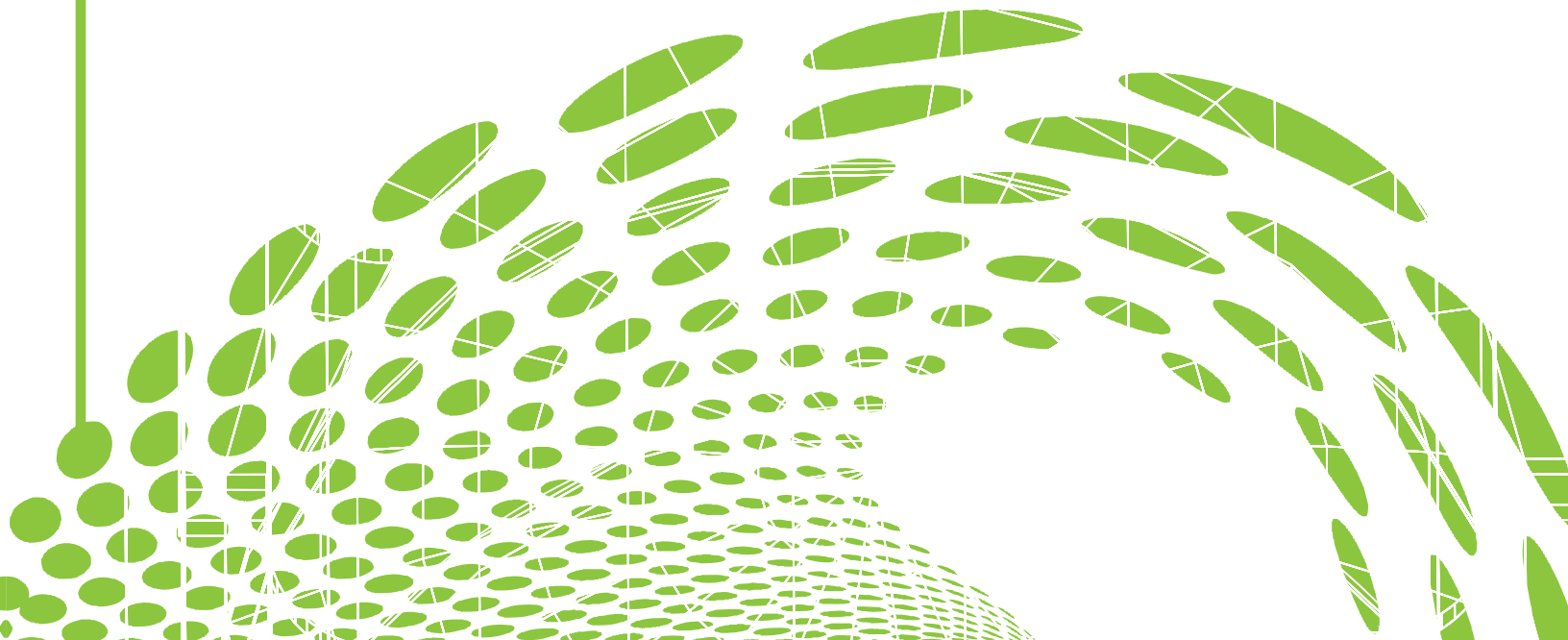
ASME STANDARDS TECHNOLOGY, LLC

STP-PT-087

YIELD STRENGTH VALUES UP TO MAXIMUM TEMPERATURE DESIGN



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YIELD STRENGTH VALUES UP TO MAXIMUM TEMPERATURE DESIGN

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FOREWORD

Table Y-1 of ASME Boiler & Pressure Vessel Code (BPVC) Section II Part D currently provides yield strength values up to 1000°F maximum, with some yield strength values at lower temperatures. The maximum design temperature in Tables 1A and 1B may be higher, therefore yield strength values need to be provided to be able to expand Table Y-1 up to the maximum temperature design of Table 1A-1B-5A and Table 1A-1B-5B for construction pursuant to ASME BPVC Section VIII Division 1 and Division 2.

The author acknowledges, with deep appreciation, the activities of ASME staff and volunteers who have provided valuable technical input, advice and assistance with review of, commenting on, and editing of, this document.

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ABSTRACT

The publication provides yield strength data for different materials (steels, copper, and nickel-base) for temperatures greater than the ones provided in current ASME BPVC IID/Y-1 tables. For this purpose, data from different sources were obtained. The current Y-1 Tables values were not to be affected; therefore, the data had to be fit to those values (customary and metric). This led to bumps in the curves, which were normalized by shifting the data of the current report (in the percent range). Providing smooth curves via a polynomial fit through all data is certainly an alternative, however, this would also affect values in ASME BPVC IID/Y-1 tables. The data provided in this report would allow for such a treatment.

ABBREVIATIONS AND ACRONYMS

AISI	American Iron and Steel Institute
ASM	American Society for Metals
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATI	Allegheny Technologies
BPVC	ASME Boiler & Pressure Vessel Code
DOE	United States Department of Energy
EURO INOX	European Stainless Steel Development Association
JTEVA	Journal of Testing and Evaluation
NIDI	Nickel Development Institute
ORNL	Oak Ridge National Laboratory
VDM	Vereinigte Deutsche Metallwerke AG

1 INTRODUCTION

In ASME BPVC Section VIII Division 1, the yield strength (Sy) is used directly, or indirectly through the allowable primary and secondary stress limit (SPS = max [3S, 2Sy]), and in many of the design rules, such as:

(a) UG-28 and UG-33 – External pressure: Calculation of allowable external pressure on cylinders and heads – Sy [see UG-28(c)(2) Step 3]

(b) Part UHX – Shell-and-tube heat exchangers: Secondary stress limit in tube sheets, channels, shells, and expansion joints – SPS 27 October 2015 Page 2 of 6

(c) Part UHX – Fixed tube sheet heat exchangers: Allowable tube buckling stress at design temperature – Sy

(d) Appendix 1-4 – Design of Head: Yield strength at design temperature – Sy

(e) Appendix 1-5 and 1-8 – Conical Reducers: Discontinuity stress limit and operating metal temperature – SPS

(f) Appendix 5 – Flanged-and-Flued and Flanged-Only Expansion Joints: Thermally induced stress limit at operating metal temperature – SPS

(g) Appendix 13 – Noncircular Vessels: Plate buckling stress at design temperature

(h) Appendix 26 – Bellows Expansion Joints: Calculation of instability due to internal pressure at design temperature – Sy

(i) Non-mandatory Appendix A – Tube-to-Tube sheet Joint Loads: Calculation of tube joint interface pressure at the operating metal temperature – Sy

Because Table Y-1 provides yield strength values up to 1000°F maximum, yield strength values up to the maximum temperature design are needed.

Due to the large number of missing values, the materials investigated will be restricted to the list below, which correspond to the most commonly used materials for heat exchangers.