

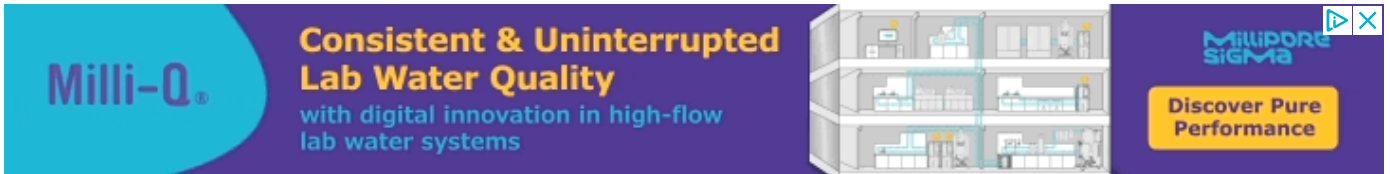
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Thermal Expansion - Linear Expansion Coefficients

Linear temperature expansion coefficients for common materials like aluminum, copper, glass, iron and many more.

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When an object is heated or cooled, its length change by an amount proportional to the original length and the change in temperature.



- [Calculate thermal expansion](#)

[Thermal expansion](#) coefficients for some common materials:

Thermal Expansion - Linear Expansion Coefficients common Products

Product	Linear Temperature Expansion Coefficient - α - ($10^{-6} \text{ m}/(\text{m } ^\circ\text{C})$) ($10^{-6} \text{ in}/(\text{in } ^\circ\text{F})$)
ABS (Acrylonitrile butadiene styrene) thermoplastic	72 - 108
ABS -glass fiber-reinforced	31
Acetal - glass fiber-reinforced	39
Acetals	85 - 110
Acrylic	68 - 75
ALLVAR Alloy 30 (negative thermal expansion)	-30
Alumina (aluminium oxide, Al_2O_3)	8.1
Aluminum	21 - 24
Aluminum nitride	5.3
Amber	50 - 60
Antimonial lead (hard lead)	26.5
Antimony	9 - 11
Arsenic	4.7
Bakelite, bleached	22
Barium	20.6
Barium ferrite	10
Benzocyclobutene	42
Beryllium	12
Bismuth	13 - 13.5
Brass	18 - 19
Brick masonry	5
Bronze	17.5 - 18
Cadmium	30
Calcium	22.3
Caoutchouc	66 - 69
Cast Iron Gray	10.8
Celluloid	100
Cellulose acetate (CA)	130
Cellulose acetate butynate (CAB)	96 - 171
Cellulose nitrate (CN)	80 - 120
Cement, Portland	11
Cerium	5.2

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Chlorinated polyether	80
Chlorinated polyvinylchloride (CPVC)	63 - 66
Chromium	6 - 7
Clay tile structure	5.9
Cobalt	12
Concrete	13 - 14
Concrete structure	9.8
Constantan	15.2 - 18.8
Copper	16 - 16.7
Copper, Beryllium 25	17.8
Corundum, sintered	6.5
Cupronickel 30% (constantan)	16.2
Diamond (Carbon)	1.1 - 1.3
Duralumin	23
Dysprosium	9.9
Ebonite	70
Epoxy - glass fiber reinforced	36
Epoxy, cast resins & compounds, unfilled	45 - 65
Erbium	12.2
Ethylene ethyl acrylate (EEA)	205
Ethylene vinyl acetate (EVA)	180
Europium	35
Fluoroethylene propylene (FEP)	135
Fluorspar, CaF ₂	19.5
Gadolinium	9
German silver	18.4
Germanium	6.1
Glass, hard	5.9
Glass, plate	9.0
Glass, Pyrex	4.0
Gold	14.2
Gold - copper	15.5
Gold - platinum	15.2
Granite	7.9 - 8.4

Graphite, pure (Carbon)	4 -8
Gunmetal	18
Gutta percha	198
Hafnium	5.9
Hard alloy K20	6
Hastelloy C	11.3
Holmium	11.2
Ice, 0°C water	51
Inconel	11.5 - 12.6
Indium	33
Invar	1.5
Iridium	6.4
Iron, cast	10.4 - 11
Iron, forged	11.3
Iron, pure	12.0
Kapton	20
Lanthanum	12.1
Lead	29
Limestone	8
Lithium	46
Lutetium	9.9
Macor	9.3
Magnalium	23.8
Magnesium	25 - 26.9
Magnesium alloy AZ31B	26
Manganese	22
Manganin	18.1
Marble	5.5 - 14.1
Masonry, brick	4.7 - 9.0
Mercury	61
Mica	3
Molybdenum	5
Monel metal	13.5
Mortar	7.3 - 13.5

Neodymium	9.6
Nickel	13.0
Niobium (Columbium)	7
Nylon, general purpose	50 - 90
Nylon, glass fiber reinforced	23
Nylon, Type 11, molding and extruding compound	100
Nylon, Type 12, molding and extruding compound	80.5
Nylon, Type 6, cast	85
Nylon, Type 6/6, molding compound	80
Oak, perpendicular to the grain	54
Osmium	5 - 6
Palladium	11.8
Paraffin	106 - 480
Phenolic resin without fillers	60 - 80
Phosphor bronze	16.7
Plaster	17
Plastics	40 - 120
Platinum	9
Plutonium	47 - 54
Polyacrylonitrile	70
Polyallomer	92
Polyamide (PA)	110
Polybutylene (PB)	130 - 139
Polycarbonate (PC)	65 - 70
Polycarbonate - glass fiber-reinforced	21.5
Polyester	124
Polyester - glass fiber-reinforced	25
Polyethylene (PE)	108 - 200
Polyethylene (PE) - High Molecular Weight	108
Polyethylene terephthalate (PET)	59.4
Polyphenylene	54
Polyphenylene - glass fiber-reinforced	36
Polypropylene (PP), unfilled	72 - 90

Polypropylene - glass fiber-reinforced	32
Polystyrene (PS)	70
Polysulfone (PSO)	55 - 60
Polytetrafluorethylene (PTFE)	112 - 135
Polyurethane (PUR), rigid	57.6
Polyvinyl chloride (PVC)	54 - 110
Polyvinylidene fluoride (PVDF)	128 - 140
Porcelain, Industrial	4
Potassium	83
Praseodymium	6.7
Promethium	11
Quartz, fused	0.55
Quartz, mineral	8 - 14
Rhenium	6.7
Rhodium	8
Rock salt	40.4
Rubber, hard	80
Ruthenium	9.1
Samarium	12.7
Sandstone	11.6
Sapphire	5.3
Scandium	10.2
Selenium	37
Silicon	3 - 5
Silicon Carbide	2.77
Silver	19 - 19.7
Sitall	0.15
Slate	10
Sodium	70
Solder lead - tin, 50% - 50%	25
Speculum metal	19.3
Steatite	8.5
Steel	10.8 - 12.5
Steel Stainless Austenitic (304)	17.3

Steel Stainless Austenitic (310)	14.4
Steel Stainless Austenitic (316)	16.0
Steel Stainless Ferritic (410)	9.9
Strontium	22.5
Tantalum	6.5
Tellurium	36.9
Terbium	10.3
Terne	11.6
Thallium	29.9
Thorium	12
Thulium	13.3
Tin	20 - 23
Titanium	8.5 - 9
Topas	5 - 8
Tungsten	4.5
Uranium	13.4
Vanadium	8
Vinyl Ester	16 - 22
Vulcanite	63.6
Wax	2 - 15
Wedgwood ware	8.9
Wood, across (perpendicular) to grain	30
Wood, fir	3.7
Wood, parallel to grain	3
Wood, pine	5
Ytterbium	26.3
Yttrium	10.6
Zinc	30 - 35
Zirconium	5.7

- $10^{-6} \text{ m/m}^{\circ}\text{C} = 1 \mu\text{m/m}^{\circ}\text{C}$
- $\text{m/m} = \text{meter per meter}$, $\text{in/in} = \text{inches per inches}$

Most values for **temperature** 25 °C (77 °F). The span in the values may be caused by the variation in the materials themselves - or by the variation in the sources used.

- [Calculate Thermal Pipe Expansion](#)
- [Volumetric expansion coefficients of common fluids](#)

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Related Topics

- **[Material Properties](#)**
Properties of gases, fluids and solids. Densities, specific heats, viscosities and more.
- **[Temperature Expansion](#)**
Thermal expansion and expansion coefficients. Expansion pipes and tubes made of stainless steel, carbon steel, copper, plastics and more.
- **[Thermodynamics](#)**
Work, heat and energy systems.

Related Documents

- **[ABS Pipes - Pressure Ratings](#)**
Pressure ratings of ABS 1208, ABS 1210, ABS 1316 and ABS 2112.
- **[ASTM D2729 - Poly\(Vinyl Chloride\) \(PVC\) Sewer Pipe - Dimensions](#)**
Dimensions of Poly(Vinyl Chloride) (PVC) Sewer Pipes with belled end.
- **[ASTM F2389 Pressure-rated Polypropylene \(PP\) - Dimensions](#)**
Dimensions of pressure rated PP pipes according ASTM F2389.
- **[Bimetallic Strips](#)**

Heat and bending of bimetallic strips

Capacity or copper tubes expansion loops.

- **Copper, Ductile Iron, Carbon Steel, Stainless Steel and Aluminum Piping Materials - Temperature Expansion**

Thermal expansion of typical piping materials.

- **Epoxy Pipes - Support Spacing**

Support spacing for reinforced Epoxy fiberglass pipes.

- **Fixed Pipes - Stress vs. Change in Temperature**

Temperature changes introduces stress fixed pipes.

- **Linear Thermal Expansion**

Online linear temperature expansion calculator.

- **Liquids - Volumetric Expansion Coefficients**

Volumetric - or cubical - expansion coefficients for common liquids.

- **Metals - Temperature Expansion Coefficients**

Thermal expansion coefficients metals.

- **Pipes and Tubes - Temperature Expansion**

Pipes expands when heated and contracts when cooled and the expansion can be expressed with the expansion equation.

- **Piping Materials - Temperature Expansion Coefficients**

Temperature expansion coefficients for materials used in pipes and tubes like aluminum, carbon steel, cast iron, PVC, HDPE and more.

- **Piping Materials - Temperature Heat Expansion and Cooling Contraction**

Expansion and contraction when cast iron, carbon and carbon molybdenum steel, wrought iron, copper, brass and aluminum pipes are heated or cooled.

- **PP - PolyPropylene Pipes - Support Spacing**

Maximum distance between PolyPropylene pipes supports.

- **Pressfit Pipes - Expansion Loops**

Temperature expansion loops with pressfit piping.

- **PVC Pipes - Temperature Expansion Loops**

Calculate temperature expansion and contraction in PVC piping systems.

- **Restricted Thermal Expansion - Force and Stress**

Stress and force when thermal expansion a pipe, beam or similar is restricted.

- **Shrink-Fits Assembly**

Assembly temperatures for shrink-fits.

- **Solids - Volume Temperature Expansion Coefficients**

Cubical expansion coefficients for solids.

Steam Pipes - Thermal Expansion

Calculate temperature expansion with carbon steel pipes.

- **Steel Pipes - Thermal Expansion Loops**

Calculating and sizing steel pipe thermal expansion loops.

- **Thermal Expansion of Steam Pipes - (inches)**

Expansion of steam pipes heated from room temperature to operation temperature.

- **Volumetric (Cubic) Thermal Expansion**

Volumetric temperature expansion calculator.

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Unit Converter

Temperature

☒ °C☐ K☐ °F

Length

☒ m☐ km☐ in

Convert!

Area

1.0

- ☒ m^2
- ☐ km^2
- ☐ in^2
- ☐ ft^2
- ☐ $miles^2$
- ☐ acres

Convert!

Volume

1.0

- ☒ m^3
- ☐ liters
- ☐ in^3
- ☐ ft^3
- ☐ us gal

Convert!

Weight

1.0

- ☒ kg_f
- ☐ N
- ☐ lbf

Convert!

Velocity

1.0

- ☒ m/s
- ☐ km/h
- ☐ ft/min
- ☐ ft/s
- ☐ mph

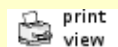
- ☒ *Pa*
- ☐ *bar*
- ☐ *mm H₂O*
- ☐ *kg/cm²*
- ☐ *psi*
- ☐ *inches H₂O*

Flow

- ☒ *m³/s*
- ☐ *m³/h*
- ☐ *US gpm*
- ☐ *cfm*

8.21.8

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