Aerodynamics Research Laboratory Safety
August 25, 2004

Overall Policies

This document applies to all students, staff, faculty, and visitors who are performing or observing research in the Aerodynamics Research Laboratory at the University of Illinois at Urbana-Champaign. Those using the facility are required to have read this document and received a safety briefing. Visitors on tours or who are observing tests for a day or less under the supervision of a laboratory staff member are not required to receive a full safety briefing. Visitors who are participating in a test program or are in the laboratory for more than a day are required to receive a safety briefing and to have signed in acknowledgement of their briefing.

The Laboratory Safety Officer is appointed by the Laboratory Director and works in cooperation with the lab director and the laboratory faculty to enforce and maintain these safety procedures. At this writing Dr. Andy Broeren has been appointed the Laboratory Safety Officer.

Safety meetings will be held at least once a year, usually early in the fall, when these procedures will be reviewed and updated as appropriate. However, if conditions change or new equipment is added these procedures will be updated as needed.

All those using the laboratory will adhere to a buddy system to be implemented in accordance to their particular activity as outlined below. The basic principle is that someone must always know what you are doing and be available to assist in case of an accident.

In case of an accident

In case of a personal injury accident the primary concern is for the safety and well being of the injured person. If serious contact 911 immediately and if needed have them transported to the hospital emergency. The buddy, laboratory safety officer and the appropriate faculty member should be contacted as soon as possible. The safety officer or faculty member should contact the Department Head or the Assistant to the Head when possible. The department will assist in determining the course of action with regard to the reporting to the college and university. If the injury only requires minor first aid then do so immediately, then contact the buddy and the safety officer or faculty member to report the incident.

General Safety Guidelines

1. Know the laboratory exits.
2. Know the location and use of the safety equipment.
3. Know the location and use of the fire extinguishers.
4. Know the potential hazards of the materials, facilities, and equipment with which you will work.
5. There are eye goggles and hearing protection available when needed for certain experiments. Be sure to wear the specified protective equipment when conducting that laboratory.

6. Chemicals, empty chemical containers or other empty containers should be disposed of according to University guidelines. Never pour chemicals down a drain.
7. Wear appropriate clothing when working in the laboratory. Loose clothes, jewelry, and long hair can be easily caught in rotating machinery with disastrous results. Remove jewelry and tie back long hair and loose-fitting clothes. Wear long pants (no shorts) and shoes that completely protect your feet (no sandals).

Toxic and Corrosive--Substances

You should also be aware of the fact that all chemicals located within the: University and our laboratories have been listed in inventories to be located in each laboratory, stockroom, or other such working areas. The list is by chemical name, Chemical Abstract Service number, and quantity. The containers of those chemicals considered by the Occupational Health to be most hazardous are identified by a yellow sticker. The purpose of such a sticker is to alert users to quickly formulate in their minds a special effort to take every possible step to handle this material with maximum care.

Everyone has the right and obligation to know the hazards (i.e., toxicity, corrosiveness, and flammability) of all chemicals with which he or she is, or may be using. Although there are very few hazardous materials at the ARL, you are always encouraged to ask the laboratory safety officer before you are possibly exposed to them. If you find an unknown chemical please contact the laboratory safety officer. Do not pour chemicals down the drain.

Flammable Materials (Gases. Liquids, Aerosols, etc-)

These are materials that readily catch fire and bum or explode in air. A flammable liquid, for example, does not itself bum; it is the rather fugitive vapor, which emanates from the liquid that is the combustible culprit! The degree of flammability, such as the flash-point temperature, the ignition temperature and the limits of flammability, is a characteristic that must be known about all chemicals with which one is involved.

Obviously, all sources of ignition, remote, and near field, must be monitored in the presence of flammable materials. Typical ignition sources are steam baths, water baths, oil baths, air baths, heating mantles, live pilot flames, electric shorts and static currents. Any hot work requiring flame-acetylene torch welding, soldering, use of a Bunsen burner, and the like, require specific permission from the laboratory safety officer. Don't forget that light switches and sparking electric motors are also common ignition sources. The key precautions in handling of flammable chemicals are, therefore: (1), eliminate sources of ignition; (2), ventilate to dilute and prevent the formation of flammable air / chemical vapor mixtures and (3), reduce sources of static electricity by grounding and bonding all equipment used to contain or handle flammable chemicals, and/or dust particles, including your own body.

Electrical Equipment Safety

All electrical equipment must have dime-prong plugs on connecting cords in order to provide grounding. Adapters which circumvent groundings are not permitted. All equipment should be certified as approved by the Underwriter Labs, or a similar certified agency. Frayed cords must be replaced. Motors must be of an induction rather than series-wound brush type to avoid sparks and a hidden ignition source. All electric

equipment must be protected from water or other spillage. Where possible, moving parts should be properly shielded to avoid entanglement. Safeguards must never be overridden, or removed.

Compressed Gas Safety

Compressed gases present a unique hazard because of both mechanical and chemical hazards. A flammable gas, like hydrogen, together with its potentially rapid spread through an area, presents the danger of a flash fire, explosion or detonation. Another hazard can arise from reactivity and toxicity, and even a "harmless" gas such as carbon dioxide or nitrogen can cause asphyxiation at high concentrations. Finally, the huge amount of potential energy stored in a gas cylinder from the compression of the gas makes a compressed gas cylinder a potential "torpedo", "rocket", or "fragmentation bomb". Careful and knowledgeable handling is therefore imperative.

The contents of each cylinder must be clearly identified. The label or tag must be on the cylinder. The pressure of the cylinder must also be shown and conform to what was ordered. Cylinders must be firmly secured at all times by use of a clamp and belt or chain. They must be moved individually and with their valve caps firmly in place and with proper wheeled carriers. The handling of gas cylinders by means of a hoist is not good engineering safety practice since the danger from a dropped cylinder is too great. Cylinders must be placed so that the valve is accessible at all times. The main cylinder valve must be completely closed when gas is not being withdrawn and always when unattended. Valves should be opened slowly, and cylinders without regulators must never be "cracked". Be sure that you know how a valve or regulator operates before using them since they may open and close in opposite directions depending on the type (i.e. regulators often increase pressure in the opposite direction as a gate valve opens, ball valves often require only a quarter of a turn to go from full open to close). Do not open valves all the way. Only approved wrenches or other tools supplied for opening valve caps or valves should be used. Never use a pair of pliers to open a valve, and never use a hammer or heavy tool to free a frozen valve by tapping. Take special precautions when opening a valve of a cylinder containing an irritating or toxic gas, and do not stand down-wind of the cylinder.

A cylinder should never be emptied to a pressure lower than 25 pounds per square inch on the gauge because residual gas may become contaminated if the valve is left open. The regulator should be removed and the valve cap replaced. Empty cylinders must be clearly marked as such.

Safety Equipment and Attire

In general when working in a laboratory or machine shop students should wear protective goggles with wraparound design. These are provided. Ordinary prescription glasses and contact lenses are not to be a substitute or used in the laboratory. Face shields, which protect the face and the throat, together with safety goggles, should be worn when maximum protection is necessary. Goggles dangling from the neck or perched on the top of a hard hat are obviously no protection whatsoever.

When corrosive or toxic chemicals are being handled, appropriate gloves should be worn. Rubber or plastic gloves should be inspected often for leaks. Insulated gloves

should be used when working at temperature extremes. Asbestos gloves and aprons are strictly forbidden.

To protect against splashes or spills, aprons, lab coats, or other protective clothing should be worn. Skimpy or loose clothing should not be worn (shorts, halter tops, saris). Unrestrained long hair can catch fire, dip into chemicals, or become ensnared with moving equipment. Jewelry that can react with chemicals or become ensnared with moving equipment must not be worn. Shoes must be worn to protect the feet. Perforated shoes, sandals, or cloth sneakers must not be worn.

The location of fire extinguishers, fire alarm stations, fire blankets, respirators, safety showers, and eye-wash stations must be memorized so they can be used in case of emergency. Always call the Fire Department (University 9-911) (private and pay phones 911) in case of an emergency.

Small scale lab spills should be cleaned up immediately and notified to the laboratory safety officer for disposal. If unsure as to what to do, ask laboratory safety officer. Larger spills must always be reported to the laboratory safety officer, or to the Department Office. The same is true for any accident. It is better to report any incident, than to subject yourself to problems later.

In case of an emergency, such as fire, theft, serious accident, fainting, fall, or the like, once again dial (University 9-911, private and pay phones 911) describe the problem as carefully as possible and give the precise location. Always identify yourself and give the extension from which you are calling.

Injury Prevention

Proper use of tools is critical to prevent personal injury when experiments are conducted. Avoid touching any moving equipment by any part of your body when one is making an observation or taking a measurement. Be alert whenever experiments are involved with high pressure, such as gas cylinders and wind tunnels. Avoid touching any extreme hot or cold part of the experiment system, otherwise, thermal "burn" may occur.

Special Safety Procedures:

Model Shop

Common power tools are available for occasional use in the model shop. The laboratory safety officer will establish a check out procedure for each piece of equipment and everyone using this equipment must be signed off by the safety officer and/or his appointee. The safety officer will establish rules as to the use of safety equipment such as eye protection, safety shoes, appropriate clothing, etc. for the use of the shop equipment.

Fan-driven wind tunnels

Users of the fan driven tunnels must have a buddy aware of their activities and their schedule. The buddy does not have to physically be in the laboratory at all times, but must check in with the tunnel user at reasonable intervals. When working in the test section the tunnel must be off and the emergency stop activated to prevent accidental starting of the tunnel. If the diffuser, fan or silencer is entered, the tunnel power should be turned completely off. Care should be taken to avoid exposure to high speed air issuing from the tunnel fan exits.

Hearing protection should be worn when occupying the tunnel room with the 3x4 tunnel fan running at 600 rpm or higher. Permanent hearing damage may occur with prolonged exposure at higher fan speeds.

High Pressure air tunnels

Greg to fill in

Laser safety

Any number of laser systems are or will be available for use at any given time at the Aerodynamics Research Laboratory. The use of a specific laser-based system will require a check-out procedure by the laboratory safety office and/or his appointee.

In general, laser operators, other research and visitors should follow basic principles of laser safety. This involves shielding, to the extent possible, the path of a beam or sheet from all areas where not required for experimentation. This can be accomplished with the strategic placement of screens, sheeting, etc. Special care should be taken to minimize reflection paths. This includes windows, metals or other surface in a room as well as personal items such as watches. Laser-safety glasses should be made available to anyone (research, visitor, etc.) present in the vicinity of the laser operations. Individual access to rooms with laser activity should be controlled in an appropriate matter by locking doors, posting signage, etc.

Only lasers which operate in the visible wavelengths should be used in the laboratory unless special arrangements are made with the laboratory safety officer. Most laser systems contain high voltage power supplies and therefore students should not repair lasers without contacting laser company and notifying laboratory safety officer or faculty advisor for proper supervision.

Flow visualization safety

Several types of flow visualization methods are used at the ARL and each method may have some specific safety guidelines. In general, most flow visualization methods require working in dimly lit or completely dark conditions. Care should be taken to minimize hazards (such as falling or tripping, misplaced sharp objects, etc.) that may become especially dangerous in the dark. If the flow visualization operation involves extensive precarious movements in the dark (such as video operations on top of the 3x4 low-speed tunnel), the researcher involved should notify the laboratory safety officer. Certain situations may dictate that two people are required to be present for a given operation.

The use of fluorescent oil flow visualization is a common technique for low-speed testing at the ARL. Care should be taken to avoid exposure to certain types of UV radiation from the black lights. More information can be found at: http://wolfstone.halloweenhost.com/TechBase/blttip_BlackLightTips.html . The surface oil method usually involves spraying the oil/dye mixture on the test surface using an airbrush. Care should be taken to avoid inhalation of the aerosol. Adequate ventilation and/or a breathing mask is required.

Certain types of smoke flow visualization use laser illumination. The safety guidelines for lasers (above) should be followed. The smoke generating apparatus may involve the use of DC power supplies capable of producing high current draws. Care

should be taken to avoid electrocution. The user should also familiarize themselves with the material safety data sheet (MSDS) information for the specific type of fluid being used to generate the smoke. Adequate ventilation should be maintained while conducting smoke flow visualization.