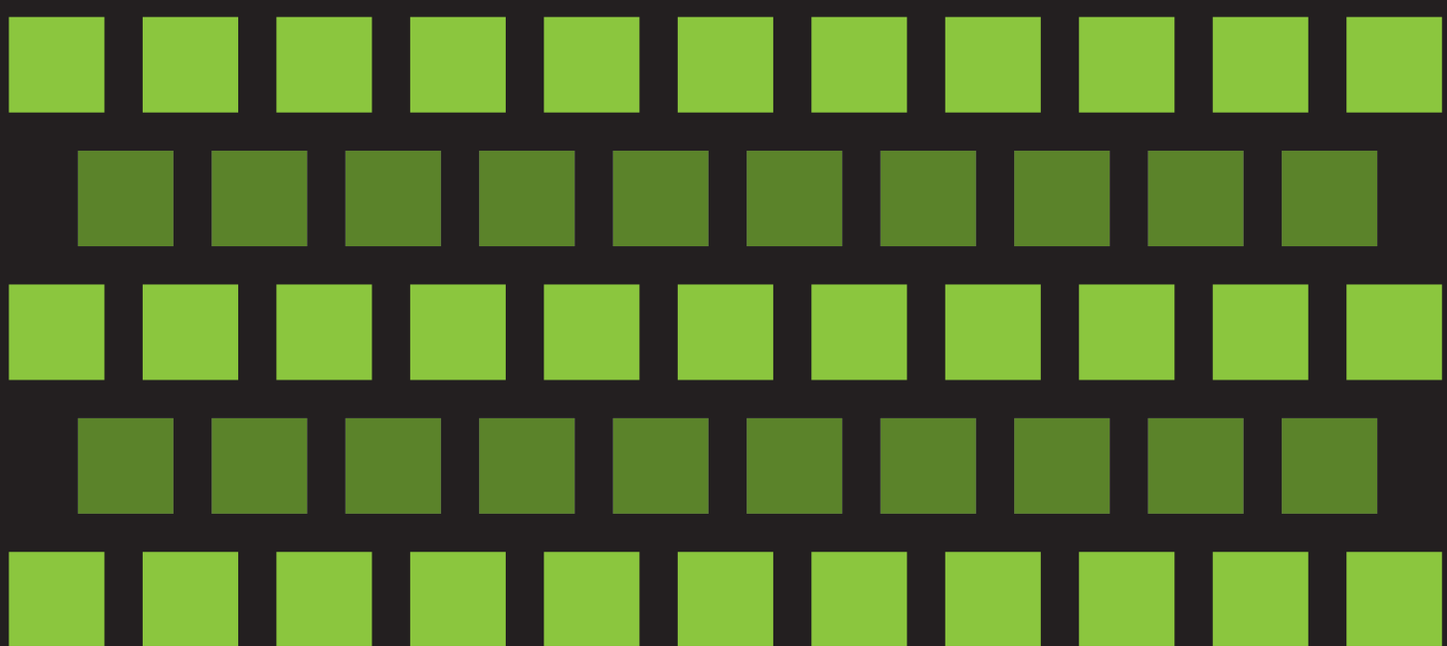
STP-PT-026

GUARANTEED HIGHER STRENGTH PROPERTIES



ASME STANDARDS TECHNOLOGY, LLC

STP-PT-026

GUARANTEED HIGHER STRENGTH PROPERTIES

Prepared by:

Elmar Upitis
Becht Engineering Company

ASME STANDARDS TECHNOLOGY, LLC

Date of Issuance: January 29, 2009

This report was prepared as an account of work sponsored by ASME Pressure Technologies Codes and Standards and the ASME Standards Technology, LLC (ASME ST-LLC).

Neither ASME, ASME ST-LLC, Becht Engineering Co. nor others involved in the preparation or review of this report, nor any of their respective employees, members or persons acting on their behalf, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe upon privately owned rights.

Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer or otherwise does not necessarily constitute or imply its endorsement, recommendation or favoring by ASME ST-LLC or others involved in the preparation or review of this report, or any agency thereof. The views and opinions of the authors, contributors or reviewers of the report expressed herein do not necessarily reflect those of ASME ST-LLC or others involved in the preparation or review of this report, or any agency thereof.

ASME ST-LLC does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a publication against liability for infringement of any applicable Letters Patent, nor assumes any such liability. Users of a publication are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this publication.

ASME is the registered trademark of the American Society of Mechanical Engineers.

No part of this document may be reproduced in any form,
in an electronic retrieval system or otherwise,
without the prior written permission of the publisher.

ASME Standards Technology, LLC
Three Park Avenue, New York, NY 10016-5990

ISBN No. 978-0-7918-3202-8

Copyright © 2009 by
ASME Standards Technology, LLC
All Rights Reserved

TABLE OF CONTENTS

LIST OF FIGURES

FOREWORD

This document was developed under a research and development project which resulted from ASME Pressure Technology Codes & Standards (PTCS) committee requests to identify, prioritize and address technology gaps in current or new PTCS Codes, Standards and Guidelines. This project is one of several included for ASME fiscal year 2008 sponsorship which are intended to establish and maintain the technical relevance of ASME codes & standards products. The specific project related to this document is project 07-07 (BPVC#4), entitled, "Guaranteed Strength Properties."

Established in 1880, the American Society of Mechanical Engineers (ASME) is a professional not-for-profit organization with more than 127,000 members promoting the art, science and practice of mechanical and multidisciplinary engineering and allied sciences. ASME develops codes and standards that enhance public safety, and provides lifelong learning and technical exchange opportunities benefiting the engineering and technology community. Visit www.asme.org for more information.

The ASME Standards Technology, LLC (ASME ST-LLC) is a not-for-profit Limited Liability Company, with ASME as the sole member, formed in 2004 to carry out work related to newly commercialized technology. The ASME ST-LLC mission includes meeting the needs of industry and government by providing new standards-related products and services, which advance the application of emerging and newly commercialized science and technology, and providing the research and technology development needed to establish and maintain the technical relevance of codes and standards. Visit www.stllc.asme.org for more information.

ABSTRACT

This report discusses the various aspects related to the tensile properties in plates and forgings, including the feasibility of using guaranteed tensile values that exceed the specified minimum tensile strength in the material specifications, and provides recommendations for design stresses and Code construction based on the higher guaranteed tensile and yield strength values.

The issues discussed in this report apply mainly to tensile strength values higher than the minimum specification values since the tensile strength generally governs the Code allowable stresses for carbon and low alloy steels for Section VIII, Division 1 construction. However, with the increase in tensile strength there is also an increase in the yield strength. The yield strength may govern the Code allowable stresses for Section VIII, Division 2 and 3 construction

1 INTRODUCTION

Material specifications list the specified minimum yield strength, minimum and, in most cases, maximum tensile strength and values for materials and grades covered by the specification. The tensile properties for a particular material and grade are based on chemical composition, heat treatment, thickness and production data. The tensile properties can also be influenced by the amount of work (reduction) during the rolling process, resulting in higher values for thin plates than for thick plates. The mill production data must show that all tensile strength values are within the specified tensile strength ranges and that the yield strength values exceed the specified minimum values to make it commercially acceptable for the producer of that material. Increasing the specified minimum tensile strength or yield strength would involve a commercial decision by the material producer, based on his production data and the expected rejection rate, as to what minimum specified tensile properties above the specification values are acceptable to that producer.

Improved melting practices, chemistry controls and rolling practices can result in improved notch toughness and tensile properties. Typical production data indicate that often the actual tensile properties (tensile strength and yield strength) significantly exceed the specified minimum properties, particularly in thinner plates. Some industry standards (e.g., API 650, Welded Steel Tanks for Oil Storage, CODAP) recognize this and include provisions for use of higher tensile properties. API 650 permits an increase up to 5 ksi above the specified minimum values for certain carbon steels. These higher tensile strength values are subject to agreement between the purchaser and the material producer. The use of higher guaranteed tensile properties (where this is feasible) reduces the weight of the vessel component, resulting in savings to the vessel manufacturer and the owner.