Stress Calculation of GDS Expansion Tank

Calculation No: NSTXU-CALC-33-05-00   **Revision No:** 0

Title: Stress Calculation of GDS Expansion Tank

Purpose of Calculation: (Define why the calculation is being performed)

The stress analysis of GDS expansion tank is to provide its design guidance and verification for the NSTX-U gas delivery system.

Codes and versions: (List all codes, if any, used)   ANSYS Workbench 19.0

References: (List any source of design information including computer program titles and revision levels.)
1. Burst Disc, Final Design Report, NSTX-U-DOC-103-00, by W. Blanchard, 2018.
2. ASME Code for Pressure Piping, B31.3-2014.
3. NSTX Structural Design Criteria Document, NSTX_CRIT-0001-02B.pdf, by I. Zatz.
4. Tank Drawing Number E-EA3509.

Assumptions: (Identify all assumptions made as part of this calculation.)

The tank pressure is uniformly applied on the tank internal surfaces. The model is fixed at four corner points of the bottom plate to simulate the tank is sitting on the ground idly

Calculation: (Calculation is either documented here or attached)

See attached Report.

Conclusion: (Specify whether or not the purpose of the calculation was accomplished.)

While applying 80 PSIG on the internal surfaces of the expansion tank, the calculated max stress intensity of the GDS expansion tank is below the requirement stress of 143 MPa with the stainless steel 304SS container.

Cognizant Individual (or designee): Dang Cai _____ 09/12/2018

Preparer: Jiarong Fang _____ 09/12/2018

I have reviewed this calculation and, to my professional satisfaction, it is properly performed and correct.
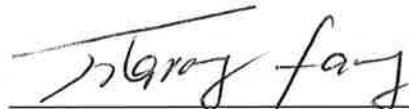
Checker: Peter Titus: _____ 9/12/2018

National Spherical Torus eXperiment - Upgrade

NSTX-U

Stress Calculation of GDS Expansion Tank

NSTXU-CALC-33-05-00

May 18, 2018

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05/24/2018

Approved By – Responsible Engineer
Dang Cai, Vacuum Systems and Fueling

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NSTX-U CALCULATION

Record of Changes

Rev.	Date	Description of Changes	Revised by
0	5/18/18	Initial Release	

Stress Calculation of GDS Expansion Tank

NSTX-U Calculation Form

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4. Tank Drawing Number E-EA3509.

Assumptions:

These are discussed throughout the attached report.

Calculation:

See attached Report.

Conclusion:

While applying 80 PSIG on the internal surfaces of the expansion tank, the calculated max stress intensity of the GDS expansion tank is below the requirement stress of 143 MPa with the stainless steel 304SS container.

Stress Calculation of GDS Expansion Tank

Table of Contents

4.0 Executive Summary

This report is intended to provide designers the stress analysis of the expansion tank to meet the stress requirement of container for the NSTX-U gas delivery system. The max stress intensity of is below the requirement stress of 143 MPa with a tank internal pressure of 80 PSIG.
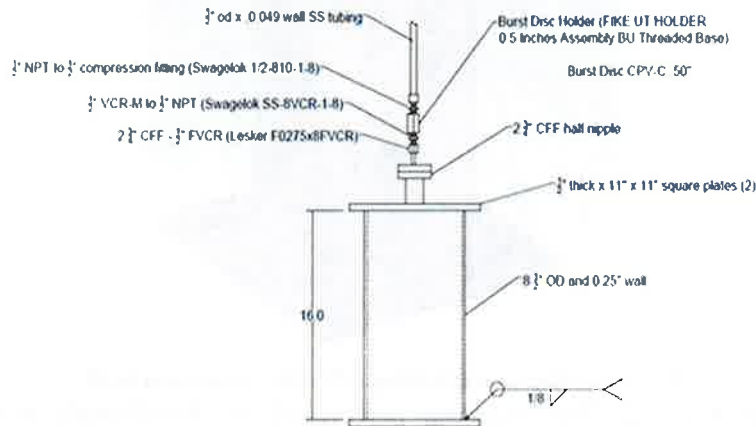
5.0 Introduction

Fig. 5-1 GDS expansion tank with the Interspace Pumping System

Figure 1 shows GDS expansion tank with the Interspace Pumping System. The normal operating pressure of the tank is vacuum (<1ATM). A burst disc will be connected to the expansion tank, and the worst overpressure protected by the burst disk is 40 PSIG.

6.0 Mathematical Modelling

6.1 Geometry

Fig. 6-1 The cross-section view of GDS expansion tank

The cross-section view of GDS expansion tank is shown in Figure 6-1.

6.2 Meshing

Fig. 6-2 The fine meshing of GDS expansion tank

As shown in Figure 6-2, the fine meshing performed by Workbench is located around the weldment areas and connection parts.
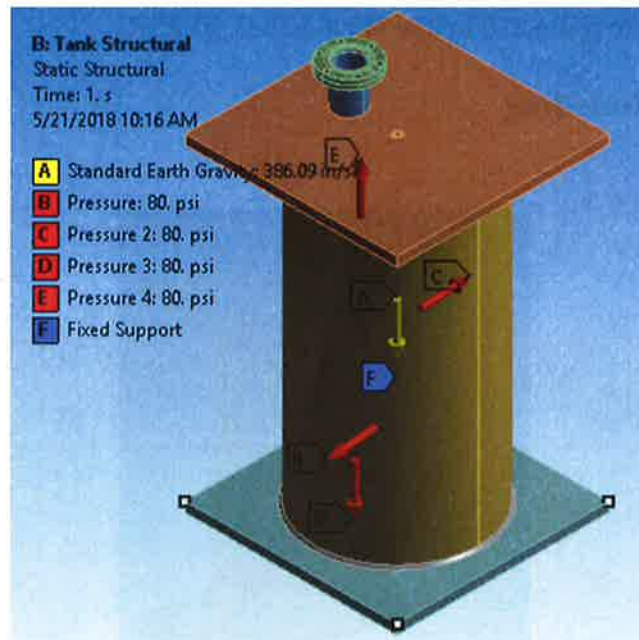
6.3 Boundary Conditions and Loads

Fig. 6-3 The boundary conditions and loads of GDS expansion tank

For a safety margin, we choose 80psi as the tank internal pressure. As shown in Figure 6-3, the model is fixed at four corner points of the bottom plate to simulate the tank is sitting on the ground idly.

7.0 Analysis Results

Fig. 7-1 The stress intensity of GDS expansion tank

Figure 7-1 shows that the max stress intensity is 134MPa, less than the required 143MPa for 304SS container according to the design criteria defined by reference 2-3.