Use Policy for Outdoor Lasers

Outdoor Lasers:
Unless otherwise noted, all ANSI Z136.6, *American National Standard for Safe Use of Lasers Outdoors*, recommendations are incorporated by reference as requirements, and will take precedence over any less rigorous requirement in this document.

Outdoor laser use covered by this policy covers all uses of Class 3b and 4 lasers; whether, ground based, air based, or space based, where the direct beam extends indefinitely, or where the insertion of a mirror into the output beam path could create a specular reflection that extends indefinitely. For more information see the final Office of Aviation Medicine report, DOT/FAA/AM-01/7, Laser Pointers: Their Potential Affects on Vision and Aviation Safety, April 2001.

All laser beams propagated in outdoor areas shall follow written procedures that are approved by the Center Laser Safety Officer (LSO). The Center LSO has the authority to invoke the requirement for Center Laser Safety Committee (LSC) approval for any outdoor laser use. Laser beams shall NOT be propagated in outdoor areas in such a manner as to cause injury to humans, endanger human life, or damage property. Provision shall be made for termination of the useful beam into a suitable beam stop or shield or by controlled propagation into a safe area.

The beam propagation path shall, insofar as possible, be free of secularly reflective surfaces and materials.

Positive access control shall be executed over personnel entry into the beam path areas including areas into which the beam may be reflected, reference ANSI Z136.6, page 19, paragraph 4.5.4.1 and 4.5.4.2. Control methods may include, but are not limited to:

- Appropriately placed physical barricades, fences, etc.
- Warning lights and horns.
- Placement of safety monitors at each entry point to assure evacuation of the laser area prior to beam propagation and to prevent entry during propagation.

The type of safety measures employed to control laser hazards shall be dependent upon the location of the exercise, the amount of aircraft traffic, the optical hazards of the laser beam, the duration of the exercise, how often the laser is used, the direction of the beam path, whether the beam moves in azimuth and/or elevation, how quickly the beam moves, and other factors.

Outdoor laser safety spotters may be used to spot aircraft in accordance with ANSI Z136.6 and under the right conditions, but this is dependent upon the specific hazards associated with each case of outdoor laser use, reference ANSI Z136.6, page 14, paragraph 4.2.1. Personnel who analyze outdoor laser hazards shall use ANSI 136.6, American National Standard for Safe Use of Lasers Outdoors, to establish outdoor laser hazard controls.

For uses near airports, a "Laser-free" zone extends five nautical miles in each direction from the center point of a runway. A "Critical Flight Zone" extends an additional five miles after the laser-free zone, reference ANSI Z136.6, page 13, paragraph 3.4.1 pages 41 and 42. See Federal Aviation Administration (FAA) Order 7400.2E, Procedures for Handling Airspace Matters.

Inside the critical flight zone, laser power levels of unsupervised uses shall not exceed five microwatts/cm2. Outside the critical flight zone, airports may define an optional "Sensitive Zone" where laser power would be limited to 100 microwatts/cm2.

All NASA Center outdoor laser use shall be in conformance with the American National Standards Institute (ANSI) Standard for Safe Use of Lasers Outdoors (ANSI Z136.6-2000 or latest revision).

Some lasers are capable of causing eye injury to anyone who looks directly into the beam or specular reflections of the beam. Diffuse reflections of a high-power laser beam can produce permanent eye damage. If hazards are not properly controlled, high-power laser beams can burn exposed skin, ignite flammable materials, and activate toxic chemicals, and cause the release of hazardous fumes, gases, and debris, reference ANSI Z136.6, page 11, paragraph 3.2.4. The equipment and optical apparatus required to produce and control the laser energy may also introduce additional hazards associated with high voltage, high pressure, cryogenics, noise, radiation, and toxic materials. Therefore, each proposed experiment or operation involving a laser shall be evaluated to determine the hazards involved and the appropriate safety measures and controls shall be required, reference ANSI Z136.6, page 23, paragraph 7.1. The two most hazardous situations, with respect to potential exposures, exist during alignment and servicing of laser equipment.

The safe operation of a laser shall be the responsibility of both the supervisor of the area or lead experimenter and the laser operator who performs the work.

Supervisors shall ensure that all individuals, including outside service technicians, understand and follow all controls and procedures as specified by their Center's LSO and/or LSC. Supervisors or lead experimenters shall not intentionally depart from established safety procedures. The laser operators shall keep the supervisor or lead experimenter fully informed of any unintended departure from established safety procedures and of any request to perform unsafe tasks. All departures from established laser procedures shall be reported to the LSO and/or the LSC immediately. This includes all laser eye or skin exposures (greater than the Maximum Permissible Exposure, or MPE), any injuries from laser-support equipment, and any uncontrolled outdoor radiation of a laser beam. Information required in the report includes:

- The nature of the accidental radiation occurrence;
- The location at which the accidental radiation occurred;
- The manufacturer, type, and model number of the electronic product or products involved, reference ANSI Z136.6, page 23, paragraph 6.3;
- The circumstances surrounding the accidental radiation occurrence, including causes;

- The number of persons involved, adversely affected, or exposed during the accidental radiation occurrence, the nature and magnitude of their exposure and/or injuries and the names of the persons involved.
- The actions, if any, which may have been taken, to control, correct, or eliminate the causes and to prevent reoccurrence; and
- Any other pertinent information with respect to the accidental radiation occurrence.

The Center Laser Safety Officer shall assist the area supervisor or lead experimenter in ensuring that safety requirements are followed and in evaluating and controlling hazards, reference ANSI Z136.6, page 2, paragraph 1.3.

All personnel who operate lasers outdoors shall successfully completed a Laser Safety Training course approved by their Center's LSO and/or LSC. Exemptions may be granted by the LSO and/or LSC, based on the operator's previous training and experience. In cases of exemption, as well as all other cases, the laser supervisor and or lead experimenter shall be responsible for ensuring compliance with Federal, State, local, NASA and Center laser safety requirements, reference ANSI Z136.6, page 23, paragraph 5.3 page 96, Figure 1.

In addition to these general requirements, operators of all outdoor lasers or laser systems shall have:

- Read any safety instructions provided by the manufacturer of the equipment.
- Received from the LSO or lead experimenter a thorough review of the laser equipment to be used.
- Received any additional training that the person in charge of laser may require.

Personnel supervising outdoor laser operations shall:

- Register the lasers with the Center's Laser Safety Officer.
- Ensure that all users of outdoor lasers have been approved by the Center LSO and/or LSC.
- Assure that maintenance personnel, who work on their lasers, are certified by their employers to do so, and retain a record of these qualifications and certifications.

Before appropriate controls can be selected and implemented, laser hazards shall be identified and evaluated, reference ANSI Z136.6, page3, paragraph 3.2.1. Three aspects of the application of a laser or laser system influence the total hazard evaluation and thereby influence the application of control measures:

- The capability of the laser or laser systems for injuring or flash blinding personnel;
- The environment in which the laser is used; and
- The personnel who may use or be exposed to laser radiation

Class 1 lasers are normally considered to be incapable of producing damaging radiation levels and are generally exempt from most control measures or other forms of surveillance. However, all outdoor uses of outdoor lasers, regardless of classification, require LSO and/or LSC approval prior to use.

A written procedure shall be required for all outdoor laser use, unless previously approved by the Center Laser Safety Committee.

The purpose of the procedure is to:

- Provide a written description of the hazards of the particular laser operation including both beam and non-beam hazards, and to
- Establish the appropriate engineering, administrative and personal protective equipment controls.

These requirements are necessary for the safe operation of outdoor lasers. The outdoor laser procedure shall be written by the laser supervisor or lead experimenter, and approved by the LSO and/or LSC.

An approved copy of the procedure shall be available in the immediate area of the laser.
As with any laser operation, outdoor laser work shall minimize direct eye exposure, reference ANSI Z136.6, page 15, paragraph 4.3.2.1, page 17, paragraph 4.3.4.4, page 18, paragraph 4.4.3.6, and page 19, paragraph 4.5.4.3. To do so, operators shall observe these precautions:

- Terminate the beam at the end of its useful path whenever possible.
- Locate the beam path at a point other than eye level.
- Prohibit beam propagation across pedestrian or vehicular thoroughfares unless the pedestrian or vehicular thoroughfares are secured to prevent traffic.
- Select a height so as to avoid the eyes of area workers.
- Minimize specular reflections and use non-reflective tools.
- Enclose beams as much as feasible.
- Locate lasers so that no beam hazard exists at locations where personnel are normally present, such as points of entry.
- Post **CAUTION** signs in operational areas.
- Assure laser classification labels are affixed to the lasers in conspicuous locations.
- Avoid direct beam viewing to align lasers.

Outdoor lasers shall be operated only in laser controlled areas as specified by the Laser Safety Officer and/or the Laser Safety Committee. These areas shall be specified during the laser use approval process. Access to these areas during laser operations requires the permission of the responsible operator.

Spectators or visitors shall not be allowed to be exposed to laser radiation greater than the MPE nor shall they be allowed to enter the NHZ for any laser system without proper training and qualification from the LSO.

Outdoor laser laboratories and controlled areas shall be designed so that personnel can enter and leave the controlled area under emergency conditions. Doors, gates, or other access control devices to laser areas shall not impede emergency egress. Means of entry by emergency personnel shall be provided.

Each entrance to a controlled outdoor laser area shall be posted with a laser classification label, which shall be conspicuously affixed to the laser housing. Laser operators shall keep signs and labels current and legible, reference ANSI Z136.6, page 15, paragraph 4.3.2.1. Personnel access into controlled laser areas, and the accessible Nominal Ocular Hazard Distance (NOHD) ground beam path, containing any laser that has greater than 5mW total power shall be regulated by the use of a Safety Access light. A red light shall indicate that the laser is in operation and unauthorized entry into the controlled area is prohibited, reference ANSI Z136.6, page 15, paragraph 4.3.3.2.

Access doors to a controlled outdoor laser areas, and the accessible NOHD ground beam path in which a laser system with greater than 5mW total accessible power is being operated shall be equipped with safety interlocks to prohibit laser beam propagation when the interlock circuit is broken.

Each outdoor laser with greater than 5mW total accessible power shall be provided with a key-controlled master switch that prevents laser light propagation when the key is removed. All protective enclosures that surround outdoor laser devices and high-voltage electrical sources shall also be equipped with safety interlocks. Outdoor laser users shall test the interlocks at least once per shift, to ensure that they are operational. A written record shall be kept of each test made, reference ANSI Z136.6, page 18, paragraph 4.4.3.7.

Interlock circuits shall reduce the laser energy to a safe level. Interlocks shall be designed so that after they are actuated, manual intervention shall be required to bring the system back to operational power, reference ANSI Z136.6, page 17, paragraph 4.3.4.6.

Authorized individuals in or outside of an outdoor laser area controlled by an entry warning light are permitted to override (bypass) door interlocks to allow access if all of the following conditions are met:

- There is no laser radiation hazard at the point of entry.
- The personnel entering the area wear the required protective devices.
- A 15-sec clock designed into the interlock control circuit shall automatically reactivate the interlock chain. The interlock bypass switch may be manually operated to extend the bypass period.
- The external interlock bypass switch shall be a key or cipher lock.
- There are no hazards other than laser radiation that require an interlock system.
- Individuals entering the controlled area are aware of and follow all applicable administrative and procedural controls.

Deviation from entry procedures may be acceptable if other precautions and controls are employed to provide an equal or greater level of protection. All deviation approaches shall be evaluated and approved by the Center LSO and/or the Center LSC.

The outdoor laser system shall be securely mounted on a stable platform to maintain the beam in an approved position(s) during operation and limit beam movement during adjustments. Open beam paths shall be clearly identified and shall not cross populated areas, traffic paths, unauthorized airspace, or enter into any other unauthorized space.

Deviation from laser system mounting requirements may be acceptable if other precautions and controls are employed to provide an equal or greater level of protection. All deviations shall be evaluated and approved by the Center LSO and/or Center LSC.

Materials (with a low reflective coefficient) that diffusely reflect laser radiation shall be used in place of specularly reflective surfaces wherever possible. To minimize personnel exposure, specularly reflecting surfaces that are needed for beam-path control shall be enclosed or shielded were ever possible. Non-reflective tools should always be used.

Ultraviolet (UV) and infrared (IR) lasers that emit invisible beams require several additional controls:

- Visual or audible beam-warning devices shall be installed.
- All warning devices shall be clearly identified and visible from all areas where a potential exposure is possible.
- All warning devices shall be activated whenever the beam is on.
- Shielding shall be installed that shall attenuate UV radiation to levels below the Class 1 AEL at all points wherever personnel may be located.

Hazardous concentrations of by-products formed by the reaction of intense UV radiation with materials in the area (including outdoor atmosphere contaminates) shall be controlled. Infrared beam enclosures and backstops shall be fabricated of IR-absorbent material. Where the power of the laser could ignite the backstop; the absorbent material shall be fire-resistant. Controlled laser areas shall be surveyed with appropriate measuring devices to locate and identify direct and reflected beams; shielding shall be provided to limit unwanted radiation. Particular care shall be taken to locate, identify, and shield invisible beams that come from IR and UV lasers.

Personnel shall never look directly into any laser beam. In those cases where it is necessary to directly view a beam from a Class 3b or Class IV laser, special provisions, such as filters, shall be employed. A procedure shall be prepared, approved, and used for operations where the beam of a Class 3b or Class 4 laser must be viewed or where it is necessary to work with the eye or optical viewers close to the laser beam.

Alignment of laser optical systems (mirrors, lenses, beam deflectors, etc.) shall be performed in such a manner that the primary beam or a specular or diffuse reflection of a beam does not expose the eye and skin, reference ANSI Z136.6, page 20, paragraph 4.5.4.4.

Using optical systems such as cameras with direct optical viewing, telescopes, microscopes, and endoscopes to view laser beams may increase the eye hazard. Therefore, interlocks or filters shall be placed on these instruments to prevent eye exposures. Normal or prescription eyewear is not considered to fall into this category, and shall not be used for this purpose. Safety equipment designed to protect the eye from laser radiation of a given wavelength and intensity shall be used if all other controls are unable to eliminate exposures. The supervisor or lead experimenter of the laser equipment shall determine the appropriate laser eyewear. This determination shall be contained in the procedure, and approved by the LSO and/or LSC.

A laser beam path of propagation that has potential for injuring personnel who may enter the area, and where the path of propagation is not under the direct observation and control of the laser operator is a "remotely operated" path of propagation.

. Before illuminating such a remotely operated area, the area shall be swept to ensure that the area is unoccupied, and where feasible, an audible warning of impending safety status change or firing, followed by a countdown to the status change, shall be made. All remotely operated lasers shall be in conformance with current revisions of ANSI Z136.6, American National Standard for Safe Use of Lasers Outdoors.

A laser is unattended if none of its authorized operators are in the laser area. If the laser is not in use, its power supply shall be de-energized and keys removed from the power switch and master interlocks, or the laser area shall be locked to prevent access to the laser.

An unattended laser may be operated if it conforms with current guidelines in, ANSI Z136.6, American National Standard for Safe Use of Lasers Outdoors, and:

- An authorized operator is available by phone or other communication and, or
- A Hazards Analysis has been performed to identify the hazards and necessary controls by LSO and/or LSC, and these controls are in place, and proper signs are posted, and lights and the access interlocks are functional. Signs shall indicate who shall be notified if an emergency occurs.

Occasionally, it may be necessary to remove protective enclosures or override equipment interlocks or other safety devices for service adjustments, maintenance, special training exercises, etc. In these instances, a temporary controlled laser area shall be set up. Specific methods of handling situations of this type shall be described in a procedure approved by the Center LSO and/or LSC. Because the area will not have all the standard safety features, the LSO and/or LSC shall describe provisions for protecting personnel who could be exposed. Access into the area shall be limited to persons wearing proper protective equipment. The operator(s) and supervisor or lead experimenter shall ensure that all optical paths from the restricted-access area are adequately covered to prevent escape of laser radiation greater than the Class 1 AEL where personnel are capable of entering the beam path.

A controlled laser area shall have only one laser or laser system whenever possible. However, when more than one laser or laser system operation is necessary, installation of appropriate shielding and definition of the conditions of coexistence and methods of maintaining a safe work environment shall be accomplished. Different operators shall not operate multiple lasers in the same area.

Protective enclosures shall be used to prevent personnel access to the laser system during normal operations. Personnel accessing the enclosure to perform maintenance or adjustment tasks shall be made aware of the higher risks and shall comply with the control measures for the higher-risk laser class. Protective housings that enclose Class 3b and 4 lasers or laser systems shall be provided with an interlock system. Service adjustments or maintenance work performed on the laser system shall be by approved procedure and shall not render the interlocks inoperative or cause personnel exposures.

Modifications to commercial laser systems shall be evaluated and approved by the LSO and the LSC.

If viewing windows are used, they shall contain a suitable filter material that will attenuate the transmitted laser radiation to levels below the Maximum Permissible Exposure (MPE) under all conditions of operation. If viewing windows do not reduce laser radiation to below MPE, protective eyewear shall be used to reduce the level to below MPE.

The outside of the laser enclosure shall be labeled with CAUTION signs that identify the laser system classification. In addition, service access panels shall have labels describing the laser embedded within the system. These labels shall be easily seen and read.

Many hazards other than laser radiation can be found in the laser area and shall also be adequately controlled. These include, but are not limited to: Electric shock from exposed power sources, exposure to laser-generated air contaminates, collateral and plasma radiation exposure to UV, visible, IR, microwave, RF, or X-ray from power supplies and discharge lamps, fire hazards from the beam striking non-flame retardant materials, and explosion hazards from lamps and capacitor banks. Other hazards are the physical from compressed gases, toxicity or gases, dyes and solvents, noise, and ergonomic issues.

Operators shall be constantly aware of the high risk of injury and fire in laser operations because of the presence of electrical power sources. Metal laser tables shall be grounded to a facility ground.

Adequate lighting is necessary in controlled areas. When natural light is not sufficient for safe egress from a laser area during an electrical power failure, emergency lighting shall be installed.

Pressure vessels and systems used in conjunction with lasers shall meet the requirements of the Center's pressure vessel and pressure systems safety program. Adequate controls for toxic gas systems shall be in place to control all associated hazards.

A laser operation may involve ionizing radiation that originates from the presence of radioactive materials or the use of electrical power in excess of 10 kV. Additionally, microwave and radio frequency (RF) fields may be generated by laser systems or support equipment. These hazards shall be evaluated and controlled before starting an operation. Operators and visitors shall bring into the laser area only those hazardous materials (at minimum quantities) that are needed for the operation. Operators and supervisors or lead experimenters shall make certain that these materials are properly used, stored, and controlled. Laser beams shall not be propagated without providing adequate controls, to assure that laser beams and specular reflections do not impinge on combustible materials, explosives, highly flammable liquids or gases, or substances that decompose into highly toxic products under elevated temperatures.

The amount of airspace affected by an outdoor laser varies with system output power, beam divergence, use of optics, and other operational aspects.

To guard against eye hazards, aircraft observer(s), in direct communication with the laser operator, shall be stationed at a location where visual surveillance of the entire area is possible at all times during the laser operation. The observer(s) shall notify the laser operator to cease projection or activate safety measures approved by the LSO and/or LSC, if any aircraft approach the area.

Laser beam divergence can be very small even over long distances. All operational aspects, including beam divergence and laser system average output power shall be considered in determining the airspace affected.

NOHD Power/Range tables for repetitively pulsed (RP) lasers will be different than NOHD Power/Range tables for continuous wave (CW) lasers, depending upon the equipment and pulse duration.

Requirements for flight zones are contained in FAA Order 7400.2E, Procedures for Handling Airspace Matters, , reference ANSI Z136.6, page 48, Appendix 1.

In the *normal flight zone*, the NOHD is based on irradiance levels for a maximum irradiance value of 2.6 mW/cm² for CW lasers, reference ANSI Z136.6, page 20, paragraph 4.6.2. This irradiance value is the maximum at which a person can typically react quickly enough to avoid an exposure that would exceed the limits of Class I. Staring into a laser beam, like staring into the sun, is dangerous. However, momentary exposure can be compared to an accidental glance at the sun, reference ANSI Z136.6, pages 35 and 43. In an accidental glance, the light does not remain focused on a single point on the retina, so the hazard potential is lessened. Considering aircraft movement and/or laser beam scanning, the probability of a prolonged exposure is statistically very low. However, to maintain a reasonable margin of safety, the value of 2.6 mW/cm² for a CW laser is chosen as the maximum permissible irradiance allowed to be directed into an aircraft flight zone, reference ANSI Z136.6, page 71.

In the *sensitive flight zone*, the SZL is based on irradiance levels for a maximum irradiance value of 100 uW/cm². At this irradiance value pilots/aircrews would expect to experience flash blindness. This level of exposure can produce sustained afterimages, but aversion response is likely to lesson the effects, reference ANSI Z136.6, page 21, paragraph 4.7.2.1.
In the *critical flight zone*, the CZL is based on irradiance levels for a maximum irradiance value of 5 uW/cm². This irradiance value is the maximum at which pilots/aircrews would not expect to experience glare. This level of exposure should not produce significant visual impairment or immediate aversion response, reference ANSI Z136.6, page 21, paragraph 4.7.2.2.

In the *laser free flight zone*, exposure values are based on irradiance levels for a maximum irradiance value of 50 nW/cm², reference ANSI Z136.6, page 21, paragraph 4.7.2.3. This is to eliminate on-axis exposures during approach and departure phases of flight, and eliminate

conditions that pose unacceptable flight hazards. Light at this level will be equal to or less than other ground lights (possibly not even detectable by the flight crew) , reference ANSI Z136.6, page 42.

Maximum irradiance levels allowed within defined zones are:

- Laser Free Flight Zone equal to or less than 50 nW/cm, reference ANSI Z136.6, page 13, paragraph 3.4.1.
- Critical Flight Zone is equal to or less than 5 uW/cm, reference ANSI Z136.6, page 35.
- Sensitive Flight Zone is equal to or less than 100 uW/cm, reference ANSI Z136.6, page 35.
- Normal Flight Zone is equal to or less than the MPE. 2.6 mW/cm for CW visible lasers (pulsed lasers will be lower) , reference ANSI Z136.6, page 20 paragraph 4.6.3.

Each location shall be evaluated on a case-by-case basis. The values of 50 nW/cm2, 5 uW/cm², and 100 uW/cm² may not meet all of the required flight safety issues for their respective flight zones based on the aeronautical study; therefore, additional adjustments of power, beam divergence, and beam angle may be required by the Center LSO and/or LSC. The Visual Interference criterion (ANSI 136.6, Section 4.7) is based on average power values for CW lasers. It should be noted that in many cases for repetitively pulsed lasers, the average power level might be much less than the NOHD. In those cases where the Visual Interference level is less than the NOHD, the Visual Interference level defaults to the NOHD.

Physical, procedural, and automated control measures can be used to ensure that aircraft flying within specific flight zones shall not be exposed to levels of illumination greater than the respective maximum irradiance levels. Such controls include but are not limited to:

- Physical beam stops to prevent laser light from accidentally being directed into protected volumes of airspace.
- The irradiance (W/cm²) limits at a given distance can be met by adjusting the beam divergence and output power emitted through the system aperture.
- Beams can be pointed in a specific range of directions. Directions shall be specified by giving bearing in the azimuth scale 0-360 degrees and elevation in degrees ranging from 0-90 degrees, where 0 degrees is horizontal and 90 degrees is vertical. Bearings shall be given in both true and magnetic north.
- Manual operation of a shutter or beam termination system can be used in conjunction with airspace observers. Use of visual observers shall be in accordance with the criteria in ANSI Z136.6. Observers shall be able to see all airspace surrounding beam paths to a distance appropriate to the affected airspace.
- Automated operation of a shutter or beam termination system can be used to detect aircraft and automatically terminate or redirect beams so the beams are not directed at an aircraft, reference ANSI Z136.6, page17, paragraph 4.3.4.6.

In addition to procedural approval, the laser operator shall notify the Center LSO and/or the Center LSC 24 hours in advance of its operation and 6 hours prior to start time, unless otherwise agreed upon by the Center LSC and the Center LSC.

A statement that a laser system capable of adversely affecting vision shall not be aimed into the Laser Free Zone of an airport capable of night operations, shall be included in all outdoor laser procedures. This statement may be omitted or amended with approval of the Center LSO and LSC.

An objection to the use of a specific outdoor laser by the FAA or the U.S. Military shall be honored until the Office of Health and Medical Systems (OHMS); in conjunction with other NASA organizations, review the complaint and authorize continuation of operations.

The Agency Environmental Health Officer shall be immediately notified (321-867-1417) of any unintended personnel laser exposure, and of any objection to propagation of any laser beam by any organization. In no case shall notification exceed 2 hours from the time of exposure or from the time the objection is raised. Initial notification shall be by telephone, and shall be followed by either email or fax written report. If the Agency Environmental Health Officer is unavailable, notification shall be to the OCHMO office in Washington, DC, (202) 358-1794 or (202) 358-2329.

The following steps shall be taken prior to outdoor laser use:

- Centers shall coordinate directly with regional FAA points of contact using the protocols found in FAA Order 7400.2E, Procedures for Handling Airspace Matters, Part 6. MISCELLANEOUS PROCEDURES, Chapter 29. OUTDOOR LASER OPERATIONS
- Additionally, requests for letters of non-objection that involve multiple FAA Regions shall be sent through the FAA at the Agency level.

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- Centers shall continue to coordinate directly with U.S. Space Command at Cheyenne Mountain.

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- Centers shall coordinate directly with local military commands on matters of outdoor laser use and associated controls for their airspace.
- Centers shall advise the NASA Senior Environmental Health Officer of all outdoor laser coordination with the FAA, U.S. Space Command, and/or local military commands via email, and shall copy the NASA Senior Environmental Health Officer on all outdoor laser correspondence with the FAA, U.S. Space Command, and/or local

military commands. This includes all requests for letters of non-objection from the FAA.

- All other coordination of matters arising from outdoor lasers, and any satellite laser use shall be coordinated with the NASA Senior Environmental Health Officer.