ASME STANDARDS TECHNOLOGY, LLC

STP-PT-097

STRESS INTENSIFICATION FACTOR, K-FACTOR, AND SUSTAINED STRESS INDEX DEVELOPMENT–PHASE II

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FOREWORD

We would like to express our thanks to Mr. Glynn Woods, GCS Consulting Services., Mr. Willy Lock and Dr. Delin Wang of PRG (Paulin Research Group), Dr. Hans Bos of Dynaflow Research Group bv., Mr. Ron Haupt of Pressure Piping Engineering Associates, Inc., Mr. Randy Bethea, Tim Pline, and Russ Diedrich of Huntington Ingalls Industries – Newport News Shipbuilding, and Mr. Doug Knode and Edwin Avila of Evident Scientific/Olympus. Their assistance, comments and recommendations are very much appreciated.

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ABSTRACT

In support of ASME B31J and B31H standards, physical testing for stress intensification factors (SIFs), flexibility factors (k-Factors), and sustained stress indices (SSIs) can be used to confirm differences between the Markl and Hinnant curves in the low-cycle ranges and finite element predictions of fatigue, stiffness, collapse and burst.

Improvement in analytical capability since the 1950s (when Markl developed the basic rules in the B31 piping codes used today) has improved the ability to numerically predict stress states. Unfortunately, not all piping components are well defined geometrically or dimensionally in ASME standard documents. Large D/T (ratio of mean header diameter to header nominal thickness) and d/D (ratio of mean branch diameter to mean header diameter) failures involve nonlinear characteristics that may not be well represented by elastic analyses. In these cases, verification by test is considered essential to verify the predicted values and the method of analysis considered.

This publication documents the results of phase II of work undertaken to investigate deficiencies in the existing test data sets identified during the data collection effort from ST-LLC Publication STP-PT-073.

ABBREVIATIONS AND ACRONYMS

ASME	- American Society of Mechanical Engineers
MTR	- Material Test Reports
NPS	- Nominal Pipe Size
NPT	- American National Standard Taper Pipe Thread
PRG	- Paulin Research Group
SCH	- Pipe Schedule
SIF	- Stress Intensification Factors
SSI	- Sustained Stress Indicators
STD	- Standard
ST-LLC	- Standards Technology, Limited Liability Company
WRC	- Weld Research Council

1 INTRODUCTION

Twelve straight pipe specimens were fabricated, material properties independently evaluated, and each specimen was pressurized to rupture at K&H Fabricator's facility in Smithville, Texas. The specimens were segregated into stainless and carbon groups, each group consisting of six specimens: three seamless specimens and three longitudinally welded specimens. Pipe specimens for each group of three tests were made from the same heat so that theoretically three identical specimens could be tested. A significant finding of these results is stainless steel samples failed at a consistently lower pressure than would otherwise be predicted for the same specimen made of carbon steel. This supports prior findings by Rodabaugh in [1].