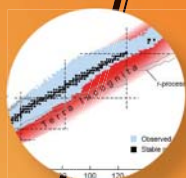
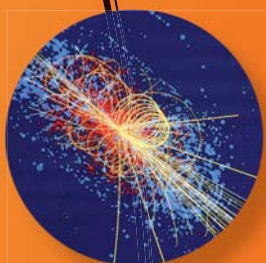


Physics Teaching Assistants' Manual



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This manual includes physics department policies for teaching recitation sections and laboratory sections. These policies have been written by the Director of Undergraduate Laboratories in consultation with members of the physics faculty.

Summary of Introductory Physics Laboratory Goals

- I. The Art of Experimentation:** The introductory laboratory should engage each student in significant experiences with experimental processes, including some experience designing investigations.
- II. Experimental and Analysis Skills:** The laboratory should help the student develop a broad array of basic skills and tools of experimental physics and data analysis.
- III. Conceptual Learning:** The laboratory should help students master basic physics concepts.
- IV. Understanding the Basis of Knowledge in Physics:** The laboratory should help students understand the role of direct observation in physics and to distinguish between inferences based on theory and the outcomes of experiments.
- V. Developing Collaborative Learning Skills:** The laboratory should help students develop collaborative learning skills that are vital to success in many lifelong endeavors.

From the American Association of Physics Teachers

Laboratory Instructor Guidelines

Policy Statement

Revised, September 1, 1996

Introduction

The following guidelines are set down to provide a basis of understanding between you, the graduate teaching assistant, Dr. Parks, the director of undergraduate laboratories, and the students we serve. However, no set of rigid rules can replace good common sense, proper preparation, constant communication, enthusiasm, and hard work in producing a lab experience for the students for which all can be proud. Think about the teachers and professors who have made you want to work hard and do well in class. What did they do to make you want to excel?

Absences

Under no circumstances are you to cancel scheduled laboratory classes. Call the Lab Director if you are physically unable to make your scheduled class, e.g., if you become sick. (If you have car problems, call a friend, call a cab, ride

your bike, or invest in roller blades.) If I can't be reached, explain the situation to Pam Carter. Do not schedule trips that conflict with your teaching duties without prior special approval by me. Finding a temporary replacement is extremely difficult and approval will not be given easily. Do not arrange for a substitute to take your place without prior approval.

Office Hours

In order to accommodate the typically limited, but often essential need for students to be able to reach their TA to discuss problems, etc., the following office hours are required. These requirements are for all TA's.

Of course, you can arrange any mutually agreeable meeting times and places with your students. Missing scheduled meetings will not be tolerated. However, you are also required to post scheduled office hours. These must be located in the physics department; your research area, the graduate student carrels or the 2nd floor lounge are possibilities. You must specify two, one-hour periods per week (9-5, Monday-Friday) on different days when you can be reached at this

location. You must advise your students of these times and the place where you can be reached, and give me a copy as well.

You are strongly encouraged to simply announce that you can be reached at the scheduled place and times. You must be there reliably. For some TA's this should be no problem. However, I recognize that this could present an unnecessary hardship for some TA's since students seldom request any meetings. On the other hand, some students have complained that they have consistently had trouble reaching their TA's. See me if you find the office hours requirement overly burdensome.

Student Instructions

You should prepare a lab syllabus for your section consistent with the schedule of labs. University policy requires a syllabus and your lab syllabus should be placed in the main office on file for anyone to view. Your syllabus should also be included on the departmental Web site.

A set of general instructions for the students is found in this manual and should be provided with and/or included in the lab syllabus for your section. That is their guide to laboratory procedures, and you should be familiar with it also.

Preparation

Read up on the topic to be covered by reading the student's textbook, and any other references you can find. Remember you are the expert!

You must perform each experiment on your own---before presenting it to your class. You may have to set up the equipment yourself. The area in the back of room 510 is set up for this purpose. Write up the lab just as you would like your students to and turn it in to me at least 3 days prior to your scheduled lab. Don't be overly embarrassed if you have any problems---that's what this exercise is all about. Better you find out before going into a room full of students counting on your expertise. TA's with at least 1 full year of experience who have done the experiment can write me a note explaining this fact in lieu of the written report.

Spreadsheet Use

You should try to become somewhat of an expert on using the Microsoft Excel spreadsheet program in the lab. The first lab has a tutorial on Excel and this should be sufficient for the student. Students should be encouraged to use Excel on the lab's computers for data analysis beginning with the very first lab experiment. There is some flexibility here, but the students should use the spreadsheet just about every week.

In the Laboratory

It is important to arrive at least 10 minutes prior to the start of the laboratory period. Check that the equipment is all there. Move any unnecessary equipment to the stockroom. If you know where it goes, put it there. If not, leave it on a cart with a note that it needs to be restocked. If you use any non-standard equipment, restock it when you are through with it.

- » Make a special effort to count equipment that might be stolen: for example, meters (everyone wants one for home use), optics---such as lenses, filters, and gratings, (they are small and fun to play with) lasers, (everybody wants one, and they are expensive) etc. Items like weights, test leads, etc., which are often stolen, but are too difficult to inventory, need not be inventoried.
- » Collect answers to prelab questions at the very beginning of the period.
- » I know there is often a problem with the coordination of the labs and the lectures, but there is no compelling reason why some new material can't be introduced in the lab. They are expected to learn it from the write-up and by studying the appropriate material in their texts. Do not present a comprehensive lecture on the subject of the experiment during the laboratory period--the laboratory is for experimentation. Try not to spend more than 15 minutes describing the theory and experiment. (10 minutes is a good average). Always warn the students of any and all safety hazards associated with the experiment.

- » Circulate around the lab, checking students' progress, and asking questions about the experiment and analysis. Don't sit at the front of the lab waiting for questions or problems to come up. Check how the students are performing the data collection and data analysis tasks and correct their procedures when necessary. Do not do the work for the student.
- » Each partner should have his or her own data sheet which you should initial at the end of the period. Check that the data appears reasonable. This is much easier if the students have already made graphs based on the data. Except where totally impractical, students should be required to show you their results and/or a graph of their work before leaving the lab.
- » Do not let the students out early. If the students finish early, make them begin preparing the laboratory report or studying for next week's experiment.

Before you leave the lab, check around. Make sure all equipment is still there: you should take it as your responsibility to guard against thefts. Your inventory made at the beginning of the period should be checked. If anything has broken during your class, put it in the stockroom with a note as to the problem, and find a replacement. If a replacement is not available, notify me immediately---by phone if possible, or if I cannot be reached, leave a note in my mailbox.

Report Grading

The student's write-ups are to be turned in at the beginning of the following lab session. You should have them graded by the session following that one. Do not be late in returning reports. Students need them as a guide to what you want to see in subsequent reports.

When you find something wrong in the report or not supplied with all the requested information, state this clearly in the returned report showing what should have been presented. If you feel uncomfortable taking off points for mistakes you

haven't specifically warned students about, take the time to warn the students in the report that next time you will take off n points for this kind of mistake. Or perhaps, write down the kind of mistakes you see, and warn the whole class early on in the semester. Then remember to be strict in the grading of the report---the students will rise to your expectations.

- » Make sure the data is clearly labeled---often this is dictated by the data sheets. Make sure they follow through with this labeling on any spreadsheet tables. (This should be checked while the students are in the lab.) Are all uncertainties given when they are appropriate? If not indicate where they should have been supplied. If units are not supplied, correct.
- » Make sure the calculations are done properly and include an estimate of uncertainty in the final results. Units should be correct in any calculations. Correct as necessary.
- » Make sure that graphs include a title, and axis labels with units. Make any corrections on the graphs.
- » Check that the conclusion is stated correctly. Check that the comparison with expectations is in agreement with the calculations. Do not penalize students if their results are many standard deviations from some accepted value. But if they are, the student should say so properly.
- » Make sure the students have answered all questions posed in the handout.
- » Grade the prelab questions and return them with the report.

If you carefully grade all lab experiments, and give out appropriate grades for each lab report, (the system is up to you, but I find a base score of 100 with points taken off for errors and omissions works well) the mean and standard deviation of your final lab grades should probably come out fairly close to those for the course

in general. This is probably in the neighborhood of a B, or around 80-85 percent with a standard deviation of about 10-15 percent. If you grade well---as you should---giving helpful suggestions in the early reports, your students may begin to present you with well written reports containing all the relevant sections discussed above. Well written reports are easier to grade!

If at any time you are concerned about your grading procedures bring me a stack of graded reports before returning them to the students. We can look them over together and discuss any problems.

If you give a laboratory exam at the end of the course, it should cover only general laboratory procedures, e.g., questions on propagation of errors, and specific experiments, e.g., how the data was taken. Drop a copy in my mailbox with your name and the section number on it.

Experiment Evaluation

In order to keep improving the laboratory, the experiments, and the write-ups, I need feedback. The students have been invited to express their thoughts to both you and me. You however are specifically requested to fill out evaluation forms for each experiment. They are available in the stockroom. A sample form is enclosed. Return them to my mailbox in room 401. They are to serve two purposes and thus should be written in twice: Once when you are in the lab to tell me about how the experiments work in the lab, and once when you are grading the reports to tell me about how the reports turn out. In both cases, tell me about any problems with the experiments (equipment, procedures, student misunderstandings, etc.) and write-ups (theory, procedures, questions, etc.) Be specific. Any suggestions for improving the experiment are welcome. Use additional paper if necessary.

Comments on general topics such as this document, the student instructions, or general laboratory procedures are also welcome. Please sign the acknowledgement form and put it in my mailbox. Comments are welcome.

Experiment Evaluation Form

Laboratory instructors: fill this out for each laboratory experiment.
Return to my mailbox in Room 401---Dr. Parks

Name:

Date:

Experiment:

Section numbers:

In the Lab

Describe how the students performed in the laboratory. Were there any problems with the instructions in the write-up for the experiment? Did the equipment have any problems? Was there anything especially good or bad about the lab? Do you have any suggestions for improving the lab? Did the students finish data collection and analysis? If not, how far did they get? Did you modify the experiment requirements? Why and how?

During the Grading

Describe how the students (on average) wrote up their reports. Was anything consistently good or bad in most of the reports? What were typical mistakes in student's answers to the questions and in student's data analysis? (Give approximate fraction of students making the mistake.) Do you have any suggestions for improving the write-up? Any questions you think should be added?---Give them below. Any you think should be deleted?

Average grade given the students (%)

Acknowledgement Form

I have read the Laboratory Instructors' Guidelines and the General Student Instructions.

Signature: _____

Comments:

Physics Laboratory General Instructions for Students

Policy Statement
September 1, 1996

1. Laboratory Objectives

The laboratory component of your physics course has many objectives. Some important ones are:

- » Experience with scientific apparatus: This ranges from being able to read instrument scales, to knowing safety hazards, to effectively using specific pieces of equipment, to using computerized data acquisition systems.
- » Data analysis: How do you assess whether theory and experiment are in agreement? You will become familiar with the formal procedures associated with data analysis such as propagation of errors and linear regression analysis. You will also use a spreadsheet on the lab's personal computers for data analysis.
- » Communication skills: You should learn how to present your results in a written report. Guidelines are given below.
- » Physical concepts: The lab should reinforce the physics from your lecture courses.

2. Ground Rules

- » Attendance: You must attend each laboratory period and do all experiments in your assigned section. In general, you will not be permitted to do your experiments in another section. An exception may be made only in cases of dire necessity with the prior approval of the instructors of the assigned section and of the section in which you would like to transfer.
- » Make-ups: The last week is usually reserved for make-ups and/or a lab final. Usually

only one (but no more than two) make-up experiment is permitted. Because of end-of-term pressures it is better to avoid needing any make-ups. If you know in advance that you cannot attend a particular lab session, speak to your instructor. It may be possible to do the experiment at some other time.

- » Penalties for Missing Reports: Failure to do and/or turn in a report on an experiment will result in a grade of zero for that experiment. Two labs or less may be made up by making an arrangement for doing so with the lab instructor (see above). Missed labs can only be made up if there is a documented medical or family exigency. In well-documented emergencies a grade of incomplete ("I") may be possible. In the case that several severe emergencies resulted in missing two or more experiments the student should apply to the Office of the Dean of the College for permission to withdraw from the course with a hardship grade of "W."
- » Preparation: Before each laboratory you are expected to read the experimental write-up and any related sections of the text so that you are familiar with the theory and the experimental procedure. As it is often impossible to have the laboratory come after the relevant material has been discussed in lecture, you will often have to read ahead in your textbook. If the write-up has prelab questions, these will be collected at the beginning of the lab period, graded, and returned with your laboratory write-up.
- » Promptness: It is important to arrive at the start of the laboratory period. The instructor uses this time to give any information not in the write-up and to warn of any possible safety hazards or pitfalls in performing the experiment.
- » Conduct: Eating, drinking, and smoking are not permitted in the laboratory. Of course, loud talking and disruptive behavior are also prohibited.

- » Partners: Generally, you will work with one partner. When necessary, groups of three may be permitted. Rotate the experimental tasks so that each partner becomes familiar with all aspects of the experiments, e.g., do not have one partner take all the data while the other does all the recording or analysis.
- » Data Sheets: Each partner must have his or her own data sheets. They should list the name of all partners and the date performed. The data sheets may come from the write-up, a spreadsheet printout, or you may have to write up your own data sheets. All necessary data should be on these data sheets. All data (single item and tabulated) should be clearly labeled with a description of the number and its units, and when appropriate, its uncertainty. If you use the spreadsheet printout, put the partners and date at the top and put data labels and units at the top of each column -- you can even do this by hand, if necessary.

The data sheets should be initialed by the instructor at the end of the period. This is not a guarantee that the performance in the lab was adequate, though the instructor should check that the data appears reasonable. Graphs made in the lab during the experiment make it much easier to detect errors or omissions. Guard the data sheet - it is the only proof that you performed the experiment.

- » Repeating All or Part of the Experiment: If the instructor finds a report unacceptable, it may become necessary to repeat all or part of the experiment. In this case, a new data sheet should be filled out with the required data and initialed by the instructor. The report should be resubmitted with any revisions in the analysis, conclusions, etc. that are warranted.
- » Checking Out: If you finish early, begin preparing the laboratory report. In some cases, you may be able to finish it in class. Clean up your area, leaving it as you found it,

unless specified otherwise. Groups coming after you should expect to find all the equipment in working order. If something broke during your experiment, report it to the instructor so a replacement can be found.

- » Laboratory Exam: Most instructors will give a short laboratory exam at the end of the course. It should cover only general laboratory procedures, e.g., questions on propagation of errors; and specific experiments, e.g., how the data was taken.

3. Laboratory Guidelines

We will do all we can to give you a quality experience in the physics laboratory. Please feel free to submit suggestions or complaints about the lab to your instructor or to Dr. Parks -- his mailbox is in the main office, Room 401. However, obtaining a quality lab experience is ultimately up to you.

You should take care that the data you obtain is the best possible. Make graphs of the data while you are in the lab and compare them with other groups'. Show them to the instructor. Do all the calculations in the lab, including the error analysis. The spreadsheet program is handy for this. Before you leave the lab, you should know whether the theory and experiment are in agreement.

4. The Report

Your lab write-ups are to be turned in at the beginning of the following lab session. Begin each of the following topics on a separate page using additional pages as necessary. It should contain the following information:

- a. Title page: A title page should include the following: (1) the name of the experiment, (2) your name, (3) the name of your partner, (4) the course name and number, (5) the section number, (6) the name of your lab instructor, (7) the date the experiment is performed, and (8) the date the report is submitted. Make sure the partners listed

on this page are those with whom you performed the experiment. As an alternative to save paper, the title information can be included on the first page instead of a separate page.

- b. Purpose and method: This should be short: a paragraph or two describing what measurements were made and for what purpose. You are trying to show that you understand the relationship between the experimental procedures and the theory. This can sometimes be fairly obvious or simple and may only take a sentence or two. Procedural details should not be given, unless they are in some way original or non-standard.
- c. Data tables: The original or photocopies of the original data sheets, collected in class and initialed by the instructor, should come first. Neatened or expanded versions of the data with additional derived quantities may come next. Once again, remember labels, units, and uncertainties.
- d. Calculations, including Error analysis: Whenever possible calculations should be done in the lab. Include in your calculations the units associated with any variable and, where appropriate, cancel units or change them to derived units (e.g., change $\text{kg}\cdot\text{m}/\text{s}^2$ to N). Describe and show all work. If you do the calculations with the spreadsheet, remember to put labels and units on any additional columns, and state in the report how these columns were calculated.
- e. Graphs, when appropriate, should include a title, and axis labels with units. These should also be done in the lab, if possible. If straight line fitting is performed on the data, either by hand or with a linear regression program, remember to record the slope and intercept and their uncertainties. Draw in the regression line determined from the slope and intercept. Whenever possible put error bars on each graph point. This is too tricky to do with the spreadsheet

program -- so you may have to add them after the printout from the spreadsheet has been made. If the error bars are too small or data points are difficult to see on the graph, put a small circle around each one.

- f. Conclusions: This should include a brief discussion of the main findings. For example: "We found that there is a linear relationship between the measured variable ... and ... This can be seen from the graph and is predicted by the theory."

Also state whether your results agree with expectations to within the uncertainties of the measurements: For example: "The slope of the graph of ... versus ... as determined by (linear regression, hand fitting) was $\dots\pm\dots$ (units). This value, together with Eqn. ..., and the measured quantities $\dots=\dots\pm\dots$ (units), and $\dots=\dots\pm\dots$ (units), allowed for a determination of $\dots=\dots\pm\dots$ (units). This is within ... standard deviations of the accepted value of ... (units)."

Discuss the main sources of error. "The main sources of uncertainty in the determination of ... are ..."

- g. Questions: Answer all questions posed in the handout.

Recitation Section Guidelines for Teaching Assistants

Policy Statement
September 1, 1995

General

The purpose of recitation sections is to help students enrolled in Physics 221 and 222 learn the principles of physics and develop problem-solving skills. Recitation sections are to provide an educational enrichment experience for the students enrolled in these normally large lecture classes by providing the more intimate, individualized, personalized instructional environment normally associated with the small classroom setting. The recitation section should promote interaction between the student and teaching assistant whereby the needs of the student can be readily identified and quickly addressed in the most effective way. The approach to teaching recitation sections can be summarized in a series of attitudes.

Professional Attitude

University teaching is a business and the student is our customer. Students pay us money to provide them with an education. It is our moral obligation to provide them the best instruction that we can deliver.

The Teaching Attitude

The instructor cannot learn for the student; the instructor can only teach. Teaching can take many forms, but in recitation sections the main focus will usually be development of problem-solving skills. While the student may learn these skills by observing the teaching assistant work a problem, emphasis should not be placed on the actual working of the problem, but rather on the procedure for working the problem. The old adage, "You can give a man fish and feed him for a day, but you can teach him to fish and feed him for a lifetime," is appropriately applied to the teaching attitude we want to assume. The teaching assistant does not want to simply work the problems for students, but should teach them the procedure and approach for successfully solving the problems.

The Saleman's Attitude

Our product is education, and we want our product to be the very best, because a good product is much easier to sell than a poor one. In addition, we not only want to deliver a good product, but we want our product to be perceived as the very best. A good product perceived to be a bad product is a bad product, because to the customer (our students), perception is reality. You must believe in our product and your own ability to deliver it. To do so, you must be enthusiastic about this product and show it. Recitation sections can be dull or truly enlightening. A major factor in a successful program is the enthusiasm we display for it. Salesmen display and demonstrate their products. They go after the customer; they don't wait for the customer to come to them. This is the same approach that should be used with recitation sections. We should offer students the opportunity to learn physics and create an atmosphere where they feel encouraged to seek help and ask for assistance.

The Team Attitude

Teaching Physics 221/222 is a team effort involving a faculty member who conducts the large lecture sections and TAs who teach the laboratory and small recitation sessions. The quality of the instruction depends on the performance of all involved. As in the case of any team, excellent team performance depends on organization and coordination. Uniformity in performance of all team members is especially important to insure fairness to the students and avoid variations in evaluation procedures between sections. Diligence and conscientiousness help assure uniformity. The coach of your team is the faculty member assigned as the lecturer. Communication with him/her is essential.

Suggested Specific Guidelines for Recitation Sections

These guidelines are presented as a suggested pedagogy for teaching assistants to follow in the recitation sections. At this time they are only suggestions. Recitations need to be closely coordinated with the lecture professor, and the final decision on the proper course of action rests with that person.

1. Meet with the lecture professor to coordinate the recitation section instruction with the lecture.
2. Obtain the course syllabus.
3. Obtain a copy of the course textbook from the physics office.
4. From the syllabus (or professor) determine the homework problems that will be assigned.
5. Begin a schedule of preparation in which you work the homework problems in a neat, orderly, and logical manner before they are assigned.
6. Once you have worked the problems, think about the best way to teach students to work them, or other examples you may formulate to illustrate the problem-solving skill involved.
7. Consider problems or like examples from the homework sets that you might use as problems for quizzes.
8. Meet your recitation sections. Be especially prepared for the first meeting. Keep a positive attitude and an enthusiastic spirit in your teaching. Remember that first impressions last a long time.
9. Adopt a required attendance policy for the recitation sections.
10. At the beginning of class, require students to turn in their laboratory report for work completed the previous week. This prevents the student from being distracted by working on the lab report during the class.
11. Give short quizzes during the first 5-10 minutes of the recitation class very frequently during the semester. At your discretion, you may schedule quizzes as often as one per meeting. The quiz should, but not necessarily, be one simple problem reviewing material and ideas from the previous recitation section. Take up the quizzes and grade them to be returned at the next meeting. Work out the quiz for the class afterwards as an example of how it should have been solved. Immediate feedback is very important, as is the prompt grading of quizzes.
12. Encourage students to suggest and request problems from the homework sets that you have prepared to use as examples. In other words, try to identify and address the students' needs. To insure that you schedule time during the class period, you should ask the students to put problems they want to see worked in your mailbox. You may give priority to those that are turned in a couple of days ahead. If the students do not request to see any specific problems solved, be prepared to work problems that you think may be beneficial to them. Remember to teach the procedure and logic for problem solving; do not just go through the motions of working the problem.
13. Make sure you have enough material prepared to keep the students in the recitation class the full hour. (No early dismissals!) Remember, they have paid you to instruct them for an hour, so be prepared to deliver the instruction.
14. Adopt a grading policy for the recitation class that rewards attendance and performance on quizzes. This may constitute 10-20% of the final lab-recitation grade.
15. Grades for homework assignments are the responsibility of the lecture professor. You may provide guidance to students in helping them with their homework, but they should supply the major effort.
16. Clearly communicate to the students in writing the attendance and grading policy for the recitation sections, as well as your general guidelines for teaching the recitation sections.

17. Establish, post, and maintain office hours for the students to confer with you outside of class and lab.
18. Remember that the student's job is to learn and that the teaching assistant's job is to teach and help the student with the learning process.
19. As an option, you may choose to send students to the blackboard so that you can evaluate their logical reasoning in solving problems.
9. In problem solving, neatness counts. A problem should be solved not only in an easily followed logical manner, but in a neat manner where the quantities can be easily read and deciphered. Messy approaches can introduce lots of errors, and for instructional purposes, may be very confusing.
10. Perform a reality check on the final result. In most cases problems are based on reasonable situations, even though the situation may not be common to the student's own experiences.

Guidelines for Problem Solving

1. Read the problem. Many times students do not read the problem, or they don't read it through completely.
2. Read the problem again, in sections, extracting each bit of information presented, and writing the known quantities and information.
3. Make a realistic diagram of the problem. The old adage that a picture is worth a thousand words applies. Bad diagrams can be very misleading and should be avoided.
4. Determine the correct dimensions or units for the quantities. Make sure that they are all in the same system of units.
5. Recall and decide which physics principle is applicable. This is usually made easy as it is the topic or topics being addressed in lecture or the book chapter. There really is no mystery.
6. Write down equations that may be applicable.
7. Determine what unknown parameters and quantities are to be solved.
8. Process the information using the appropriate mathematical skills.
11. Check the dimensions of the result by performing dimensional analysis on the process.
12. Remember that the instructor's primary responsibility is not to work the problems, but to teach the methods and procedures for solving them.

Interim-Grade Report Policy

Policy Statement

June 6, 2000

Revised August 21, 2002

Statement of Purpose:

The purpose of this statement is improve the grading policy for the undergraduate laboratories by insuring feedback to the students about their grades on lab reports and to insure that lecturers receive grades in a timely manner. A second purpose is to insure that lab grades are provided in a timely manner for students who repeat the lecture portion of the course, but do not need to repeat the laboratory portion.

Policy Statement:

For labs in all lower-division physics courses (Physics 221, 222, 231, and 232) lab instructors will please post interim grades at two points during the term:

- » For Physics 221—Interim reports will be posted by the beginning of the fifth, and ninth experiments. The first posting of interim grades will reflect the successful completion of the tutorials in the first two meetings and the performance and report of the first experiment in the third meeting.
- » For Physics 222, 231, and 232, reports will be posted by the beginning of the fourth and eighth experiments. For Physics 231, the first posting of interim grades will reflect the successful completion of the tutorial in the first meeting and the performance and report of the first experiment in the second meeting. For Physics 222 and 232, the first posting of interim grades will reflect the performance and report of the first two experiments completed in the first two meetings.
- » The comprehensive lab schedule posted in the laboratories will be marked to indicate the posting times for interim grades.

- » Interim grade reports should reflect the results for any quizzes given.

The reports should be posted on the bulletin boards inside the laboratories at the front of the rooms. The reports should not include the names of the students. Only the last 5 digits of the student's ID number should be used for the posting. Copies of the reports should be given to the instructor and to the Lab Director, but they should show the grades by both names and student id #'s of students.

Make sure the TA's name and section number appear on the spreadsheet.

Both interim reports must show the grades for each individual lab report, not simply an average on work done to date. It is assumed that all TAs will use an Excel spreadsheet program that makes the required functions (updating, averaging, printing out) very easy; otherwise the burden of these tasks might become a barrier to timely and effective communication to students about their grades.

The spreadsheets should show the average and median grades for each experiment and for all experiments combined. Average and median grades should be computed and displayed in two ways, one using zeros or missed labs in the computation and the other eliminating the zeros and missed labs from the calculation. This makes four ways altogether.

It is expected that these interim reports will serve several purposes:

- » to make sure that the students understand what is expected of them with regard to preparing their lab reports.
- » to serve as "trial runs" to assure that the grading machinery is functioning smoothly.
- » to help the different TAs develop grading standards that are mutually consistent.

- » to verify class rosters; especially to pick up non-standard cases (e.g., students who have switched sections or who are applying lab grades earned in a previous semester).

We note that, in the absence of a policy requiring interim reports, it is only natural that a few TAs might postpone the grade-reporting process until the end of the semester. When this happens, it results in a number of problems that could easily have been averted by interim reports.

Laboratory Policy Regarding Repeating a Course

Policy Statement

Adopted August 21, 2002

Revised January 12, 2004

At the discretion of the lecturer, if a student repeats Physics 231 or 232 and successfully completed the laboratory for that course, the student may not have to repeat the lab, if the course is repeated within one year. For example, if the lab grade is from the spring of 2002, this old grade can be used no later than the spring 2003 semester. The student must have approval from the lecturer for the course, the TA for the section in which he is registered, and the Lab Director before the second experiment. The student must contact his TA, his lecturer, and the Lab Director by e-mail and announce his intent to use the old lab grade. The old lab grade must be sent by e-mail from the previous TA or the previous lecturer to both the current TA and the current lecturer before the end of the first two and a half weeks of classes.

If a student repeats Physics 221 or 222 and successfully completed the laboratory for that course, then, at the discretion of the lecturer, the student may be allowed to use the lab grade from the previous course and will not have to repeat the lab, if the course is repeated the following semester. However, Physics 221 and 222 students will be required to attend all recitations and will receive a new grade for activities

associated with recitation. This grade will be combined with the previous lab grade according to the procedure set forth in the lab syllabus provided by the TA for the new lab grade. The student must have approval from the lecturer for the course, the TA for the section in which he is registered, and the Lab Director before the second experiment. The student must contact his TA, his lecturer, and the Lab Director by e-mail and announce his intent to use the old lab grade. The old lab grade must be sent by email from the previous TA or the previous lecturer to both the current TA and the current lecturer before the end of the first two and a half weeks of classes.

Sexual Harassment Policy Statement

Adopted August 21, 2002 from “Sexual Harassment is Illegal,” pamphlet presented by Diversity Resources and Educational Services of the University of Tennessee, Knoxville.

University Policy and Statement

The University of Tennessee, Knoxville is committed to providing an environment free of sexual harassment. Sexual harassment by any member (faculty, staff, students, applicants) of the University community is a violation of Federal and State laws and University policy. Sexual harassment will not be tolerated. Sexual harassment is an issue which may affect any member of the University community and will be dealt with promptly by the University administration.

Myths about Sexual Harassment

- » If females would just say “No” it would stop.
- » Harassment will stop if a person just ignores it.
- » If females watched the way they dress, there would not be a problem with sexual harassment.
- » Sexual harassment is no big deal – it’s the natural way males and females express affection and friendship with each other.
- » Most people enjoy sexual attention at work and school. Teasing and flirting make work and school fun.
- » Sexual harassment is harmless. Persons who object have no sense of humor or don’t know how to accept a compliment.
- » Sexual harassment policies will negatively affect friendly relationships between students and teachers, or those between male and female students.
- » Nice people could not possibly be harassers.

Profile of Sexual Harassment: Survey of Faculty, Staff, and Students

- » 27% of Women and 10% of Men say they have been Harassed
- » Most are Undergraduates
- » Most Experience what they say is Verbal Harassment
- » Most Perpetrators are Peers

Source: 1994 UTK Social Science Research Institute

Important Dates in the Development of the Law of Sexual Harassment

- » 1964 Civil Rights Act
- » 1972 Education Amendments
- » 1980 Sexual Harassment defined as Sex Discrimination
- » 1986 Hostile Environment defined
- » 1991 Reasonable Woman vs Reasonable Person
- » 1992 Compensatory and Punitive Damages

The Two Types of Sexual Harassment

Quid Pro Quo (“this for that”)

Unwelcome sexual advances, requests for sexual favors, and other verbal and physical conduct of a sexual nature when:

- » Submission to such conduct is made either explicitly or implicitly a term or condition of an individual’s employment or academic status in a course, program, or activity; or
- » Submission to or rejection of such conduct is used as the basis for employment or academic (grades, academic progress, internships, etc.) decisions affecting an individual

Hostile Environment

Unwelcome sexual advances, requests for sexual favors, and other verbal and physical conduct of a sexual nature when:

- » Such conduct has the purpose or effect of substantially interfering with an individual’s work performance, academic perfor-

mance, or creating an intimidating, hostile, or offensive work or academic environment.

Physical Harassment May Include

- » Patting, Pinching, and any other Inappropriate Touching or Feelling
- » Brushing Against the Body
- » Attempted or Actual Kissing or Fondling
- » Assault
- » Leering or Ogling, i.e. Staring at Another's Genital Area
- » Making Obscene Gestures

Verbal Harassment May Include

- » Sexual Innuendos, Comments, and Sexual Remarks about One's Clothing, Body, or Sexual Activities
- » Suggestive or Insulting Sounds
- » Whistling in a Suggestive Manner
- » Humor and Jokes about Sex or (Wo)Men in General
- » Sexual Propositions, Invitations, or other Pressures for Sex
- » Implied or Overt Threats

Where Can You File a Complaint of Sexual Harassment?

- » University of Tennessee, Knoxville
 - Office of Diversity Resources (DRES)
 - or Dean of Students, Department Head, Ombudsperson, Student Affairs,
 - Office of Human Resources Management (ORM)
- » Outside the Workplace
 - Equal Employment Opportunity Commission – EEOC (federal);
 - Tennessee Human Rights Commission – THRC (state)
- » Outside the Educational Setting
 - Office of Civil Rights -- OCR

The University of Tennessee, Knoxville Equal Opportunity Complaint Process

Who is covered:

- » UTK employees
- » Applicants for UTK employment
- » Student employment/applications for employment
- » Students
- » Other participants of UTK programs or activities

What is covered:

- » Belief that he//she has been discriminated against on the basis of race, sex, religion, national origin, age, disability, or veteran status

When to file:

- » Within 300 calendar days of the alleged act.

Where to File:

- » DRES, Dean, Department Head, Ombudsperson, Dean of Students, Office of Human Resources Management (OHRM)

What Happens When You file a Complaint with DRES?

Complaints are handled on a case by case basis; some require the following:

- » The DRES staff will ask you for all the details of the alleged harassment. The description will be written and you will be asked to sign the description/statement.
- » DRES staff will inform you of your rights to protected from retaliation, and you will be kept informed of all activities.
- » DRES staff will inform the Vice Chancellor, Dean and Department Head (for faculty); the Vice chancellor and Director (for staff); and the Vice Chancellor, Dean of Students and Department Head (for students) that a complaint has been filed.
- » The DRES staff will meet with the alleged perpetrator.
- » Information will be gathered, assessed and a recommendation will be made based on such information.

- » All appropriate parties will be informed and appropriate action taken.

Possible Disciplinary Actions:

- » Oral and/or Written Reprimand
- » Change in Status (e.g.: Reassignment, Demotion)
- » Suspension
- » Counseling
- » Monetary Loss (example: Denial of Raise)
- » Any Combination of the Above
- » Termination

Be Cautious of These Phases:

- » It's just teasing – no big deal.
- » I know he/she didn't mean anything like that.
- » If they wouldn't dress like that there wouldn't be any sexual harassment.
- » If you're going to work (or study) here, you need to learn to handle things like that.
- » Just ignore it.
- » He puts his arm around everyone.
- » Why can't she learn to accept a compliment?
- » She must have wanted it; otherwise she would have told him "No".
- » It's just a joke; what's the big fuss about?
- » Boys will be boys.

EEO/AA Tagline

The University of Tennessee, Knoxville does not discriminate on the basis of race, sex color, religion, national origin, age, disability, or veteran status in provision of educational opportunities and benefits. This policy extends to both employment by and admission to the University.

The University does not discriminate on the basis of race, sex, or disability in the education programs and activities pursuant to requirements of Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Section 504 of the Rehabilitation Act of 1973, and Americans with Disabilities Act (ADA) of 1990.

Inquiries and charges of violation concerning Title VI, Title IX, Section 504, ADA or the Age Discrimination in Employment Act (ADEA) or and

of the other above referenced policies should be directed to the Office of Diversity Resources and Educational Services (DRES), 1818 Lake Avenue, The University of Tennessee, Knoxville, Tennessee 37996-3650; telephone (865) 974-2498 (TDD available). Requests for accommodation of a disability should be directed to the ADA Coordinator at the Office of Human Resources Management, 600 Henley Street, Knoxville, TN 37996-4125.

Information Sources

- » In Case of Sexual Harassment, a publication of the Project on the Status and Education of Women, Association of American Colleges.
- » Sexual Harassment, a Vanderbilt University Guide for Faculty, Staff, and Students, prepared by the Opportunity Development Center and the Women's Center.
- » Sexual Harassment at the University of Tennessee Knoxville, Final Report, 1994 UTK Social Science Report, Research Institute.

For more information contact:

Diversity Resources and Educational Services
1818 Lake Avenue
Knoxville, Tennessee 37996-3560
(865) 974-2498

Pregnancy Declaration Regulations for Physics Laboratory Teaching Assistants

Policy Statement
September 1, 1995

The Tennessee Division of Radiological Health radiological safety regulation (excerpts attached) strongly encourages the female employee to report in writing to her employer/institution when she becomes pregnant. The employer/institution is then required to maintain the radiation exposure to the fetus to less than 500 millirem during the entire gestation period per the attached regulation and to report the fetus exposure to the pregnant female. Please note that "pregnancy declaration" is

voluntary according to the regulation. However, once notified of the pregnancy, the employer/institution is required to limit fetus exposure to less than 500 millirem.

Physics laboratory teaching assistants may work with students who use radiation sources in the laboratory while performing certain experiments. As a result, the pregnancy declaration policy is extended to the teaching assistants and the students with whom they work. It is the teaching assistant's responsibility to make his/her students aware of this policy. If you are involved in any way with students performing experiments in which they may be exposed to radiation sources in the Physics Department, you must inform each student of Tennessee's pregnancy declaration, the UT Radiological Safety Department's policy on pregnancy declaration, and the "Pregnancy Declaration Form" and its location. This may be done best in the first meeting of the lab section with a reminder the week prior to performance of the experiment involving the use of radiation sources. The "Pregnancy Declaration Form" will be in Pam Carter's (departmental office manager's) office, along with other personnel administrative forms. The names of these persons should also be brought to the attention of the Radiation Safety Officer and Director of Undergraduate Laboratories in the Department of Physics and Astronomy, Dr. James Parks.

Exposure to radioactive sources in the Department of Physics and Astronomy is practically non-existent for most employees of the department. For those few employees and students who have reason to use radioactive sources, exposure levels are normally negligible, well below the natural background level and the 500 millirem limit. Most of the radioactive sources in the department have been eliminated. At present, we have only four non-exempt sources, and those are kept in the storage vault or used in the modern physics lab. We use exempt quantities in the introductory labs and the teaching assistants and students receive minimal exposures, well below the 500 millirem limit. Nevertheless, the regulation must be enforced.

To comply with this regulation, we are required to carry out diligently the mandate as described. We should have a healthy respect for radiation, recognize the damage it can do, and acknowledge that it is ever present in our environment and that there is not much that we can reasonably do to avoid it. Although no radiation is best, we can minimize our exposure to reduce the risks, keep our exposures well within acceptable limits, and not let our concern and apprehension be more of a detriment to our health than the falsely perceived additional hazard attributed to our use of small amounts of radiation.

The following statement is suggested for the teaching assistant to inform the laboratory class of this policy:

"During this semester, experiments will be performed where you will receive an exposure to radiation in addition to that received from the natural background of radiation. Although this exposure will be very minimal, the Division of Radiological Health of the Tennessee Department of Environment and Conservation requires that a student who is pregnant and who formally declares she is pregnant in writing to her laboratory instructor be monitored for radiation dose received to prevent a radiation dose to her embryo/fetus from exceeding 500 millirem during the entire pregnancy. In order to monitor the radiation dose received, notification in writing via a pregnancy declaration form must be made in sufficient time prior to an experiment using radiation to allow the acquisition of the proper radiation monitor, usually a film badge. Otherwise, the student must be precluded from the experiment to prevent exposure to radiation from laboratory sources. Pregnancy declaration forms are the proper forms for reporting this information, and copies of these forms can be obtained from the departmental office. Radiation sources used in this lab are exempt quantities, and it is estimated that the exposures received from these sources will be less than 1.0 millirem (10 times an exposure to our Co-60 sources at 25 cm for 2 hours), which is well below the 500 millirem dose."

Each teaching assistant is asked to sign a statement of compliance with these requirements regarding the pregnancy declaration policy. This statement of compliance is required and kept on file with the laboratory personnel and performance records. If you have questions about this new policy or about any aspect of radiation exposures within our department, please direct your questions to the Department of Physics Radiation Safety Officer, Dr. James Parks.

woman. The declaration of pregnancy shall also be kept on file, but may be maintained separately from the dose records.

Rulemaking Hearing Rules

Tennessee Department of Environment and Conservation
Division of Radiological Health

New Rules

These rules expand Chapter 1200-2-5, STANDARDS FOR PROTECTION AGAINST RADIATION, to add the following:

Chapter 1200-2-5
STANDARDS FOR PROTECTION AGAINST RADIATION

1200-2-5-.32 DEFINITIONS

Declared pregnant woman means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

Embryo/fetus means the developing human organism from conception until the time of birth.

1200-2-5-.56 DOSE TO AN EMBRYO/FETUS

(1) The licensee or registrant shall ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv). (For recordkeeping requirements see 1200-2-5-.135).

1200-2-5-.135 RECORDS OF INDIVIDUAL MONITORING RESULTS

(6) The licensee or registrant shall maintain the records of dose to an embryo/fetus with the records of dose to the declared pregnant

Pregnancy Declaration Form

Completion of this form is strictly voluntary and in no way are you to consider it as mandatory; however you are strongly encouraged to declare your pregnancy. Once you declare yourself as pregnant, exposure to the fetus will be closely monitored as required by State and Federal regulations. Further, the regulatory limit for exposure to the fetus will be enforced. If you have any questions, please contact Roy P. Osborne, Radiation Safety Office, at Radiation Safety: 673-6670. Return completed form to: Roy Osborne, Radiological Safety, 3512.

Full Name: _____ Social Security #: _____
(Type or print clearly)

Supervisor: _____ License Holder: _____

Series Code you are monitored under: _____ Your badge #: _____

Lab Address: _____ Lab Phone #: _____

By completing this form I am formally notifying the U.T.K. Radiological Safety Department that I am pregnant. I understand the regulatory limit for exposure to the fetus is 500 millirem during the entire gestation period and that I will be informed of the fetus exposure on a monthly basis.

Estimated date of conception: _____

Signature of individual completing this form **and** date of completion

License holders: Please make additional blank copies of this form as necessary to keep in your files for future use.

Also, you are required to keep a copy of each completed form in your files.

**Department of Physics and Astronomy
The University of Tennessee, Knoxville
Teaching Assistants'
Statement of Compliance with Requirements Regarding
Pregnancy Declaration Policy**

I, _____ have received instruction concerning the new
(type or clearly print full name)
Tennessee Division of Radiological Health radiological safety regulation on fetus exposure and understand that it strongly encourages women working with radiation sources to report in writing to their employer/institution when they become pregnant.

Sign and Date

I will inform each of my students working with radiation sources of the University of Tennessee Radiological Safety Department's policy on pregnancy declaration; inform them of the "Pregnancy Declaration Form" attached, and report any student's desire to make a formal declaration in writing to Dr. James Parks, Radiation Safety Officer for the Department of Physics and Astronomy.

Sign and Date

Print your full name where indicated above, sign and date each signature line after reading each statement.

THE UNIVERSITY OF TENNESSEE, KNOXVILLE

GUIDELINES FOR EVACUATION OF FACILITIES IN EMERGENCY CONDITIONS

A variety of emergency situations could require evacuation of a building or buildings on the UTK campus, and your safety and that of other building occupants may be dependent upon your having planned your response to such situations and acting promptly when an emergency occurs.

PREPARATION FOR EMERGENCY SITUATIONS

There are five steps which all UTK employees, students and visitors should take to prepare themselves for prompt and appropriate actions in emergency situations which require evacuating a building. Since the most likely emergency situation requiring building evacuation is that of fire, some specific suggestions for dealing with fire-related emergencies are provided as part of these GUIDELINES.

1. Learn the location of emergency exits and the shortest routes to the exits. You should do this in all buildings in which you work, live or visit, not just for the building in which the majority of your time is spent.
2. Learn the location of emergency alarm activation stations. Again, you should locate these stations in all buildings in which you work, live or visit. The emergency alarm stations are red, box-like devices located on the wall near the emergency exits.
3. Learn the procedures for reporting emergencies. The on-campus emergency telephone number is 911. Dialing 911 on any University 974 or 595 exchange number will connect you to the Knox County Emergency Communications District. All emergency situations should be reported promptly. If the telephones are not working in the building, you should go to a nearby building or to a "blue light" emergency telephone to report the situation. The "blue light" phones are connected directly to the University Police Department dispatcher who will relay a request for assistance to the appropriate response agency.
4. Learn the sound of emergency alarm systems. Emergency alarm system sounds vary from building to building, but are designed to sound distinctly different from all other bells, buzzers or other signaling devices in the building. Should you hear a constant ringing or buzzing which you are not able to identify, evacuate and report the situation to the 911 emergency operator.
5. Learn the location of fire extinguishers in buildings in which you work, live or visit. Check to see against which types of fires the extinguishers are effective and learn how to operate the extinguishers.

COMMON FIRE EXTINGUISHER CLASSIFICATIONS

- » Type A: Ordinary combustibles, such as cloth, wood and paper.
- » Type BC: Flammable liquids (such as gasoline, cooking grease, duplicating fluids, cleaning fluids) and energized electrical equipment
- » Type ABC: Multipurpose (suitable for use with fires involving all the materials described above).

NOTE: Attempt to extinguish a fire only after you have sounded the alarm and if it is very small and not producing significant smoke or fumes. Evacuate if the fire grows while you are attempting to extinguish it. If there is any doubt whatsoever about whether to fight the fire or evacuate the building, sound the alarm as you evacuate and call 911.

EMERGENCY - CALL 911

REACTING TO AN EMERGENCY SITUATION

The following procedures should be followed in the event of an emergency situation:

1. Notify other building occupants of the existence of an emergency. The best way to alert others is by activation the building's emergency alarm system as you leave the building. The alarm system will sound when the activation handle is pulled out or down.
2. Notify 911 of the emergency from a safe location. this may be an office or a room down the hall, your own office/room or a nearby building. when the 911 operator answers, describe the type of emergency, its exact location and the severity of the problem. Stay on the line, if you can safely do so, until you are sure the operator has all the information you can provide.
3. If it is not safe to use a building telephone(s), use the nearest "blue light" emergency telephone. The "blue light" telephones are connected directly to the University Police Department dispatcher who will relay the request for assistance to the appropriate response agency. Stay on the line until you are sure the dispatcher has all the information you can provide.
4. Procedures for evacuation: One of the most important responsibilities of each individual is to evacuate the building promptly and safely. In response to the sounding of an emergency alarm (or other notification) leave the building immediately. As you leave the area, close the door behind you in order to retard the spread of flames and smoke. Proceed along your previously determined escape route to the building's exit. (If an exit is blocked, use an alternate path.) After you have entered a stairwell, be sure that the door closes and latches behind you. **DO NOT USE THE ELEVATORS.** The elevator may fail as a result of damage or it may move to the location of the emergency and the doors may open.
5. Once outside the building, move away to a safe location. Do not return to the building until instructed to do so by authorized personnel (Fire or Police Officer). If there are no authorized personnel on the scene, go to a nearby building or to a "blue light" emergency telephone and call for instructions.

IF YOU REALIZE A FIRE HAS OCCURRED WHILE YOU ARE INSIDE A ROOM

1. Feel the door to see whether it is hot. If the door is hot, the area on the other side is probably involved in the fire. If the door is cool, kneel down and check the air coming into the room from under the door. If the air is cool, it should be safe to open the door.
2. Kneel behind the door and open it a crack, being sure to keep your face turned away from the opening. Listen and smell for smoke and fire. If the area on the other side of the door is on fire, very hot air and gases may rush into the room when you open the door. if this occurs, close the door immediately.
3. If you determine that it is safe to leave the room, close all the windows and then the door as you exit. When leaving a smoke-filled area, move quickly, crawling on your hands and knees. (Hot air and poisonous gases rise; fresh air will be nearer the floor.)
4. If you must stay in the room and wait rescue, place a wet towel or other material along the bottom of the door to impede the entry of smoke and gases. Check all windows for an escape route. If no unaided safe escape from a window is possible, attempt to open a window slightly and hang something out to show rescuers that you are there. The small opening will also provide fresh air.

HANDICAPPED INDIVIDUALS

Special arrangements must be made for individuals who have a handicap which would hinder their evacuation from the building. The head of a unit in which a handicapped individual is employed is responsible for make arrangements for provision of necessary assistance in the event of an emergency. The person or persons designated to assist the handicapped person should go to the handicapped person when the alarm sounds. The University Police Department should be apprised of persons for whom special arrangements have been made.

Fire Extinguisher Safety

Fire Extinguisher Types

A = Water

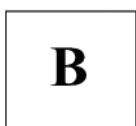
ABC = Dry Chemical

BC = CO₂

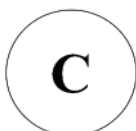
D = Metal Specific



Class A: Ordinary Combustibles such as wood, cloth, paper, rubber, and many plastics.



Class B: Ordinary Combustibles such as oil, oil based paint, gases, greases, paint thinner, dry cleaning agents, tar, propane, and natural gas.



Class C: Live electrical equipment such as wiring, fuse boxes, circuit breakers, machinery, and appliances.



Class D: Combustible Metals such as sodium, magnesium, titanium, zirconium, lithium, and potassium. Found mainly in industrial settings.

Use of a Fire Extinguisher

P = Pull the pin: This will unlock the operating lever and allows you to discharge the extinguisher

A = Aim Low: Point the extinguisher hose (or nozzle) at the base of the fire.

S = Squeeze handle: This discharges the extinguishing agent.

S = Sweep from side to side: Moving carefully toward the fire, aim the extinguisher at the base of the fire and sweep back and forth until the fire is out.

Fire Safety Tips

1. Do not attempt to fight a large or rapidly spreading fire.
2. Keep your back to the exit.
3. Stand 6 to 10 feet from the fire.
4. Use the correct extinguisher for the type of fire. Do not use water or Class A extinguisher on a grease or electrical fire.
5. Extinguishing agent will only last 10 to 30 seconds.

FIRE SAFETY REVIEW CHECKLIST

From participation in this exercise, you should be able to place a check mark before each of the items listed below:

1. The layout of the work facility has been observed and the emergency exits located and noted.
2. The shortest routes to the emergency exits have been identified.
3. If the facility is equipped with an emergency alarm system, alarm activation stations have been located.
4. Understand that a constant ringing or buzzing sound will be the emergency alarm and that the building should be evacuated immediately.
5. Understand that the prescribed procedure to report an emergency and summons help is by dialing “911” from a University system telephone.
6. Know the basic evacuation principles:
 - a. Close doors behind you;
 - b. Proceed along the previously identified escape routes;
 - c. Close and latch stairway doors;
 - d. DO NOT use elevators;
 - e. Once outside the building, move away;
 - f. Feel closed room doors to judge if there is a fire on the other side; and
 - g. If you must move through a smoke filled area to escape, crawl.
7. Observed the type and location of fire extinguishers in the work area.
8. Know what type fires (materials or equipment) that can be extinguished by the different classes of extinguishers.
9. Know the principles of using an extinguisher represented by the abbreviation “PASS.”
10. Understand the “Fire Safety Tips” presented at the end of the Fire Extinguisher Safety factsheet.

FIRE EXTINGUISHER AND EMERGENCY RESPONSE TRAINING SURVEY

NAME _____ DEPARTMENT _____

UT MAILING ADDRESS _____

UT WORK LOCATION _____

UT PHONE NUMBER _____

1. The packet of training materials was received and I have reviewed the information.

YES__NO__

2. The materials were of such a nature that I was able to gain a reasonable understanding of the University emergency response procedures and fire extinguisher characteristics.

YES__NO__

3. At this time, I have additional questions relative to fire extinguishers and/or emergency response procedures.

YES__NO__

(Note: If the response to this question is yes, please list your questions in the comments and questions section.)

QUESTIONS AND COMMENTS (Attach additional pages if necessary)

SIGNATURE _____ Date _____

Please mail completed form to:
Environmental Health and Safety
2110 Terrace Ave. 3503

Laboratory Chemical Hygiene Plan
Department of Physics and Astronomy
The University of Tennessee
Knoxville, Tennessee 37996-1200

The plan follows the outline that was provided by the Department of Environmental Health and Safety, UTK.

1. Emergency Preparedness

The actions to be taken in case of emergency, suggested by the Department of Environmental Health and Safety, will be followed. The appropriate material has been distributed to the principal investigators in the Physics Department.

2. Hazardous Materials Information

The Material Safety Data Sheets (MSDS) are being kept at the "Right to Know Station" in Room 201. If the desired information cannot be located in the files, Dr. Jim Parks, (974-8952) should be contacted for assistance. Reference materials relative to the hazards, safe handling, storage and disposal of chemicals are available in the following locations:

- a. Rooms 201 & 216
- b. The Department of Environmental Health and Safety at 2110 Terrace Ave., 974-5084. Contact person - Mr. Casey Anderson, Hazardous Material Manager.
- c. The University Wide Safety Office. Contact persons - Mr. Murray Edge, Safety Officer (974-5409) and Ms. Krysty Ball, Safety Coordinator (974-8170).
- d. The University of Tennessee Library.

3. Training

The principal investigator for each laboratory is responsible for the training of personnel working in that laboratory. The personnel has been made aware of and encouraged to attend training sessions offered by the Department of Environmental Health and Safety, UTK.

4. Permission to Use Particularly Hazardous Chemicals

Substances which will be identified by the Departmental Hygiene Officer as being acutely hazardous may be used only after the following procedure is followed. The principal investigator must complete the Permission for Chemical Use Form and submit it to the Departmental Hygiene Officer, who will evaluate the application and submit a recommendation for approval or rejection to the Departmental Head.

5. Hazards Control Procedures

Hazardous chemicals in the different laboratories of the Physics Department will be handled in fume hoods or in glove boxes whenever necessary. Operations that cannot be performed in hoods or glove boxes will be evaluated by the appropriate principal investigator in consultation with the Departmental Hygiene Officer.

6. Maintenance and Testing of Fume Hoods
Testing of the air velocity should be done by the Department of Environmental Health and Safety. Maintenance should be handled by the Physical Plant.
7. Specific Personal Protective Equipment
The use of protective equipment, such as aprons, lab coats, gloves, safety goggles, boots, and personal respirators in all laboratories in the Physics department will be implemented as the situation requires. Wall-mounted eyewash devices have been installed in all laboratories. Currently only two laboratories are quipped with emergency showers, however. It is suggested that the possibility be examined of installing emergency showers in more laboratories when needed.
8. General Laboratory Safety Procedures
Appropriate signs for radiation, lasers, and hazardous materials are posted in all laboratories in the Physics Department. There are 3 persons in the Department, certified in CPR, who may offer assistance in case of emergency. It is planned to have additional persons trained in CPR.
9. Provisions for the Control of Flammable Liquids
Technical grade flammable liquids are kept in metal containers properly labeled. Analytical grade flammable liquids are kept in small quantities in their original containers and stored in safety cabinets. Acids and bases are kept in separate safety cabinets.
10. Control of Hazards Associated with Compressed Gas Cylinders
The gas cylinders in storage at the Department are kept in a separate area which is located outside the building. (Empty cylinders are labeled and kept separately from full cylinders.) When in use, the cylinders are held securely either to the wall or in a cylinder stand.

The Right to Know Station is located in Room 201 of Nielsen Physics Building and contains a collection of Material Safety Data Sheets, MSDSa as well as some other safety books. A couple of examples of MSDs are shown in the f

Baxter Healthcare Corporation
Burdick & Jackson Division
1953 South Harvey Street
Muskegon, MI 49442 USA

Flow 207 B

information/emergency telephone no. 616.726.3171
chemtrec telephone no. 800.424.9300
canadian emergency telephone no. 613.996.6666

**MATERIAL SAFETY
DATA SHEET**

ACETONE

I. Identification

chemical name Acetone molecular weight 58.08
chemical family Ketone formula C₃H₆O
synonyms Dimethyl Ketone
DOT proper shipping name Acetone
DOT hazard class Flammable Liquid
DOT identification no. UN1090 CAS no. 67-64-1

II. Physical and Chemical Data

boiling point, 760mm Hg. 56.29°C freezing point -94.7°C evaporation rate (BuAc=1) ca 12
vapor pressure at 20°C 184.5 mm Hg vapor density (air=1) 2.0 solubility in water @ 20°C complete
% volatiles by volume ca 100 specific gravity (H₂O=1) @ 20°C 0.79 stability Stable
hazardous polymerization Not expected to occur.
appearance and odor Clear, colorless liquid with a penetrating, sweet odor.
conditions to avoid Heat, sparks, open flame, open containers, and poor ventilation.

materials to avoid Strong oxidizing agents and strong acids and bases.

hazardous decomposition products Incomplete combustion can generate carbon monoxide and other toxic vapors.

III. Fire and Explosion Hazard Data

flash point, (test method) -18°C (Tag closed cup) auto ignition temperature 465°C
flammable limits in air % by volume: lower limit 2.6 upper limit 12.8
unusual fire and explosion hazards Very volatile and extremely flammable. Mixtures with water can be flammable.

extinguishing media Carbon dioxide, dry chemical, alcohol foam, water mist or fog.

special fire fighting procedures Wear full protective clothing and self-contained breathing apparatus.
Heat will build pressure and may rupture closed storage containers.
Keep fire-exposed containers cool with water spray.

IV. Hazardous Components

Acetone % ca 100 TLV 750 ppm CAS no. 67-64-1

Burdick & Jackson's Disclaimer: The information and recommendations presented in this Material Safety Data Sheet are based on sources believed to be reliable on the date hereof. Burdick & Jackson makes no representation on its completeness or accuracy. It is the user's responsibility to determine the product's suitability for its intended use, the product's safe use, and the product's proper disposal. No representations or warranties, either express or implied, of merchantability or fitness for a particular purpose or of any other nature are made with respect to the information provided in this Material Safety Data Sheet or to the product to which such information refers. Burdick & Jackson neither assumes nor authorizes any other person to assume for it, any other or additional liability or responsibility resulting from the use of, or reliance upon, this information.

V. Health Hazards

<u>Occupational Exposure Limits</u>			<u>Concentration Immediately Dangerous to Health</u>	
OSHA	TWA	- 750 ppm	OSHA/NIOSH	20,000 ppm
	STEL	- 1000 ppm		
	Ceiling	- not listed		
<u>Odor Threshold</u>				
ACGIH	TLV-TWA	- 750 ppm	NSC	2 ppm
	TLV-STEL	- 1000 ppm		
NIOSH	10 hour TWA	- 250 ppm	NIOSH	not listed

Carcinogenic Data

Acetone is not listed as a carcinogen by IARC, NTP, OSHA or ACGIH.

Primary Routes of Entry

Acetone may exert its effects through inhalation, skin absorption, and ingestion.

Industrial Exposure: Route of Exposure/Signs and Symptoms

Inhalation:	Exposure can cause eye, nose, and throat irritation, headache, nausea, dizziness and narcosis.
Eye Contact:	Liquid and high vapor concentration can cause irritation.
Skin Contact:	Prolonged or repeated skin contact can cause irritation and dermatitis through defatting of skin.
Ingestion:	Symptom information is inadequate/unknown.

Effects of Overexposure

Acetone is a mild eye and mucous membrane irritant, primary skin irritant, and central nervous system depressant. Acute exposure irritates the eyes and upper respiratory tract. Direct skin contact produces dermatitis, characterized by dryness and erythema. High concentrations produce narcosis and hypoglycemia.

Medical Condition Aggravated by Exposure

Preclude from exposure those individuals susceptible to dermatitis.

Emergency First Aid

- Inhalation:** Immediately remove to fresh air. If not breathing, administer mouth-to-mouth rescue breathing. If there is no pulse administer cardiopulmonary resuscitation (CPR). Contact physician immediately.
- Eye Contact:** Rinse with copious amounts of water for at least 15 minutes. Get emergency medical assistance.
- Skin Contact:** Flush thoroughly for at least 15 minutes. Wash affected skin with soap and water. Remove contaminated clothing and shoes. Wash clothing before re-use, and discard contaminated shoes. Get emergency medical assistance.
- Ingestion:** Call local Poison Control Center for assistance. Contact physician immediately. Never induce vomiting or give anything by mouth to a victim unconscious or having convulsions.

VI. Safety Measures and Equipment

- Ventilation:** Adequate ventilation is required to protect personnel from exposure to chemical vapors exceeding the PEL and to minimize fire hazards. The choice of ventilation equipment, either local or general, will depend on the conditions of use, quantity of material, and other operating parameters.
- Respiratory:** Use approved respirator equipment. Follow NIOSH and equipment manufacturer's recommendations to determine appropriate equipment (air-purifying, air-supplied, or self-contained breathing apparatus).
- Eyes:** Safety glasses are considered minimum protection. Goggles or face shield may be necessary depending on quantity of material and conditions of use.
- Skin:** Protective gloves and clothing are recommended. The choice of material must be based on chemical resistance and other user requirements. Generally, neoprene or rubber offers acceptable chemical resistance. Individuals who are acutely and specifically sensitive to acetone may require additional protective equipment.
- Storage:** Acetone should be protected from temperature extremes and direct sunlight. Proper storage of acetone must be determined based on other materials stored and their hazards and potential chemical incompatibility. In general, acetone should be stored in an acceptably protected and secure flammable liquid storage room.

Other: Emergency eye wash fountains and safety showers should be available in the vicinity of any potential exposure. Ground and bond metal containers to minimize static sparks.

VII. Spill and Disposal Data

Spill Control: Protect from ignition. Wear protective clothing and use approved respirator equipment. Absorb spilled material in an absorbent recommended for solvent spills and remove to a safe location for disposal by approved methods. If released to the environment, comply with all regulatory notification requirements.
CERCLA Reportable Quantity: 5,000 lbs.

Waste Disposal: Dispose of acetone as an EPA hazardous waste. Contact state environmental agency for listing of licensed hazardous waste disposal facilities and applicable regulations.
Hazardous waste numbers: U002(Ignitable); F003(Ignitable).

VIII. SARA/Title III Data

<u>Hazard Classification</u>		<u>Chemical Listings</u>	
Immediate Health	Yes (Irritant)	Extremely Hazardous Substances	No
Delayed Health	No	CERCLA Hazardous Substances	Yes
Fire	Yes	Toxic Chemicals	Yes
Sudden Release	No		
Reactive	No		

Acetone is subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) and 40CFR Part 372. This product does not contain any other toxic chemical above 1% concentration or a carcinogen above 0.1% concentration.

Revision Date: July, 1989

KEY

ca	Approximately	STEL	Short Term Exposure Level (15 minutes)
na	Not applicable	TLV	Threshold Limit Value
C	Ceiling	TWA	Time Weighted Average
		BuAc	Butyl Acetate

CERCLA Comprehensive Environmental Response, Compensation and Liability Act of 1980
NSC National Safety Council ("Fundamentals of Industrial Hygiene," 3rd Ed., 1988)

MALLINCKRODT

Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

ETHYL ALCOHOL COMPLETELY DENATURED

PRODUCT IDENTIFICATION:

Synonyms: Alcohol; spirits of wine; potato alcohol

Formula CAS No.: 64-17-5

Molecular Weight: 46.07

Chemical Formula: C_2H_6O (major component)

Hazardous Ingredients:

CAS# 108-10-1 Methyl isobutyl ketone
8008-20-6 Kerosene

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE! HARMFUL IF SWALLOWED OR INHALED.

AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES EYE IRRITATION.

Keep away from heat, sparks and flame.

Keep container closed.

Use with adequate ventilation.

Wash thoroughly after handling.

Avoid contact with eyes, skin and clothing.

Avoid breathing vapor.

EMERGENCY/FIRST AID

If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician.

SEE SECTION 5.

DOT Hazard Class: Flammable Liquid

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Emergency Telephone Number: 314-982-5060

SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Mild odor.

Solubility: Infinite in water.

Boiling Point: 78°C (172.4°F)

Melting Point: <-114°C (-173°F)

Specific Gravity (water = 1): 0.80

Vapor Density (Air = 1): 1.6

Vapor Pressure (mm Hg): 47 @ 25°C (77°F)

Evaporation Rate: (BuAc = 1): ca. 3.3

SECTION 2 Reactivity Data

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

May produce carbon monoxide and carbon dioxide when heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Strong oxidizers, heat and sources of ignition.

SECTION 3 Fire and Explosion Information

Fire:

Flammable. Flash point: 13°C (55°F) (closed cup).

Auto ignition temperature: 422°C, (793°F)

Flammable limits in air, % by volume:

lcl = 3.3, ucl = 19.0.

Dangerous fire hazard when exposed to heat or flame.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above.

Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Water spray may be used to

keep fire exposed containers cool. Water may be used to flush

spills away from exposures and to dilute spills to non-flammable

mixtures.

Special Information:

In the event of a fire, wear full protective clothing and

NIOSH-approved self-contained breathing apparatus with full

facepiece operated in the pressure demand or other positive

pressure mode. Vapors can flow along surfaces to distant

ignition source and flash back.

SECTION 4 Leak/Spill Disposal Information

Ventilate area of leak or spill. Remove all sources of

ignition. Clean-up personnel require protective clothing and

respiratory protection from vapors. Contain and recover liquid

when possible. Collect as hazardous waste and store in a

suitable RCRA approved combustion chamber, or absorb with

vermiculite, dry sand, earth or similar material for disposal

as hazardous waste in a RCRA approved facility. Do not flush

to sewer.

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

AD

ETHYL ALCOHOL COMPLETELY DENATURED

ETHYL ALCOHOL COMPLETELY DENATURED

Effective Date: 04-06-89 Supersedes 07-13-87

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Exposure may cause irritation to the mucous membranes of the upper respiratory tract. Prolonged exposures to high concentration may cause drowsiness, loss of appetite, and inability to concentrate.

Ingestion:
Can cause gastritis, vomiting, central nervous system depression with headache, dizziness, and dullness.

Skin Contact:
May cause irritation. Prolonged contact may produce discoloration.

Eye Contact:
May cause severe irritation. Splashes may cause temporary pain and blurred vision.

Chronic Exposure:
Prolonged exposure may cause drying and cracking of skin. May affect the nervous system. May cause liver injury and pancreatitis.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems, or impaired kidney or respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

If swallowed, induce vomiting immediately by giving two glasses of water, or milk if available and sticking finger down throat. Call a physician immediately. Never give anything by mouth to an unconscious person.

Skin Exposures:

Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye Exposure:

Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1986)

For ethyl alcohol: Inhalation Rat LC50: 20,000 ppm/10Hl Oral Rat LD50: 7060 mg/kg. Mutation references cited. Reproductive Effects cited. Irritation data: skin rabbit 400mg open mild eye rabbit 100mg/24H severe For Keratene: Oral rabbit LD50: 28gm/kg For Methyl Isobutyl ketone: Oral rat LD50: 2080 mg/kg

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL):
1,000 ppm (TWA) for Ethyl Alcohol
50 ppm (TWA), 75 ppm (STEL) for Methyl Isobutyl Ketone
-ACGIH Threshold Limit Value (TLV):
50 ppm (TWA), 75 ppm (STEL) Methyl Isobutyl Ketone
1,000 ppm (TWA) For Ethyl Alcohol

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)

If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn up to the maximum use concentration specified by the respirator supplier. Alternatively, a supplied air full facepiece respirator or airtight hood may be worn.

Skin Protection:

Gloves and lab coat, apron or coveralls.

Eye Protection:

Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment.

ETHHD

MALLINCKRODT

Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

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Emergency Telephone Number: 314-992-5000

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be

Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS

must include a copy of this addendum

(Chem.Key: ETHDE)

Hazard Categories for SARA

Section 311/312 Reporting

Acute Chronic Fire Pressure Reactive

X X X X

Product or Components of Product:

ETHYL ALCOHOL COMPLETELY DENATURED codes:

7018 3791 3122 The following percentages correspond one to one with the product codes given here.

Ethyl alcohol (64-17-5) 95%, 95%, 95%

Methyl isobutyl ketone (108-10-1) 4%, 4%, 4%

Kerosene (8008-20-6) < 1%, < 1%, < 1%

SARA EHS Sect. 302 RQ (lbs.)	TPQ (lbs.)	SARA Section 313 Chemicals Name List	CERCLA Sec. 103 RQ (lbs.)	RCRA Sec. 261.33
No	No	No	No	No
No	No	Yes	5000	U161
No	No	No	No	No

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.

CERCLA Sec. 103: Comprehensive Environmental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4

RCRA: Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

ETHYL ALCOHOL COMPLETELY DENATURED

Effective Date: 04-06-89 Supersedes 07-13-87

LABORATORY SAFETY SURVEY

1. Do you work with hazardous chemicals? YES___ NO___

2. Are you familiar with the chemicals you work with? YES___ NO___

3. What is an MSDS?

4. Where are the MSDS's located for the chemicals that you work with?

5. Who is the Chemical Hygiene Officer for your laboratory?

6. Have you reviewed the Chemical Hygiene Plan for your laboratory?

7. Where is the Chemical Hygiene Plan located for your laboratory?

8. What protective measures do you use to prevent over-exposure to chemical substances?

9. What is the difference between "acute" and "chronic" adverse effects of chemical exposure?

10. NAME (If You Wish) _____

Title _____

Building _____ Department _____ Room # _____

Interviewed By _____

Comments: _____

Compressed Gas Safety Environmental Health and Safety University of Tennessee – Knoxville

INTRODUCTION

Many industrial and laboratory operations require the use of compressed gases for a variety of different operations. Compressed gases present a unique hazard. Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards. Gases may be:

- » Flammable or combustible,
- » Explosive,
- » Corrosive,
- » Poisonous,
- » Inert,
- » or a combination of hazards.

If the gas is flammable, flash points lower than room temperature compounded by high rates of diffusion present a danger of fire or explosion. Additional hazards of reactivity and toxicity of the gas, as well as asphyxiation, can be caused by high concentrations of even “harmless” gases such as nitrogen. Since the gases are contained in heavy, highly pressurized metal containers, the large amount of potential energy resulting from compression of the gas makes the cylinder a potential rocket or fragmentation bomb. Careful procedures are necessary for handling the various compressed gases, the cylinders containing the compressed gases, regulators or valves used to control gas flow, and the piping used to confine gases during flow.

IDENTIFICATION

The contents of any compressed gas cylinder must be clearly identified. Such identification should be stenciled or stamped on the cylinder or a label. Commercially available three-part tag systems may also be used for identification and inventory. No compressed gas cylinder should be accepted for use that does not legibly identify its contents by name. If the labeling on a cylinder becomes unclear or an attached tag is defaced to the point the contents cannot be identified, the

cylinder should be marked “contents unknown” and returned directly to the manufacturer.

ALWAYS READ THE LABEL!

Never rely on the color of the cylinder for identification. Color coding is not reliable because cylinder colors may vary with the supplier. Additionally, labels on caps have little value because caps are interchangeable. The labels should be color coded to distinguish hazardous gases (such as flammable, toxic, or corrosive substances) (e.g., a yellow background and black letters). All gas lines leading from a compressed gas supply should be clearly labeled to identify the gas, the laboratory or area served, and the relevant emergency telephone numbers. Signs should be conspicuously posted in areas where flammable compressed gases are stored, identifying the substances and appropriate precautions (**e.g., HYDROGEN - FLAMMABLE GAS - NO SMOKING - NO OPEN FLAMES**).

HANDLING AND USE

Gas cylinders must be secured **AT ALL TIMES** to prevent tipping.

Cylinders may be attached to a bench top, individually to the wall, placed in a holding cage, or have a non-tip base attached. Chains or sturdy straps may be used to secure them.

If a leaking cylinder is discovered, move it to a safe place (if it is safe to do so) and inform Environmental Health and Safety Services at 974-5084. You should also call the vendor as soon as possible.

Under no circumstances should any attempt be made to repair a cylinder or valve!

Standard cylinder-valve outlet connections have been devised by the Compressed Gas Association (CGA) to prevent mixing of incompatible gases. The outlet threads used vary in diameter; some are internal, some are external; some are right-handed, and some are left-handed. In general, right-handed threads are used for non-

fuel and water-pumped gases, while left-handed threads are used for fuel and oil-pump gases. To minimize undesirable connections, only CGA standard combinations of valves and fittings should be used in compressed gas installations; the assembly of miscellaneous parts should be avoided. The threads on cylinder valves, regulators and other fittings should be examined to ensure they correspond and are undamaged. Cylinders should be placed with the valve accessible at all times. The main cylinder valve should be closed as soon as it is no longer necessary that it be open (i.e., it should never be left open when the equipment is unattended or not operating). This is necessary not only for safety when the cylinder is under pressure, but also to prevent the corrosion and contamination resulting from diffusion of air and moisture into the cylinder after it has been emptied. Cylinders are equipped with either a hand wheel or stem valve. For cylinders equipped with a stem valve, the valve spindle key should remain on the stem while the cylinder is in service. Only wrenches or tools provided by the cylinder supplier should be used to open or close a valve. At no time should pliers be used to open a cylinder valve. Some valves may require washers; this should be checked before the regulator is fitted. Cylinder valves should be opened slowly. Main cylinder valves should never be opened all the way. When opening the valve on a cylinder containing an irritating or toxic gas, the user should position the cylinder with the valve pointing away from them and warn those working nearby.

Cylinders containing flammable gases such as hydrogen or acetylene **must not** be stored in close proximity to open flames, areas where electrical sparks are generated, or where other sources of ignition may be present.

Cylinders containing acetylene shall never be stored on their side.

An open flame shall never be used to detect leaks of flammable gases. Hydrogen flame is invisible, so “feel” for heat. One common practice is to use a natural bristle broom to “sweep” the air in front of you. All cylinders containing

flammable gases should be stored in a well-ventilated area.

Oxygen cylinders, full or empty, shall not be stored in the same vicinity as flammable gases. The proper storage for oxygen cylinders requires that a minimum of 50 feet be maintained between flammable gas cylinders and oxygen cylinders or the storage areas be separated, at a minimum, by a fire wall five feet high with a fire rating of 0.5 hours.

Greasy and oily materials shall never be stored around oxygen; nor should oil or grease be applied to fittings.

Regulators are gas specific and not necessarily interchangeable!

Always make sure that the regulator and valve fittings are compatible.

If there is any question as to the suitability of a regulator for a particular gas, check with Environmental Health and Safety Services or call your vendor for advice. After the regulator is attached, the cylinder valve should be opened just enough to indicate pressure on the regulator gauge (no more than one full turn) and all the connections checked with a soap solution for leaks. Never use oil or grease on the regulator of a cylinder valve.

The following rules should always be followed in regards to piping:

- » Copper piping shall not be used for acetylene.
- » Plastic piping shall not be used for any portion of a high pressure system.
- » Do not use cast iron pipe for chlorine.
- » Do not conceal distribution lines where a high concentration of a leaking hazardous gas can build up and cause an accident.
- » Distribution lines and their outlets should be clearly labeled as to the type of gas contained.
- » Piping systems should be inspected for leaks on a regular basis.

- » Special attention should be given to fittings as well as possible cracks that may have developed.

A cylinder should never be emptied to a pressure lower than 172 kPa (25 psi/in²) (the residual contents may become contaminated if the valve is left open). When work involving a compressed gas is completed, the cylinder must be turned off, and if possible, the lines bled.

Empty and full cylinders should be stored in separate areas.

When the cylinder needs to be removed or is empty, all valves shall be closed, the system bled, and the regulator removed. The valve cap shall be replaced, the cylinder **clearly marked as “empty;”** and returned to a storage area for pickup by the supplier. All compressed gas cylinders, including lecture-size cylinders, must be returned to the supplier when empty or no longer in use.

Where the possibility of **flow reversal** exists, the cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders connected to a closed system. “Sucking back” is particularly troublesome where gases are used as reactants in a closed system. A cylinder in such a system should be shut off and removed from the system when the pressure remaining in the cylinder is at least 172 kPa (25 psi/in²). If there is a possibility that the container has been contaminated, it should be so labeled and returned to the supplier.

Liquid bulk cylinders may be used in laboratories where a high volume of gas is needed. These cylinders usually have a number of valves on the top of the cylinder. All valves should be clearly marked as to their function. These cylinders will also vent their contents when a preset internal pressure is reached, therefore, they should be stored or placed in service where there is adequate ventilation.

Always use safety glasses (preferably with a face shield) when handling and using compressed gases, especially when connecting and disconnecting compressed gas regulators and lines.

TRANSPORTATION OF CYLINDERS

The cylinders that contain compressed gases are primarily shipping containers and should not be subjected to rough handling or abuse. Such misuse can seriously weaken the cylinder and render it unfit for further use or transform it into a rocket having sufficient thrust to drive it through masonry walls.

1. To protect the valve during transportation, the cover cap should be screwed on hand tight and remain on until the cylinder is in place and ready for use.
2. Cylinders should never be rolled or dragged.
3. When moving large cylinders, they should be strapped to a properly designed wheeled cart to ensure stability.
4. Only one cylinder should be handled (moved) at a time.

To complete the Compressed Gas Safety Training Module, please take the Quiz.