APS
ALUMINUM PIPE SYSTEMS
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"Sales, Installation, Parts & Repair Services"

Aluminum Pipe Systems

"The coiled pipeline company"

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SIZE AND SPECIFICATIONS

COILED ALUMINUM PIPE GRADE 6063 T1A and 6063 T1B

OUTSIDE DIAMETER (MM)	WALL THICKNESS (MM)	AVERAGE LENGTH PER COIL (METRES)	6063 T1A M.O.P (kPa)	6063 T1B M.O.P (kPa)
48.3	2.2 2.8	2350 2350	5247 6678	6267 7976*
60.3	2.8 3.2 3.9	1450 1450 1450	5349 6113 7451	6388 7301* 8899*
73.0	3.0 3.9	1000 1000	4734 6155	5654* 7351*
82.6	3.6	800	5021	5997

NOTE:

1. **M.O.P is based on 80% of Yield Strength. This will allow testing at 25% above M.O.P.**
2. **Minimum material Yield Strength for 6063 T1A is 72 MPA, and 6063 T1B is 86 MPA.**

* **Please check the AVAILABILITY of 6063 T1B.**

Flow Rate and Pressure Drop of Gases

Panhandle-Eastern Pipeline Formula - an empirical equation for Reynolds Numbers between 5×10^6 and 14×10^6

$$Q = 4.5966\,(10)^{-3}\,E\left[\frac{T_o}{P_o}\right]^{1.0788}\left[\frac{P_1^2 - P_2^2}{G^{0.8539}\,T_f\,L}\right]^{0.5394} d^{\,2.6182}$$

where,

- Q = rate of flow, m^3/d measured at base pressure P_o kPa, and base temperature T_o Kelvins
- P_1 = inlet pressure, kPa absolute
- P_2 = outlet pressure, kPa absolute
- G = relative density (air = 1.00)
- T_f = actual temperature of flowing gas, Kelvins
- L = length of pipe, km
- d = inside diamter of pipe, mm
- E = pipeline flow efficiency factor (see below)

The value of E, ideally 1.00, varies between 0.92 and 0.96 for aluminum, with 0.94 usually taken as average. For steel pipe, E varies between 0.82 and 0.92 and averages 0.88. In terms of capacity this gives aluminum pipe an advantage varying between 3.2% and 15.8% and averaging 6.8% over steel pipe of the same internal diameter.

Assuming a pressure base of P_o of 101.594 kPa and a temperature base T_o and actual temperature T_f both of 15^0 C, i.e. 288.7 K for a gas of specific gravity 0.60 flowing through aluminum pipe with an efficiency factor of 0.94, the formula simplifies to:

$$Q = 0.794\,(10)^{-3}\left[\frac{P_1^2 - P_2^2}{L}\right]^{0.5394} d^{\,2.6182} = m^3/d$$

Flow Rate and Pressure Drop of Liquids

Hazen-Williams Formula – an empirical equation

$$\Delta p^{0.54} = \frac{11.07 \times 10^{6}\ Q\ G^{0.54}}{C\ d^{2.63}}$$

$$Q = \frac{C\ \Delta p^{0.54}\ d^{2.63}}{11.07 \times 10^{6} \times G^{0.54}}$$

where Δp = pressure drop, kPa / km
Q = rate of flow, m^3 / h
G = relative density
d = inside diameter of pipe, mm
C = roughness factor (see below)

When aluminum's common C factor, (see below) is applied to the formula, it becomes:

$$Q = 13.1 \times 10^{-6} \left(\frac{\Delta p}{G}\right)^{0.54} d^{2.63}$$

Or,

$$d = \left[\frac{Q}{13.1 \times 10^{-6}} \left(\frac{G}{\Delta p}\right)^{0.54} \right]^{0.38}$$

C Factors for Various Pipe Material

Type of Pipe	Value of C: Range [1]	Average[2]	Common[3]
Aluminum Pipe – extruded	160 - 140	150	145
Iron or steel with bitumastic-enamel lining	160 - 130	148	140
Welded and seamless steel	150 - 80	140	100
Copper, brass, lead, tin or glass pipe and tube	150 - 120	140	130
Tar-coated cast-iron	145 - 80	130	100
Concrete	152 - 80	120	100

1 Range: High – best, smooth, well laid
Low – poor or corroded
2 Average value for clean new pipe
3 Common value used for design purposes

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Chemical Composition Limits

Alloy designation	Chemical composition, in % by mass							
	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
6061	0.4-0.8	0.7	0.15-0.40	0.15	0.8-1.2	0.04-0.35	0.25	0.15
6063	0.20-0.6	0.35	0.10	0.10	0.45-0.9	0.10	0.10	0.10

Mechanical Properties

Alloy designation and temper	Tensile strength, MPa	Yield strength, MPa (0.2 offset)
6061-T6	262	241
6063-T1A	130	72
6063-T1B	130	86

Temperature Limitations

Both 6063 T1A and 6063 T1B are not derated up to 90 degrees C. It should be noted that unless otherwise specifically ordered, coiled aluminum pipe is coated with Shaw Pipe Protection yellow jacket coating and this coating is recommended for operating environments with a maximum operating temperature of 60 degrees C. Therefore the coating will be the first limiting factor with regards to temperature.

For applications in higher than 93 degree C environments an engineering assessment would have to be completed.

Linear Coefficient of Thermal Expansion and Modulus of Elasticity

Design temperature, °C-1	Up to -46	-45 to +21	+22 to +93	+94 to +149	+ 150 to +204
Linear coefficient of thermal expansion (α), $°C^{-1}$ (x 10^{-6})	20.9	22.1	23.4	23.9	24.5
Modulus of Elasticity, (E_c), (MPa)	71 700	68 900	67 600	65 500	62 100