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With a new ammonia pump module installed during a Christmas Eve spacewalk operating properly, the International Space Station's Expedition 38 crew spent Thursday cleaning up U.S. spacesuit systems and tools and completing preparations for an unrelated Russian spacewalk on Friday.

Flight controllers in Houston's Mission Control successfully restarted the new pump Tuesday night following two spacewalks - including a 7-hour, 30-minute excursion Tuesday -- by Flight Engineers Rick Mastracchio and Mike Hopkins to replace a degraded pump module on the station's starboard truss.

Early on Christmas Day, the heat exchangers for the Destiny laboratory, the Harmony and Tranquility nodes and the Japanese Kibo laboratory were reintegrated to enable experiments racks and other systems affected by the partial Cooling Loop A shutdown Dec. 11 to come back on line. The Columbus laboratory heat exchanger will remain down until the European Space Agency, at its own request, conducts that module's integration next week when personnel return from the holiday.

Mastracchio and Hopkins began their Thursday with a round of post-spacewalk medical exams conducted by Flight Engineer Koichi Wakata, who served as the robotics operator for the two spacewalks. Afterward, Mastracchio and Hopkins focused on scrubbing the cooling loops and refilling the water tanks of the spacesuits they wore Tuesday. The suits functioned perfectly during the spacewalk, remaining dry throughout the excursion.

The completion of the spacewalk and the successful restart of the ammonia pump module clears the decks for Commander Oleg Kotov and Flight Engineer Sergey Ryazanskiy to conduct their own 7-hour spacewalk Friday out of the Pirs docking compartment. Their work is not related to the two U.S. spacewalks to replace the faulty ammonia coolant pump.

Kotov and Ryazanskiy, in Russian Orlan spacesuits, will exit the Pirs airlock at 8 a.m. EST Friday to install a pair of high-fidelity cameras on the Zvezda service module as part of a Canadian commercial endeavor designed to downlink Earth observation imagery. The two spacewalking cosmonauts also will refresh several experiment packages on the exterior of the Russian segment of the station.

Kotov and Ryazanskiy spent Thursday preparing equipment inside the Pirs airlock and later joined Flight Engineer Mikhail Tyurin for a final review of spacewalk procedures.

Source: NASA
Rough edged rocks on the Red Planet are clearly taking their toll on rover Curiosity's hi tech wheels as she speeds towards her ultimate goal – humongous Mount Sharp – in search of the ingredients necessary to sustain potential Martian microbes.

Several of the NASA rovers six big aluminum wheels have suffered some significant sized rips, tears and holes up to several centimeters wide – in addition to numerous dents – as she has picked up the driving pace across the rugged, rock filled Martian terrain this past fall and put over 4.5 kilometers (3 mi.) on the odometer to date.

It’s rather easy to spot the wheel damage to the 1 ton behemoth by examining the mosaic imagery we have created. The latest imagery from Mars captured just prior to Christmas is delivering an undesired holiday present of sorts to team members that might well cause the scientists and engineers to alter Curiosity’s extraterrestrial road trip to traverse smoother terrain and thereby minimize future harm.

So the wheel damage is certainly manageable at this point but will require attention.
The team of Marco Di Lorenzo and Ken Kremer have assembled the new Mastcam and MAHLI raw images captured on Sol 490 (Dec. 22) into fresh color mosaics.

Indeed the rovers handlers have already directed the SUV sized Curiosity to snap close up images of the wheels with the high resolution color cameras located on the Mast as well as the Mars Hand Lens Imager (MAHLI) camera at the end of the rover’s maneuverable robotic arm.

“We want to take a full inventory of the condition of the wheels,” said Jim Erickson of NASA’s Jet Propulsion Laboratory, project manager for the NASA Mars Science Laboratory Project, in a NASA statement.

The rover team certainly expected some wear and tear to accumulate along the rock strewn path to the base of Mount Sharp – which reaches 5.5 km (3.4 mi) into the Martian sky.

But the volume of sharp edged rocks encountered in the momentous trek across the floor of Curiosity’s Gale Crater landing site apparently has picked up- as evidenced by the new pictures – and consequently caused more damage than the engineers anticipated.

“Dents and holes were anticipated, but the amount of wear appears to have accelerated in the past month or so,” Erickson noted. “It appears to be correlated with driving over rougher terrain. The wheels can sustain significant damage without impairing the rover’s ability to drive. However, we would like to understand the impact that this terrain type has on the wheels, to help with planning future drives.”

The team is now inspecting the new imagery acquired of the wheels and will decide if a course alteration to Mount Sharp is in order.

The left front wheel may have suffered the most harm. “Routes to future destinations for the mission may be charted to lessen the amount of travel over such rough terrain, compared to smoother ground nearby,” says NASA.

Following a new, post Christmas drive today, Dec. 26, 2013 (Sol 494) Curiosity’s odometer stands at 4.6 kilometers.

Curiosity has already accomplished her primary goal of discovering a habitable zone on Mars that could support Martian microbes if they ever existed.

NASA’s rover Curiosity uncovered evidence that an ancient Martian lake had the right chemical ingredients that could have sustained microbial life forms for long periods of time – and that these habitable conditions persisted on the Red Planet until a more recent epoch than previously thought.

Right now the researchers are guiding Curiosity along a 10 km (6 mi) path to the lower reaches of Mount Sharp – which they hope to reach sometime in mid 2014.

Source: Universe Today
Environmental research and weather forecasting are about to get a significant technology boost as NASA and the Japan Aerospace Exploration Agency (JAXA) prepare to launch a new satellite in February.

NASA and JAXA selected 1:07 p.m. to 3:07 p.m. EST Thursday, Feb. 27 (3:07 a.m. to 5:07 a.m. JST Friday, Feb. 28) as the launch date and launch window for a Japanese H-IIA rocket carrying the Global Precipitation Measurement (GPM) Core Observatory satellite from JAXA's Tanegashima Space Center.

GPM is an international satellite mission that will provide advanced observations of rain and snowfall worldwide, several times a day to enhance our understanding of the water and energy cycles that drive Earth's climate. The data provided by the Core Observatory will be used to calibrate precipitation measurements made by an international network of partner satellites to quantify when, where, and how much it rains or snows around the world.

"Launching this core observatory and establishing the Global Precipitation Measurement mission is vitally important for environmental research and weather forecasting," said Michael Freilich, director of NASA's Earth Science Division in Washington. "Knowing rain and snow amounts accurately over the whole globe is critical to understanding how weather and climate impact agriculture, fresh water availability, and responses to natural disasters."

With the addition of the new Core Observatory, the satellites in the GPM constellation will include the NASA-National Oceanic and Atmospheric Administration (NOAA) Suomi National Polar-orbiting Partnership mission,
launched in 2012; the NASA-JAXA Tropical Rainfall Measuring Mission (TRMM), launched in 1997; and several other satellites managed by JAXA, NOAA, the U.S. Department of Defense, the European Organisation for the Exploitation of Meteorological Satellites, the Centre National D'Etudes Spatiales of France and the Indian Space Research Organisation.

"We will use data from the GPM mission not only for Earth science research but to improve weather forecasting and respond to meteorological disasters," said Shizuo Yamamoto, executive director of JAXA. "We would also like to aid other countries in the Asian region suffering from flood disasters by providing data for flood alert systems. Our dual-frequency precipitation radar, developed with unique Japanese technologies, plays a central role in the GPM mission."

The GPM Core Observatory builds on the sensor technology developed for the TRMM mission, with two innovative new instruments. The GPM Microwave Imager, built by Ball Aerospace and Technology Corp., Boulder, Colo., will observe rainfall and snowfall at 13 different frequencies. The Dual-frequency Precipitation Radar, developed by JAXA with the National Institute of Information and Communication Technology in Tokyo, transmits radar frequencies that will detect ice and light rain, as well as heavier rainfall. It also will be able to measure the size and distribution of raindrops, snowflakes and ice particles.

For more information on the Global Precipitation Measurement mission, visit:


Source: NASA
The Night Sky

Friday, December 27

- Got a new Christmas telescope? Wondering what to do with it? Read this!

- In Saturday's cold dawn, Alpha Librae (Zubenelgenubi) shines 1° to 3° lower left of the waning crescent Moon for North America, with Saturn 5° farther on, as shown here. The Moon occults (covers) Alpha Librae for Hawaii; timetable.

- Yes it's cold out. That's no reason to be cold or to shun the beauties of winter astronomy. Learn to be a toasty winter observer with "Dress for Stargazing Success" in the December Sky & Telescope, page 66.

Saturday, December 28

- Very late tonight, tomorrow, and Monday nights, Mars is just 3/4° from Gamma Virginis (Porrima), magnitude 2.7 — a famous close double star for telescopes at high power. Mars and Gamma Vir rise together after midnight and are best seen high in the south before dawn.

Sunday, December 29

- Orion's Sword is the dimmer straight line of stars at an angle to Orion's Belt. It's currently to the belt's lower right, as Orion climbs the southeastern evening sky.

- Often you read that the Great Orion Nebula, partway down the sword, looks to the naked eye like a slightly fuzzy star. Well, maybe. To start with you need sharp (or fully corrected) distance vision. You also need a good sky — and light pollution doesn't seem to be the whole story here. On some nights in the suburbs I can see the nebula around the 5th-magnitude stars Theta-1 and Theta-2 Orionis fairly positively. On other nights with the same light pollution, not so much. How about you?

Monday, December 30

- When evening twilight turns to night at year's end, the constellation Andromeda is crossing the zenith (for the world's mid-northern latitudes). The Great Andromeda Galaxy passes right through your zenith if you're near latitude 41° north (New York, Denver, Madrid). This happens at 6:05 p.m. tonight if you live at your time zone's standard longitude. If you're east or west of there, as you probably are, the galaxy will transit as much as 30-plus minutes earlier or later, respectively. Lie on your back and look straight up with binoculars for a dim, elongated little glow of fuzzy gray among the pinpoint stars.

Sky & Telescope
ISS Sighting Opportunities

For Denver:

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<td>51°</td>
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Sighting information for other cities can be found at NASA's Satellite Sighting Information

NASA-TV Highlights
(all times Eastern Daylight Time)

**December 27, Friday**
7:30 a.m. - ISS Expedition 38 Russian Spacewalk Coverage - (Spacewalk begins at 8 a.m. ET; replaces Space Station Live) - HQ (All Channels)

**December 30, Monday**
11 a.m. - 12 p.m. - Replay of Space Station Research: Top 10 Results; Parts 1 and 2 (preempts Space Station Live) - HQ (All Channels)

Watch NASA TV on the Net by going to the NASA website.
Space Calendar

- Dec 27 - Comet C/2012 S1 (ISON) Closest Approach To Earth (0.429 AU)
- Dec 27 - Comet 120P/Mueller Closest Approach To Earth (2.301 AU)
- Dec 27 - Asteroid 6 Hebe Occults HIP 95168 (3.9 Magnitude Star)
- Dec 27 - Asteroid 2013 WV45 Near-Earth Flyby (0.061 AU)
- Dec 27 - Asteroid 7850 Buenos Aires Closest Approach To Earth (1.621 AU)
- Dec 27 - Comet P/2000 R2 (LINEAR) At Opposition (2.225 AU)
- Dec 27 - Comet 65P/Gunn At Opposition (3.916 AU)
- Dec 28 - Asteroid 2011 YD29 Near-Earth Flyby (0.016 AU)
- Dec 28 - Asteroid 2011 BT15 Near-Earth Flyby (0.032 AU)
- Dec 28 - Asteroid 3169 Ostro Closest Approach To Earth (0.801 AU)
- Dec 29 - Mars Express, Phobos Flyby
- Dec 29 - Cassini, Orbital Trim Maneuver #367 (OTM-367)
- Dec 29 - Moon Occults Saturn
- Dec 29 - Asteroid 2010 XZ67 Near-Earth Flyby (0.064 AU)
- Dec 29 - Asteroid 35977 Lexington Closest Approach To Earth (1.424 AU)
- Dec 29 - Asteroid 73520 Boslough Closest Approach To Earth (1.833 AU)
- Dec 29 - Asteroid 434 Hungaria Closest Approach To Earth (2.224 AU)
- Dec 29 - Asteroid 5223 McSween Closest Approach To Earth (2.269 AU)
- Dec 29 - Asteroid 1154 Astronomia Closest Approach To Earth (2.654 AU)
- Dec 29 - 5th Anniversary (2008), EPOXI, Earth Flyby
- Dec 30 - Comet 290P/Jager At Opposition (1.297 AU)
- Dec 30 - Comet P/2006 S1 (Christensen) At Opposition (2.080 AU)
- Dec 30 - Comet C/2013 V5 (Ouakimeden) At Opposition (3.104 AU)
- Dec 30 - Asteroid 2009 XZ1 Near-Earth Flyby (0.051 AU)
- Dec 30 - Asteroid 8299 Tealeoni Closest Approach To Earth (1.419 AU)
- Dec 30 - Asteroid 3430 Bradfield Closest Approach To Earth (1.967 AU)
- Dec 30 - Asteroid 3313 Mendel Closest Approach To Earth (1.995 AU)
- Dec 30 - Asteroid 293909 Matterhorn Closest Approach To Earth (2.212 AU)
- Dec 30 - Asteroid 3933 Portugal Closest Approach To Earth (2.573 AU)

Source: JPL Space Calendar
Food for Thought

Work on NASA’s New Orion Spacecraft Progresses as Engineers Pivot to 2014

Orion’s first mission, Exploration Flight Test-1, or EFT-1, is less than a year away now, and the team building the spacecraft is meeting milestones left and right as they prepare the vehicle for its debut.

The Orion crew module that will fly 3,600 miles above Earth on the spacecraft’s first mission is continuing to come together inside the Operations and Checkout Building at NASA’s Kennedy Space Center in Florida. Since the heat shield that will protect it from temperatures near 4,000 degrees Fahrenheit was delivered to Kennedy in early December, the Orion team has been preparing it for installation. They’ve placed it on a work stand and begun drilling the holes necessary to attach it to the module. The heat shield is scheduled be put in place in the spring.

Once the heat shield has done its job getting Orion through the Earth’s atmosphere after its two orbits around Earth, it will be up to the parachutes to do the heavy lifting, literally. A total of 11 parachutes will be used for various landing functions, but three main parachutes that together could almost cover a football field ultimately will slow Orion’s descent down to less than 20 miles per hour for the finale: a relatively gentle splashdown in the Pacific Ocean.

The three main parachutes that will be used for EFT-1 were installed on the vehicle this month. A crane lowered each of the 300-pound main parachutes into place near the top of the capsule, and technicians in clean suits fit them into their compartments. They’ll be deployed using three smaller pilot parachutes that pull them out after the preceding drogue parachutes have done the initial work of slowing the vehicle down.

While those activities are preparing the spacecraft in Florida, the rockets that will launch Orion into space are nearing completion in Decatur, Ala., home of United Launch Alliance’s final assembly facility. The core, port and starboard boosters of the Delta IV heavy lift rocket that will be used for EFT-1 are all final assembly, with the starboard section leading the charge. It’s currently in final acceptance testing, while the RS-68 engine was recently installed on the core booster, and the propulsion and wire harness assemblies are being integrated into the port booster.

The rocket is scheduled to be completed and shipped to Florida in the spring.

With all this activity wrapping up 12 months of arrivals, installations and tests, 2013 has been a good year for the Orion Program. In fact, the only thing that could top it would be 2014 and the launch of EFT-1.

Source: NASA
The Hydrogen Clouds of M33

**Explanation:** Gorgeous spiral galaxy M33 seems to have more than its fair share of glowing hydrogen gas. A prominent member of the local group of galaxies, M33 is also known as the Triangulum Galaxy and lies about 3 million light-years distant. Its inner 30,000 light-years are shown in this telescopic galaxy portrait that enhances the reddish ionized hydrogen clouds or HII regions. Sprawling along loose spiral arms that wind toward the core, M33's giant HII regions are some of the largest known stellar nurseries, sites of the formation of short-lived but very massive stars. Intense ultraviolet radiation from the luminous, massive stars ionizes the surrounding hydrogen gas and ultimately produces the characteristic red glow. To enhance this image, broadband data was used to produce a color view of the galaxy and combined with narrowband data recorded through a hydrogen-alpha filter, transmitting the light of the strongest hydrogen emission line. To see the monochromatic narrowband data alone, move your cursor over the image online, or take this video tour of the hydrogen clouds of M33.

**Image Credit & Copyright:** Adam Block, Mt. Lemmon SkyCenter, U. Arizona

Source: Astronomy Picture of the Day