Information for employees and students working at the Faculty of Science (W&N)

This AMD information sheet contains practical advice for your own assessment of risks before you start your research. There is a mandatory order to the way measures should be taken, the so-called hierarchy of controls (Dutch: "arbeidshygiënische strategie"). This strategy is clarified in Chapter 3.

1 Hazards in research

In a laboratory there are more sources of hazards in comparison to household circumstances. In research there may even be unknown hazards. For example, a new synthesis product may be carcinogenic. However, not every hazard needs to become a risk. If you think about what might go wrong in your research or set-up beforehand, you can eliminate or diminish many risks by taking the right measures in the proper order. The hazard may be caused by interaction with the environment, but also by an external source (power failure, fire, falling objects, etc.) Many specific situations that you may take into account, are described in the AMD information sheets on the website under the heading *Working safely using*. Here we provide tips for the approach of a risk assessment. Obviously, you are welcome to ask for support by the AMD at any time in this process.

Hazard: *source of potential harm to man, environment, goods, etc.*
Risk*: the chance that the potential consequences of the hazard occur.*

2 Risk assessment per research or set-up

2.1 Risk assessment in general

To assess risks you will first have to know and name the hazards. As soon as you have a global idea of how you would like to set up your research, you can start with this yourself. *In case of research projects involving GMOs, isotopes, or synthetic nanomaterials the risk assessment must always be drawn up by consultation with the AMD, as prescribed by current regulations.* Please also try to think of the required permits and trainings beforehand.

- Please remember that risk assessment is not a one-person job. Ask others with knowledge of the research, the set-up, or the risks involved. First brainstorm on the hazards present. What may go wrong, and what will be its effects? How real is that risk? Please also consider the environment: are emissions possible of gas, dust, or vapour?
- Next, check if other hazards are mentioned in the Checklist for technical reseach set-ups in the "arbocatalogus Nederlandse Universiteiten" (OHS catalogues of the Dutch Universities) (Dutch link). Aside from many potential hazards in laboratory settings, these contain many other matters that

need to be addressed, such as informing the emergency response teams (BHV) about the manner of intervention in case of a calamity. You might also use the checklist from the start, but then you run the risk of being guided by the questions, and you might miss matters.

- Finally, prioritize the diverse risk in order from high to low. A high risk is not only presented by visible circumstances that happen often (high chance, small effect), but also by circumstances with a low chance and a large effect (like fire). The risk prioritization forms the basis for the order of measures to be taken, but please do make sure that the less severe, but very easily solved issues are taken care of quickly.

Risk = chance x effect

Please do not hesitate to make an appointment for a guided risk assessment if you are in doubt: AMD@science.leidenuniv.nl

Modification in the set-up, design, or use may lead to unforeseen risks. In such a case the risk assessment has to be adapted to the new circumstances. This may mean that additional safety measures will have to be taken before continuation. Therefore, try to include the entire life cycle of your research set-up:

- *Design phase*
  In which environment will the set-up be put (external hazards)? What rules and standards apply? Are all parts at logical places? Please consider the intended safety measures in this phase already. If modifications to the room are required, then apply for these now (for example, wall sockets in logical places to avoid complex power loops and the danger of tripping). If a permit is required, then please remember these always take time. You may be able to circumvent a permit application by using another design, method, or substances.
- *Building phase*
  What risks are there in and around the set-up for all those who work at the set-up or neighbouring set-ups (such as the risk of falling and tripping, or electrical hazards) ?
- *Use phase*
  Prevent exposure by operational errors. Draw up a work protocol that is clear for students as well. Please also consider the risks to others that work in the room or who may enter, such as colleagues, cleaners, emergency response teams (BHV), or chance visitors. Are there other types of work or calamities in the room possible that may have adverse effects?
- *Maintenance and cleaning*
  These may present entirely different hazards (and to different people) in comparison to daily use! For example, think of a device with an in-built laser head, that is never opened by the user, but is opened during maintenance (a class 1 laser product, such as a FACS, changes during maintenance into an open class 3B laser to which a number of safety measures apply). Will the maintenance person be able to reach all the required facilities in all places, or does he need to move his body in an uncomfortable way? How are you going to clean the device in case you spill something?
- *Dismantling*
  Please also consider, among other things, the release requirements for the equipment and room, environmental aspects, changes in permits, and changes in the room signage. Does one, for example, have to take special cleaning or the disposal of radioactive sources into account in dismantling?

2.2 Exceptional circumstances

In the following circumstances a slightly less extensive risk assessment may suffice:

1. In case of standard laboratory practices in temporary set-ups in a fumehood (distilling, synthesis, purification) or a biosafety cabinet. Minimal requirements are: From the lab journal it should be clear that reliable MSDSs[1] of the substances are studied and present, that you know what reaction products with which properties will be released, that the properties of organisms are known, and that the other risks (detachment of water hoses, overheating of equipment, release of gases, etc.) are covered. When doing this, you could use the checklist on the Overnight/Weekend form (bilingual). This should under all circumstances be filled in and be attached to the fumehood in a visible place, when equipment stays on or when a reaction continues overnight or in the weekend. That way, the content and contact person are immediately clear in case of calamities. If the MSDSs mention certain substances that should be at hand for neutralization in case or calamities, then please make sure that these are present!

2. If you use a purchased electrical device, then check for the presence of the CE marking and a declaration of conformity plus a manual in a language you understand. Set up the device according to the supplier's instructions (or have it installed), and follow the manual in use, or draw up a shortened set of work instructions. Perform regular maintenance or have maintenance performed, and register this in a log.
   *If there is no original manual available anymore for older equipment, then **still** perform a risk assessment yourself. If this shows that the device is no longer safely usable according to the current standards, then dispose of it . If not, draw up internal work instructions and make these known to the users.*

3 Taking safety measures

After you have mapped out the risks, the next step is to take effective measures and to make these known to the relevant employees and students. When taking preventive measures we are obliged to follow the **hierarchy of controls** **("arbeidshygiënische strategie")**. This is a binding order of measures from the Dutch Working Conditions Act ("Arbowet"), which starts at the removal or replacement of the source of the risks. Only *motivated*[2] measures of a lower protection level are allowed. Please also consider that sometimes measures of several levels need to be combined to complement each other and reach the desired effect.

[1] The most reliable MSDS comes from the substance's supplier. Validated MSDS information may also be found in GROS, if the substance is mentioned in the BIG database. If you are looking on the internet, then search for the CAS number of the substance with "MSDS" and choose a European hit.

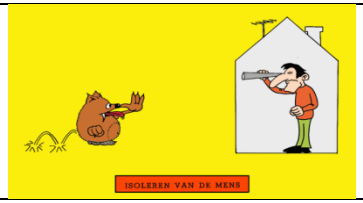
[2] Lowering a level is allowed only if there are proper reasons for it (technical, operational, or economical). This is the principle of reasonability. This evaluation applies to each level anew. Exceptions to these are the risks of carcinogens and biological agents. In those cases a step lower in the hierarchy is allowed only when a higher measure is not technically feasible. For these two groups no economical reasons may be used as reason for a lower level measure.

Below, you will find a description of the hierarchy of hazard controls including the diverse protection levels. On page 5 you may find a table with examples for each level.

1. **Source-centred measures:**
   A. Elimination and substitution
   Can you eliminate risks by using an alternate substance, process, or method that is just as effective, but entails less risks? Then please choose to do so already in the *design phase*
   Is the experiment worth the risk? Abandoning it may sometimes be an option, if the risks cannot be controlled properly. Perhaps you might move it to an external location in which there *are* provisions, or you might consider having an expert perform it somewhere else for you.
   B. Adapting the risk source to diminish the effect.
2. **Technical measures / engineering controls**
   Can you adapt the risk source technically, or perhaps isolate it from the person(s) exposed to it? Many options apply to this, depending on the risk. For example, you may put the risk source in a separate room, enclose it, use insulation? Please take this into account in the *design phase*.
   Ventilation is also a form of a technical measure, which sometimes is mentioned as a separate control level.
3. **Organizational measures / administrative controls**
   Can you separate in time or place in such a way that people are exposed for a shorter time period, or fewer people are exposed? Other measures that fall in this category are: drawing up a stepwise work protocol, making working together mandatory, informing colleagues in the same room about the risks, and applying safety signage.
4. **Personal protective equipment (PPE)**
   Which PPE protect against the (remaining) risk? The application of personal protection equipment is allowed only if the measures under 1, 2, and 3 are not reasonably feasible in a technical, operational, or financial sense, *or* do not provide sufficient risk reduction. Furthermore, the employer is responsible for the costs.

Corrective measures, such as fire or gas detection, do not fall under the hierarchy of hazard controls, because these neither take away the hazard, nor reduce the risk. Obviously, these measures are also important to review! Please see AMD Information sheet RhL020 *Safety equipment*. This sheet also contains information on the choice of personal protection equipment.

Please also register the choice of the measures in your risk assessment document.

Level		Example 1	Example 2	Example 3
1A. Elimination of the source: - alternatives		Replacing a preserving agent in a practical biology instruction by a less harmful alternative.	Replacing working with radioactive markers by a newer analysis method without radiation risk.	Preventing RSI by pipetting large series by purchasing a pipetting robot.
1B. Adaptation of the source – reduction of the effect		Purchasing an ethidium bromide solution, instead of weighing and dissolving the powder yourself, reduces the risk of dusting and skin contact.	Adapting the DNA of biological agents to eliminate harmful properties.	Looking for the smallest possible volume of a gas when purchasing and setting up at the workplace.
2A. Technical measures at the source: - Isolation of the source - Encasing - Screening		Setting up noisy pumps in a separate adjoining technical room, instead of in the lab room.	Having class 3B and 4 laser bundles run through bundle pipes.	Placing gas bottles with toxic, flammable, or explosive content in a separate, vented gas bottle cabinet.
2B Technical measures: -Ventilation		Installing a fumehood to prevent inhalation of hazardous substances.	Installing local exhaust ventilation above points where hot or harmful vapours are released by the device.	
3. Organizational measures: - separation in time - separation in place - procedures - job rotation		Putting the people in a control room, and thus physically separating them from the process.	Dividing the pipetting task over several persons, to prevent one single colleague being exposed to the risk of CANS/RSI.	Drawing up work instructions in which the proper order of operations is stated.
4. Personal protection equipment		Wearing cold-insulating gloves when working with liquid nitrogen.	Wearing a lab coat and safety spectacles to cover the remaining risks when working with chemicals.	Putting on hearing protection when working with ultrasonic sounds.