The combustor-diffuser system remains one of the most studied sections of the turbomachine. Most of these investigations are due to the fact that quite a bit of flow diffusion is required in this section as the high speed flow exits the compressor and must be slowed down to enter the combustor. Like any diffusion process there is the chance for the development of an unfavorable adverse pressure gradient that can lead to flow separation; a cause of drastic losses within a turbine. There are two diffusion processes in the combustor-diffuser system: The flow first exits the compressor into a pre-diffuser, or compressor discharge diffuser. This diffuser is responsible for a majority of the pressure recovery. The flow then exits the pre-diffuser by a sudden expansion into the dump diffuser. The dump diffuser comprises the majority of the losses, but is necessary to reduce the fluid velocity within acceptable limits for combustion. The topic of active flow control is gaining interest in the industry because such a technique may be able to alleviate some of the requirements of the dump diffuser. If a wider angle pre-diffuser with separation control were used the fluid velocity would be slowed more within that region without significant losses.

Experiments were performed on two annular diffusers to characterize the flow separation to create a foundation for future active flow control techniques. Both diffusers had the same fully developed inlet flow condition, however, the expansion of the two diffusers differed such that one diffuser replicated a typical compressor discharge diffuser found in a real machine while the other would create a naturally separated flow along the outer wall. Both diffusers were tested at two Reynolds numbers, 5x10^4 and 1x10^5, with and without a vertical wall downstream of the exit to replicate the dump diffuser that re-directs the flow from the pre-diffuser outlet to the combustor. Static pressure measurements were obtained along the OD and ID wall of the diffusers to determine the recovered pressure throughout the diffuser. In addition to these measurements, tufts were used to visualize the flow. A turbulent CFD model was also created to compare against experimental results. In the end, the results were validated against empirical data as well as the CFD model. It was shown that the location of the vertical wall was directly related to the amount of separation as well as the separation characteristics. These findings support previous work and help guide future work for active flow control in a separated annular diffuser both computationally and experimentally.