Bulletin on Formulas and Calculations for Casing, Tubing, Drill Pipe, and Line Pipe Properties

API BULLETIN 5C3
SIXTH EDITION, OCTOBER 1, 1994

Contains ISO 10400:1993

Petroleum and natural gas industries—Formulae and calculations for casing, tubing, drill pipe, and line pipe properties

American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005

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Exploration and Production Department

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FOREWORD

Note: This section is not part of ISO 10400:1993.

API Bulletin 5C3 serves as the basis for ISO 10400:1993. The complete text of both the API and ISO standards is contained in this document. Some differences exist between the API version and the ISO version of this standard; for example:

- The Special Notes and Foreword are not part of ISO 10400:1993.
- Section 12 is not part of ISO 10400:1993.

Language that is unique to the ISO version is shown in ***bold oblique type*** in the text or, where extensive, is identified by a note under the title of the section. Language that is unique to the API version is identified by a note under the title of the section or is shaded. The bar notations identify parts of this publication that have been changed from the previous API edition.

This standard is under the jurisdiction of the Committee on Standardization of Tubular Goods.

This standard shall become effective on the date printed on the cover but may be used voluntarily from the date of distribution.

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1 Scope

The purpose of this bulletin is to show the formulas used in the calculation of the various pipe properties given in API standards, including background information regarding their development and use. This bulletin is under the jurisdiction of the Committee on Standardization of Tubular Goods.

2 Collapse Pressure

2.1 COLLAPSE PRESSURE FORMULAS

The minimum collapse pressures given in API Bulletin 5C2 are calculated by means of Formulas 1, 3, 5, and 7, adopted at the 1968 Standardization Conference and reported in API Circular PS-1360 dated September 1968.

Formulas 2, 4, and 6 for the intersections between the four collapse pressure formulas have been determined algebraically and used for calculating the applicable *D/t* range for each collapse pressure formula. Factors A, B, C, F, and G have been calculated using Formulas 21, 22, 23, 26, and 27. When determining the appropriate formula to be used for calculating collapse resistance for a particular *D/t* ratio and minimum yield strength, the *D/t* ranges determined by Formulas 2, 4, and 6 govern, rather than the collapse formula that gives the lowest collapse pressure. The *D/t* ranges are given in Tables 1, 2, 3, and 4.

The collapse pressures for API Bulletin 5C2 are calculated using the specified values for *D* and *t*, rounding *D/t* to two decimals carrying eight digits in all intermediate calculations and rounding the collapse pressure to the nearest 10 pounds per square inch.

Theoretical studies of the effect of ovality on tubular collapse resistance consistently indicate that an ovality of 1 to 2 percent can effect a reduction in collapse resistance on the order of 25 percent. However, experimental/empirical investigations indicate a much smaller effect. Test data indicate that ovality is only one of many pipe parameters that influence collapse (including residual stress, isotropy, shape of stress-strain curve/microstructure, and yield strength). Thorough review of industry collapse data indicates that the influence of ovality does not warrant singling out the ovality as a dominant parameter. A work group on collapse resistance concluded the effect of ovality on tubular collapse has been handled during the adjustment of average collapse predictions to minimum performance values and that ovality should not be awarded the status of an independent variable in an API formula for collapse performance.

2.1.1 Yield Strength Collapse Pressure Formula

The yield strength collapse pressure is not a true collapse pressure, but rather the external pressure, P_{Y_p}, that generates minimum yield stress, Y_p, on the inside wall of a tube as calculated by Formula 1.

$$P_{Y_p} = 2Y_p\left[\frac{(D/t)-1}{(D/t)^2}\right] \quad (1)$$

Formula 1 for yield strength collapse pressure is applicable for *D/t* values up to the value of *D/t* corresponding to the intersection with the plastic collapse Formula 3. This intersection is calculated by Formula 2 as follows: