LUNAR CRATER OBSERVATION AND SENSING SATELLITE (LCROSS) SCIENCE PAYLOAD GROUND DEVELOPMENT, TEST, AND CALIBRATION. K. Ennico[1*], A. Colaprete[1], J. Heldmann[1], G. Kojima[1], D. Lynch[1], M. Shirley[1], D. Wooden[1], [1]NASA Ames Research Center, Moffett Field, CA 94043, *Kimberly.Ennico@nasa.gov

Introduction: The Lunar CRater Observation and Sensing Satellite (LCROSS) is a lunar impactor mission designed to target and impact a permanently shadowed region at a lunar polar latitude to create and measure the characteristics of an ejecta cloud of regolith and possibly ice and water vapor. The LCROSS mission is co-manifested with the Lunar Reconnaissance Orbiter (LRO) whose six science instruments will survey the Moon to prepare for and support future human exploration of the Moon. The LCROSS mission uses the United Launch Alliance's Atlas Centaur launch vehicle Earth Departure Upper Stage as the primary impactor. The impact creates an ejecta plume whose properties, including water ice and water vapor content, will be observed by the LCROSS shepherding spacecraft (S-S/C) plus Earth- and space- based telescopes, providing additional information at other wavelengths and/or timescales. Following a similar trajectory of the Centaur, the S-S/C will fly through the Centaur impact plume and then the S-S/C will also impact the Moon. The LCROSS mission is managed by NASA Ames Research Center (ARC) with industry partner Northrop Grumman Space Technology. LCROSS is a NASA Class-D mission.

LCROSS Science Payload Design: The LCROSS payload consists of nine science instruments, their supporting electrical, mechanical and optical harnesses and a central data handling unit assembled onto one of six radiator panels on the LCROSS space vehicle. The nine science instruments include one visible wavelength context imager provided by Ecliptic Enterprises Corporation, two near-infrared (1-1.4 micron/ 1-1.7 micron) cameras from Goodrich Sensors Unlimited, one mid-infrared (5-9.4 micron) thermal imager from Thermoteknix Systems, Ltd., one mid-infrared (5-15 micron) camera from FLIR Systems/Indigo Operations, a custom-built highly sensitive total luminance photometer (0.4-1 micron), a UV-visible spectrometer (260-650 nm) provided by Ocean Optics, and two compact low power near-infrared spectrometers (1.2-2.4 micron) built by Polychromix. The three spectrometers are connected via fiber optics to specially designed fore-optics provided by Aurora Design & Technology. These nine instruments are powered and controlled by a Data Handling Unit (DHU) provided by Ecliptic Enterprises. The DHU is interfaced with the space vehicle command and data handling and power systems. Thermal control of the science payload is provided using heaters and thermostats.

LCROSS Science Payload Testing: As many units of the LCROSS science payload are COTS (Commercial Off-the-Shelf) or modified-COTS, the LCROSS payload test program stressed early verification testing of Engineering Test/Development Units (ETU/EDUs) which, for the most part are identical in form and function to the vendor-proposed flight version. These ETU tests were primarily development tests in the process to bring "COTS-like to flight." Development tests were shared between NASA/ARC and the vendors to alleviate schedule burden and promote rapid turn-around for flight unit development. This proved to be a successful paradigm to increase the robustness of this Class-D payload over the course of a few months. The flight science instruments are tested for functionality and performance at both the unit and assembly level, the latter which is more representative of "test-as-you-fly" approach. After flight environmental acceptance testing, the payload is delivered to the spacecraft provider, Northrop Grumman, for integration at the space vehicle. Testing at the space vehicle level continues until the space vehicle is ready for transport to Cape Canaveral for integration with the LRO in the fairing of the Atlas Centaur.

LCROSS Science Payload Calibration Status: The calibration plan for the LCROSS science payload is a multi-faceted approach relying on 1) vendor-provided specifications, 2) in-situ radiometric and performance characterization at the NASA/ARC Calibration Laboratory facilities, and 3) in-orbit calibrations. The flight spectrometers and total luminance photometer have been radiometrically, spectrally, thermally, and temporally calibrated. This data provides a benchmark to compare against future in-orbit calibration checks. The flight cameras are being tested for image quality, responsivity and co-alignment. This paper will summarize the current ground calibration of these instruments in the context of the overall LCROSS test program. The several month cruise phase of the LCROSS mission profile will provide a number of opportunities to obtain instrument health, performance, alignment and contamination checks, before the final descent. In particular, a lunar swing-by is planned at launch + 5 days, by which the science instruments are pointed at several places along the lunar surface and measurements along lunar limb. Additional earth and space looks are part of the in-orbit calibration plan.