**ASME PTB-6-2013** 

# Guidelines for Strain Gaging of Pressure Vessels Subjected to External Pressure Loading in the PVHO-1 Standard



PTB-6-2013

# GUIDELINES FOR STRAIN GAGING OF PRESSURE VESSELS SUBJECTED TO EXTERNAL PRESSURE LOADING IN THE PVHO-1 STANDARD

Lawrence J. Goland

Southwest Research Institute



#### PTB-6-2013

#### Date of Issuance: June 21, 2013

This document was supported by ASME Pressure Technology Codes and Standards (PTCS) through the ASME Standards Technology, LLC (ASME ST-LLC).

Neither ASME, the author, nor others involved in the preparation or review of this document, 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 or others involved in the preparation or review of this document, or any agency thereof. The views and opinions of the authors, contributors and reviewers of the document expressed herein do not necessarily reflect those of ASME or others involved in the preparation or review of this document, or any agency thereof.

ASME does not "approve," "rate", or "endorse" any item, construction, proprietary device or activity.

ASME 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 standard against liability for infringement of any applicable letters patent, nor assume any such liability. Users of a code or standard 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.

The American Society of Mechanical Engineers

Two Park Avenue, New York, NY 10016-5990

Copyright © 2013 by THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

All rights reserved

Printed in the U.S.A.

# TABLE OF CONTENTS

Forew	ord	V
Abstra		vi
Acknowledgements		
1	PURPOSES OF STRAIN GAGING PRESSURE HULL	1
1.1	General	1
1.2	Monitoring For Behavior	1
1.3	Monitoring For Stability	2
2	STRAIN GAGE ROSETTE TYPES AND RECOMMENDED USES	3
2.1	General	3
2.2	Use of Uniaxial Strain Gages	4
2.3	Use of Biaxial (Tee) Strain Gage Rosettes	4
2.4	Use of Triaxial Strain Gage Rosettes	5
3	NOMENCLATURE FOR PRESSURE HULLS	6
4	GENERAL GUIDELINES FOR LOCATIONS OF STRAIN GAGES AND ROSETTES	9
5	EXAMPLE OF BASIC STRAIN GAGE LOCATIONS	10
6	EXAMPLE OF COMPLEX STRAIN GAGE LOCATIONS	12
6.1	General	12
6.2	Locations on Ring-Stiffened Cylindrical Hull	17
6.3	Locations on Hemispherical Heads	17

## LIST OF FIGURES

Figure 2.1 – Examples of Uniaxial and Typical Strain Gage Rosettes	3
Figure 3.1 – Illustrative Hull Components	6
Figure 3.2 – End Bay Region in Typical Ring Stiffened Hull (and Exaggerated Displaced	t
Shape under External Pressure Load)	7
Figure 3.3 – Out-of-Circularity (OOC) of Cylindrical Pressure Hull	7
Figure 3.4 – Out-of-Fairness (OOF) of Cylindrical Pressure Hull	8
Figure 3.5 – Out-of-Sphericity (OOS) of Spherical/Hemispherical Pressure Hull	8
Figure 5.1 – Basic Strain Gage Location on Pressure Hull 1	0
Figure 6.1 – Complex Strain Gage Locations on Pressure Hull 1	3

### PTB-6-2013

Figure 6.2 – Complex Strain Gage Locations on Pressure Hull	. 14
Figure 6.3 – Complex Strain Gage Locations on Pressure Hull	. 15
Figure 6.4 – Complex Strain Gage Locations on Pressure Hull	. 18
Figure 6.5 – Complex Strain Gage Locations on Pressure Hull	. 19
Figure 6.6 – Complex Strain Gage Locations on Pressure Hull	. 20
Figure 6.7 – Complex Strain Gage Locations on Pressure Hull	. 21
Figure 6.8 – Complex Strain Gage Locations on Pressure Hull	. 22
Figure 6.9 – Complex Strain Gage Locations on Pressure Hull	. 23
Figure 6.10 – Complex Strain Gage Locations on Pressure Hull	. 24
Figure 6.11 – Complex Strain Gage Locations on Pressure Hull	. 25
Figure 6.12 – Complex Strain Gage Locations on Pressure Hull	. 26
Figure 6.13 – Complex Strain Gage Locations on Pressure Hull	. 27