ASSEMBLY OF ATLAS POWER FLOW CHANNEL

M. Salazar, S. Feng, J. Griego and P. Reardon
Polymers and Coatings Group, MST-7
Material Science and Technology Division
Los Alamos National Laboratory
Los Alamos, NM 87545, USA

Abstract

Assembly of the Atlas Power Flow Channel (PFC) containing the target cassette was a difficult operation prior to moving the machine to the Nevada test site (NTS). The assembly operation consisted of the target cassette manufactured at the Target Fabrication Facility of Los Alamos National Laboratory (TFF), vacuum containment hardware, and the PFC. The combination was made up of approximately 317 separate components that were required to fit accurately and become vacuum tight. The assembly process also included wired diagnostic feed through and x-ray diagnostic components inside the vacuum containment. All this activity occurred for each experiment on the deck of the Atlas machine. Each experiment altered the position of the conductor plates due to the dynamic forces of the electrical and magnetic pulse causing each subsequent installation to be unique with its own unique problems. An evolutionary design for the Atlas vacuum envelope (VE) eliminates the fit problems on the machine and reduces components assembled on the Atlas deck to one vacuum envelope assembled in a laboratory consisting of approximately 223 parts, and one part for mating to the PFC. The original Atlas PFC had a pumped volume of approximately 37.7 liters. The VE has a pumped volume of approximately 0.8 liters.

I. INTRODUCTION

The evolutionary design of the VE for Atlas at the NTS addresses many of the issues associated with the previous designs [1] as shown in Fig 1. Much of the Atlas assembly involved vacuum components, wired and fiber optic diagnostic feed through, and x-ray diagnostic components inside the vacuum containment.

The joints connecting the liner/glide plane assembly of the Atlas design [2] are a hard bolted design that has no accommodation in the vertical direction. The cryogenic fit liner/glide plane joints of the previous design separate easily because of the Atlas power flow channel non-uniformity. These joints relied exclusively on the inference of the glide plane/liner interface for electrical conductivity and structural integrity. Slipping the liner on the glide planes accommodates deviation in the vertical direction. This displacement adversely affected some experiments. The fabrication of the glide plane/liner of the Atlas design interface could not yield predictable assembly results.

Assembly of the VE (Fig. 2) is now a mechanically interfered joint type eliminating the cryogenic fit of precision components. The upper liner/glide plane interface joint [3] described uses wedging interference to securely join the glide plane, liner and return conductor into a strong assembly.

The lower liner/current joint [4] eliminates one of the cryogenic interfered joints. The lower liner/current joint also uses wedging interference to secure the hardware together. This different joint design allows a large accommodation of the separate components in the axial direction. This joint type is used in three places.

The Cassette is the now VE. This eliminates the Hex Chamber with its many penetrations. The Hex Chamber is replaced with the Hex Pipe, a very simple lattice pipe.

Figure 1. Old style Atlas PFC and Cassette assembly were used when the Atlas machine was located at Los Alamos National Laboratory.

Figure 2. Power Flow Channel and Cassette Assembly
Assembly of the Atlas Power Flow Channel (PFC) containing the target cassette was a difficult operation prior to moving the machine to the Nevada test site (NTS). The assembly operation consisted of the target cassette manufactured at the Target Fabrication Facility of Los Alamos National Laboratory (TFF), vacuum containment hardware, and the PFC. The combination was made up of approximately 317 separate components that were required to fit accurately and become vacuum tight. The assembly process also included wired diagnostic feed through and x-ray diagnostic components inside the vacuum containment. All this activity occurred for each experiment on the deck of the Atlas machine. Each experiment altered the position of the conductor plates due to the dynamic forces of the electrical and magnetic pulse causing each subsequent installation to be unique with its own unique problems. An evolutionary design for the Atlas vacuum envelope (VE) eliminates the fit problems on the machine and reduces components assembled on the Atlas deck to one vacuum envelope assembled in a laboratory consisting of approximately 223 parts, and one part for mating to the PFC. The original Atlas PFC had a pumped volume of approximately 37.7 liters. The VE has a pumped volume of approximately 0.8 liters.

### Subject Terms
- Assembly of the Atlas Power Flow Channel
- Atlas PFC
- Vacuum Envelope
- Los Alamos National Laboratory
- Target Fabrication Facility

### Distribution/Availability Statement
Approved for public release, distribution unlimited
structure. The entire Vacuum Envelope is assembled in the laboratory at TFF. Its diagnostics are installed and the entire system is vacuum leak checked. This single sealed unit is installed at Atlas/NTS.

II. VACUUM

The previous Atlas PFC vacuum may not have been as good as quoted due to the large volumes, material out gassing, long plumbing runs, and the remoteness of the gauging. Testing of the VE system that has much less volume, less surface area to outgas, short plumbing runs, and close gauging shows that a vacuum of no less than 5E-5 Torr can be achieved. Testing has revealed that out gassing exists in the VE design. A very tight leak system does not ensure that a good vacuum can be sustained without pumping. During vacuum testing it has become apparent that the vacuum in the test volume will rise quickly without continuous pumping. An auxiliary pump will be placed in line to run after mechanical pumps have been isolated.

III. HEX PIPE

The Hex Pipe is a simple lattice structure and takes the place of the Hex Chamber of the previous design. The replacement of the Hex Chamber decreases vacuum volume and the many vacuum seals associated with windows and bonded diagnostic penetrations. The current design is shown in Fig. 3. The Hex Pipe is a load carrying member used for lifting and for supporting the weights of the finished test assembly. The large openings allow better access to the experiment for placement of diagnostics.

IV. LINER

The new liner design is much longer. It is, however, much simpler to machine. The cryogenic fit of liner to glide plane has been eliminated. The upper joint uses mechanical wedging of the upper Glide Plane/Liner/Return Current Conductor into a single unit. The lower joint uses a different wedging system to assure electrical contact and structural integrity and the ability to accommodate vertical non-uniformity.
V. RETURN CURRENT CONDUCTOR

The Return Current Conductor (RCC) becomes the vacuum vessel. The vacuum volume of the new design is much less than the old design. The diameter of lower section of this component has increased from 14.39” to 27.7”. This increase eliminates a current joint and the associated hardware. Penetrations for diagnostics are accommodated at this level by easily sealed o-ring type compression fittings. The alignment of target load to RCC is done by asymmetric mounting holes. Rotational indexing is fixed by locating holes to the Atlas power flow channel. These features insure the exact alignment of diagnostics to the target load and the PFC. The Return Current Conductor is shown in Fig. 5.

VI. VACUUM ENVELOPE

The entire VE is assembled in the laboratory at TFF. The diagnostics are installed and the entire system is vacuum leak checked. This single sealed unit is installed at Atlas/NTS. As shown in Fig. 6, the VE is installation consists of only one part.

VII. CONCLUSION

Atlas Vacuum Envelope redesign has enabled the pumped volume to be reduced to approximately 2% of the old style. The total parts count of the VE is approximately 70% of the PFC. The parts assembled on the deck of Atlas are about 14% of the previous design. This extensive effort allows a more efficient and effective installation of the VE, faster turn around between experiments, and machine variability. Load vacuum and diagnostic issues can be solved in the lab as opposed to on deck. The VE can be readily redesigned to meet physics needs in both diameter and height.

Application of these techniques allows Atlas targets to be designed that are pressurized and subject to significant static load. These targets might contain liquid or gas in concentric layers. The residual stress analysis in conjunction with finite element analysis is assisting designing targets and target systems that are less massive, thus allowing experiments to be optimized and produce better diagnostic clarity.

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Laboratory, Los Alamos, NM 87545, USA

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