Cryogenic Flange and Seal Evaluation

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Nomenclature

LC-39 = Launch Complex 39
KSC = Kennedy Space Center
LN2 = Liquid Nitrogen
LO2 = Liquid Oxygen

I. Abstract

The assembly of flanges, seals, and pipes are used to carry cryogenic fluid from a storage tank to the vehicle at launch sites. However, after a certain amount of cycles these raised face flanges with glass-filled Teflon gaskets have been found to have torque relaxation and are as a result susceptible to cryogenic fluid leakage if not re-torqued. The intent of this project is to identify alternate combinations of flanges and seals which may improve thermal cycle performance and decrease re-torque requirements. The general approach is to design a test fixture to evaluate leak characteristics between spiral and concentric serrations and to test alternate flange and seal combinations. Due to insufficient time, it was not possible to evaluate these different types of combinations for the combination that improved thermal cycle performance the most. However, the necessary drawings for the test fixture were designed and assembled along with the collection of the necessary parts.

II. Introduction

Flanges at Launch Complex 39 (LC-39) were disassembled in the 1980's and both spiral and concentric serrated flanges were found. Kennedy Space Center (KSC) has experienced torque relaxation with both of these raised face flanges with glass-filled Teflon gaskets, causing them to be prone to leaks when not re-torqued. Therefore, a test set-up that can be used for testing different combinations of flanges and seals will be designed and assembled using PTC Creo, a design software. Once the drawing models are done and approved, the next step will be to weld the assembly together and prepare it for testing by doing a cold-shock test. This is the NE NASA design process that is followed.[1] Along with the design and model of the testing fixture, a skid to place the testing set-up on, must also be designed and put together. Once all of this is done, several cycles will be done on the alternate combinations of flange and seals in order to evaluate the combination that results in the least amount of leakage. Improving thermal cycle performance is the major goal of this project.

III. Methodology/Technical Approach

In order to evaluate which alternate flange and seal combination will result in the most efficient thermal cycle performance, several cycles will be done on the test fixture, only changing in the types of flanges and seals it contains. As shown in Figure 1, the flanges and seals will be interchanged on the ends of the fixture. The idea is to analyze alternate seal and flange combinations on both sides of the test fixture. The alternate combinations that will be used on the left side of the fixture are raised face spiral flange on raised face spiral flange, and raised face concentric flange on raised face spiral flange. The alternate combinations that will be used on the right side are raised face concentric flange on raised face concentric flange. Along with the alternate combinations of

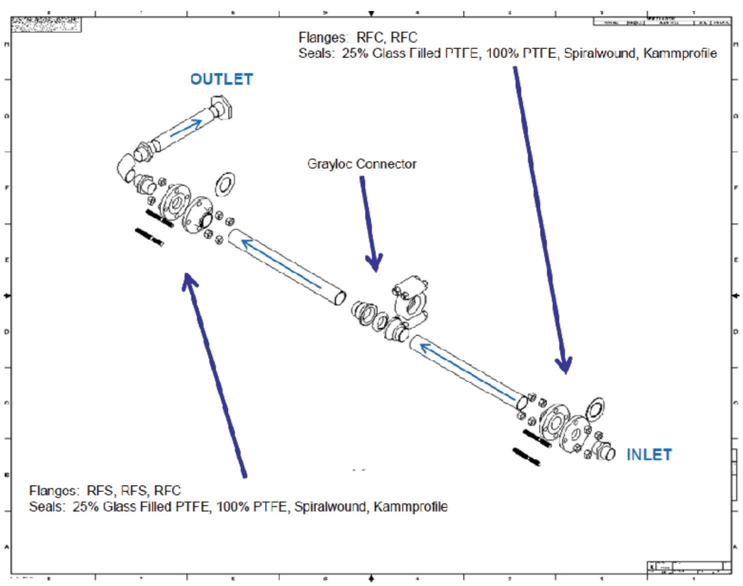

Figure 1. Test fixture with interchangeable locations shown.

flanges, the seals in between the flanges will change as well. The seals that will be used are 25% glass-filled PTFE, 100% PTFE, Spiralwound, and Kammprofile. However, before the testing procedure can be reached, the testing fixture had to be designed and assembled. As mentioned earlier, the design software PTC Creo was used to model this set-up. After the model was done, drawings for the pipe spools on each side were done, as shown on figure 2. The pipe spool on the left will have a concentric flange welded onto the pipe and the pipe spool on the right will have a spiral flange welded onto that pipe.

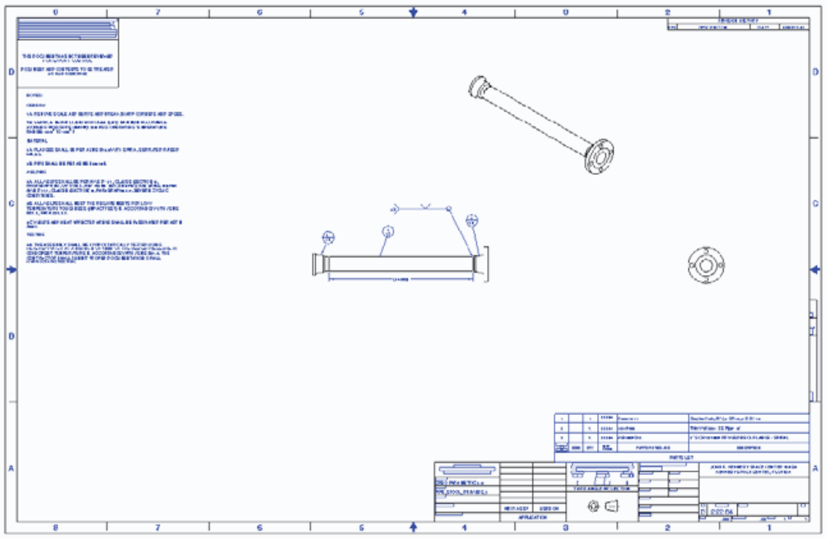

Figure 2. Pipe spool drawing for the right end.

After the drawings are approved and the parts have been welded together then the next step will be to run the tests. Liquid nitrogen (LN2) which resembles liquid oxygen temperatures (LO2) will be used for testing purposes for cost and safety reasons.

IV. Conclusion

This project was not completed by the time of this report. The advances made for this project include, the drawings for the pipe spools, the model for the complete testing fixture, and the collection of the necessary parts. The next step at this point is to submit the drawings for approval and weld all the parts together in order to obtain the full testing fixture. During the few weeks that still remain for this project, it is intended to have the test fixture welded and ready for testing. Once the testing fixture is done, a design for a skid to place the fixture on is the next step. The project will conclude once each of the alternate combinations is put through several cycles of flowing LN2 and the combination that improves thermal cycle performance is determined.

Acknowledgments

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