

Australian Standard[®]

Design charts for water supply and sewerage



This Australian Standard® was prepared by Committee PL-045, Plastics Pipe Systems Test and Calculation Methods. It was approved on behalf of the Council of Standards Australia on 13 October 2005.

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The following are represented on Committee PL-045:

- Australian Chamber of Commerce and Industry
 - Australian Nuclear Science and Technology Organisation
 - CSIRO Manufacturing and Infrastructure Technology
 - Certification Interests (Australia)
 - Energy Networks Association
 - Engineers Australia
 - Master Plumbers, Gasfitters and Drainlayers New Zealand
 - New Zealand Water and Waste Association
 - Plastics Industry Pipe Association of Australia
 - Plastics New Zealand
 - Water Services Association of Australia
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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee, PL-045, Plastics pipe systems test and calculation methods to supersede AS 2200—1978.

This Standard incorporates Amendment No. 1 (April 2009). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

After consultation with Stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian, rather than an Australian/New Zealand Standard.

The objective of this Standard is to provide designers of pipelines for the conveyance of water and sewerage, with a set of charts and mathematical formulae for the determination of flow characteristics.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard. Other notes are for information and guidance only.

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FOREWORD

The pipe-flow charts in this Standard are based on the Manning formula and the Colebrook-White formula. These two formulae were chosen as they represent those most commonly used for pipeline design in Australia. Designers will need to make their own choice as to which formula they wish to adopt.

It must be realized that the charts and formulae on which they are based may have limitations on the range of velocities, diameters and roughness coefficients to be used. They may be inaccurate particularly where the parameters used are outside the conditions upon which the formulas were originally based. A guide to roughness coefficients for various pipe materials is given in Table 2.

The Colebrook-White formula is regarded by many hydraulic design experts throughout the world as the most accurate basis for hydraulic design. It has had ample experimentation confirmation over wide conditions of flow.

STANDARDS AUSTRALIA

Australian Standard

Design charts for water supply and sewerage

1 SCOPE

This document provides design charts for the flow of liquid through pipes and fittings based upon surface roughness, diameter, velocity and hydraulic gradient. The resistance coefficients of fittings are also included.

The use of computer spreadsheets and programmable calculators has allowed the determination of pipe flow and head loss to be made without the use of charts. Where the unknown factor is the hydraulic gradient, this can be determined either by successive approximation using the Colebrook-White formula or by use of Moody's approximation to the Colebrook-White transition formula.

Therefore the charts provided in this document are for approximate evaluations only. For critical calculations the mathematical formulae must be used.

2 DERIVATION OF CHARTS

2.1 Formulae

The design charts are based on the following formulae:

(a) Manning:

$$V = \frac{1}{n} R^{0.67} S^{0.5}$$

or

$$V = \frac{0.3950}{n} D^{0.67} S^{0.5}$$

(b) Colebrook-White:

$$V = -(32gRS)^{0.5} \log \left(\frac{k}{14.8R} + \frac{1.255v}{R(32gRS)^{0.5}} \right)$$

or

$$V = -2(2gDS)^{0.5} \log \left(\frac{k}{3.7D} + \frac{2.51v}{D(2gDS)^{0.5}} \right)$$

where

n	=	Manning roughness coefficient
k	=	Colebrook-White roughness coefficient, in metres
V	=	velocity, in metres per second
R	=	hydraulic radius, in metres, ($= D/4$ for circular pipes)
D	=	circular cross-section pipe, inside diameter, in metres
S	=	slope, in metres per metre

- g = gravitational acceleration, in metres per second squared
- ν = kinematic viscosity of water, in square metres per second.

2.2 Kinematic viscosity of water at various temperatures

The kinematic viscosities for water at various temperatures given in Table 1 allow designers to evaluate the effects of water at various temperatures.

TABLE 1
KINEMATIC VISCOSITY ν BETWEEN 0°C and 50°C

Temperature °C	Kinematic viscosity ν m ² /s
0	1.79×10^{-6}
4	1.57×10^{-6}
5	1.53×10^{-6}
10	1.31×10^{-6}
15	1.14×10^{-6}
20	1.01×10^{-6}
25	8.95×10^{-7}
30	8.03×10^{-7}
35	7.25×10^{-7}
40	6.58×10^{-7}
45	5.95×10^{-7}
50	5.40×10^{-7}

NOTES:

- 1 The Colebrook-White charts have been drawn for a water temperature of 20°C. Although the temperature of water and sewage varies between seasons and also between localities, 20°C is considered to be a suitable mean value for Australian conditions. A temperature correction table has not been included because the increase or decrease in discharge due to temperature variations is small. In fact an increase or decrease in temperature of 10°C will vary the discharge by only about 3 percent.
- 2 Diameters given on the various charts represent internal diameters of pipes. Designers should therefore ensure that, when using the charts, actual internal diameters are applied, and not the 'nominal size' from the various Australian standards for pipes.
- 3 Examples of the use of the Colebrook-White formula charts are given in Appendix A. For some other charts, an example is given below the chart.

3 HYDRAULIC DESIGN OF PIPES—COLEBROOK-WHITE FORMULA

Charts 1 to 11 are based upon the Colebrook-White formula and assume the pipes are flowing full, with water at 20°C.

4 HYDRAULIC DESIGN OF PIPES—MANNING FORMULA

Chart 12 is based upon the Manning formula for pipes flowing full.

5 DEPTH/FLOW CHARACTERISTICS OF PIPES PART FULL

The relationship between proportional depth, velocity and discharge is given in Chart 13.

6 RESISTANCE AND ROUGHNESS COEFFICIENTS

A guide to resistance coefficients of valves and fittings is given in Chart 14. A guide to roughness coefficients for various pipe materials is given in Table 2.

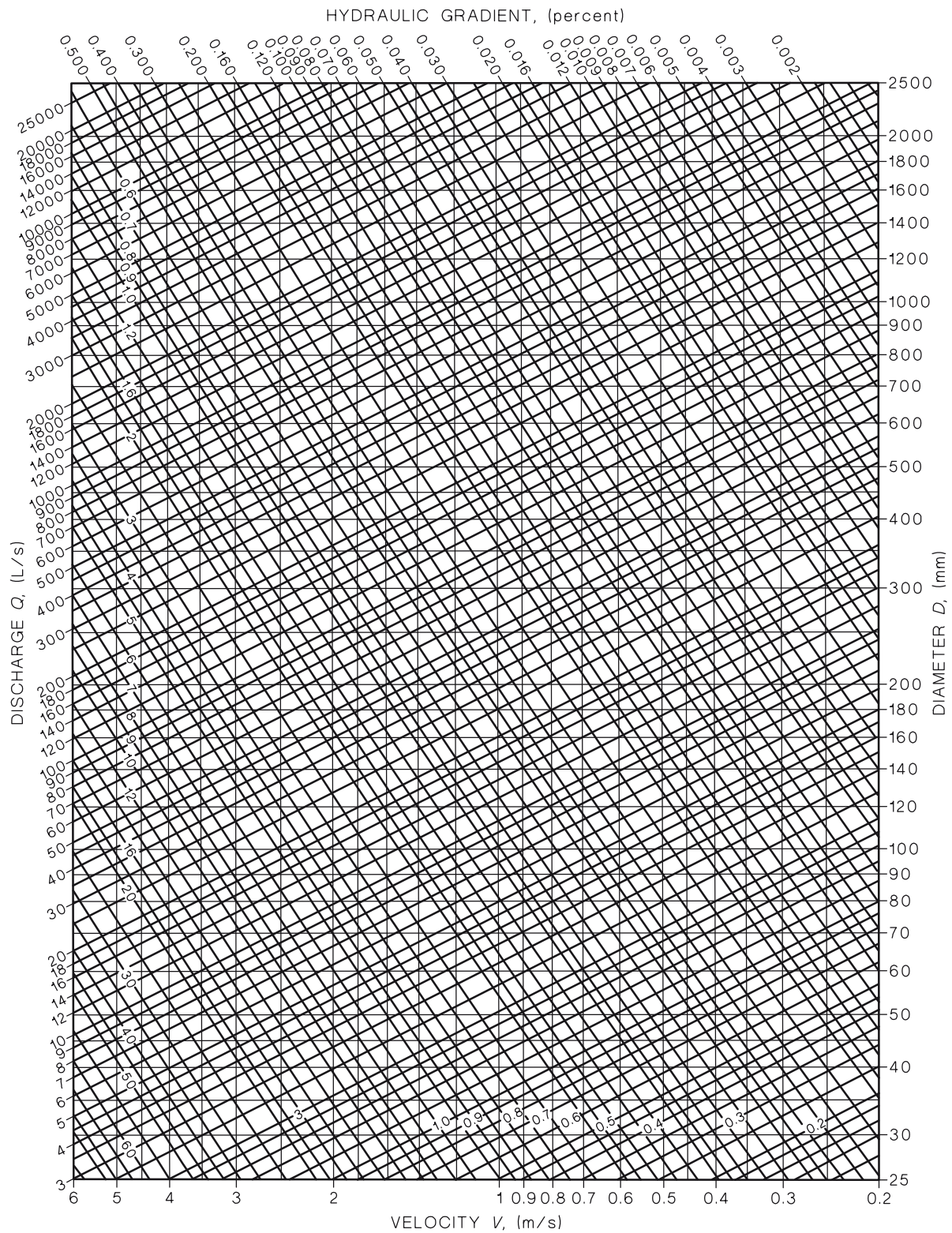


CHART 1 COLEBROOK-WHITE FORMULA WITH $k = 0.003$ mm