

CARNEGIE MELLON UNIVERSITY'S STANDARD OPERATING PROCEDURE FOR WORKING SAFELY WITH GENE GUNS

Background

The gene gun is a biolistic transfection device, which offers a mechanical means for introducing foreign genetic material (i.e. DNA, RNA) into tissues, cells and/or organelles. To transfect the target tissues, cells, or organelles, the nucleic acids of interest are first precipitated onto microcarrier particles (usually gold or tungsten), which are delivered in quick succession to their targets by adjustable strength helium pulses. Due to the nature of the gene gun's function, several safety concerns must be addressed.

Device Requirements

Any gene gun used at Carnegie Mellon should be designed and certified to meet EN55011, EN50082-1, and EN61010 requirements, the internationally accepted electromagnetic compliance and electrical safety standards, as well as the limits for a Class A digital device as written in Title 47 CFR Part 15 for FCC regulations. Alterations to the gene gun will void the regulatory certifications and have the potential to create additional safety hazards. Please consult the FCC guidelines and EH&S before making modifications to this device.

Approval

Experiments using a gene gun require the approval of the IBC before their commencement. Please fill out the *rDNA Application Form* for review.

Hazards & Control Measures

Numerous procedures and safety features have been developed to protect experimenters from the hazards that accompany the usage of the gene gun. (Please see the gene gun manual for step-by-step instructions):

1. General Gene Gun Safety- Due to the velocity of the expelled microparticles, the gene gun should always be aimed in a direction away from people. Whenever the gene gun is in use, signs should be posted outside of the room to warn others and doors should be locked. The gene gun is to be secured in a locked cabinet when not in use.
2. Handling of Pressurized Gases- Consult CMU's Chemical Hygiene Plan for specific directions on the storage and usage of non-flammable, pressurized gases (always keep cylinders secured, etc.). Always wear eye protection when working with high pressure gases. Ensure that the tubing, fittings, control valve, and pressure regulator on the gene gun are not damaged and are in proper working order before each use.
3. Power Safety- Specific power requirements can be located near the gun's serial number. Gene guns generally require a 9 V battery for their use. Please detach the gun from the helium hose before changing the battery.

4. Noise Production and Ear Protection- Sounds generated by the gene gun during sample discharge can reach up to ~108 decibels (db) at 400 psi (lbs/in²). As continuous noise levels of 85 db or brief noise levels of 110 db could lead to permanent hearing damage, hearing protection, in the form of earmuffs or earplugs, is required for all those in the immediate area when the gene gun is in use. Ear plugs can be purchased through Mellon Store.
5. Tubing Cutter Safety- Keep hands clear of the razor at all times. When changing the razor or disassembling the cutter for decontamination, follow the instructions in the manual and take necessary sharps precautions.
6. General Biosafety- Users must wear the standard personal protective equipment (gloves, lab coat, etc.) required for biological laboratories. Also, steps must be taken to minimize aerosol production (proper pipetting techniques, etc.).

Training Requirements

For all persons working with biological materials requiring BSL-2 containment or higher, Biological Safety Training is mandatory. Bloodborne Pathogens (BBP) training is required for any persons working with human blood, bodily fluids, tissues, organs, non-human primates, non-human primate bodily fluids or tissues, or animals infected with BBP's. Both of these training sessions can be scheduled through EH&S. On-site training should also be provided by the PI. Additionally, all personnel working with the gene gun MUST receive training from their PI's on the proper technique for using this device. Contact EH&S if you have any questions regarding handling procedures.

Waste Disposal

Follow the university procedures for biological waste disposal of sharps and non-sharps.

Decontamination/Clean-up

To disinfect the gun, the barrel liner can be wiped down with a 10% bleach or 70% ethanol solution and rinsed with distilled water. The barrel liner, cartridge holder, and cartridge extractor tool can also be autoclaved for sterilization. The gene gun, tubing prep station, tubing cutter, and helium regulator should never be autoclaved or immersed in liquid, but can be cleaned with a cloth and mild soap (NOTE: This is NOT a substitute for disinfection).

Emergency Procedures

If you are exposed to a gene gun emission, contact your supervisor immediately. He/she will complete the *Post-Exposure Incident Report* and submit it to the EH&S office within 24 hours of the exposure. Contact Campus Police at 8-2323 to arrange for medical attention.

References

Bio-Rad Laboratories. (2013, April 4). *Helios Gene Gun System Instruction Manual*. Retrieved from Bio-Rad: www.bio-rad.com/webroot/web/pdf/lsr/literature/M1652411.pdf

Bio-Rad Laboratories. (2013, April 4). *Helios Gene Gun System: Right on Target*. Retrieved from Bio-Rad: http://www.gene-rad.com/pdf/Bulletin_2084Helios%20gene%20gun.pdf

O'Brien, J. A., & Lummis, S. C. (2006, August 3). "Biolistic transfection of neuronal cultures using a hand-held gene gun". *Nature Protocols*, pp. 977-981.

U.S. Government Printing Office. (2013, April 3). *Title 47 CFR Part 15*. Retrieved from Electronic Code of Federal Regulations (e-CFR): http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title47/47cfr15_main_02.tpl