REAL TIME NITROGEN MONITORING AND QUALITY CONTROL SYSTEM FOR NASA ASTROMATERIALS COLLECTION. L. Yan[1] and J. McQuillan[1 1] Amentum at NASA Johnson Space Center, Astromaterials Research and Exploration Science Division, Houston, TX; lesong.yan@nasa.gov

Abstract: The Nitrogen system is a vital utility supporting the curation office within NASA's Astromaterials Research and Exploration Science (ARES) Division at the Johnson Space center (JSC). Since the Apollo samples were returned in 1969. It has played an essential role in preserving NASA's astromaterial collections (now nine collections) by maintaining contamination-free, controlled environments required for long term curation and advanced scientific research.

To meet the stringent purity requirements for contamination control, high purity modified Grade C Liquid Nitrogen (LN2) is delivered weekly by an industrial gas vendor to a 15,000-gallon tank located outside at NASA JSC near the ARES facility. This nitrogen is vital for creating an inert atmosphere to store the collection in, ensuring they are continuously shielded from contaminants and alterations through a constant N2 purge. For most of the past 65 years deliveries of LN2 have required a CoA (Certificate of Analysis) prior to delivery. If those were not available, then LN2 deliver were sent to third-party laboratories for verification, creating an operational bottleneck and quality gap. To address this challenge and maintain rigorous quality control, NASA JSC Infrastructure and Astromaterials Acquisition & Curation Office initiated the development of an on-site Analytical Gas Sampling (AGS) Laboratory. Designed to streamline quality verification if a CoA unavailable, the AGS lab was constructed by a subcontractor in Newton, NJ. After a successful factory acceptance test conducted by the NASA ARES Infrastructure team, the lab was transported to NASA JSC, where it was anchored and integrated into the site's nitrogen pressure system using stainless steel, oxygen-cleaned tubing. The ARES nitrogen system was modified to provide parallel flows to the AGS lab for quality control and to the astromaterials collection labs for maintaining an inert environment.

The AGS lab features two operational modes: (1) Primary: Gaseous Nitrogen (GN2) Quality Monitoring – The AGS system continuously samples the site's GN2 supply every 15 minutes to ensure compliance with required purity levels. (2) Secondary: LN2 Quality Verification when a comprehensive CoA is not available, a cryogenic vaporizer converts LN2 to GN2, which is then analyzed for impurities: H_2, Ar, O_2, CO, CO_2, H_2O, and total hydrocarbons (THC). By significantly enhancing on-site analytical capabilities, the AGS lab eliminates reliance on external testing, ensures uninterrupted quality monitoring of the nitrogen pressure system, and reinforces NASA's commitment to preserving pristine astromaterials under the highest standards of curation and research integrity.