - s - (kJ/kgK)Liquid - hl - (kJ/kg)Evaporation - he - (kJ/kg)Steam - hs -

(kJ/kg)0.83.81600.0062615.8249325099.0582.017.567.00.014973.5246025348.7255.032.928.20.0354137.8242425628.39610.045.814.70.0682191.8239325858.15120.060.17.650.131251.5235826107.9092867.55.580.179282.7234026237.7933572.74.530.221304.3232726327.7174578.73.580.279329.6231226427.6315583.72.960.338350.6229926507.5626588.02.530.395368.6228826577.5067591.82.220.450384.5227926637.4578595.21.970.507398.6227026687.4159598.21.780.563411.5226226737.37710099.61.690.590417.5225826757.360101.331)1001.67 steam is the general term used for saturated steam at temperatures below 100C.1) Atmospheric pressureAbsolute Pressure = Gauge Pressure + Atmospheric PressureSpecific enthalpy - or Sensible Heat - is the quantity of heat in 1 kg of water according to the selected temperatureExample - Boiling Water at 100 oC and 0 barAt atmospheric pressure - 0 bar gauge or absolute 101.33 kN/m2 - water boils at 100 oC. 419 kJ of energy is required to heat 1 kg of water from 0 oC to the saturation temperature 100 oC.Therefore, at 0 bar gauge (absolute 101.33 kN/m2) and 100 oC - the specific enthalpy of water is 419 kJ/kg. Another 2257 kJ of energy is required to evaporate the 1 kg of water at 100 oC to steam at 100 oC. Therefore, at 0 bar gauge (absolute 101.33 kN/m2) - the specific enthalpy of evaporation is 2257 kJ/kg.The total specific enthalpy of the steam (or heat required to evaporate water to steam) at atmospheric pressure and 100 oC can be summarized as:hs = 419 + 2257 = 2676 kJ/kg = 2676 (kJ/kg) / 3600 (s/h) = 0.74 kWh/kg (1 hour = 3600 seconds, 1 kW = 1 kJ/s)Example - Boiling Water at 170 oC and 7 barSteam at atmospheric pressure is of limited practical use since it can not be conveyed by its own pressure along a steam pipe to the points of consumption. At 7 bar gauge (absolute 800 kN/m2) - the saturation temperature of water is 170 oC. More heat energy is required to raise the temperature to the saturation point at 7 bar gauge than needed for water at atmospheric pressure. From the table a value of 720.9 kJ is needed to raise 1 kg of water from 0 oC to the saturation temperature 170 oC. The heat energy (enthalpy of evaporation) needed at 7 bar gauge to evaporate the water to steam is actually less than the heat energy required at atmospheric pressure. The specific enthalpy of evaporation decrease with steam pressure increase. The evaporation heat is 2047 kJ/kg according the table.Note! Because the specific volume of steam decreases with increasing pressure, the amount of heat energy transferred in the same volume actually increases with steam pressure. In other words the same pipe may transfer more energy with high pressure steam than with low pressure steam. Arithmetic Mean Temperature Difference in Heat Exchangers - AMTD - and Logarithmic Mean Temperature Difference - LMTD - formulas with examples - Online Mean Temperature Calculator. Specific volume, enthalpy and entropy of compressed water. Calculate flash steam generation in condensate pipe lines. Heat transfer when steam condensates. Evaporation of water from a water surface - like a swimming pool or an open tank - depends on water temperature, air temperature, air humidity and air velocity above the water surface - online calculator. Evaporative cooling tutorial. When flash steam is generated and vented to the surroundings a considerable amount of energy is lost Steam table with sensible, latent and total heat, and specific volume at different gauge pressures and temperatures. Steam is a compressible gas where pipe line mass flow capacity depends on steam pressure. Online calculator, figures and tables showing specific heat of liquid water at constant volume or constant pressure at temperatures from 0 to 360 C (32-700 F) - SI and Imperial units. Steam consumption and condensate generation when heating liquid or gas flows Calculate steam flow rate vs. kW rating. Calculate the stress in steam boiler shells caused by steam pressure. Steam consumption rates for typical steam heated consumers in industries like bakeries, breweries, paper factories etc. Basic steam thermodynamics - entropy diagram. Calculate steam heated air systems. Steam systems carries heat through pipes from the boiler to consumers as heat exchangers, process equipment etc. Calculate pressure drops in steam distribution pipe lines. Steam trap selection guide - Float & Thermostatic, Inverted Bucket, Bimetal Thermostatic, Impulse and Thermodynamic Disc steam traps. A back pressure in a condensate systems will reduce steam trap capacity The entropy of steam superheated to temperatures above saturation points. Saturated Steam Table with properties like boiling point, specific volume, density, specific enthalpy, specific heat and latent heat of vaporization. An introduction to vapor and steam. Vapor pressure and specific weight of water at temperatures ranging 32 to 212 oF - Imperial Units. Online calculator, figures and tables showing Specific Volume of water at temperatures ranging from 0-370 C and 32 - 700 F - Imperial and IS Units. Enthalpy-entropy diagram for water and steam. Wet steam, dryness fraction and enthalpy. Introduction and definition of steam quality and dryness fraction including calculating wet steam enthalpy and specific volume. Wet steam and specific volume. Share copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. This calculator works by reading the values that the user inputs and then finding the closest ones in a normalized table of steam propierties. Once the closest values are found, the calculator saves the ones that are before and after the input value and then performs a single or double interpolation (depending on the case) on every propierty for the selected input. Finally, the values are displayed to the user in the form of a table. This way, the user can get accurate values of entropy, enthalpy, steam quality and more for a selected pressure, temperature or both, either in the wet steam, saturated or superheated regions of the T-S, P-V or any other diagram. Why was this calculator made? This Online Steam Calculator was made after many other free online steam properties calculators lacked the set of inputs I needed to solve excercises for my Thermodynamics class. As a Mechanical Engineer trying to get into the world of web development and programming, I thought it would be a great project to practice coding and also offer a solution to my problem for free and to everyone. Did you know that boilers do not generate 100% saturated steam (dry steam)? When a steam boiler heats up water, bubbles breaking through the water surface will pull tiny water droplets in with the steam. Unless a superheater is used, this will cause the steam supply to become partially wet (wet steam) from the added liquid.The steam dryness fraction is used to quantify the amount of water within steam. If steam contains 10% water by mass, it's said to be 90% dry, or have a dryness fraction of 0.9.Steam dryness is important because it has a direct effect on the total amount of transferable energy contained within the steam (usually just latent heat), which affects heating efficiency and quality.For example, saturated steam (100% dry) contains 100% of the latent heat available at that pressure. Saturated water, which has no latent heat and therefore 0% dryness, will only contain sensible heat.Steam Dryness = 100% - [% Entrained Water] (by mass)Steam tables contain values such as enthalpy (h), specific volume (), entropy (s), etc. for saturated steam (100% dry) and for saturated water (0% dryness), but typically not for wet steam.These can be calculated by simply considering the ratio of steam to water, as described in the equations below:Specific Volume () of Wet Steam = X g+ (1 - X) fwhere:X = Dryness (% / 100)f = Specific Volume of Saturated Waterg = Specific Volume of Saturated SteamSpecific Enthalpy (h) of Wet Steamh = hf+ X hfgwhere:X = Dryness (% / 100)hf = Specific Enthalpy of Saturated Waterhfg = Specific Enthalpy of Saturated Steam - Specific Enthalpy of Saturated WaterSpecific Entropy (s) of Wet Steams = sf+ X sfgwhere:X = Dryness (% / 100)sf = Specific Entropy of Saturated Watersfg = Specific Entropy of Saturated Steam - Specific Entropy of Saturated WaterThe wetter the steam, the lower the specific volume, enthalpy, and entropy will be because the dryness percentage is a factor of the 100% condition. Since steam dryness has a significant effect on all these values, to enable greater heating efficiency it is crucial to supply steam that is as close to being 100% dry as possible.The Relationship Between Steam Dryness and EnthalpyAs the amount of water in steam increases, the latent heat decreases, providing less heat to transfer from the steam to the process / product being heated.During transport, radiant heat loss from piping causes part of the steam to lose some of its latent heat and revert back to water, thereby decreasing steam dryness.Water Droplets Entrained in SteamProper measures should be taken to discharge all condensate within steam piping, including water droplets entrained within the flow of steam.Since wet steam not only affects heat transfer efficiency, but can also cause erosion of piping and critical equipment such as turbine blades, it is highly recommended to take preventative measures such as using a steam separator to remove the entrained condensate and by following the advice written in these articles:Can steam dryness rise above 100%? It might seem unlikely, but actually it can. When steam is more than 100% dry it is called superheated steam. This type of steam is created by adding heat above the saturated steam threshold. The added heat raises the steams temperature higher than its saturation point, allowing the amount of superheat to be easily determined by simply measuring its temperature.Go to TLV's Superheated Steam Table The Steam Tables by Temperature Calculator is designed to provide quick and accurate thermodynamic properties of steam and water at various temperatures. It is a useful tool for engineers, scientists, and students who need to analyze the behavior of steam under different conditions. The application allows users to input temperature in either Celsius (C) or Kelvin (K) and retrieve key properties such as specific volume, density, enthalpy, and entropy. Additionally, the calculator supports unit conversions, making it versatile for different contexts.2. Physical and Chemical BackgroundSteam, the gaseous phase of water, plays a critical role in many industrial processes, power generation, and heating systems. Understanding its properties at different temperatures and pressures is essential for designing efficient systems and conducting accurate thermodynamic analyses.Thermodynamic Properties ExplainedSpecific Volume (m/kg)This is the volume occupied by a unit mass of a substance. For steam, it represents the space taken by the vapor per kilogram. It is inversely related to density.Density (kg/m)Density is the mass per unit volume of a substance. In the context of steam, it's crucial for understanding flow dynamics and energy transfer in systems.Enthalpy (kJ/kg)Enthalpy is the total heat content of a substance. For steam, it's a measure of the energy required to produce steam from water at a constant pressure. It's a key parameter in calculating the efficiency of steam engines and turbines.Entropy (kJ/(kg K))Entropy is a measure of the disorder or randomness in a system. In steam processes, it helps in understanding the irreversibilities and efficiency of thermodynamic cycles, such as the Rankine cycle used in power plants.Why These Properties MatterEfficiency of Energy SystemsThe accurate calculation of steam properties is vital in designing efficient energy systems like boilers, turbines, and heat exchangers. Knowing the enthalpy and entropy changes allows engineers to maximize the efficiency of these systems, thereby reducing fuel consumption and emissions.Process OptimizationIn industries where steam is used for heating or power, understanding these properties helps in optimizing processes to ensure consistent quality and energy efficiency.Safety and DesignThe density and specific volume are crucial for safety calculations, ensuring that equipment can withstand the operational pressures and volumes involved in steam generation and utilization.3. How to Use the Calculator1. Input TemperatureEnter the desired temperature in the input field. You can input the temperature in either C or K, depending on your preference.2. Select Temperature UnitChoose the unit of temperature using the radio buttons provided. This will allow you to switch between Celsius and Kelvin.3. Calculate PropertiesClick the "Calculate" button to retrieve the steam properties for the given temperature. The results will display specific volume, density, enthalpy, and entropy.4. Interpret ResultsUse the displayed properties to analyze the steam's behavior at the given temperature. The values can be used in further calculations for energy systems, process simulations, or educational purposes.4. Unit ConversionsThe calculator provides built-in conversions to handle different units commonly used in thermodynamic calculations:TemperatureConverts between C and K.PressureConvert between different pressure units if necessary, such as from bar to MPa.EnergyConvert between kJ/kg and other energy units like Btu/lb if extended functionality is implemented.5. Implementation DetailsThe calculator is built using Django and Dash, providing a seamless integration of data processing and interactive UI elements. Data is loaded from an Excel file containing steam table data, which is essential for calculating the thermodynamic properties at different temperatures.Data SourceThe steam properties data is derived from standard steam tables, a critical reference in thermodynamics.Application LogicThe input temperature is processed based on the selected unit, and the corresponding properties are fetched from the pre-loaded data. Calculations for density and other derived properties are performed in real-time.6. Future EnhancementsThe following features could be added to enhance the calculator's functionality:Pressure Input: Allow users to input pressure and calculate properties at superheated or subcooled conditions.Graphical Output: Display P-V and T-S diagrams for better visualization of thermodynamic processes.Expanded Unit Conversions: Implement more extensive unit conversion options for all calculated properties.7. ConclusionThe Steam Properties Calculator is an essential tool for anyone dealing with steam in a thermodynamic context. It simplifies the process of retrieving critical properties, supports educational and industrial applications, and provides the necessary flexibility through unit conversions. By understanding and utilizing these properties, users can design, analyze, and optimize steam-related processes with greater precision and efficiency.

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