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IDENTIFIERS: *Waste Water Treatment.

ABSTRACT: This is one of several short-term courses developed to assist in the training of waste water treatment plant operational personnel in the tests, measurements, and report preparation required for compliance with their NPDES Permits. The Staff Guide provides step-by-step information on course planning, development, and implementation involving classroom instruction and laboratory application of critical learning outcomes. Part I is concerned with the administrative aspects of the training program. Part II consists of instructional staff guidelines on technical content, learning objectives, and lesson-by-lesson guides for the self-monitoring procedures contained in this course. (CS)
EFFLUENT MONITORING PROCEDURES:
METALS ANALYSES

STAFF GUIDE

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER PROGRAM OPERATIONS
STAFF GUIDE
for
CONDUCTING THE COURSE

EFFLUENT MONITORING PROCEDURES: METALS ANALYSES

National Training and Operational Technology Center
Municipal Operations and Training Division,
Office of Water Program Operations
U.S. Environmental Protection Agency
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Background of Effluent Self-Monitoring Requirement

With passage of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) a new permit program was created to replace and improve upon the earlier permit system which existed under the 1899 Refuse Act.

Under the 1972 Act, the United States Environmental Protection Agency is required to establish national effluent limitations and national treatment performance standards for all sources of water pollution, including not only municipal discharges, but also factories, animal feedlots, and power plants. These effluent limitations are the maximum amount of a pollutant that any discharger may release into a water body.

In order to insure that the prescribed effluent limits are met, every discharger is required to obtain an NPDES (National Pollutant Discharge Elimination System) Permit. Types of water discharge sources for which a permit is required include municipal wastewater treatment facilities; manufacturing plants; agriculture, forestry, mining and fishing operations, and other service, wholesale, retail, and commercial establishments having operations which result in discharge of water to the Nation's bodies of water.

The NPDES Permit is not a license to pollute. To the contrary, a Permit stipulates what may be discharged, and how much may be discharged over a defined period of time. Each Permit is tailored to the discharger, and sets specific limits on each effluent.

Furthermore, the NPDES Permit also requires dischargers to monitor their effluents, performing specified tests and measurements at designated frequencies specified in the individual Permit, and to report the amount and nature of all waste components discharged.

Training Need Associated with Self-Monitoring Requirements

Compliance with NPDES requires that all specified tests and measurements be performed in accordance with methods specified by EPA and announced in the Federal Register. Only under very limited conditions are deviations from specified methods acceptable.

These requirements are the basis of an immediate, massive, training need to provide the responsible waste water treatment personnel with the knowledge and skills required to comply with the self-monitoring requirement. There is at present a wide range of initial capabilities for performing the tests and measurements. This range, from the situation in the large, fully-staffed, fully-equipped facility in which little or no training is required, through all shades and levels to the limited staff in small, inadequately-equipped facilities in which at present there is little or no capability for performing the required tests and measurements.
This is one of several special short-term courses recently developed and currently under development by the Environmental Protection Agency and associated educational institutions. This Instructor's Guide is intended to assist other training organizations in conducting training of waste water treatment plant operational personnel in the tests, measurements, and report preparation required for compliance with their NPDES Permits.

### TRAINING AVAILABLE OR UNDER DEVELOPMENT TO MEET SELF-MONITORING REQUIREMENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Workers should take this who:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Laboratory Skills for Self-Monitoring Tests and Measurements</strong></td>
<td>Have little or no laboratory experience or training, and need to develop basic skills including use of balances; preparation of solutions and reagents; names, characteristics, preparation and care of common laboratory equipment supplies. This course prepares students requiring such training for entry into the following named courses in which procedures for designated tests and measurements are learned.</td>
</tr>
<tr>
<td><strong>Self-Monitoring Procedures: Basic Parameters for Municipal Effluents</strong></td>
<td>Have basic laboratory skills, as designated above, but need to learn one or more of the procedures required for most municipal effluents including BOD, fecal coliform, pH, suspended solids, flow, and reporting of results.</td>
</tr>
<tr>
<td><strong>Effluent Monitoring Procedures: Metals Analyses</strong></td>
<td>Usually have completed the &quot;Basic Parameters&quot; course, but have a Permit which requires report on one or more metals.</td>
</tr>
<tr>
<td><strong>Effluent Monitoring Procedures: Nutrients</strong></td>
<td>Usually have completed the &quot;Basic Parameters&quot; course, but have a Permit which requires periodic report on one or more of the so-called &quot;nutrients&quot; including nitrogen and phosphorus.</td>
</tr>
<tr>
<td><strong>Effluent Monitoring Procedures: Flow Measurement and Sampling Techniques</strong></td>
<td>Have made arrangements whereby the required laboratory procedures are performed elsewhere by contract or other special arrangement, and who are required only to collect and care for samples, and to make such tests and measurements as must be made at the sampling site.</td>
</tr>
<tr>
<td>Any of the analytical courses of EPA National Training and Operational Technology Center for specific Permits</td>
<td>Are professional chemists, microbiologists, or key laboratory technicians in large treatment facilities where they work full-time doing a designated series of analytical tests and measurements.</td>
</tr>
</tbody>
</table>
A Personal Note to the User of this Guide

The need for providing this training, and the nature of current efforts of the Environmental Protection Agency to meet this need have been discussed in foregoing paragraphs.

It is an oversimplification of a classic quotation to say that all that is needed to conduct training is to "put Mark Hopkins on one end of a log and a student on the other." It is almost as much an oversimplification to say that all that is needed to conduct a course is to bring together the students and the instruction staff in a classroom and laboratory equipped with requisite equipment and supplies for the instruction to be delivered.

A short course such as this, involving both classroom instruction and laboratory application, and with critical learning outcomes to be achieved within a limited period of time, absolutely requires careful, detailed planning, preparation, and implementation. Meticulous attention to detail and effective staff teamwork are essential at every step of course planning, development, and implementation.

The purpose of this Staff Guide is to provide you, the training staff member; with useful, practical assistance in presenting this course in your own facilities. The Guide is a resource. It is not a blueprint to be followed rigidly or unthinkingly. Even with this guide or any other form of assistance, you will have to plan, to think and to prepare in order to perform effectively in conducting this course. On the other hand, this Guide should be helpful in reducing the amount of original development work you will have to do, and it should be helpful in suggesting factors in course planning and presentation which otherwise might be ignored or glossed over.

You are invited, in fact requested, to participate actively in making this Guide a living document which effectively represents the best experience of all in planning, preparing for, conducting and terminating this course. Please provide this office with your constructive suggestions for strengthening and improving upon this Guide, based on your own experiences in conducting the course. Your recommendations will be fully considered in future editions of this and other Staff Guides for other courses of this series. In the event that questions arise in interpretation of any aspect of this Instructors' Guide, please write or call:

Director, National Training and Operational Technology Center
Office of Water Program Operations
U.S. Environmental Protection Agency
Cincinnati, OH 45268

Telephone: (513) 684-7501

Format of this Manual

This manual consists of two major parts. Part I is concerned with administrative aspects of planning, preparing, and conducting the course. Part II consists of guidance to the instructional staff on the technical content, learning objectives to be achieved by the students, and lesson-by-lesson instructional guides for each of the several self-monitoring procedures covered in this course.
Part I, which immediately follows, will have greatest value to those conducting this course for the first time or for the first few times. With practice in conducting the training most organizations will develop their own adaptations and ramifications of this plan to meet their own requirements and the specific situation.

It is strongly urged that each institution conducting this training course develop its own formal version of such a guide as this. Staff does change; new personnel require indoctrination and training on standard procedures of the organization they have joined. Rules and procedures promulgated by regulatory authority do change; such changes will require adjustment in course content. With repetition of specified tasks, many staff members, however dedicated, do slip into unconscious variations in practice or omissions in details which can subtly change the character of the course. A formal plan and guide, consciously studied and followed, can help the training instructor and the administrator to avoid many pitfalls.

Intelligent use of a plan such as this, with variations as proven necessary, can go far in keeping this course in harmony with the needs of the students and with requirements of regulatory authorities. Above all, the course should remain free of the distractions and last-minute corrections of errors or omissions discovered at untimely stages in course preparation and presentation.
PART I - COURSE PLANNING AND MANAGEMENT

A. Course Plan and Working Schedules

This section considers five topics;

Responsibilities in self-monitoring training

It is an inherent responsibility of any teacher to provide a learning situation which gives the student the best possible opportunity to develop the target level of knowledge and skills.

In addition, and not to be overlooked, this course involves a responsibility to the regulatory agency—to assure that students acquire specified knowledge and skills and that these skills are acquired to a level such that data reported by the student will be accepted as reliable by the regulatory authority.

Announcing the course

This section gives examples of course announcements, and identifies specific information which should be provided in any course announcement.

Summary plan for the course

This is a one-page summary of the course plan in which the reader can discover the subject matter coverage, days and approximate time allocations and the designation of the instructional specialty involved in presenting the instruction.

Sample course schedule

This covers the same information as the summary plan. The format is different, providing a day-by-day, hour-by-hour class schedule. This schedule format has been found most practical at EPA training centers for more than 20 years. It works. It is recommended for your use.

Milestones in course planning and preparation

Each member of the training staff has individual and cooperative duties in planning and conducting the course. Much of the responsibility of each staff member is outlined later in this Guide in the section on Training Staff (Outline 6). The milestone chart shown here is an example of a plan to accomplish necessary tasks in a timely manner. It is necessary that each training institution develop its own logistics of course preparation to meet the situation at hand. It is urged that a formal milestone chart be developed.

1. Responsibilities in Self-Monitoring Training

a. Implications of NPDES

Each Permit issued under the National Pollutant Discharge Elimination System (NPDES) includes a program of required self-monitoring analyses of effluents and reporting of results at prescribed intervals.
1) The methodology to be followed in performing the self-monitoring tests and measurements is described in issuances in the Federal Register (FR).

2) In some cases, two or more alternative procedures are available to the analyst for compliance with monitoring requirements.

3) Provisions do exist whereby the regulatory agencies (State and EPA) can recommend and permit use of methods not listed in the FR. Procedures for orderly application of accepted methods are described in the FR issuance at the end of this section. It cannot be too strongly emphasized that the Permit-holder does not have the authority to make a unilateral decision to introduce analytical procedures not found in the FR issuances or not specifically authorized by the appropriate regulatory authorities.

b. Training Response to NPDES/FR Requirements

1) Methods taught in this and associated courses developed by EPA are limited to those most recently prescribed in issuances of the FR.

2) Usually, when alternative methods are available, the course will include only one of the alternatives. In planning the details of a specific course offering, a training representative should in every case consult with responsible representatives of the regulatory agency in the area in which the course is conducted. This consultation should include determination of:

a) Which, if any, of more than one alternative analytical method is preferred (or required) by the regulatory agency for the Permit-holders under its jurisdiction?

b) What, if any, changes have occurred since the last course offerings which require adjustment in course content?

c) What advice does the regulatory agency have to offer about the planned course presentation based on problems encountered in implementation of self-monitoring procedures, and in observations of performance of past graduates from previous offerings of the course?

3) The training institution which fails to apply these elementary practices, with a result of sometimes teaching inappropriate methods, stands in danger of committing a serious disservice to those it purports to serve:

a) To the students enrolled in the course; and

b) To the Permit-holding organization, which is being led to believe that through this training the qualifying student will perform self-monitoring tests and measurements in accordance with methods approved by the regulatory authority.
c. Responsibilities in Accreditation of Students

1) Successful completion of this course of training will be a factor used by many regulatory agencies in the accreditation or certification of treatment plant personnel to perform self-monitoring tests and measurements.

2) The instructional staff has a responsibility to provide a learning experience through which the qualifying student will have every expectation of being able to perform the required self-monitoring procedures in a satisfactory manner on return to his normal working environment.

3) Student Evaluation and Testing

For permanent record of qualification and performance, a record of student performance should be made.

a) Tests (both written and applied) should be criterion tests, i.e., designed to demonstrate ability of the student to perform the required analyses, as contrasted with tests designed to develop a comparative rating of the individual students.

b) Written tests should be strictly applied to the procedures being taught and should be appropriate to a written answer. Thus definitions, matters of specific information, solving of problems, and similar matters are appropriate to written tests.

c) Many students will take alarm at written tests, and may not perform up to expectations due to this alarm. One means of alleviating this fear is to give open-book quizzes but to expect a high standard of performance. It is pointed out here that it is more important for the student to know where to refer for needed facts and to check these facts, than it is to demonstrate rote memory. The memory will come with practice of the test procedures. The student should learn to check the facts when in doubt, rather than to risk a blunder.

d) Much of the student evaluation will be based on performance in the laboratory. It will be appropriate to keep records on such factors in student performance as:

(1) Accuracy in following directions as given;

(2) Demonstration of acceptable manipulative skills;

(3) Reporting of laboratory results falling within acceptable relationship to a class norm; and other factors as determined by the instructor.

e) Each instructor is responsible for reporting the quality of performance of each student for the procedures for which he has primary responsibility. These reports should be written; and they should be made a part of the permanent course record. This course plan provides for having at least two instructors in the laboratory during all laboratory phases of the course. At any
given session, one instructor will be the designated primary instructor, with others in a supporting role. To make a system like this work satisfactorily in evaluation of students and to assure consistence in student instruction each member of the instructional team has definite, if implied, responsibilities. These include:

1. The primary instructor is the individual who reports on acceptability or non-acceptability of student performance.

2. The instructor-assistant(s) must instruct students in the same way as designated by the primary instructor. Introduction of individuality in manipulative procedures, order of proceeding with a test, etc., can only confuse the student.

3. The instructor-assistant(s) should bring the problem-student to the attention of the primary instructor at the earliest possible moment. This is to provide maximum opportunity to correct problems which might result in failure of the student to qualify in a given analytical procedure.

4. Primary instructor and instructor-assistsants have, of course, a continuing responsibility of preserving the highest standards of professional and ethical relationships with each other throughout the course. Differences of opinion will arise among individuals of any instructional staff. These differences must be resolved outside the classroom and laboratory. Furthermore, these differences are not subjects for airing with students at any time.

4) The Nonqualifying Student:

a) There is a job/financial implication to any student failing to qualify for any of the analytical tests and measurements included in this course. Therefore instructors should be particularly careful to document the reasons for any nonqualification.

b) Any nonqualifying student should be entitled to be informed on the reasons why he is judged nonqualifying.

c) Ideally, an opportunity should be provided for nonqualifying students to have another chance to correct deficiencies in their performance. This could be accomplished through a number of different approaches such as makeup work (evenings) during the course itself, through repeating the training module in which acceptable results were not achieved (at a mutually agreeable time for the student and for the instructor), or by enrollment in a future offering of the course with participation only in the module which was failed the first time around.
PART II:

ENVIRONMENTAL PROTECTION AGENCY

WATER PROGRAMS

Guidelines Establishing Test Procedures for the Analysis of Pollutants

Amendments
RULES AND REGULATIONS

On June 9, 1975, proposed amendments to the Guidelines Establishing Test Procedures for the Analysis of Pollutants (40 CFR 136) were published in the Federal Register (40 FR 24535) as required by section 304(g) of the Federal Water Pollution Control Act Amendments of 1972 (38 Stat. 816; set out in Pub. L. 92-500, 1972). Hereinafter referred to as the Act. Section 304(g) of the Act requires that the Administrator shall promulgate guidelines establishing test procedures for the analysis of pollutants that shall include factors which must be provided in: (1) any certification pursuant to section 401 of the Clean Water Act, or (2) any permit application pursuant to section 402 of the Act. Such test procedures are to be used by permit applicants to demonstrate that effluent discharges meet applicable pollution control standards.

Interested persons were requested to submit written comments, suggestions, or objections to the proposed amendments by September 7, 1975. One hundred and thirty-five letters were received from commenters. The following categories of organizations were represented by the commenters: Federal agencies accounted for nineteen responses; State agencies accounted for twenty-six responses; local agencies accounted for seventeen responses; regulated major dischargers accounted for eight responses; analytical instrument manufacturers accounted for seven responses; and analytical services laboratories accounted for six responses.

All comments were carefully evaluated by a technical review committee. Based upon the review of comments, the following principal changes to the proposed amendments were made:

(A) Definitions. Section 136.2 has been amended to update references. Twenty commenters, representing the entire spectrum of commenters, requested that the reference cited in § 136.2(f), 136.2(g), and 136.2(h) be updated to include the following edition of the standard reference: "4th Edition of Standard Methods for the Examination of Water and Waste Water." The Environmental Protection Agency agreed.

(B) Identification of Test Procedures. Both the content and format of § 136.3, Table I, List of Approved Test Procedures, has been revised in response to twenty-one comments received from State and local government agencies, major regulated dischargers, professional and trade associations, and analytical laboratories.

(C) Clarification of Test Parameters. The conditions for analysis of several parameters have been more specifically defined as a result of comments received by the Agency. (1) In response to five commenters, the allowance for "dissolved" in the procedure would change the definition of the parameter. The conditions for analysis of several parameters have been more specifically defined as a result of comments received by the Agency. (2) In response to four commenters, the conditions for analysis of inorganic substances, the difference in drying temperatures for these residue parameters must be preserved. (3) In response to three requests from Federal or State agencies and major dischargers, the drying temperature for these residue parameters is now specified for ammonia measurement.

(D) Sample Preservation and Handling Procedures. Four new parameters have been added to Table I. In addition to the designation of analytical procedures for these new parameters, the following modifications have been made in analytical procedures designated in response to comments:

(1) The ortho-tolidine procedure was not approved for the measurement of residual chlorine because of its poor accuracy and precision. Its approval had been requested by seven commenters representing major dischargers, State, or local government agencies, and analytical instrument manufacturers. Instead, the "Dinitrophenylhydrazine (DNPH) procedure has been approved as an interim procedure pending more intensive laboratory testing. It has many of the advantages of the ortho-tolidine procedure such as low cost, ease of operation, and also is of acceptable precision and accuracy.

(E) Deletion of Measurement Techniques. Some measurement techniques that had been proposed have been deleted in response to objections raised during the public comment period.

(F) Sample Preservation and Handling Times. Criteria for sample preservation and handling times for the measurement of fecal coliform bacteria in the "Most Probable Number" (MPN) procedure has been withdrawn. In response to requests from forty-five commenters including State pollution control agencies, permit holders, analysts, treatment plant operators, and a manufacturer of analytical supplies, the membrane filter (MP) procedure will continue to be an approved technique for the routine measurement of fecal coliform in the presence of chlorine. However, the MPN procedure must be used to resolve controversial situations. The technique selected by the analyst must be reported with the data.

(G) A total of fifteen objections, representing the entire spectrum of commenters, addressed the drying temperatures used for measurement of residues. The use of different temperatures in drying residue, dissolved residue, and suspended residue was cited as not allowing direct intercomparability between these measurements. Because the first finding of the three separate residue parameters is anticipated to measure anhydrous inorganic substances, the different drying temperatures for these residue parameters must be preserved.

(H) Deletion of Measurement Techniques. Some measurement techniques that had been proposed have been deleted in response to objections raised during the public comment period.

(I) The proposed separate parameter for sulfide at concentrations below 1 mg/l has been withdrawn. Methylene blue spectrophotometry is now included in Table I as an approved procedure for sulfide analysis. The titrimetric iodine procedure for sulfide analysis may only be used for analysis of sulfide at concentrations in excess of one milligram per liter.

(J) Sample Preservation and Handling Times. Criteria for sample preservation and handling times for the measurement of fecal coliform bacteria in the "Most Probable Number" (MPN) procedure has been withdrawn. In response to requests from forty-five commenters including State pollution control agencies, permit holders, analysts, treatment plant operators, and a manufacturer of analytical supplies, the membrane filter (MP) procedure will continue to be an approved technique for the routine measurement of fecal coliform in the presence of chlorine. However, the MPN procedure must be used to resolve controversial situations. The technique selected by the analyst must be reported with the data.

(K) A total of fifteen objections, representing the entire spectrum of commenters, addressed the drying temperatures used for measurement of residues. The use of different temperatures in drying residue, dissolved residue, and suspended residue was cited as not allowing direct intercomparability between these measurements. Because the first finding of the three separate residue parameters is anticipated to measure anhydrous inorganic substances, the different drying temperatures for these residue parameters must be preserved.
these procedures for experimentally approved alternate test procedures. Four applications for approval of alternate test procedures were submitted and commented on by NFDES permit holders, and approval of such applications will come effective on April 1, 1977. The intent of the alternate test procedure is to allow the use of measurement systems which are known to be equivalent to the approved test procedures in waste water discharges.

Applications for approval of alternate test procedures applicable to specific discharges will continue to be made only by NFDES permit holders, and approval of such applications will be made on a case-by-case basis by the Regional Administrator whose Region the discharge is made in.

Applications for approval of alternate test procedures which are intended for nationwide use will be submitted and considered directly to the Director of the Environmental Monitoring and Support Laboratory in Cincinnati. Such applications should include a complete methods description, performance references, comparability data between the proposed alternate test procedure and those already approved by the Administrator. The applications should also include the expected accuracy data of the proposed alternate test procedure and data confirming the general applicability of the test procedure to the industrial categories of waste water for which it is intended. The Director of the Environmental Monitoring and Support Laboratory, after review of submitted information, will recommend approval or rejection of the application to the Administrator, or he will return the application to the applicant for more information. Approval or rejection of applications for alternate test procedures intended for nationwide use will be made by the Administrator, after considering the recommendations of the Director of the Environmental Monitoring and Support Laboratory, Cincinnati. Since the Administrator considers these procedures for approval of alternate test procedures for nationwide use to be interim procedures, we will welcome suggestions for criteria for approval of alternate test procedures for nationwide use.

Interested persons should submit their written comments in triplicate or before June 1, 1977 to: Dr. R. B. Medz, Environmental Protection Technology, Monitoring Quality Assurance Standards, Office of Monitoring and Technical Support (RD-10-S), Environmental Protection Agency, Washington, D.C. 20460.

(H) Freedom of Information. A copy of all public comments, an analysis by the Administrator, recommended amendments, and all documents providing further information on the rationale for the changes made in the final regulation are available for inspection and copying at the Environmental Protection Agency's Public Information Reference Unit, Room 2022, Water'side Mall, 401 M Street, SW, Washington, D.C. 20460, during normal business hours. The EPA information regulation 40 CFR 2 provides that a reasonable fee may be charged for copying such documents.

Effective date: These amendments become effective on April 1, 1977.

[Signature]

John Quarells, Acting Administrator, Environmental Protection Agency.

Chapter I, Subchapter D, of Title 40 Code of Federal Regulations is amended as follows:

1. In § 136.2, paragraphs (g), (h), and (j) are amended to read as follows:

536.2 Definitions.


(b) "ASTM" means Annual Book of Standards, Part 31, Water, 1975. This publication is available from the American Society for Testing and Materials, 111 Race Street, Philadelphia, Pennsylvania 19103.

(h) "EPA Methods" means Methods for Chemical Analysis of Water and Waste, 1974, Methods Development and Quality Assurance Research Laboratory.

Table 1.—List of approved test procedures

<table>
<thead>
<tr>
<th>Parameter and units</th>
<th>Method</th>
<th>494th EPA Methods</th>
<th>Other references (page nos.)</th>
</tr>
</thead>
</table>

1. Alkali, as CaCO3, milligrams per liter. 270-22 1.14 3.40 | 1067 |
2. Alkali, as Na+ (as N), milligrams per liter. | 227 77 111 | 41 |

3. Ammonia (as N), milligrams per liter. 130 513 637 116 | 1014 |

4. Calcium (total), number per 100 ml. | 322 | | |
5. Coliform (total) in presence of alcohols, number per 100 ml. | 220 | | |
6. Coliform (total) in absence of alcohols, number per 100 ml. | 222 | | |

7. Coliform (total) in presence of alcohols, number per 100 ml. with gelatin. | 224 | | |

8. Fecal streptococci, number per 100 ml. | 225 | | |

9. Benzidine, milligrams per liter. 1905 | | |

10. Biochemical oxygen demand (BOD), mg per liter. | 226 | | |

11. Chemical oxygen demand (COD), milligrams per liter. | 226 | | |

12. Chloride, milligrams per liter. | 228 | | |

BACTERIA

13. Hydrogen sulfide, milligrams per liter. | 229 | | |

14. Nitrate, milligrams per liter. | 229 | | |

15. Oxygen—oxygenates. | 229 | | |

16. Phenol, milligrams per liter. | 230 | | |

17. Pesticides, milligrams per liter. | 230 | | |

18. Silver, milligrams per liter. | 230 | | |

19. Silver, milligrams per liter. | 230 | | |

See footnote at end of table.
## RULES AND REGULATIONS

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<th>Parameter and units</th>
<th>Method</th>
<th>EPA methods</th>
<th>APHA methods</th>
<th>Other approved methods</th>
</tr>
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<tr>
<td>14. Chlorinated organics compounds (except pesticides), milligrams per liter</td>
<td>Gas chromatography</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Chlorine—total residual, milligrams per liter</td>
<td>Indomeric titration, ammonomeric or starch-iodine end-point</td>
<td>25</td>
<td>252</td>
<td>376</td>
</tr>
<tr>
<td>16. Cyanide, total, milligrams per liter</td>
<td>Colorimetric, spectrophotometric, or AAS procedure</td>
<td>40</td>
<td>104</td>
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</tr>
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<td>18. Cyanide amenable to chroma-</td>
<td>Whipple (Arno modification) or electrode method.</td>
<td>40</td>
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<td></td>
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<td>21. Hardness—Total, as CaCO₃, milligrams per liter</td>
<td>EDTA titration, automated colorimetric, or atomic absorption (sum of Ca and Mg as their respective carbonates)</td>
<td>104</td>
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<td>106</td>
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<td>22. Hydrogen ion (pH) pH units,</td>
<td></td>
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<td>23. Total nitrogen (as N), milligrams per liter</td>
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<td>106</td>
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</table>

### METALS

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<tr>
<th>Parameter and units</th>
<th>Method</th>
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<th>APHA methods</th>
<th>Other approved methods</th>
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<tr>
<td>24. Aluminum—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption or by spectrophotometric (Briocromes)</td>
<td>104</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
<td>25. Aluminum—Dissolved, milligrams per liter</td>
<td>O.56 microfiltration followed by reference methods for total aluminum.</td>
<td>104</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
<td>26. Antimony—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
<td>104</td>
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<td>106</td>
</tr>
<tr>
<td>27. Antimony—Dissolved, milligrams per liter</td>
<td>O.56 microfiltration followed by reference methods for total antimony</td>
<td>104</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
<td>28. Arsenic—Total, milligrams per liter</td>
<td>Digestion followed by silver</td>
<td>104</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
<td>29. Arsenic—Dissolved, milligrams per liter</td>
<td>Reductive separation of atomic absorption.</td>
<td>104</td>
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</tr>
<tr>
<td>30. Barium—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
<td>104</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
<td>31. Barium—Dissolved, milligrams per liter</td>
<td>O.56 microfiltration followed by reference methods for total barium</td>
<td>104</td>
<td>106</td>
<td>106</td>
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<tr>
<td>32. Beryllium—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
<td>104</td>
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<tr>
<td>33. Beryllium—Dissolved, milligrams per liter</td>
<td>O.56 microfiltration followed by reference methods for total beryllium</td>
<td>104</td>
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<td>106</td>
</tr>
<tr>
<td>34. Boron—Total, milligrams per liter</td>
<td>O.56 microfiltration followed by reference methods for total boron,</td>
<td>104</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
<td>35. Boron—Dissolved, milligrams per liter</td>
<td>O.56 microfiltration followed by reference methods for total boron,</td>
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<td>106</td>
</tr>
<tr>
<td>36. Cadmium—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
<td>104</td>
<td>106</td>
<td>106</td>
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<tr>
<td>37. Cadmium—Dissolved, milligrams per liter</td>
<td>0.56 microfiltration followed by reference methods for total cadmium.</td>
<td>104</td>
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<td>106</td>
</tr>
<tr>
<td>38. Chromium VI, milligrams per liter</td>
<td>Digestion followed by atomic absorption or EDTA titration.</td>
<td>104</td>
<td>106</td>
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</tr>
<tr>
<td>39. Chromium VI-Dissolved, milligrams per liter</td>
<td>0.56 microfiltration followed by reference methods for total chromium VI.</td>
<td>104</td>
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</tr>
<tr>
<td>40. Chromium—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption or by spectrophotometric (Diphon)</td>
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<tr>
<td>41. Chromium—Dissolved, milligrams per liter</td>
<td>0.56 microfiltration followed by reference methods for total chromium VI.</td>
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<td>44. Cobalt—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>127</td>
<td>126</td>
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<td>(287)</td>
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<td>44. Cobalt—Dissolved, milligrams per liter.</td>
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<td>126</td>
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<tr>
<td>43. Copper—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption or by colorimetric (Flammonet).</td>
<td>123</td>
<td>122</td>
<td>121</td>
<td>(289)</td>
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<td>43. Copper—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
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<td>122</td>
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<td>(289)</td>
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<tr>
<td>42. Gold—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
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<td>121</td>
<td>120</td>
<td>(289)</td>
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<td>42. Iridium—Total, milligrams per liter.</td>
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<td>122</td>
<td>121</td>
<td>120</td>
<td>(289)</td>
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<tr>
<td>42. Iron—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
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<td>119</td>
<td>118</td>
<td>(289)</td>
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<tr>
<td>41. Iron—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
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<td>119</td>
<td>118</td>
<td>(289)</td>
</tr>
<tr>
<td>43. Lead—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>117</td>
<td>115</td>
<td>113</td>
<td>(289)</td>
</tr>
<tr>
<td>43. Lead—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>117</td>
<td>115</td>
<td>113</td>
<td>(289)</td>
</tr>
<tr>
<td>54. Magnesium—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption or gravimetric.</td>
<td>114</td>
<td>113</td>
<td>112</td>
<td>(289)</td>
</tr>
<tr>
<td>55. Magnesium—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption or gravimetric.</td>
<td>114</td>
<td>113</td>
<td>112</td>
<td>(289)</td>
</tr>
<tr>
<td>56. Manganese—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>112</td>
<td>111</td>
<td>110</td>
<td>(289)</td>
</tr>
<tr>
<td>57. Manganese—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>112</td>
<td>111</td>
<td>110</td>
<td>(289)</td>
</tr>
<tr>
<td>58. Mercury—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
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<td>109</td>
<td>108</td>
<td>(289)</td>
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<tr>
<td>59. Mercury—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
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<td>109</td>
<td>108</td>
<td>(289)</td>
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<td>60. Molybdenum—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>109</td>
<td>108</td>
<td>107</td>
<td>(289)</td>
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<tr>
<td>61. Molybdenum—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>109</td>
<td>108</td>
<td>107</td>
<td>(289)</td>
</tr>
<tr>
<td>62. Nickel—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption or by colorimetric (Permuth or Phokolite).</td>
<td>108</td>
<td>107</td>
<td>106</td>
<td>(289)</td>
</tr>
<tr>
<td>63. Nickel—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption or by colorimetric (Permuth or Phokolite).</td>
<td>108</td>
<td>107</td>
<td>106</td>
<td>(289)</td>
</tr>
<tr>
<td>64. Cadmium—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>107</td>
<td>106</td>
<td>105</td>
<td>(289)</td>
</tr>
<tr>
<td>65. Cadmium—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>107</td>
<td>106</td>
<td>105</td>
<td>(289)</td>
</tr>
<tr>
<td>66. Zinc—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>105</td>
<td>104</td>
<td>103</td>
<td>(289)</td>
</tr>
<tr>
<td>67. Zinc—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>105</td>
<td>104</td>
<td>103</td>
<td>(289)</td>
</tr>
<tr>
<td>68. Silver—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption or by colorimetric (Permuth or Phokolite).</td>
<td>105</td>
<td>104</td>
<td>103</td>
<td>(289)</td>
</tr>
<tr>
<td>69. Silver—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption or by colorimetric (Permuth or Phokolite).</td>
<td>105</td>
<td>104</td>
<td>103</td>
<td>(289)</td>
</tr>
<tr>
<td>71. Cadmium—Total, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>105</td>
<td>104</td>
<td>103</td>
<td>(289)</td>
</tr>
<tr>
<td>72. Cadmium—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption.</td>
<td>105</td>
<td>104</td>
<td>103</td>
<td>(289)</td>
</tr>
<tr>
<td>73. Sodium—Dissolved, milligrams per liter.</td>
<td>Digestion # followed by atomic absorption or by colorimetric (Permuth or Phokolite).</td>
<td>105</td>
<td>104</td>
<td>103</td>
<td>(289)</td>
</tr>
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</table>

See footnotes at end of table.
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<tr>
<th>Parameter and units</th>
<th>Method</th>
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<th>APHA methods</th>
<th>Other approved methods</th>
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<tr>
<td>70. Thallium—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
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<tr>
<td>71. Thallium—Dissolved, milligrams per liter</td>
<td>0.45 micron filtration followed by atomic absorption.</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>72. Tin—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
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<td>110</td>
<td>110</td>
<td>110</td>
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<tr>
<td>73. Tin—Dissolved, milligrams per liter</td>
<td>0.45 micron filtration followed by atomic absorption.</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
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<tr>
<td>74. Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
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<tr>
<td>75. Vanadium—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
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<tr>
<td>76. Vanadium—Dissolved, milligrams per liter</td>
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</tr>
<tr>
<td>77. Zinc—Total, milligrams per liter</td>
<td>Digestion followed by atomic absorption.</td>
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<tr>
<td>78. Zinc—Dissolved, milligrams per liter</td>
<td>0.45 micron filtration followed by atomic absorption.</td>
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<td>110</td>
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<tr>
<td>79. Nitrate as N, milligrams per liter</td>
<td>Manual or automated colorimetric (dilution).</td>
<td>110</td>
<td>110</td>
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<tr>
<td>80. Oil and grease, milligrams per liter</td>
<td>Liquid-liquid extraction with isobutyl-trifluoroacetic acid.</td>
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<td>81. Organic carbon (total TOC), milligrams per liter</td>
<td>Combustion-flame photometer.</td>
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<td>82. Organic nitrogen (g N), milligrams per liter</td>
<td>Kjeldahl nitrogen minus ammonium nitrogen.</td>
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<td>83. Orthophosphate as P, milligrams per liter</td>
<td>Manual or automated colorimetric (Phosphate).</td>
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<td>110</td>
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<tr>
<td>84. Pentavalent phosphorus, milligrams per liter</td>
<td>Manual or automated colorimetric (phosphorus).</td>
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<tr>
<td>85. Phosphate (elemental), milligrams per liter</td>
<td>0.45 micron filtration followed by atomic absorption.</td>
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<tr>
<td>86. Phosphate (total), milligrams per liter</td>
<td>Peridate digestion followed by manual or automated colorimetric (lead reduction).</td>
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<td>110</td>
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<td>87. Alkalinity, milligrams per liter</td>
<td>Granulometric or titrimetric.</td>
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<td>110</td>
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<td>88. Alpha, milligrams per liter</td>
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<td>89. Beta, milligrams per liter</td>
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<td>90. Total, milligrams per liter</td>
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<tr>
<td>91. Total distributed (soluble), milligrams per liter</td>
<td>Granulometric or titrimetric.</td>
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<tr>
<td>92. Total suspended, milligrams per liter</td>
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<td>93. Turbidity, degrees F.</td>
<td>Turbidimeter or nephelometric.</td>
<td>110</td>
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<td>94. Temperature, degrees F.</td>
<td>Thermometer.</td>
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<td>95. pH</td>
<td>pH meter.</td>
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</table>

1 Recommendations for sampling and preservation of samples according to parameter measured may be found in "Methods for Chemical Analysis of Water and Waste," U.S. Environmental Protection Agency, 1975.
RULES AND REGULATIONS

§ 136.5 (Amended)

5. In § 136.5, paragraph (a) is amended by deleting the phrase "proposed by the responsible person or firm making the discharge," immediately after the words "such application" and immediately before the comma.

§ 136.5, paragraph (b) is amended by deleting the phrase "Methods Development and Quality Assurance Research Laboratory" immediately after the phrase "application for an alternate test procedure" and immediately before the comma.

§ 136.5, the first sentence of paragraph (d) is amended by deleting the phrase "proposed by the responsible person or firm making the discharge," immediately after the phrase "application for an alternate test procedure," and immediately before the comma.

The second sentence of paragraph (d) is amended by deleting the phrase, "Methods Development and Quality Assurance Research Laboratory," immediately after the phrase, "to the Regional Administrator by the Director of the," immediately preceding the period ending the sentence and inserting in its place the phrase, "Environmental Monitoring and Support Laboratory, Cincinnati.

The third sentence of paragraph (d) is amended by deleting the phrase, "Methods Development and Quality Assurance Research Laboratory," immediately after the phrase, "for the Regional Administrator by the Director of the," immediately preceding the period ending the sentence and inserting in its place the phrase, "Environmental Monitoring and Support Laboratory, Cincinnati.

§ 136.5, paragraph (e) is amended by the addition of a new paragraph (e) to read as follows:

4. In § 136.4, the second sentence of paragraph (c) is amended by deleting the word "substitution" immediately following the word "procedure under this" and immediately preceding the word "shall" and replaced with the phrase "paragraph c," and § 136.4 is amended by adding a new paragraph (d) to read as follows:

§ 136.4 Application for alternate test procedure.

(c) Any application for an alternate test procedure under this paragraph (c) shall:

(1) Provide the name and address of the responsible person or firm making the discharge;

(2) Identify the pollutant(s) or parameter(s) for which nationwide approval of an alternate testing procedure is being requested;

(3) Provide a detailed description of the proposed alternate procedure, together with references to published or other studies confirming the general applicability of the proposed alternate test procedure to the pollutant(s) or parameter(s) for waste water discharges from representative and specified industrial or other categories;

(4) Provide comparability data for the performance of the proposed alternate test procedure compared to the performance of the approved test procedures.

FEDERAL REGISTER, VOL. 41, NO. 237, FRIDAY, DECEMBER 11, 1976
§ 136.5 Approval of alternate test procedure.

(b) Within ninety days of the receipt by the Director of the Environmental Monitoring and Support Laboratory, Cincinnati of an application for an alternate test procedure for nationwide use, the Director of the Environmental Monitoring and Support Laboratory, Cincinnati shall notify the applicant of his recommendation to the Administrator to approve or reject the application, or shall specify additional information which is required to determine whether to approve the proposed test procedure. After such notification, an alternate method determined by the Administrator to satisfy the applicable requirements of this part shall be approved for nationwide use to satisfy the requirements of this subchapter; alternate test procedures determined by the Administrator not to meet the applicable requirements of this part shall be rejected. Notice of these determinations shall be submitted for publication in the Federal Register not later than 15 days after such notification and determination is made.

[FR Doc. 78-85383 Filed 11-30-78; 8:45 am]
2. Announcing the Course

a. Course Availability

Course availability is most likely to be established through one of two mechanisms:

1) Management or regulatory authority determines that training is required, makes arrangements for course presentation and instructs designated personnel to appear at a specified time and place for training, or,

2) The course may be planned by a training organization which schedules and publicly announces the course either as a special offering or as an element of an overall curriculum of training.

b. Responsibility for Course Announcement

All training organizations should establish and maintain mailing lists of officials, organizations and interested individuals to whom training announcements should be addressed.

Course announcements should be released by the training organization and/or the sponsoring agency (if applicable).

When a special course offering is planned at the request of management or regulatory authority with identified class participants, it usually is best for the requesting authority to make the announcement.

c. Types of Course Announcements

1) Training bulletins, or catalogues are widely used by established training organizations, and should be used for announcement of this course when offered as part of an ongoing curriculum of courses.

2) Special fliers or brochures should be developed for public announcement through established mailing lists. These releases may be used for regular offerings of an ongoing curriculum of courses, but they are particularly applicable when a special offering of the course is planned.

3) The course may be announced in a journal, newsletter or other periodical widely read by the personnel for whom the training is intended.

4) The course may be announced by personal letter or other direct communication with a student assigned to take the training.

d. Timing of Course Announcements

Training catalogues or bulletins usually are for a period of one year or more. Accordingly, the prospective student should have from three months to one year of advance notice of the training.
When the course is a special offering announced through a flier or other special mechanism, at least 90 days should be provided between the release of the announcement and the start of the course. There are at least two reasons for this:

1) Permits course applicants to secure necessary approvals for attendance, and to make personal scheduling arrangements; and,

2) Provides course presentation staff with lead time for course preparation, acquiring special instructional materials, preparation of laboratory supplies and equipment, and related tasks.

e. Information Provided in Course Announcements

The following list should be helpful as a checklist to those preparing a course announcement. Samples of an announcement for this course as it might appear in a catalogue of courses, and as it might appear in a special flier are shown in the section of this Guide titled SECRETARIAL SUPPORT.

In the event that the course is announced in a periodical, the editor may apply constraints on style and format which make it impossible to provide all the pertinent information on the course. In such cases the announcement must provide the name and address of an office from which further information can be obtained. The information to be provided should be as complete as that given in a course catalogue or flier and, naturally, should include any additional special information specifically requested.

The following will be helpful as a checklist to those preparing an original course announcement:

1) Course title, dates and location

2) Name of organization conducting the course (and name of co-sponsor, if applicable)

3) Description of intended student body, reason why this training is needed and summary of Course content.

4) Prerequisites for attendance (special skills or training which the applicant must have for admission)

5) Description of the training environment to be used (classroom, laboratory, field, in-plant, etc.)

6) Identification of knowledge and skills the participant will have on satisfactory completion of training

7) Tuition (if applicable)

8) How and where to apply for admission to this course
3. Summary Plan for the Course

A convenient format to use in the early stages of devising a course plan is a day-to-day assignment of time blocks based on estimates by authors of the training time required for each parameter. (An example is on the next page.) Using available time as a first criterion will allow a variety of possible sequences. Then other considerations should be applied. Some examples are:

a. If some equipment must be used in more than one test, schedule another topic between the two tests to allow time for the required clean-up.

b. Schedule the topics so each instructor alternates between prime and assistant responsibilities to allow time for preparations which must be done right before training sessions.

c. If one procedure requires skills taught in another procedure, order the presentations accordingly.

d. If most students need only 80% of the procedures taught, schedule the remaining 20% of the procedures as a group so students can conveniently schedule their attendance for training pertinent to their needs.
## Summary Plan for Course

### MONDAY

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>1/2</td>
</tr>
<tr>
<td>Course Objectives</td>
<td>1/4</td>
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### TUESDAY

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### THURSDAY

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<td>Course Evaluation &amp; Closing</td>
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<td>All Staff</td>
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### NOTES:

1. Class is divided into three sections of two groups each so that each individual will utilize three and one-half hours for each of the six laboratory exercises respectively.

2. Program time only is shown. Additional time required for lunch and breaks.

3. Leading instructor only is designated. Other instructors will provide support to leading instructors for all laboratory instruction.
**EFFLUENT MONITORING PROCEDURES: METALS ANALYSES (164.27)**

**LOCATION**

**DATE**

**AGENDA**

**Course Coordinator:**

<table>
<thead>
<tr>
<th>DAY AND TIME</th>
<th>SUBJECT</th>
<th>SPEAKER</th>
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<tbody>
<tr>
<td><strong>Monday</strong></td>
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<tr>
<td>8:00 - 8:30</td>
<td>Registration Welcome</td>
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<tr>
<td>8:30 - 8:45</td>
<td>Course Objectives</td>
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<tr>
<td>8:45 - 9:30</td>
<td>Introduction to Atomic Absorption</td>
<td>Chemist</td>
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<tr>
<td>9:30 - 9:45</td>
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<tr>
<td>10:30 - 11:15</td>
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<tr>
<td>11:15 - 12:00</td>
<td>Volumetric Metal Analysis</td>
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<td>12:00 - 1:00</td>
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<td>1:00 - 4:30</td>
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<tr>
<td>1:00 - 1:45</td>
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<td>1:45 - 2:30</td>
<td>Volumetric Determination</td>
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<td>2:30 - 2:45</td>
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AT. EMP. (164.2) 5.7.77
### AGENDA

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<td>10:00 - 10:15</td>
<td>Break</td>
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Course Milestones (164.2)

The following pages list individual responsibilities in a chronological order for preparation for this course.

The individual EMPs listed in the accompanying course manual and professional level of competence required for the principal instructor is shown in Table I.
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<thead>
<tr>
<th>Code</th>
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<tr>
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<td>Determination of Boron, Curcumin Method</td>
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<td>CH.ca.EMP.1.1.76</td>
<td>Determination of Total Calcium (Volumetric Method)</td>
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<tr>
<td>CH.ME.aa.EMP.1a.1.76</td>
<td>Determination of Copper (Cu^{++}), Magnesium (Mg^{++}), Manganese (Mn^{++}), and (Zn^{++})</td>
<td>Chemist</td>
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<tr>
<td>CH.ME.aa.EMP.2a.1.76</td>
<td>Determination of Lead By Atomic Absorption Using the Extraction Procedure</td>
<td>Chemist</td>
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<tr>
<td>CH.ME.aa.EMP.3a.1.76</td>
<td>Determination of Mercury Using the Flameless Atomic Absorption (Cold Vapor) Technique</td>
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<tr>
<td>CH.ME.es.EMP.2a.1.76</td>
<td>Determination of Potassium Using Flame Photometry</td>
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<td>CH.ME.es.EMP.1a.1.76</td>
<td>Determination of Sodium Using Flame Photometry</td>
<td>Chemist</td>
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</tbody>
</table>
5 to 6 months before Course

Determination of the need and decision to have course.

Designation of Course Director and Course Secretary.

Development and release of Course Announcement including location, date, general statement of course content and training objectives.

Course Registrations received and accepted from time of announcement to first day of course, subject to class size limitations.

3 Months before Course

Review equipment and supplies list for items which may be purchased or borrowed.

Commit all staff personnel who will participate in course.

Inventory stock of course manual.

2 Months before Course

Request equipment and supplies from lending organizations (analytical instrumentation, audiovisual training aids, audiovisual support equipment, etc).

Director reviews application form and forwards to secretary for appropriate action.

Professional staff initiates requests through director.

First assignment will be equipment and supplies review.

Supplies should be adequate for each trainee and staff member.

Professional staff initiates requests through director. Should be received at least one week before course and checked when received.
Outline No.

3 Weeks before Course
- Prepare glassware, all reusable and consumable supplies.
- Capital equipment operational check.

2 Weeks before Course
- Inventory availability of all reusable and consumable materials and supplies.

1 Week before Course
- Final checkout of all analytical instrumentation.

Final

All EMPs

Training Supervisor
Course Director
Course Secretary
Chemist
Outline No.
and Remarks
PART I - COURSE PLANNING AND MANAGEMENT

B. Training Resources

This section considers four topics: Training Staff, Training Facilities, Laboratory Equipment and Supply Requirements, and Instructional Resources.

Staffing plans, facilities, equipment and supplies described in this Guide are based on a class of 18 students. For at least the first several (3 of 4) course offerings, it is urged that this maximum number of students per class be strictly adhered to.

A staff experienced in presentation of this course may be able to increase class size to, say, 24 students. On no account should this laboratory-oriented course exceed 24 students with an instructional staff of the size described here. Large numbers of students per instructor simply cannot be provided with the individual attention and instruction required for effective training and assurance that they have indeed learned to perform the analyses which are the subject of this course.

If the number of workers requiring this course is quite large, the best course of action is to meet the training need through providing a greater number of course offerings.

The required instructional resources, shown in outline 9, are compiled from the individual instructional package worksheets shown in Part II. Training administrators should coordinate requests for instructional resources to be acquired, through loan or through purchase, from other sources. This outline provides a basis for such coordination.

1. Training Staff

Each member of the training staff for this, as for any short course, is a member of a team. This team can function effectively only through each member's understanding of the training goals to be met and the plans for meeting these goals, through performance of his/her own duties, and through providing mutually supportive activity with other team members for the effective conduct of the course as a whole.

b. Qualifications of Instructional Staff

1) Each should have a thorough knowledge of the subject matter for which he/she has responsibility, including a high order of technical skill in any procedures to be carried out.

2) Each should be able to perform effectively as an instructor, both in the classroom and in the laboratory. This includes ability to make rapid adjustments in the style and technical level of instruction in order to work with students having a varied range of entry-level knowledge, skills, and prior education.

3) Each should be willing to accept a certain rigidity in the choice of analytical procedures to be taught, in accordance with policies
and formal directives of the applicable regulatory authority (-ies). The basis for, and recommended procedures to be followed, in introducing variations in methods to be taught in tests and measurements of municipal effluents is discussed elsewhere in this Guide.

b. Estimated Time Allocations for Training Staff

Each member of the training staff has specific duties before, during, and after the scheduled course dates. For planning purposes, it is assumed that pre-course activity will begin three months or more, as required, before classroom instruction begins. During this period, the estimated time allocations will permit the phasing-in of work activity for this course with other duties of all personnel. During the course, all instructional staff and laboratory assistant (if used) are fully occupied, and should not be given any other duty assignments. Post-course activities should be completed within one or two weeks after the last day of instruction. In the post-course period, all staff may begin to phase-in other duties pending final completion of all details associated with this training effort.

<table>
<thead>
<tr>
<th>Staff Identification</th>
<th>Working Days (estimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
</tr>
<tr>
<td>Course Administration</td>
<td></td>
</tr>
<tr>
<td>Course Coordinator (ordinarily, this is one of the instructional staff, who is assigned double-duty as coordinator-instructor)</td>
<td>12</td>
</tr>
<tr>
<td>Course Secretary</td>
<td>10</td>
</tr>
<tr>
<td>Instructional Staff</td>
<td></td>
</tr>
<tr>
<td>Chemist #1</td>
<td>8</td>
</tr>
<tr>
<td>Chemist #2</td>
<td>8</td>
</tr>
<tr>
<td>Chemist #3</td>
<td>8</td>
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<tr>
<td>Chemist #4</td>
<td>8</td>
</tr>
<tr>
<td>Chemist #5</td>
<td>8</td>
</tr>
<tr>
<td>Chemist #6</td>
<td>8</td>
</tr>
<tr>
<td>Laboratory Support</td>
<td></td>
</tr>
<tr>
<td>Laboratory Assistant (optional)</td>
<td>10</td>
</tr>
</tbody>
</table>

c. Duties and Responsibilities of Training Staff

1) Course Coordinator

This individual may be known variously as Course Director, Course Leader, or by some other term suitable to the situation. In most cases the Course Coordinator will function in a dual capacity as one...
of the instructional staff for the course. In principle, any one of the Instructors could function as Course Coordinator. In the absence of other factors, it may be best to have the individual who bears the lightest teaching load to act as Course Coordinator.

a) Before the course, the Coordinator receives assignment from management to lead the course, after which he/she:

1. Obtains commitment of the other members of the training team for the course, including Secretary, Instructors, and (if used) Laboratory Assistant;

2. Determines the composition and geographic origin of the student body to be trained;

3. Develops a working schedule and specific staff assignments for all significant milestone stages of course preparation and implementation;

4. Meets with course staff, distributes instructional guides and related training materials, and reviews the preparation plans and day-to-day working schedule; assigns specific topics and time allocation for which each Instructor has prime instructional responsibility and for which each Instructor serves as assistant to prime Instructor;

5. Identifies which, if any, available options in procedures should be taught for compliance with directives of the governing regulatory authority (-ies);

6. Prepares announcement of the course, and distributes it as appropriate to the potential student body;

7. Reviews classroom and laboratory facilities, making arrangements for any required repairs or adaptations;

8. In consultation with Instructors, reviews availability and condition of all equipment, supplies, and other training resources required for the course; and makes timely arrangements for repair and maintenance, reorder, or borrowing of needed items;

9. Arranges for supplies of student reference texts and associated training materials;

10. Works with Secretary in registration of students and in all pre-course communications on schedules, local housing and transportation, and other pertinent matters;

11. If the course is to be conducted in a "field" location, coordinates timely arrangements for staff travel, transportation of equipment and supplies, arrangements for training facilities, local housing and transportation, determination of availability and location of dining facilities, and any other preparations required for course conduct away from normal base location;
(12) Initiates periodic and timely checks with other training team members to assure that their pre-course preparations are on schedule and that preparation of required resources is moving ahead according to plan. Takes action as necessary to identify problems and to expedite solutions as the need arises.

(13) Represents the training team in all formal communications with management, host organizations, students, and with commercial or private sources of equipment and supplies.

b) During the course, the Course Coordinator:

(1) Takes charge of course opening exercises including student registration, welcome and staff introductions. Presents and discusses course objectives;

(2) Maintains general supervision of course, assuring that all activities are kept on schedule; maintains liaison between staff members and other interfacing organizations/individuals as necessary;

(3) Maintains consolidated summary record of student performance based on information provided by other instructors; with staff determines which students should/shall not be recorded as having satisfactorily met training objectives;

(4) Provides Course Secretary with timely information necessary for preparation of course certificates; signs course certificates as representative of the course training staff;

(5) Presides over course closing activities, including award of certificates.

c) After the course, the Course Coordinator:

(1) Reviews and evaluates with the instructional staff all matters considered pertinent to the effective implementation of the course as planned, developing proposals and plans for adjustments as necessary for future offerings of the course;

(2) Orders repair, renovation, and replacement of any equipment or supplies that require such attention;

(3) Coordinates return of any borrowed resources used in the course;

(4) If course was conducted in the field, coordinates repacking and return shipment of all equipment and supplies;

(5) Drafts course summary/evaluation report;

(6) Prepares and forwards any reports required by other supervising, coordinating, or financing authority.
2) Course Secretary

The Course Secretary works under the direct supervision of the Course Coordinator, and prepares or arranges preparation of all formal communications, procurement documents, training materials, and records required for course preparation and implementation. The Course Secretary also provides office support work for the course instructional staff in all matters pertaining to course preparation and implementation.

a) Before the course, the Course Secretary:

(1) Works with the Course Coordinator in identification and preparation of copies of all pertinent course materials for use in planning conferences between Course Coordinator and the instructional staff, including instructors' copies of working schedules for course preparation, course agenda from preliminary to final draft, staff assignments, instructors' instructional package worksheets, all student instructional materials and associated data sheets, student evaluation sheets, quizzes, and any other typed or printed material projected for course use;

(2) After Course Coordinator's conference with instructional staff, and resolution of decision making issues, arranges for printing (or reproduction) and assembly of all materials indicated under (1) above, in a quantity adequate for projected course requirements;

(3) Arranges for printing or reproduction, and distribution of the projected course announcement as directed by Course Coordinator;

(4) Serves as Registrar, maintaining roster and records of students submitting application and accepted for admission to the course, prepares routine response to students announcing acceptance with information as appropriate on course dates and schedule, local "geography" including key addresses, hotel/motel/dining information, local transportation information, and any other information which will simplify personal planning of registered students;

(5) Prepares, or arranges for, all individual student supplies, including registration cards, course manuals, note paper, pencils, name tags (1 for wearing and 1 for use at classroom seating position), course certificates, etc.;

(6) Prepares orders or procurement requests for equipment and supplies needed for the course based on specifications provided by the instructional staff;

(7) If the course is a "field" presentation, makes arrangements for shipment of equipment and supplies to course site and return, staff travel schedules and order of tickets, hotel reservations, and associated functions;
(8) Prepares the classroom for use in the course, including distribution of individual student materials to seating positions, arrangements for classroom organization of audiovisual projection or playback equipment, chalkboards and associated supplies, and other classroom needs. (Ordinarily, the Course Secretary does not travel to a "field" presentation; this function will have to be provided through special arrangements with the host organization at the course site.)

b) During the course, the Course Secretary functions as an "unofficial staff hostess," and:

(1) Attends course opening exercises, assisting students in completion of registration cards and associated records;

(2) Prepares course summary registration information, prepares class roster on first day of course and distributes copies to students and instructors, keeping copies for future records;

(3) Provides clerical/secretarial support to Course Coordinator and instructional staff as required;

(4) Receives incoming mail and messages for staff and students, expediting communications to extent practical and feasible;

(5) Prepares course certificates as specified by Course Coordinator on last day of course;

(6) Inspects classroom daily, making arrangements as necessary for coordination of deficiencies in janitorial services, and personally corrects minor deficiencies to extent feasible;

(7) Attends and participates in course closing exercises.

c) After the course, the Course Secretary:

(1) Prepares typed copy of all reports drafted by the Course Coordinator, and forwards reports as indicated;

(2) Places purchase orders or procurement requests for repair, renovation, or replacement of equipment and supplies as directed by Course Coordinator;

(3) Removes all course supplies from the classroom, returns borrowed resources, leaves classroom in condition suitable for use by following class (this does not imply janitorial services);

(4) If course is conducted on a repetitive basis, inventories all consumable classroom supplies (including data sheets, worksheets, quizzes, course schedules, and the like, and reorders or provides for reproduction of any items coming into short supply.

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3) Instructors-Chemists

a) Before the course, each Instructor receives course duty assignment from management, and:

1.Meets with Course Coordinator for discussions of course plans, objectives, and for development of day-to-day course preparation schedule;

2. In conference with Course Coordinator determines which of any options in tests and measurements will be taught, determines lesson guides to be followed and student reference materials to be used, and resolves any other problems on instructional materials, their content, and related matters which should be determined beforehand;

3) Reviews requirements for equipment, supplies, audio-visual training aids, and other training resources to be included in individual instructional assignments. Performs equipment upkeep and maintenance procedures; prepares supplies and reagents required to be available for student use. Provides Course Coordinator with timely, detailed information on specifications for all equipment, supplies and other training resources which must be purchased, rented, or borrowed for the course;

4) If the course is to be conducted in a "field" location, packs equipment and supplies for shipment so that they will arrive at destination in good condition; identifies to the Course Coordinator the equipment and supplies which should not or cannot be shipped which should be provided otherwise at the course site;

5) Rehearses all classroom and laboratory instructional presentations to the extent necessary to assure effective performance within the scheduled time allocation;

6) Reviews and practices all tests for which he/she has responsibility as primary instructor to assure personal proficiency and adequacy of pre-course plans and preparations. Supervises pre-course practice of those who will serve as assistant instructors for the tests;

7) Prepares to serve as assistant instructor for specified tests and measurements, developing personal proficiency through pre-course practice under supervision of the applicable primary Instructor, and prepares to teach the tests and measurements in accordance with techniques specified by the primary instructor;

8) Reports periodically as requested to the Course Coordinator on status of course preparations, and cooperates in working out timely procedures for their accomplishment.
b) During the course, each Instructor:

(1) Attends and participates in course opening exercises;

(2) Serves as primary Instructor for the tests and measurements assigned to him/her. In this capacity, he/she is responsible for all classroom instruction on the designated subjects, leadership of all laboratory instruction, collection of (or arrangements for) samples for laboratory examination by class, student performance evaluation and associated records for submission to Course Coordinator, and student counseling on pertinent matters related to area of personal responsibility;

(3) Assists primary Instructor in laboratory instruction phases of the tests and measurements as assigned, including preparation and organization;

(4) Attends and participates in all classroom start-of-day evaluation sessions on previous day's student performance;

(5) Attends and participates in course closing exercises.

c) After the course, each Instructor:

(1) Reviews the course implementation experience with the Course Coordinator, mutually developing proposals and plans for future offerings of the course;

(2) Evaluates condition of all equipment and supplies, initiating action to repair, renovate, or replace any items found deficient or in short supply;

(3) Takes necessary action to put laboratory into state of neatness and order for occupancy of the next course (this does not imply janitorial service);

(4) If course was conducted in the field, repacks all equipment and supplies for return to home institution, after at least superficial cleaning of all dirty or contaminated glassware;

(5) On return of shipment to home institution, unpacks all equipment and supplies, returning it to designated custodial site, including return of borrowed equipment and other returnable resources.

4) Laboratory Assistant

The Laboratory Assistant is designated as "optional" in the staffing plan, but services of a Laboratory Assistant are strongly recommended. This is particularly urged in a fixed training installation where this and other courses are being conducted on a continuing or repetitive basis. The Laboratory Assistant works particularly in support of the
The Assistant will be given routine tasks which will free the instructional staff for more specialized or complicated tasks associated with the planning, preparation, and implementation of the training.

a) Before the course, the Laboratory Assistant:

1. Works closely with the instructional staff members, performing standardized tasks as specified in the course preparation plan;

2. Organizes laboratory supplies and equipment for each procedure in such a way as to permit distribution to the students or to their working sites with maximum efficiency during the course presentation;

3. Assists Course Secretary wherever feasible in assembly and organization of student instructional materials, classroom preparation, and related tasks.

b) During the course, the Laboratory Assistant:

1. Performs all possible tasks in support of primary instructors in setting up student work positions, collecting and returning used glassware, supplies and equipment, etc., to central repository;

2. Cleans and maintains all glassware and supplies excepting those stipulated for student performance;

3. Notifies primary instructor promptly of any noted discrepancies or deficiencies in supplies, equipment, or planning which would lead to problems in implementing the course;

4. In field courses, packs equipment in shipping cases as rapidly as its use has been completed for the course.

c) After the course, the Laboratory Assistant:

1. Assists instructors in all equipment and supply inspection, renovation, and return to proper location;

2. Puts laboratory in state of neatness and order preparatory to use for next class;

3. Prepares any stable supplies required for next offering of the course, within limits of technical capability.
2. Training Facilities

This course requires both a classroom and a laboratory for class use. Effective presentation of the course requires staff attention to many details related to these facilities. Problems more often occur in field courses (i.e., away from "home base"). In any location it is unusual that all desired features of a training facility will be met, but with timely attention most problems can be solved or at least partially resolved.

a. General Considerations

1) Spatial Relationships

Classroom and laboratory should be separate, but close together. Much of the instruction requires frequent shifts between classroom and laboratory. Therefore, the classroom and laboratory must not be in separate buildings, and should not be far apart within any structure.

2) Associated Comforts

a) The classroom and the laboratory should have a comfortable temperature, be free of obvious drafts, be well-ventilated, and should be well-lighted. It is, of course, possible to develop specifications for acceptable temperature ranges, light intensity ranges, humidity, etc.; but there is no substitute for exercise of good judgment.

b) Suitable restroom and drinking fountain facilities should be convenient to the classroom and laboratory.

c) Smoking:

(1) NO SMOKING IN THE LABORATORY. There should be no compromise on this.

(2) Some schools permit smoking in the classrooms. If this is the practice, it is advisable to locate ashtrays so that smokers sit in an area where their smoking will not disturb others.

3) Lunchroom Facilities

Most schedules for this course will allow a one-hour lunch break. It is advisable that the course staff identify and make known to the class the names and locations of convenient dining facilities where service, variety, quality, and price are satisfactory.

4) Comments to Class about Facilities

a) On the first day of the course the general orientation should include such information as the class needs on the location and use of facilities and conveniences for class use.
b) It is strongly urged that the entire staffing staff never at any time indulge in apologies or criticisms of the classroom or laboratory facilities being used. Such remarks serve no useful purpose and can only detract from an effective program, provided that everything possible has been done beforehand to resolve existing problems with facilities. Student comments and complaints should be given an honest response, but such comments from students should not be regarded as an excuse for staff to enlarge on the subject.

b. Classroom

1) General Features

a) Door at rear of room is preferred; this permits entry of latecomers without excessive distraction of class.

b) The classroom should be free from excessive extraneous noises, such as from construction projects, heavy traffic, or aircraft.

c) The classroom should have adequate electric power outlets (115 V) for use of audiovisual equipment. The receptacles should be inspected for assurance that they are compatible with the plugs on the audiovisual projector equipment being used, and adapters and extension cords secured as required.

d) Room size should be adequate for seating 18 students, plus providing for instructor equipment, projection equipment, and a modest number (4 to 8) of intermittent visitors to the classroom.

e) The classroom should be capable of being darkened quickly and effectively for use of projection equipment or television. Room dimmer lights for indirect lighting (not striking the screen directly) are recommended in fixed training installations, but can be dispensed within a field training situation.

2) Student Facilities

a) Ideally, students should be seated at tables, with all seats facing the instructor's area at the front of the classroom. Each student should be allocated 30" or more of table width. The sidearm chairs so familiar in the classrooms of secondary schools and colleges may be used if absolutely necessary, but are distinctly inferior to tables for student work.

b) Student seating should be at least two screen widths from the projection screen (assuming a 6' screen, no student closer than 12' from the screen) and not more than 6 screen widths from the screen (again assuming a 6' screen, no student more than 36' from the screen). Furthermore, all students should be seated within a 30° angle to the left and to the right of a line from the middle of the projection screen to the projector.
3) Classroom Instructional Facilities

a) Lectern, either freestanding or table-type; suitable for standing instructor

b) Demonstration table at front of classroom, approximately 3' x 5'

c) Chalkboard, at least 3' x 5' (preferably larger), with chalk, erasers, pointer

d) Audiovisual equipment

   (1) Public address system (optional but recommended) with lavalier microphone with adequate cord length to permit instructor to move about at front of classroom with relative freedom

   (2) Projection screen (for size consideration see 2) b above), matte, beaded, or lenticular surface

   (3) Projector, 35-mm slide projector for slides mounted in cardboard or plastic mount; carousel type preferred. Should have projection lens with cord length suitable for use from rear of room

   (4) Projector, overhead type, for use with projectuals approximately 7" x 9"

   (5) Cassette type playback unit, with cueing feature for automatic operation of cassette type slide projector; compatible with National Training and Operational Technology Center (EPA) tape/slide instructional units

   (6) Television tape playback unit (3/4" cassette type, "U-Matic" or equivalent)

   (7) Television receiver, commercial type, color, 19" diagonal picture, or larger. At least one receiver, preferably two

c) Laboratory

1) General Features

   a) Should be well-lighted, adequately ventilated. It is particularly important that the laboratory be free from strong drafts in student working areas.

   b) Should provide for students to stand at laboratory benches which are approximately 36" from floor to bench surface.

   c) Conventional laboratory services should be available at student work areas, including electricity (115 V), gas, and vacuum.
d) Space between benches should be adequate for students to work without interfering with each other, and to permit free movement of instructors in the student working area.

e) Safety features of the laboratory should be checked, including location and condition of first aid kits, fire extinguishers, emergency showers, eye-wash facilities, and other emergency equipment.

2) Student Facilities

a) Provide at least 6' of bench width per student pair. While students will work in pairs to the extent that they will share certain limited equipment, each student will perform all tests and measurements.

b) Provide bench space or floor space as necessary for laboratory equipment described in the equipment and supply lists, such as balances, ovens, waterbaths and other items not assigned to individual student work.

3) Laboratory Instructional Facilities

a) A chalkboard and demonstration table are recommended.

b) Provide at least 20 square feet for reserve supplies and equipment of each instructor.

c) For field courses, provide area for packing and unpacking, area for equipment to be shipped. This should be at least 100 square feet of floor space, with at least 20 square feet of table space.

d. Security

Valuable property is used both in the classroom and in the laboratory. Some of the items are particularly susceptible to theft. Accordingly:

1) Provide for locking of both classroom and laboratory when not in use, or assure that adequate security is provided in the facility by other means.

2) Be sure that the necessary keys are available to the instructional staff at their need.

3) With field courses, often it is necessary for the training staff to work in the evening or weekends to prepare for coming classwork. Arrangements must be made well in advance to secure authorized entry to the training facilities being made available by a host organization.

4) Thefts during normal working hours may be a special problem. Maintain surveillance to the extent practical, and keep out-of-service theft-prone items out of exposed locations.
3. Laboratory Equipment and Supply Requirements

The consolidated list in this section is for overall planning purposes. For day-to-day laboratory requirements, see the "IPW Equipment and Supply Requirements" and the "IPW Reagent Requirements" in each Instructional Package Worksheet contained in Part II of this Guide.

The quantities of laboratory materials needed for a course depend on the specific laboratory work assigned to each student. For the consolidated list in this section, the basis for quantities required is the assignment stated in each Instructional Package Worksheet (IPW).

The abbreviations used in the listing to refer to the various procedures that might be taught and the assignment given for each in the related IPW are stated in a table preceding the laboratory listing.

The listing itself is divided into three sections: capital equipment of more than $100 unit value, reusable equipment of less than $100 unit value, and consumable equipment of less than $100 unit value.

As noted, numbers represent minimum quantities. It is strongly recommended that instructors provide surplus equipment and additional supplies ready for use in case of need. Many instructors plan for a margin of at least 10% of extra supplies to provide for student errors, planning miscalculations, or other unforeseen events.

This list can be of great value in pre-course planning, to determine the availability of needed equipment and supplies, and to take action to provide needed resources. Further, this list can be of vital importance when planning for courses to be conducted in field locations. Copies of the list in the hands of the Course Coordinator and a representative of the host organization can be used to determine which will provide needed resources, on an item-by-item basis. When the responsibility is assigned/accepted, this can be annotated in the "remarks" column, with a copy of the annotated list in the hands of the Course Coordinator and a copy for the representative of the host organization. Each can then use the annotated equipment and supply list as a checklist for carrying out his own agreed-upon responsibilities in preparing for the course.
### A. CAPITAL EQUIPMENT (More than $100.00 Unit Value)

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>Quantity For:</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance, analytical with a 0.1 milligram sensitivity</td>
<td>2</td>
<td>For weighing reagent chemicals for the preparation of standard solutions</td>
</tr>
<tr>
<td>Refrigerator capable of maintaining a 4°C temperature</td>
<td>1</td>
<td>For storage of standard solution</td>
</tr>
<tr>
<td>Spectrophotometer, absorption</td>
<td>1</td>
<td>For colorimetric analyses</td>
</tr>
<tr>
<td>Water Bath, constant temperature to maintain 55±2°C</td>
<td>1</td>
<td>For boron procedure</td>
</tr>
<tr>
<td>Water, still and mixed bed ion exchange resin cartridge to prepare metal free distilled water</td>
<td>1</td>
<td>Water used in all reagent preparation</td>
</tr>
<tr>
<td>Balance - triple beam 0.1g accuracy</td>
<td>1</td>
<td>Used for weighing reagent chemicals</td>
</tr>
<tr>
<td>pH meter</td>
<td>3</td>
<td>For pH determination of samples</td>
</tr>
<tr>
<td>Atomic absorption spectrophotometer</td>
<td>2</td>
<td>For metals analyses</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>Class of 18</td>
<td>REMARKS</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pressure regulator valve: two stage regulator designed to deliver acetylene (CGA 510 fitting)</td>
<td>2</td>
<td>For fuel supply to AA spectrophotometers</td>
</tr>
<tr>
<td>Pressure regulator valve: two stage for air (CGA 1340 fitting)</td>
<td>2</td>
<td>For air supply to AA spectrophotometers</td>
</tr>
<tr>
<td>Magnetic stirrer - hot plate and magnet retriever</td>
<td>1</td>
<td>For preparing reagent solutions</td>
</tr>
<tr>
<td>Steam bath and fume hood</td>
<td>1</td>
<td>For evaporation of samples</td>
</tr>
<tr>
<td>Flameless Mercury Analyzer System - Coleman MAS-50 or equivalent</td>
<td>1</td>
<td>For mercury determination</td>
</tr>
<tr>
<td>Recorder (optional)</td>
<td>1</td>
<td>For mercury determination</td>
</tr>
<tr>
<td>Flame Photometer</td>
<td>2</td>
<td>For flame photometric procedures</td>
</tr>
<tr>
<td>Oven, drying (100°C)</td>
<td>1</td>
<td>For sodium and potassium determination</td>
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</tbody>
</table>
### B. REUSABLE EQUIPMENT (Less Than $100 Unit Value)

<table>
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<tr>
<th>DESCRIPTION</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Aprons, laboratory (plastic 'acceptable')</td>
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<td></td>
</tr>
<tr>
<td>Beakers, 100 ml</td>
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<td>Beakers, 150 ml</td>
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<td>Beakers, 250 ml</td>
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<td></td>
</tr>
<tr>
<td>Beakers, 600 ml</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Bottles, glass, 250 ml with glass stoppers</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Bottles, glass, 500 ml with glass stoppers</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Bottles, glass, 1000 ml with glass stoppers</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Bulb, pipette</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Buret, 50 ml glass</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Cylinder, graduated, 10 ml</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Cylinder, graduated, 50 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Cylinder, graduated, 100 ml</td>
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<td></td>
</tr>
<tr>
<td>Dishes, evaporating, porcelain, 100 ml</td>
<td>54</td>
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</tr>
<tr>
<td>Flasks, volumetric, 100 ml</td>
<td>152</td>
<td></td>
</tr>
<tr>
<td>Flasks, volumetric, 1000 ml</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>QUANTITY FOR CLASS OF 18</td>
<td>REMARKS</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Flasks, erlenmeyer, 125 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Flasks, erlenmeyer, 250 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Flasks, erlenmeyer, 500 ml</td>
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<td></td>
</tr>
<tr>
<td>Funnel, fluted, 60°, 50 mm, diameter 65mm, stem</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Funnel, 80 mm diameter</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Mortar and pestle, 70 ml porcelain</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Paper Clips</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Pipet, Mohr, 10 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 1.0 ml</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 2.0 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 3.0 ml</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 4.0 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 5.0 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 8.0 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 10.0 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 50.0 ml</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Pipet, volumetric, 100 ml</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Ring Stand and 3 inch ring</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>QUANTITY FOR CLASS OF 18</td>
<td>REMARKS</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>--------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Stirring Rod, (policeman), six inches</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Thermometer, degrees C</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Wash Bottles, polyethylene, squeeze type</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Watch Glass, 100 ml diameter.</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

* Quantities given are for participants working in pairs. To equip class working individually double numbers listed.
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONSUMABLE SUPPLIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For a class of eighteen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetylene (cyl DOT - 8a1)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Air (dry grade DOT - 3aa 2015)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ammonia hydroxide concentrated</td>
<td>5 lbs</td>
<td></td>
</tr>
<tr>
<td>Boric acid (H₃BO₃), ACS; reagent anhydrous powder</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Bromphenol blue (ACS)</td>
<td>5 g</td>
<td></td>
</tr>
<tr>
<td>Brush, bottle</td>
<td>3</td>
<td>For cleaning glassware</td>
</tr>
<tr>
<td>Calcium Carbonate</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Carbon disulfide (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Chloroform (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>QUANTITY</td>
<td>REMARKS</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>----------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Copper metal (ACS reagent)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Curcumin; Eastman No. 1179 or equivalent</td>
<td>26 g</td>
<td></td>
</tr>
<tr>
<td>EDTA (Ethylenedinitrilotetra-acetic acid disodium salt)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Eriochrome Blue Black R indicator</td>
<td>5 g</td>
<td></td>
</tr>
<tr>
<td>Ethyl alcohol, 95%</td>
<td>3 kg</td>
<td></td>
</tr>
<tr>
<td>Filter paper, Watman No.3</td>
<td>1 Box</td>
<td>For funnel in Boron Analysis</td>
</tr>
<tr>
<td>Glass tubing (5mm diameter)</td>
<td>2 ft</td>
<td></td>
</tr>
<tr>
<td>Glass wool</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Graph paper 8½&quot; x 11&quot;</td>
<td>3 Tablets</td>
<td></td>
</tr>
<tr>
<td>Hydrogen peroxide, 30%</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Hydrochloric acid - concentrated</td>
<td>5 lbs</td>
<td></td>
</tr>
<tr>
<td>Hydroxylamine sulfate (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>QUANTITY</td>
<td>REMARKS</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td>Ilionizing column (Fisher # 9-034-3)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lables for reagent bottles</td>
<td>3 dozen</td>
<td></td>
</tr>
<tr>
<td>Laboratory notebooks</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Lead nitrate (ACS)</td>
<td>¼ lb</td>
<td></td>
</tr>
<tr>
<td>Magnesium metal (ACS reagent)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Magnesium perchlorate (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Marking pen or wax pencil</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Matches, packet</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Mercuric chloride (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Methyl red indicator</td>
<td>5 g</td>
<td></td>
</tr>
<tr>
<td>Nitric acid, ACS reagent</td>
<td>7 lbs</td>
<td></td>
</tr>
<tr>
<td>Nitric acid - concentrated</td>
<td>5 lbs</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>QUANTITY</td>
<td>REMARKS</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>----------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Oxalic acid, ACS reagent</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td>1 cyl</td>
<td>For flame photometry</td>
</tr>
<tr>
<td>pH paper (phydrion)</td>
<td>1 package</td>
<td></td>
</tr>
<tr>
<td>Potassium chloride (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Potassium dichromate</td>
<td>1 lb</td>
<td>For cleaning glassware</td>
</tr>
<tr>
<td>Potassium permanganate (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Potassium persulfate (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Pyrrolidine (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Soap</td>
<td>1 lb</td>
<td>For cleaning glassware</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Sodium dichromate (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Sodium hydroxide</td>
<td>1 lb</td>
<td></td>
</tr>
</tbody>
</table>
C. CONSUMABLE SUPPLIES

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sponges</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Stannous sulfate (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Sulfuric acid (ACS)</td>
<td>1 lb</td>
<td></td>
</tr>
<tr>
<td>Tissues, lint-free</td>
<td>9 small boxes</td>
<td>For wiping spectrophotometer cells.</td>
</tr>
<tr>
<td>Towels, paper</td>
<td>4 packages</td>
<td></td>
</tr>
<tr>
<td>Water, distilled, metal free</td>
<td>5 kg</td>
<td></td>
</tr>
<tr>
<td>Weighing boats, disposable plastic</td>
<td>3 dozen</td>
<td></td>
</tr>
<tr>
<td>Zinc metal (ACS reagent)</td>
<td>1 lb</td>
<td></td>
</tr>
</tbody>
</table>
4. Instructional Resources

a. Introduction

Most training institutions will make the fullest possible use of pre-existing instructional resources. The purpose of this section is to describe the nature, sources, and availability of instructional resources suggested for use with this course.

1) The Instructional Package Worksheets (IPWs) in Part II of this Manual and the student reference text refer to a number of different instructional resources. These include:

a) The student reference text itself;

b) Audiovisual training aids; and

c) Supportive references

2) Instructional resources are discussed in this section from the viewpoint of the sources of the materials:

a) Resources developed by United States Environmental Protection Agency (U.S. EPA)

b) Resources developed by other sources; and

c) Resources already in possession of the training institution conducting this course.

b. Instructional Resources Developed by U.S. EPA

1) Student Reference Text and Staff Guide for the course "Effluent Monitoring Procedures Nutrients":

a) While present supplies last, a sample copy (can be duplicated) is available on specific request to:

National Training and Operational Technology Center
ATTN: Training Information Clerk
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

b) NTOTC has negatives of the Text and Guide which are available for temporary loan on request of a sponsoring Agency wishing to duplicate the materials.
c) NTIS can supply copies of the Text and Guide. A paper copy of the Text (PB-261-290/AS) costs $9.75. Contact NTIS for the identification number and cost of a paper copy of this Guide.

A microfiche copy of either the Text or Guide is also available from NTIS at $3.00 each.

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22151

d) Your state agency may be able to arrange a direct supply of the texts and/or guides. Before ordering/reproducing materials, you might consult with your state agency about this possibility.

2) Audiovisual Training Aids developed for the course:

a) Audiovisual training aids are listed in the respective IPW's for this course.

b) How to request loan of audiovisual training aids:

(1) All items described in the IPW's are available on scheduled loan from NTOTC to institutions conducting this course. Requests should contain the information items on the "Request for Loan" form (next page). Send requests to NTOTC at the address given in b.1a) above.

(2) It is urged that materials desired from NTOTC for a specific course offering be requested in a single, consolidated communication. This will give greatest assurance of a well-coordinated response. Because these requests ordinarily will cover a number of different items, telephonic requests should not be made.
REQUEST FOR LOAN
AUDIOVISUAL INSTRUCTIONAL UNIT

Title and Catalog No. ____________________________

____________________________________________

Intended Use: ____________________________________________________________________________

Preferred Date of Use: _____________________________________________________________________

Alternate Date: __________________________________________________________________________

BORROWER'S NAME ____________________________________________________________

Title _____________________________________________

Organization __________________________________________________________________________

Address ____________________________________________________________

__________________________________________ (Zip)

Phone Number (include Area Code): ________________________________________________

There is no charge for use of the Audiovisual Instructional Units. However, the BORROWER assumes financial responsibility for the value of all loaned equipment and instructional materials.

Unless special arrangements are made with the loaning office, units should be returned within two weeks. Return the unit by REGISTERED, CERTIFIED or INSURED MAIL IMMEDIATELY after use.
(3) **Requests should be timely.** To assure effective delivery in time for use in the course, requests should be received at NTOTC at least 45 days prior to the course date. The Center will, in turn, make every effort to assure that the requested materials are delivered to the requesting institution several days prior to the start of the course on which they are to be used. This will permit review and practice by the instructional staff for the most effective use of such resources.

(4) It is expected that all borrowed resources be returned to the Center within two weeks after completion of the course on which they are used.

(5) With returned borrowed training resources, it is requested that the user provide the Center with an evaluation of the training resource(s) used. In this manner the experience of users can be a factor in continuous improvements and responses to problems in using the resources. All reports on use of such resources should include the number of students with whom the material was used.

3) **Supportive References:**

a) **Manual:** EPA-EMSL, "Methods for Chemical Analysis of Water and Wastes". This is the reference source of all the methods presented in this course in the Effluent Monitoring Procedure (EMP) format. Address requests for a copy to:

U.S. EPA  
Office of Technology Transfer  
Industrial Environmental Research Laboratory  
Cincinnati, Ohio 45268

b) **AV Catalog:** NTOTC, "Audiovisual Instructional Units". This is a catalog of slide-tape instructional units developed by the Center. Although not developed specifically for this course, several of the units are on course topics and might be useful supplementary material. Address requests for a copy to NTOTC at the address given in b. 1) above.

c) **IRIS:** A Water Quality Instructional Resources Information System has been developed through an EPA training grant. The "Master Reports" contain availability information and descriptions for 2300 entries of instructional and resource materials. These are printed matter, slides, films, slide-tape units and video tapes developed by varied sources for training personnel involved in all aspects of water quality assessment and control. Thus, IRIS serves as an information source of available, water quality training resources covering a wide range of subjects.
The user does not need data processing equipment to use the system. Four of the commonly used elements of IRIS (Users Manual, Tables, Master Report, Subject Index) are currently available.

(1) While present supplies last, a set is available to qualifying educational institutions and training agencies from NTISIC at the address given in b.1)(a) above.

(2) Paper copies can be ordered as a set of four volumes from NTIS. (PB-262-223/AS, Set, 1120 pp. "Water Quality Instructional Resources Information System, Volumes I through IV) for $31.00. The NTIS address is given in b.1)(c) above. Microfiche copies cost $12.00 per set.

(3) Paper or microfiche copies of individual volumes can also be ordered from NTIS at the address given in b.1)(c) above using this information:

(a) PB-262-224/AS, 99 pp. "Water Quality Instructional Resources Information System, Volume I - Users Manual" @ $5.00 (microfiche $3.00)

(b) PB-262-225/AS, 96 pp. "Water Quality Instructional Resources Information System, Volume II - IRIS Tables" @ $5.00 (microfiche $3.00)

(c) PB-262-226/AS, 494 pp. "Water Quality Instructional Resources Information System, Volume III - Identification Number Master Report" @ $12.50 (microfiche $3.00)

(d) PB-262-227/AS 431 pp. "Water Quality Instructional Resources Information System, Volume IV - Subject Index" @ $11.75 (microfiche $3.00)

c. Instructional Resources Developed by Other Sources

1) Minimum technical references which should be in possession of the institution include:


2) Audiovisual and Other Training Aids

a) A wide variety of training resources is listed in the EPA sponsored publication, "Water Quality Instructional Resources Information System" (IRIS), cited in b, 3) c) above.

b) Information on sources of the listed items is provided.

c) Training institutions having information about training resources applicable to this course, which are not currently listed in IRIS, are invited to relay this information to the Director, National Training and Operational Technology Center. Such resources, as applicable, will be made known to other organizations which could benefit from their use.

d. Instructional Resources Already in Possession of the Training Institution

1) Many training organizations prefer to develop their own texts and audiovisual training resources.

2) To the extent that these resources can be released for free reproduction and use by others, institutions are invited to make such resources available to other training organizations.

3) The National Training and Operational Technology Center is prepared to serve as a focal point for making information about such resources widely available, provided that copyright or other restrictions on reproduction do not limit availability of such materials.

   a) Before encouraging other training institutions to use such resources in relation to this Course, elements of EPA will:

      (1) Review the training resources to determine whether the instruction is consistent with existing laws, regulations, and Agency policy;

      (2) Review the resource for technical validity and educational quality.

   b) Materials found suitable by EPA would be recommended to other institutions known to be presenting this Course.

4) All training resources referred to NHTOTC as available for use by others will be added to the overall inventory listing cited in IRIS, b. 3) c), above. It is hoped that a mutually supportive activity in this area will, in time, result in:

   a) making IRIS a diversified, total resource system for training materials which will be of the highest technical quality;

   b) offering training institutions a wide variety of types of training resources;

   c) reducing the amount of duplication of effort that so often results from lack of information on what is available, from what sources, and how obtained.
PART I - COURSE PLANNING AND MANAGEMENT

C. Secretarial Support

The key role of the office worker(s) designated "Course Secretary" cannot be overemphasized.

This function has many elements including being the right arm of the Course Coordinator, being Course Registrar, being Course Secretary and being a "Course Watchdog" to give the alarm when essential milestone stages of course planning and preparation are being overlooked.

In this section, these elements are considered under the headings: Course Records and Record-keeping, Suggested Student Registration Procedures and Printed and Reproduced Materials - Summary.

1. Course Records and Record-keeping
   a. General Considerations

1) Complete, detailed, and accurate records should be established for each course presentation. Each course record will be a separate file. In addition to the individual course files, it may be necessary to establish a finder-system for locating the records of individual students.

2) Response to Inquiries about Former Students
   a) Students enroll in this course in order to acquire necessary knowledge and skills to perform the self-monitoring procedures required for municipal effluents.

   b) In many, if not all cases, satisfactory completion of this course will be a factor in the accreditation of individuals to perform the analyses and measurements required for compliance with NPDES Permits.

   c) It is anticipated that numerous inquiries from former students and from regulatory agencies will be addressed to the training institution. Typical requests for information may include any or all of the following:

      (1) Verification of attendance and satisfactory completion of training;

      (2) Identification of the specific analyses and measurements covered in the course, as well as designation of the method which was taught;

      (3) Quality of student performance in the course;
(4) Documentation of any specific analyses, tests, or measurements in which the student did not meet the required standard of performance, and the nature of such failure; and

(5) Documentation of any other events which made the student unusual. This could be a record of exceptionally high performance, or it could be a record of any specific difficulty which arose in connection with the student, within or outside the scheduled training activities.

3) Reports

Most training institutions require submission of periodic reports on progress and achievements. It is safe to predict that management or cognizant regulatory agencies from time to time will call for information not provided in routine reports. If such demands are to be met, complete course records will be the most reliable source for such information.

4) Retention of Records

The length of time course record files should be retained is uncertain, and must be determined by each institution.

Institutions having a system of archives for inactive files may find it convenient to retain course records in active office files for approximately two years, then retire them to archives storage. Institutions not having archives storage probably should retain the complete file on each course presentation for at least five years.

b. Contents of Course Files

1) In the planning and development stage, and until completion of each course presentation, course records are kept most effectively in two sections.

These are:

a) A file folder, kept in the filing cabinet or in the desk of the Course Secretary; and,

b) A student record notebook, usually a 3-ring binder, kept on the Course Secretary's desk, or in a convenient bookcase.

Both sections of the Course files should be maintained by the Course Secretary, and should be made available to other staff members under rigid controls providing for direct examination and immediate return. After completion of the course, the two sections can be combined in a single large file packet for future retention.
2) The file folder is best suited for such records as:

a) Copies of all correspondence, memoranda, and records of telephonic conferences related to course planning and development;

b) Copies of course schedules;

c) Records of equipment and supply acquisition for the course, through purchase or through loan (with information and records on return to owner);

d) Records of staff assignments, classroom and laboratory reservations;

e) Copy of course announcement and/or description (See pages 12-7 and -8);

f) Sample record copies of all routine informational material sent to students accepted for training; (See pages 12-13 through 16);

g) Records of arrangements for travel of personnel and transportation of equipment and supplies, arrangements for field facilities, and other records pertaining to a field course; and

h) Course evaluation commentaries by Course Coordinator and other staff members as appropriate.

3) The student record notebook is best suited as a vehicle for all records and copies of communications related to individual students. This may be organized effectively in a 3-ring notebook, containing separator sheets with alphabetical tabs. The personal records of each student will be retained under the alphabetical tab corresponding with his last name. In the student record notebook may be found:

a) At the front (before the "A" of the series of tabbed dividers):

(1) A registration summary sheet showing record of standard communications with each accepted student, fees paid, etc... (See page 12-17);

(2) A waiting list summary sheet showing record of standard communications with each student placed on a waiting list prior to the course due to early maximum enrollment. (See page 12-18)

(3) A non-attendance summary sheet showing record of students who applied for admission but could not be admitted for lack of qualification, or due to an already-filled class. This summary also is used to identify applicants who applied for admission, who were admitted, and who failed to appear without due explanation ("no shows"). (See page 12-19);
(4) A summary sheet recording student performance (acceptable or not acceptable) for each of the units of instruction in the course. (Such a summary worksheet has not been developed at the writing of this Guide).

b) In the alphabetical section of the student record notebook, each student's personal record will contain such items as:

1) The application for admission to training (see pages 12-7 and 8);

2) Copies of all correspondence with the student (see pages 12-11 through 14), except for the routine local information sheets (see pages 12-15 through 18), one set of which is kept in the loose file folder;

3) Record copies of student quizzes, data sheets, and other individual records of class performance provided by instructor.

4) Copy of the certificate awarded at end of course which is a record of the measurements completed by the student in a satisfactory manner. (See page 12-22);

5) Documentation of any information about the student judged to be of possible future concern or inquiry. (An example of such a sheet had not been developed at the time of writing this Guide).
2. Suggested Student Registration Procedures

a. Introduction

1) Purpose

Formal registration and enrollment procedures are intended to assure that:

a) The class consists of students for whom the training is intended and designed;

b) The accepted students meet minimum knowledge and skills required for reasonable assurance of satisfactory completion of the course;

c) Accepted students are provided with adequate pre-training information so that they will make their personal arrangements and travel schedules to assure arrival at the appointed time and place, with full participation throughout the program of training;

d) The size of the class is in accordance with the course plan; and

e) Those not accepted for training are provided with suitable advice which can lead to future admission.

2) Alternative Approaches to Registration

Three different approaches to registration are considered here, though only the first is described in detail. Most details of the second and third identified alternatives can be inferred through study of the first alternative. The three approaches considered are:

a) Registration by priority of receipt of application;

b) Registration by comparative evaluation of all applicants; and

c) Registration for special course offering at request of another organization. Students are nominated by the requesting organization and are accepted without further evaluation of entry-level qualifications by the training institution.

b. Registration by Priority of Receipt of Application (Recommended)

1) Applicant

a) Receives course announcement;

b) Completes application and secures internal approval as required in his own organization;

c) Mails application to registration office of the institution conducting the training.
2) Course Secretary
   a) Receives application;
   b) As received, checks status of registration for availability of
      class space, and makes appropriate notation on the application
      or on attached transmittal slip;
   c) Depending on b), records application either in the registration
      summary, or the waiting list summary, in front of student notebook;
   d) Delivers application to Course Coordinator.

3) Course Coordinator
   a) Evaluates the student application and the space availability
      situation;
   b) Directs the Course Secretary by notation on the application to:
      (1) Accept the applicant, or
      (2) Notify the applicant of closed class enrollment, or
      (3) Refer the applicant to the "Basic Laboratory Skills" course
      before entry into this course;
   c) Prepares a special letter for non-admissible applicants
      (or memorandum record of other form of communication with
      applicant) which sets forth the reasons why the applicant
      is being rejected. Because of the compulsory nature of
      the self-monitoring tests on municipal effluents for NPDES
      Permit compliance, rejection of a bona fide applicant may
      be a very serious matter, and should be handled with care.

4) The Course Secretary
   a) Prepares a standard letter or special letter as directed, and
      obtains signature of Course Coordinator:
   b) Places a file copy of the letter and the application in the
      appropriate place under the alphabetical tab section of the
      student record notebook;
   c) Mails the original letter to the applicant, and records the
      date of mailing in the appropriate place in the summary
      records at the front of the student notebook.
   d) Approximately 30 days before the course, mails to each accepted
      applicant a standard communication, consisting of
      (1) A form letter of welcome to the course, including information
          on starting and closing dates and hours of the course, direc-
          tions and how to proceed to the classroom area, and related
          information (See page 12-12); and
(2) Local information helpful to outside visitors, such as hotel/motel information, local transportation and schedules, a schematic map of the area, and related information. (See pages 12-13 through 16);

e) Records the mailing of the standard packet on the registration summary sheet.

f) When applications are still being accepted within 30 days before the start of the course, includes the general informational material with the letter of acceptance for admission.

g) On the first day of the course:

(1) Obtains a detailed registration card from each student. Some institutions may dispense with this record, though it can be of value in report preparation (See page 12-20);

(2) Prepares any registration tallies required by requesting organization(s) and/or administrative regulations. (See page 12-21);

(3) Prepares a class roster of those in attendance, distributes to class, staff, and keeps a permanent record copy in course files;

(4) Records any "no shows" (applicants accepted for training but who did not appear) on the student non-attendance summary record sheet. (See page 12-19)

c. Registration by Comparative Evaluation of all Applicants

1) Applicant

a) Receives course announcement;

b) Completes application and secures internal approvals as required in his own organization;

c) Mails application to registration office of the institution conducting the training.

2) The Course Secretary

a) Receives the applications;

b) Records receipt of application in a summary record in student record notebook;

c) Files application in student notebook;

d) Sends standardized letter acknowledging the application, and briefly explaining the registration procedure, with assurance that decision on admission will be announced not less than 30 days prior to start of the course;
e) Delivers all applications to the Course Coordinator, approximately 35 days before start of the course.

3) The Course Coordinator
   a) Reviews and evaluates all applications;
   b) Selects students to be admitted for training;
   c) Directs Course Secretary to send appropriate standardized letters and information packets as described in b. above;
   d) Special note should be taken of the particular attention which should be given to rejected applicants. See b., 3), c). above.

4) The Course Secretary
   a) Sends communications;
   b) Prepares records and student files as described in b.4) above.

4) Registration for Special Course Offering

Here a requesting organization has designated a student body which it wishes to have trained. It is the duty of the training institution to provide the requesting organization with admission standards for the course. It becomes the duty of the requesting organization to screen its candidates for conformance to these standards, and to provide the training institution with the names of the students to be trained. The requesting organization usually notifies the students.

1) For record purposes, it is best that students complete a course application form, though it will not be evaluated as in b. and c. above.

2) On receipt in the training institution, the Course Secretary makes the necessary entries showing record of receipt and class composition. Files are kept in the usual way. Approximately 30 days before the course, the individual standardized welcome and information packets are sent to students in the usual way. The training organization follows its usual practices in preparation of records, rosters, and any other data required for reports.
3. Printed and Reproduced Materials - Summary

a. General Information

In addition to the student reference text, standardized letters and administrative forms/materials; presentation of this course also requires calculation forms, laboratory data sheets, and graph forms which must be prepared in quantity by the Course Secretary.

1) In the following summarizing table, all of the standardized materials noted above are identified and supported with additional information on due date, the number to be prepared (for a class of 18 students), and the ultimate fate of the materials in permanent course records. Institutions offering this course may find it necessary to add to or to modify these standardized materials. It is suggested that plans to do so be noted on the summarizing table, with samples or examples provided on separate pages.

2) A sample or example of each item listed (except the student reference text) is shown following the summarizing table.
   a) Samples can be copied directly if meeting requirements of the training institution.
   b) The examples are shown in recognition that a corresponding item probably will be needed by the training institution, but probably will have to be modified to fit the situation.

b. Responsibilities for Printed and Reproduced Material

1) Course Coordinator
   a) Reviews the administrative materials for conformance to the requirements of the regulatory authority;
   b) Makes modifications as necessary to the samples and examples provided in this Guide;
   c) Decides upon and designs any additional administrative documents or records needed; and
   d) Provides the Course Secretary with complete identification of material to be copied directly or to be modified, and also provides samples of any new material required for course administration.

2) Instructors
   a) Review all materials identified for the procedures for which they have instructional responsibility;
   b) Design new supportive instructional material as required; and
c) Provide the Course Secretary with complete information on material to be copied, directly or to be modified, and also provide samples of any new material required for student instruction.

3) Course Secretary

a) Receives from Course Coordinator and Instructors identification of existing materials, samples of modified and new material;

b) Adds to the summarizing table, in the appropriate locations, the identifying information, together with the supporting information on due date, quantity, confidentiality, and ultimate fate of any new or revised material designed by Course Coordinator or by Instructors;

c) Reproduces, or arranges reproduction of, the needed course materials, so that they will be available for use at the time and place required.

c. Special Warnings.

1) All staff members should be particularly alert to adjustments in "Due Date" which must be made when the course is conducted in the field, if training equipment and supplies must be shipped to the course site.

2) Preparation of these training materials is a potential source for great difficulty in course development and presentation. Few activities in course planning and development require a greater amount of effective teamwork among all staff members. The greatest problem here is one of timing.

a) All staff members must provide necessary information and samples of new or modified materials with adequate lead time to meet "Due Dates." The amount of lead time is not specified here; this will vary from one institution to another.

b) The Course Secretary must be diligent in advising Course Coordinator and Instructors of impending logistic problems if delays occur in submission of materials, and must give prompt attention to printing or reproduction of needed materials when delivered by staff members.

c) The author of this guide ruefully confesses that the worst and most frequent breakdowns in this area usually are the result of belated delivery of needed material from Instructional Staff to the Course Secretary.
<table>
<thead>
<tr>
<th>Description</th>
<th>Lesson</th>
<th>When Needed</th>
<th>Number to be Prepared</th>
<th>Confidential?</th>
<th>Permanent Record?</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative</td>
<td>-</td>
<td>6 months before course</td>
<td>Indeterminate</td>
<td>No</td>
<td>1 copy</td>
<td>Distribute to target group 6 months before course.</td>
</tr>
<tr>
<td>Course Announcement</td>
<td>-</td>
<td>6 months before course</td>
<td>Indeterminate</td>
<td>No</td>
<td>1 copy</td>
<td>Same as announcement. Can be used in conjunction with chronological course listings.</td>
</tr>
<tr>
<td>Course Description</td>
<td>-</td>
<td>6 months before course</td>
<td>Indeterminate</td>
<td>No</td>
<td>No</td>
<td>Usually part of course announcement. May be separate sheet.</td>
</tr>
<tr>
<td>Application for Admission</td>
<td>-</td>
<td>6 months before course</td>
<td></td>
<td></td>
<td>No</td>
<td>Attached to application form</td>
</tr>
<tr>
<td>Prerequisite Verification</td>
<td>-</td>
<td>6 months before course</td>
<td>Indeterminate</td>
<td>No</td>
<td>1 copy</td>
<td>Copies will show up in student files.</td>
</tr>
<tr>
<td>Standard Letter: Acceptance</td>
<td>-</td>
<td>5 months before course</td>
<td>100</td>
<td>No</td>
<td>No</td>
<td>Copies will show up in student files.</td>
</tr>
<tr>
<td>Standard Letter: Standby: Full Class Waiting List</td>
<td>-</td>
<td>5 months before course</td>
<td>100</td>
<td>No</td>
<td>No</td>
<td>Copies will show up in student files.</td>
</tr>
<tr>
<td>Standard Letter: Referral to Basic Lab Skills Course</td>
<td>-</td>
<td>5 months before course</td>
<td>100</td>
<td>No</td>
<td>No</td>
<td>Copies will show up in student files.</td>
</tr>
<tr>
<td>Standard Letter: Welcome and Local Information: Hotels/Motels, Transportation Schedule, Schematic Area Map Classroom Location</td>
<td>-</td>
<td>30 days before course</td>
<td>100</td>
<td>No</td>
<td>1 copy</td>
<td>In Course file folder.</td>
</tr>
<tr>
<td>Registration Summary Record</td>
<td>-</td>
<td>5 months before course</td>
<td>1</td>
<td>No</td>
<td>Yes</td>
<td>In Registrar's three-ring notebook.</td>
</tr>
<tr>
<td>Description</td>
<td>Lesson</td>
<td>When Needed</td>
<td>Number to be Prepared</td>
<td>Confidential?</td>
<td>Permanent Record?</td>
<td>Remarks</td>
</tr>
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<td>----------------------------------------------</td>
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<tr>
<td>Administrative (Cont'd.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting List Summary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In Registrar's three-ring notebook</td>
</tr>
<tr>
<td>Non-attendance Summary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In Registrar's three-ring notebook</td>
</tr>
<tr>
<td>Trainee Registration Card</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Institution's Records</td>
</tr>
<tr>
<td>Registration Tally and Class Roster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In course file folder</td>
</tr>
<tr>
<td>Course Certificates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In student file</td>
</tr>
<tr>
<td>Student Performance Summary Record</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In Registrar's three-ring notebook</td>
</tr>
<tr>
<td>Classroom/Laboratory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ANNOUNCING USEPA SPONSORED INSTRUCTOR TRAINING FOR PERMIT COMPLIANCE

The National Training and Operational Technology Center has developed a series of "packaged" courses for training municipal treatment plant personnel on how to sample, measure, and analyze their wastewater discharges so as to comply with NPDES Permit requirements. Each course has been prepared in modular form, with each module containing detailed step-by-step procedures for the performance of a specific monitoring task. A description of each of these courses appears below:

1. Effluent Monitoring Procedures: Basic Parameters for Municipal Wastewaters (164.1)
   - Duration: 5 days
   - Description: This course is designed for municipal wastewater treatment plant technicians and other personnel engaged in the analysis of wastewater treatment plant effluents for compliance with requirements of NPDES permits issued under the National Pollutant Discharge Elimination System. Upon completion, participants will be able to collect samples, perform the tests, and report results for COD, BOD, nitrate, nitrite, total nitrogen, total phosphorus, pH, suspended solids, chlorine, and measure flow by weir and paddle wheels. The test procedures conform to Agency-approved methods as promulgated in the Code of Federal Regulations.

2. Effluent Monitoring Procedures: Metals Analysis (164.2)
   - Duration: 5 days
   - Description: This course is designed for wastewater treatment plant technicians who will be responsible for performing selected metals analyses in treatment plant effluents. Upon completion, participants will be able to collect samples, perform the tests, and report results for boron, copper, lead, mercury, selenium, and zinc. Classroom instruction is limited to information about performing these analyses, while most of the time is given to laboratory experience in the analysis of wastewater samples. Classroom instruction will be supplemented by on-the-job training at a wastewater treatment plant. The test procedures conform to Agency-approved methods as promulgated in the Code of Federal Regulations.

3. Effluent Monitoring Procedures: Nutrients (164.3)
   - Duration: 5 days
   - Description: This course is designed for wastewater treatment plant technicians who are responsible for monitoring nutrient concentrations in municipal wastewater discharges. The student will be able to perform selected nutrients analyses in wastewater samples. Classroom instruction will be limited to information about performing these analyses, while most of the time is given to laboratory experience in the analysis of wastewater samples. Classroom instruction will be supplemented by on-the-job training at a wastewater treatment plant. The test procedures conform to Agency-approved methods as promulgated in the Code of Federal Regulations.

   - Duration: 8 days
   - Description: This course is designed for the treatment plant operator or technician who has had little or no previous experience in the collection of wastewater samples, or in initial and final wastewater quality analyses. Classroom instruction will be supplemented by on-the-job training at a wastewater treatment plant. The course will focus on the collection of wastewater samples and the performance of initial and final analyses of wastewater samples. Classroom instruction will be limited to information about performing these analyses, while most of the time is given to field experience in the collection of wastewater samples and the performance of initial and final analyses of wastewater samples. The test procedures conform to Agency-approved methods as promulgated in the Code of Federal Regulations.

APPLICATION FOR INSTRUCTOR TRAINING

I am interested in attending the following training course or courses in Cincinnati, Ohio:

1. Effluent Monitoring Procedures: Basic Parameters for Municipal Wastewaters (164.1) - July 11-20, 1977
2. Effluent Monitoring Procedures: Metals Analysis (164.2) - June 13-17, 1977
3. Effluent Monitoring Procedures: Nutrients (164.3) - August 1-5, 1977

(For additional offerings of these courses, call the NTOTC Registrar - 513/684-7501)

Organization in which you will be providing instruction:

Your Name: __________________________ Phone: __________________________
Business Address: ____________________________________________________________

90 12-5
EFFLUENT MONITORING PROCEDURES:
METALS (Course 164.2)

5 Days

This course is designed for wastewater treatment plant technicians who will be responsible for performing selected metals analyses in treatment plant effluents. Participants will perform selected metals analyses including: boron, copper, iron, mercury, sodium, and zinc. Classroom instruction is limited to information about performing these analyses and reporting the results. Most of the time is given to laboratory experience for the trainee who uses detailed, stepwise procedures to analyze typical samples. Procedures will be in conformance with Agency approved methods as promulgated in the Code of Federal Regulations.

PRE-REQUISITES

Self-Monitoring Procedures: Course I - Basic Laboratory Skills or equivalent experience is pre-requisite for the course. A "Student Skills Checklist," signed by the applicant's employer, must be submitted before an application for the course can be processed.

June, 1976

TUITION: $175.00
COURSE APPLICATION FORM

1 Name of Applicant. 
   Mr. 
   Miss 
   Mrs. (last) (first) (middle initial) 
   Course No. 
   Dates 

2 Course desired. 
   Course Title 
   Place, 
   where given 
   Dates 

3 Previous Courses Attended. 
   Course Title 
   Course Title 
   Course Title 
   Dates 

4 Sponsor or Employer. 
   Employer (name of organization or firm) 
   (street address) 
   (city) (state) (zip code) (telephone) 

5 Mailing address of applicant (if different from above) 
   (street address) 
   (city) (state) (zip code) (telephone) 

6 Job Duties: (Briefly describe your present position) 

7 Education: Last year of school completed 

8 Experience: Total years in wastewater treatment plant work 

9 Student Skills Checklist: This checklist must be submitted before Application can be processed

   signature of supervisor (where applicable) title 
   signature of applicant 
   date 

SAMPLE
**SAMPLE STUDENT SKILLS CHECKLIST**

**Name**

**Employer**

To assist us in processing applications, please check YES or NO for each of the following items:

<table>
<thead>
<tr>
<th>Item</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have operated a laboratory gas burner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have operated a laboratory hotplate/stirrer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have operated an autoclave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have operated a laboratory drying oven</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have used a vacuum source to filter liquids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have used a desiccator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have weighed items on an analytical balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have weighed items on a single pan balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have used a graduate to measure liquids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have used a volumetric pipet to measure liquids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have used a graduated (Mohr) pipet to measure liquids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have used a pipet bulb to fill a pipet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have used a volumetric flask to prepare solutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have used chromic acid to clean glassware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have operated a laboratory safety shower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have operated a laboratory eye washer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have operated a fume hood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have prepared 0.0375N potassium biiodate solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have made out labels for bottles of reagents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have recorded a reading at a meniscus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have titrated a solution against another to a color change end point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have calculated the normality (N) of a solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have recorded laboratory data in a laboratory notebook</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have entered laboratory data on a pre-printed form</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have recorded information about samples on record sheets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have located required purchase information in a catalog of laboratory equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have written a purchase order for chemicals</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Volume means space occupied by a solid, liquid, or gas.

- mg/l means milligrams per liter
- 1 kilogram equals 0.001 gram
- 1 inch equals 2.54 cm
- 1000 ml equals 1 liter
- 85 times 4.1 equals 348.5
- 7 minus 3 divided by 0.02 equals 250
- 3.26 rounded to the nearest tenth is 3.2
- 84.55147 rounded to the nearest thousandth is 84.55
(SAMPLE LETTER OF ACCEPTANCE FOR TRAINING)

(Institutional Letterhead)

(Date)

To

Dear (Name):

A reservation has been confirmed for your participation in the course "Effluent Monitoring Procedures: Metals", to be conducted at (address, including building and room identification if pertinent):

Formal class activities will begin promptly at 8:30 AM on Monday, (date) and the course will be completed by 12:30 PM on Friday, (date). Please arrange your travel schedule so that you will be in the classroom at the start of course activities on Monday and that you will not have to hurry your departure on Friday.

Information about local travel, transportation, and local hotels is enclosed for your assistance. We believe that you will wish to make your own hotel or motel reservations.

We look forward to seeing you at the course, and we will do everything in our power to make this course a pleasant and rewarding experience for you.

Sincerely yours,

(signature)

Course Coordinator

Note: If something develops which makes it impossible for you to attend the course, please telephone (number) or write this office immediately, in order that another applicant may be admitted to the course in your place. Please do not arrange for a substitute without first getting the approval of this office.
Dear (Name):

We have received your application for admission to the course "Effluent Monitoring Procedures: Nutrients" to be conducted at (name of institution) during the period (date to date).

We would be most pleased to enroll you in this course, but by the time we received your application, all available positions in the class had been reserved. As you may know, we limit the class size to a fixed number in order to provide for the greatest possible amount of personal instruction during the course, and to provide each participant with the greatest possible opportunity for actual practice in the laboratory.

We have made a tentative reservation for you in the next offering of the course, which is scheduled to be given (dates). If this will be satisfactory to you, please write or call us within (number) days, so that we can confirm your reservation.

In the meantime, we have placed your name on the waiting list for the course dates which you requested. If a vacancy does become available, we will let you know immediately.

Sincerely yours,

(signature)
Course Coordinator
To

Dear (Name):

We have received your application for admission to the course "Effluent Monitoring Procedures: Nutrients," to be conducted at (name of institution) during the period (date to date).

Based on our review of your previous laboratory experience, we consider that it would be very doubtful whether this course would provide you with all the knowledge and skills you will require to perform the self-monitoring tests and measurements on your municipal wastewater effluents.

Accordingly, we are confirming your reservation in this course, subject to your first satisfactorily completing the course (title of "Basic Skills" course). This course will be conducted at (location) (dates). We have made a tentative reservation for you to attend this course. Please let us know if you can attend this offering of the course.

If you must delay taking the course (name of "Basic Skills" course) at this time, then it will be necessary to delay your acceptance in the course which you have requested.

In the course (name of "Basic Skills" course) you will learn many things not covered in the later course, including use of the analytical balance, preparation and standardization of laboratory reagents, care and maintenance of laboratory supplies and equipment, and related tasks.

We are most anxious to help you learn to perform all the tasks required for self-monitoring of your municipal wastewater effluents. Please let us know if you can come to both courses.

Sincerely yours,

(signature)
Course Coordinator
(SAMPLE LETTER OF WELCOME)

(Institutional Letterhead)

(Date)

TO: COURSE PARTICIPANTS --

We are looking forward to your participation in the course "Effluent Monitoring Procedures: Nutrients", scheduled for presentation at this Center during the period (date to date). If you find you cannot attend the course, please call us (telephone number).

To assist your planning and preparation for this course, the following items are enclosed:

1. List of hotels and motels

2. Information on local bus transportation and city map, (NOTE: If bus service is used to the Center, you must have exact fare of (amount) on boarding bus).

On your arrival in the classroom you will be provided a course manual and related materials. Production schedules make it impossible to mail manuals to you in advance of course date.

The course will start at 8:30 AM on Monday, (date) in (room identification) and will close no later than 12:30 PM, Friday, (date). At the conclusion of the course, a certificate will be awarded verifying which analytical measurements you have performed in a satisfactory manner. Please arrange your travel schedule for after closing exercises. (Approximately (number) hours should be allowed for travel from (name of institution) to the airport.)

This course involves a considerable amount of work in the laboratory, using concentrated acids and bases. You will want to bring appropriate clothing.

(Name), of our staff, is serving as Course coordinator and will be available to assist you in solving any special problems you encounter while attending the course.

Should you have questions or desire assistance in any way, please do not hesitate to contact us.

Sincerely yours,

(signature)
Director
Institution Name
DOWNTOWN HOTELS

CINCINNATIAN HOTEL
6th & Vine Sts.
Cincinnati, Ohio 45202
Phone: 513/241-0180

Single $6.45
Double 8.60
Twin 10.75

225 Rooms
Meeting Room 1 - Capacity 25
TV, restaurant adjoining

NETHERLAND HILTON HOTEL
35 W. 5th Street
Cincinnati, Ohio 45202
Phone: 513/621-3800

Single $22.00
Double 30.00
Twin 34.00

Family plan, 800 rooms, TV, meeting rooms 15, cap. 70-1500, special Gov't. rates - $16.00 single, $23.00 double, $24.00 twin.

TERRACE HILTON HOTEL
15 W. 5th Street
Cincinnati, Ohio 45202
Phone: 513/381-4000

Single $23.00
Double 31.00
Twin 35.00

Family plan, 350 rooms, meeting rooms 4, cap. 75-400, color TV, special Gov't. rates - $18.00 single, $25.00 double, $26.00 twin.

STOUFFER'S CINCINNATI INN
150 W. 5th Street
Cincinnati, Ohio 45202
Phone: 513/721-8600

Single $25.00 - 28.00
Double 31.00 - 34.00
Twin 31.00

462 rooms, meeting rooms 11, cap. 50-550, swimming pool, cocktail lounge, sauna bath, color TV, Gov't. rates - $20.00 single, $26.00 double.

HOLIDAY INN
8th & Linn Sts.
Cincinnati, Ohio 45203
Phone: 513/241-8660

Single $22.00
Double 28.00

245 rooms, meeting rooms 4, cap. 25-135, swimming pool, TV, 2 dining rooms, and bars, night club "Top of the Inn" (entertainment nightly).

NOTE: We recommend you checking the rate at the time you make your reservation in the event there has been a price increase.

These hotels and motels are listed for your information to assist you in planning for your accommodations during your stay in Cincinnati while attending our training course, and does not imply endorsement by the Office of Water Program Operations, U.S. Environmental Protection Agency.

* REQUIRES TRANSFER TO SECOND BUS.
# BUS SCHEDULE

**EXAMPLE INFORMATION SHEET**

## BUS NO. 53 - AUBURN/CLIFTON

<table>
<thead>
<tr>
<th>AM</th>
<th>Arrive</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:16</td>
<td>7:36</td>
<td>9:04</td>
</tr>
<tr>
<td>7:41</td>
<td>7:59</td>
<td>8:40</td>
</tr>
<tr>
<td>8:03</td>
<td>8:21</td>
<td>8:40</td>
</tr>
<tr>
<td>8:25</td>
<td>8:43</td>
<td>8:40</td>
</tr>
<tr>
<td>8:46</td>
<td>9:04</td>
<td></td>
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## BUS NO. 78 - LOCKLAND/READING

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## NOTE:
The above two routes are the most direct routes to the Environmental Research Laboratory, 26 W. St. Clair Street, Cincinnati, Ohio. Information has been provided by the Queen City Metro. Times selected are those most apt to be used by students attending NTC Training Courses. Arrival times are approximate, and will vary because of road and traffic conditions.
(EXAMPLE INFORMATION SHEET)

FROM GREATER CINCINNATI AIRPORT TO U.S. EPA ST. CLAIR FACILITY

Interstate 75 (North or South)
EXIT HOPPLE ST. TO CENTRAL PKY., RIGHT TO MARSHALL AVE., LEFT TO RIDDLE RD., RIGHT TO ST. CLAIR AND EPA FACILITY.

Interstate 71 (North)
EXIT READING RD. TO BURNET AVE., TO W. H. TAFT RD., LEFT TO JEFFERSON AVE., RIGHT TO EPA FACILITY.

FROM GREATER CINCINNATI AIRPORT TO U.S. EPA RIDGE RD. FACILITY

Interstate 71 (North)
EXIT INTERSTATE 75 TO INTERSTATE 71 TO RIDGE RD. (NORTH) EXIT TO EPA FACILITY.

FROM ST. CLAIR FACILITY TO RIDGE RD. FACILITY

JEFFERSON TO MCCULLIN, LEFT TO INTERSTATE 71 NORTH, EXIT RIDGE RD. NORTH TO FACILITY.

FROM U.S. EPA ST. CLAIR FACILITY TO GREATER CINCINNATI AIRPORT

RIGHT ON ST. CLAIR TO RIDDLE RD., LEFT ON MARSHALL AVE., RIGHT ON CENTRAL PKY., LEFT ON HOPPLE ST., RIGHT TO INTERSTATE 75 SOUTH.

FROM U.S. EPA RIDGE RD. FACILITY TO GREATER CINCINNATI AIRPORT

RIGHT ON RIDGE RD., RIGHT TO INTERSTATE 71 SOUTH TO INTERSTATE 75 SOUTH.
(SAMPLE REGISTRATION SUMMARY)

(Course Title)

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(SAMPLE WAITING LIST SUMMARY)
(SAMPLE NON-ATTENDANCE SUMMARY)

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**YEARS OF PROFESSIONAL EXPERIENCE**

- 0-1 YEARS
- 2-4
- 5-7
- 8-10
- 11-15
- 16-20
- 21 OR OVER

**PROFESSION OR OCCUPATION**

- ADMINISTRATOR
- BIOLOGIST
- CHEMIST
- CIVIC ORGANIZATION
- CONSERVATIONIST
- EDUCATOR
- ENGINEER
- GEOLOGIST
- MICROBIOLOGIST
- OCEANOGRAPHER
- PHARMACIST
- SANITARIAN
- STATISTICIAN
- TECHNICIAN
- TREATMENT PLANT OPERATOR
- OTHER

**EDUCATION**

- HIGH SCHOOL NON-GRADUATE
- HIGH SCHOOL GRADUATE
- COLLEGE NON-GRADUATE 1-2 YEARS
- COLLEGE NON-GRADUATE OVER 3 YEARS
- BACHELOR DEGREE
- MASTER DEGREE
- DOCTOR DEGREE
- OTHER (describe)
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**Example Registration Tally**

106

12-21
This certifies that

THOMAS JONES

has completed the course

Effluent Monitoring Procedures: Metals (164.2)

and has performed the following determinations in a satisfactory manner:

Determination of Calcium

Determination of Lead

Determination of Beryllium

Determination of Mercury

Determination of Copper

Determination of Sodium and Potassium

Determination of Magnesium, Manganese and Zinc

INSTRUCTOR

INSTRUCTOR

INSTRUCTOR

INSTRUCTOR

INSTRUCTOR

Director, (Institution Name)

Course Coordinator

19 to 19
PART II INSTRUCTIONAL PACKAGE WORKSHEETS

For each Effluent Monitoring Procedure (commonly termed "EMP" by Instructors) in the Student Reference Manual, there is an Instructional Package Worksheet (IPW) in this Guide. The Worksheet is for guidance to the Instructor for development of the subject matter covered in the course.

These Worksheets are not scripts. The Instructor will need to make extensive and detailed preparation in order to perform the assigned tasks effectively and efficiently. The Instructional Packages do provide a perspective on the background of each analytical procedure, lesson-by-lesson learning achievement levels the students should attain, an indication of available audiovisual and other instructional resources, and a recommended course of action in pre-course preparation and classroom/laboratory instruction.

Application of these Instructional Packages will help the Instructor to reduce the time required for planning and organizing a strategy of preparation and instruction. But time and effort are required for physical preparations for classroom and laboratory instruction; time and effort are required for rehearsals of Instructor performance in classroom and laboratory. These requirements never can be met by such a Course Guide as this; ultimately the Instructor is the key person in assuring that the student acquires the needed knowledge and skills.
A PROTOTYPE FOR DEVELOPMENT OF
ROUTINE OPERATIONAL PROCEDURES
for the
DETERMINATION OF BORON, CURCUMIN METHOD

as applied in
WASTEWATER TREATMENT FACILITIES
and in the
MONITORING OF EFFLUENT WASTEWATERS

INSTRUCTIONAL PACKAGE WORKSHEET.

National Training and Operational Technology Center
Municipal Operations and Training Division
Office of Water Program Operations
U.S. Environmental Protection Agency
A. Determination of Boron, Curcumin Method

1. This method is the only acceptable method listed in the Federal Register.

2. The reference used is from the 14th Edition of Standard Methods for the Examination of Water and Wastewater, 1975 page 287.

3. Student will prepare one blank, one calibration standard and carry them through the procedure with one unknown sample prepared by the instructor.
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Determination of Boron, Curcumin Method

UNIT OF INSTRUCTION: Summary of 3 Elements

ESTIMATED TIME: 240 minutes

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: Many National Pollution Discharge Elimination System Permits require the determination of boron or else of metals using similar colorimetric procedures.

ENTRY LEVEL BEHAVIOR: The learner must have skills equivalent to those in the Level I Course, Basic Laboratory Skills. He must also know how to use a spectrophotometer and how to construct a calibration graph.

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior: The learner will locate and scan Procedures A, B, C and D which give directions for preparing to test the sample. Then he will record sample identification information, prepare a blank and at least one standard, measure out sample, treat each solution to develop color, filter the sample, obtain and post absorbance readings for his solutions, construct a calibration curve from class results, use this curve and his absorbance value for the sample to find its boron concentration, submit his graph and completed data sheet to the instructor, and participate in a summary session on Procedure J and Conditions critical to the test, all according to the Procedures in the EMP.

2. Conditions: He will be given the EMP, classroom instruction, copies of the EMP data sheet and calibration graph form, cleaned equipment, the required reagents, a sample, absorbance values from the class, and total working time of 200 minutes.

3. Accepted Performance: His techniques must conform to those described in the EMP according to an instructor's rating. In addition, his answer must agree within ±0.02 mg/liter of the class average unless some explanation of the disagreement is accepted by the instructor.

B. INSTRUCTIONAL RESOURCES:


2. Suggested Media: None
C. INSTRUCTIONAL APPROACH:

1. Preparation for Instruction:
   
a. Duplicate copies for the students of the EMP data sheet and calibration graph. (OPTION: Two completed sheets of each will be required for each student—one for him and one for the record. You can distribute 1 data sheet and 1 graph form and later duplicate the completed sheets submitted by the student. Alternatively, you can distribute 2 of each sheet and have the student make copies.)

b. Check the water bath for consistency of test temperature (55 ± 2°C).

c. Check evaporating dishes for uniformity of size and composition. They must be clean and free of scratches.

d. Check on the number of evaporating dishes your water bath(s) can hold. One dish requires about 5 square inches of space. Decide how many are available per student during the test. Plan assignment of standards accordingly.

e. Plan the table needed on the chalk board for students to post absorbance results.

f. Make out tags for the sample bottles (1 per 3 students) including the information required for the EMP Data Sheet.

g. Obtain or plan to prepare a sample (1.0 ml per student) with boron concentration between 0.1 to 1.00 mg/liter. Sample dilutions extend this range of applicability.

h. See that the equipment and reagents required for each student to do the planned "Student Performances" are prepared and assembled in the laboratory.

2. Sequencing:

a. Lesson one - 195 minutes
   
   This time includes 80 + minutes for an evaporation process. Students should periodically observe the test solutions during evaporation but they can work in a 20 minute break during that process.

b. No Break

   (Alternative: There can be a break of indefinite length before the next lesson on constructing the calibration curve).

c. Lesson two - 25 minutes

d. No Break

   (Alternative: There can be a break of indefinite length before the final summary lesson.)
D. IPW EQUIPMENT AND SUPPLY REQUIREMENTS

1. For Each Student:
   a. 1 beaker, 50 ml
   b. 3 dishes, evaporating, porcelain, 100 ml, equal diameters
   c. 1 long dropper, 1-2 ml with bulb
   d. 1 piece filter paper, Whatman No. 30, to fit funnel
   e. 3 flasks, volumetric, 25 ml, with stoppers
   f. 2 flasks, volumetric, 100 ml, with stoppers
   g. 1 funnel, fluted, 60°, 40 mm diameter, 50 mm stem length
   h. 1 glass rod, short
   i. 1 pipet, measuring, Mohr, 10 ml
   j. 3 pipets, volumetric, 1 ml
   k. 1 pipet, volumetric, 4 ml
   l. 1 propipet or pipet bulb
   m. 1 stirring rod (policeman), polyethylene, about 6 inch length
   n. 1 support, ring stand with small ring
   o. 1 triangle, clay (for filter funnel)
   p. 2 wash bottles, polyethylene squeeze type (one for alcohol, one for water)
   q. 1 wax pencil

2. Shared:
   a. 1 set of volumetric pipets (2, 5, 8 and 10 ml) per 4 students
   b. 1 sample bottle, tagged, per 3 students (polyethylene or alkali-resistant, boron-free glassware)
   c. 1 spectrophotometer per 3 students for use at 540 nm, with cell(s), minimum path length of 1 cm; box of lint-free tissues by each instrument and container for wastes
   d. 1 thermometer, degrees C, per water bath
   e. X water bath(s), constant temperature to maintain 55 ± 2°C. (Number required depends on size of bath and planned student assignment. (Each 100 ml evaporating dish requires about 5 square inches of space.)

E. IPW REAGENT REQUIREMENTS:
(minimum amounts per student)

300 ml distilled water, boron-free

12 ml curcumin reagent (95% ethyl alcohol, curcumin, oxalic acid, concentrated hydrochloric acid)

100 ml 95% ethyl alcohol

100 ml stock boron solution (For accuracy in preparation, it is convenient to make 1 liter of this solution. In turn, 100 ml of stock is required for 1 liter of standard solution.)
25 ml standard boron solution--Prepare fresh on day of use. (For accuracy, it is convenient to make 1 liter of this solution.)

1 ml sample with boron concentration between 0.1 to 1.00 mg/liter (It is convenient to dilute say 20 ml of standard boron solution to 500 ml to give a concentration of 0.4 mg/liter so sample absorbance falls below the midpoint of the calibration curve.)
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Determination of Boron, Curcumin Method

UNIT OF INSTRUCTION: Procedure A, Preparing to Test the Sample (with references to Procedures B, C, and D); Procedure E, Preparation of Standards; Procedure F, Color Development of Standards and Sample; Procedure G, Removal of Cationic Interferences from the Sample(s) and Procedure H, Spectrophotometric Measurements.

LESSON: 1 of 3

ESTIMATED TIME: 195 minutes

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The learner must perform these procedures in order to determine boron concentrations in samples.

ENTRY LEVEL BEHAVIOR: The learner must have skills equivalent to those in the Level I Course, Basic Laboratory Skills, and he must know how to use a spectrophotometer.

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior: The learner will locate and scan Procedures A, B, C, and D which give directions for preparing to test the sample. Then he will record sample identification information, prepare a blank and at least one calibration standard and measure an aliquot of sample, treat each solution with curcumin reagent and evaporate to dryness to develop a colored product (rosocyanine), dissolve the product in alcohol, filter the sample solution, and measure absorbances of all processed solutions, keeping indicated records and performing all according to EMP Procedures E, F, G, and H.

2. Conditions: He will be given classroom instruction, the EMP, a copy of the EMP data sheet, the required equipment cleaned and ready to use (Procedures B & C), the required reagents (Procedure D), minimal supervision and total working time of 175 minutes.

3. Accepted Performance: His techniques must conform to those described in the EMP according to an instructor's rating. (Particularly note if he checks evaporating dishes before use, uses correct pipetting techniques and observes the evaporation process.)

B. INSTRUCTIONAL RESOURCES:

1. Available Media: EMP, overheads (2) of EMP Flow Sheet and EMP Data Sheet, copies of EMP Data Sheet

2. Suggested Media: None

C. INSTRUCTIONAL APPROACH:

1. Presentation: (20 minutes)
   a. Introduction - Training Guide I
b. Overview of test - use overhead of EMP Flow Sheet

c. Procedure A
   (1) Go through A, steps 1 - 4 to note references to and locations of EMP Procedures B, C, D. Any instructional remarks about these Procedures can be made at this time.

   (2) A, step 5 - Distribute copies of EMP "Example Laboratory Data Sheet." Use overhead of same to note the format with step designations in left column. Use A 5 and A 6 as examples of using the sheet with the EMP.

   (3) A; step 7 - Note students will begin with Procedure E, Preparation of Standards.

d. Procedure E
   (1) Read through E, step 1 to note the division of this procedure for establishing or checking the calibration curve.

   (2) E, step 2 - assign a blank and at least one standard to each student. Announce that they will post results so class can construct a calibration curve.

e. Procedure F
   (1) Read through F, step 1 to note the division of this procedure for establishing or checking the calibration curve.

   (2) F, step 2 - Go through the notes about the evaporating dishes.

   (3) F, step 3 - Note small volume (1.0 ml) to be measured. Remind class to use clean, dry pipet for each, wiping excess off outside of pipet, care in adjusting meniscus.

   (4) F, step 9 - Assignment: All are to do the sample. If dilutions are planned, assign them now.

   (5) F, step 14 - Breaks: Each can take breaks here but each should observe the progress of the evaporation and the appearance of the product when dry.

   (6) F, step 15 - note 15b

   (7) F, step 36 - note 36b

f. Procedure G
   Assignment: All are to do all of Procedure G.
   (1) G, step 6 - note 6a

f. Procedure H
   Assignment: All are to do all of Procedure H.

2. Student Performance and Evaluation: (175 minutes)
   As stated in the Instructional Objective above
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Determination of Boron, Curcumin Method

UNIT OF INSTRUCTION: Procedure I, Making a Calibration Curve and Procedure K, Finding the Concentration of Boron, mg/liter for the Sample(s)

LESSON: 2 of 3

ESTIMATED TIME: 25 minutes

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: This colorimetric procedure requires a calibration curve to determine concentrations of boron.

ENTRY LEVEL BEHAVIOR: The learner must know how to construct and use a calibration graph.

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior: The learner is to post his absorbance results, participate in a discussion of the posted class results, construct a calibration graph from the set of absorbances chosen by the class, use this curve and his absorbance value for the sample to determine the concentration of boron, record the result on the data sheet and submit the graph and the completed data sheet to the instructor, all according to EMP Procedures I and K.

2. Conditions: He will be given the EMP, a copy of the EMP Calibration Graph, absorbances from the class, minimal supervision and total working time of 10 minutes plus .5 minutes in group session.

3. Accepted Performance: His work is to conform to the instructions in the EMP and his concentration for the sample must agree within ± 0.02 mg/liter of the class average unless some explanation of the disagreement is accepted by the instructor.

B. INSTRUCTIONAL RESOURCES:

1. Available Media: EMP, overhead (1) of EMP Calibration Graph, copies of graph

2. Suggested Media: None

C. INSTRUCTIONAL APPROACH:

1. Group Session: (10 minutes)
   a. Have students post absorbance results for their standard and sample.
   b. With class, choose a set of absorbance values to be used to construct a calibration curve.
   c. Read through Procedure I, step 1 to note location of procedures for checking or establishing a calibration curve.
d. **Note Procedure K on using the calibration curve.**

e. Distribute copies of EMP Calibration Graph Form. You may want to use the overhead of same to remind students how to construct a graph and how to use it to get a concentration value for a sample.

2. **Student Performance and Evaluation:** (15 minutes)

   As stated in the Instructional Objective above.

3. **NOTE:** Collect the graphs and completed data sheets.
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Determination of Boron, Curcumin Method

UNIT OF INSTRUCTION: Procedure J, Checking the Calibration Curve and a Summary of Conditions Critical to the Test.

LESSON: 3 of 3

ESTIMATED TIME: 20 minutes

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The learner must know how to check his calibration curve and should be alert to conditions critically affecting test results.

ENTRY LEVEL BEHAVIOR: The learner must have performed the determination of boron, using the EMP provided.

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior: The learner is to participate in a summary session on critical conditions of the test and learn the procedure for checking calibration curves.

2. Conditions: He will have the EMP and any notes he made and a total time of 10 minutes.

3. Accepted Performance: Active participation in the session as judged by the instructor.

B. INSTRUCTIONAL RESOURCES:

1. Available Media: EMP and overhead (1) of conditions critical to test accuracy.

2. Suggested Media: None

C. INSTRUCTIONAL APPROACH:

1. Discussion: (10 minutes)
   a. If time between lesson 2 and 3 permitted the instructor to correct the data sheets, return them now and make any comments of general interest. If sheets are not ready for return, announce that instructor will do so as soon as possible.
   b. Use overhead and the EMP to emphasize conditions critical to accurate performance of the test:

   (1) temperature for evaporation - F, step 14 Notes a and b
   (2) length of drying time - F, step 14 Notes e and f
   (3) effect of evaporating dish characteristics - F, step 2 and H step 4 notes

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c. Note information on diluting samples - F, step 10 notes

d. Briefly go through Procedure J, "Checking the Calibration Curve:"
   (1) Recall when a check is used - E Note 1a
   (2) Note acceptable range for check - J Note 5a

2. Student Performance and Evaluation: (10 minutes)
   As stated in Instructional Objective above.
A PROTOTYPE FOR THE DEVELOPMENT OF
ROUTINE OPERATIONAL PROCEDURES
for the
VOLUMETRIC DETERMINATION OF TOTAL CALCIUM

as applied in
WASTEWATER TREATMENT FACILITIES
and in the
MONITORING OF EFFLUENT WASTEWATERS

Instructional Package Worksheet

National Training and Operational Technology Center
Municipal Operations and Training Division
Office of Water Program Operations
U.S. Environmental Protection Agency

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B. Determination of Total Calcium (Volumetric Method)


2. The volumetric procedure was selected since it can be performed with inexpensive, readily available, conventional laboratory glassware. If a laboratory is equipped with atomic absorption instrumentation, the atomic absorption method would be preferred.

3. Student will prepare calcium stock and standard solutions and standardized EDTA solution. Student will digest, titrate and calculate the result of the analysis of a sample prepared by the instructor.
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT-MATTER: Volumetric Determination of Total Calcium

UNIT OF INSTRUCTION: Summary of Three Elements
CH. ca. EMP. 1.1.76

ESTIMATED TIME: Five Hours

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The reporting of Total Calcium is required by many National Pollutant Discharge Elimination System Permits.

ENTRY LEVEL BEHAVIOR: The learner must have completed Course I, Basic Laboratory Skills or have shown competence in the areas covered by this course. Course II is not a prerequisite, but is desirable. The learner must also be able to perform the following:
1. Adjust pH of sample
2. Use an analytical balance

A. INSTRUCTIONAL OBJECTIVE

1. Terminal Behavior - The learner will perform all laboratory work and calculate results.
2. Conditions - The learner will have available all necessary glassware, reagents, and equipment along with a copy of Volumetric Determination of Total Calcium Effluent Monitoring Procedure.
3. Accepted Performance - Given a checklist to be kept by the Instructor, the student will obtain 80%. He will also repeat the analysis until 80% is accomplished.

B. INSTRUCTIONAL RESOURCES:

2. Suggested Media: Overheads showing digestion of sample.

C. INSTRUCTIONAL APPROACH: (Sequencing) Theoretical concepts of EDTA Titrimetric method to be discussed in the classroom. Procedure description to include the digestion techniques and pH adjustment to the sample. Analyses which includes student performance as well as instructor evaluation. IPW Equipment and Supply Requirements - see page 2-5, part A of Effluent Monitoring Procedure. IPW Reagent Requirements - see page 2-5, part C of Effluent Monitoring Procedure.
GUIDELINES FOR INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Volumetric Determination of Total Calcium

UNIT OF INSTRUCTION: Theoretical Concepts

LESSON NUMBER: 1 of 3

ESTIMATED TIME: 1 Hour

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The reporting of Total Calcium is required by many National Pollutant Discharge Elimination System Permits.

ENTRY LEVEL BEHAVIOR: The learner must have completed Course I, Basic Laboratory Skills or have shown competence in the areas covered by this course. Course II is not a prerequisite, but is desirable. The learner must also be able to perform the following:

1. Adjust pH of sample
2. Use an analytical balance

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior: The learner will participate in classroom discussion.

2. Conditions: The learner will have a copy of the Volumetric Determination of Total Calcium Effluent Monitoring Procedure.

3. Accepted Performance: The learner will answer all questions orally given by the Instructor.

B. INSTRUCTIONAL RESOURCES:


2. Suggested Media: None

C. INSTRUCTIONAL APPROACH: (Sequencing) The Instructor should cover the basic chemistry of EDTA titrimetric method of determining calcium. The color changes of the titration should also be emphasized at this time.
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Volumetric Determination of Total Calcium

UNIT OF INSTRUCTION: Procedure Description

ESTIMATED TIME: 30 Minutes

LESSON NUMBER: 2 of 3

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The reporting of Total Calcium is required by many National Pollutant Discharge Elimination System Permits.

ENTRY LEVEL BEHAVIOR: The learner must have completed Course I, Basic Laboratory Skills or have shown competence in the areas covered by this course. Course II is not a prerequisite, but is desirable. The learner must also be able to perform the following:

1. Adjust pH of sample
2. Use an analytical balance

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior: The learner will participate in classroom discussion.

2. Conditions: The learner will have a copy of the Volumetric Determination of Total Calcium Effluent Monitoring Procedure.

3. Accepted Performance: The learner will answer all questions orally given by the Instructor.

B. INSTRUCTIONAL RESOURCES:


2. Suggested Media: Overheads showing digestion and reflux of sample.

C. INSTRUCTIONAL APPROACH (Sequencing) The Instructor should cover the actual procedure as outlined in the EMP beginning on page 2-11. It should be emphasized at this point that the EDTA must be standardized after preparation. The digestion of the sample should be explained. It is also important that the student be made aware that correct pH adjustment of sample is critical to the analysis.
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Volumetric Determination of Total Calcium

UNIT OF INSTRUCTION: Analysis

LESSON NUMBER: 3 of 3

ESTIMATED TIME: 3.5 Hours

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The reporting of Total Calcium is required by many National Pollutant Discharge Elimination System Permits.

ENTRY LEVEL BEHAVIOR: The learner must have completed Course I, Basic Laboratory Skills or have shown competence in the areas covered by this course. Course II is not a prerequisite, but is desirable. The learner must also be able to perform the following:

1. Adjust pH of sample
2. Use an analytical balance

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior: The learner will perform the Total Calcium Determination by the EDTA Volumetric Method.

2. Conditions: The learner will have a copy of the Volumetric Determination of Total Calcium Effluent Monitoring Procedure.

3. Accepted Performance: The student must obtain an 80% on the Instructor checklist or repeat until he does.

B. INSTRUCTIONAL RESOURCES:


2. Suggested Media: Photo or color slides of an actual endpoint color change.

C. INSTRUCTIONAL APPROACH (Sequencing) Student prepares Calcium Stock and Standard Solutions, as well as EDTA solution. Student standardizes EDTA. Student digests sample. Student titrates sample. Student calculates results.
A prototype for development of routine operational procedures for the determination of copper (Cu$^{++}$), magnesium (Mg$^{++}$), manganese (Mn$^{++}$), and zinc (Zn$^{++}$) as applied in wastewater treatment facilities and in the monitoring of effluent wastewaters.

Instructional Package Worksheet

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PART II  INSTRUCTIONAL PACKAGE WORSHEET

C. Determination of Copper (Cu++), Magnesium (Mg++), Manganese (Mn++), and Zinc (Zn++)

1. Copper: The Federal Register also provides a colorimetric procedure (Neocuproine Method). This procedure can be found in Standard Methods for the Examination of Water and Wastewater 14th Edition, 1975 page 196.

2. Magnesium: The Federal Register also provides a gravimetric procedure. This procedure can be found in Standard Methods for the Examination of Water and Wastewater 14th Edition, 1975 page 221.


4. Zinc: The Federal Register also provides a colorimetric procedure (Dithizone Method II). This procedure can be found in Standard Methods for the Examination of Water and Wastewater 14th Edition, 1975 page 265.

   a. The atomic absorption technique was chosen to demonstrate the use of this instrument for the analysis of these metals.

   b. The student prepares his own standard solutions, prepares calibration curves and analyses an unknown sample prepared by the instructor.
GUIDELINES FOR INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Determination of Copper (Cu⁺⁺), Magnesium (Mg⁺⁺), Manganese (Mn⁺⁺), and Zinc (Zn⁺⁺)

UNIT OF INSTRUCTION:
LESSON NUMBER: 1 of 1
ESTIMATED TIME: 3 hours

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The learner will need to know how to perform this determination if it is required by his permit.

ENTRY-LEVEL BEHAVIOR: The learner must be able to:
1. Perform weighings on an analytical balance
2. Perform weighings on a trip or platform balance
3. Correctly use common laboratory glassware such as:
   a. volumetric flasks
   b. pipets and pipetting bulbs
4. Calculate and use dilution factors
5. Prepare solutions of acids safely
6. Handle compressed gas cylinders safely

A. INSTRUCTIONAL OBJECTIVE:
1. Terminal Behavior: The learner will record sample identification information, prepare a blank and series of standards, optimize the atomic absorption instrument, and aspirate the standards and samples. He will clean up his equipment and use the obtained data to determine the concentration of copper, magnesium, manganese and zinc in a sample.
2. Conditions: The learner will be provided with the necessary glassware, reagents, a sample, an atomic absorption instrument and a copy of the EMP.
3. Accepted Performance: The learner's technique must be satisfactory according to an instructor's rating. His calibration curves and obtained results must be within 5 percent of the correct value.
B. INSTRUCTIONAL RESOURCES:


2. Suggested Media: Overheads showing location of controls of the atomic absorption instrument and theory of atomic absorption.

C. INSTRUCTIONAL APPROACH (Sequencing):

1. Classroom: Using overhead projecturals acquaint the learner with the basic theory of atomic absorption. The tape/slide audio visual unit XT-26 can be used to explain the theory of atomic absorption. Have the students read the sections of the EMP and review the procedure.

2. Laboratory: Supply the learner with all necessary equipment. Have the student optimize the instrument until it is ready for use. Have the student prepare the sample for analysis, prepare calibration curves by aspiration of standards into the instrument, aspirate sample, prepare calibration curves and calculate results.

3. Classroom: Discuss the laboratory performance of the learner.
A PROTOTYPE FOR DEVELOPMENT OF ROUTINE OPERATIONAL PROCEDURES
for the
DETERMINATION OF LEAD BY ATOMIC ABSORPTION USING THE EXTRACTION PROCEDURE

as applied in
WASTEWATER TREATMENT FACILITIES
and in the
MONITORING OF EFFLUENT WASTEWATERS

INSTRUCTIONAL PACKAGE WORKSHEET

National Training and Operational Technology Center
Municipal Operations and Training Division
Office of Water Program Operations
U.S. Environmental Protection Agency

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PART II INSTRUCTIONAL PACKAGE WORKSHEET

D. Determination of Lead by Atomic Absorption Using the Extraction Procedure

1. The Federal Register lists an alternate procedure (Dithizone Method). This procedure can be found in Standard Methods for the Examination of Water and Wastewater 14th Edition, 1975 page 215.

2. The atomic absorption technique was selected and can be found in Standard Methods for the Examination of Water and Wastewater 14th Edition, 1975 page 148.

3. The student prepares his own standard solutions, prepares calibration curves and analyzes an unknown sample prepared by the instructor.
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET.

SUBJECT MATTER: Determination of Lead by Atomic Absorption Spectroscopy Using the Extraction Procedure

UNIT OF INSTRUCTION:

LESSON NUMBER: 1 of 1

ESTIMATED TIME: 2.5 hours

JUSTIFICATION FOR THIS INSTRUCTION OBJECTIVE: The learner will be responsible for determining the lead content of wastewater samples for NPDES report requirement.

ENTRY LEVEL BEHAVIOR: The learner must be able to:

1. Perform weighings on an analytical balance
2. Perform weighings on a trip or platform balance
3. Correctly use common laboratory glassware such as
   a) volumetric flasks
   b) separatory funnel
   c) graduated cylinders
   d) pipets and pipetting bulbs
4. Construct and use a graph
5. Transfer solids from a weighing boat to flask
6. Calculate and use dilution factors
7. Prepare solutions of acids safely
8. Handle compressed gas cylinders safely

A. INSTRUCTIONAL OBJECTIVE

1. Terminal Behavior: The learner will record sample identification information, prepare a blank and series of standards, optimize the atomic absorption instrument, and aspirate the standards and samples. He will clean up his equipment and use the obtained data to determine the concentration of lead in the sample.
2. **Conditions** - The learner will be provided with the necessary glass-ware, reagents, a sample, an atomic absorption instrument, a copy of the EMP and 105 min.

3. **Accepted Performance** - The learner's technique must be satisfactory according to an instructor's rating. His calibration curve and obtained results must closely match the instructor's.

B. **INSTRUCTIONAL-RESOURCES**


2. **Suggested Media** - Overheads showing location of controls of the atomic absorption instrument, also overheads dealing with the basic theory of atomic absorption.

C. **INSTRUCTIONAL APPROACH (SEQUENCING)**

1. **Classroom** - Using overheads acquaint the student with the basic theory of atomic absorption. Explain the reasons for using the extraction procedure. Using the overheads show the student the operation of the atomic absorption instrument he will be using. The slide sequence XT-26 can be used to explain the theory of atomic absorption. Have the students read the sections of the EMP and go over the operation procedure.

2. **Laboratory** - Supply the learner with all necessary equipment. Have the student optimize the instrument until it is ready for use. Then have the student extract the sample or samples and series of standards and aspirate the sample and standards.

3. **Classroom** - Discuss the laboratory performance of the learner.
A prototype for development of routine operational procedures
for the

determination of mercury using the flameless atom absorption (cold vapor) technique

as applied in
wastewater treatment facilities
and in the
monitoring of effluent wastewaters

Instructional Package Worksheet

National Training and Operational Technology Center
Municipal Operations and Training Division
Office of Water Program Operations
U.S. Environmental Protection Agency
PART II  INSTRUCTIONAL PACKAGE WORKSHEET

E. Determination of Mercury Using the Flameless Atomic Absorption (Cold Vapor) Technique


2. The learner will determine the necessary content of several standard solutions and typical samples of treatment plant effluents.
GUIDELINES FOR
INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Mercury Determination

UNIT OF INSTRUCTION: Determination of Mercury Using the Flameless Atomic Absorption (Cold Vapor) Technique

LESSON NUMBER: 1 of 1

ESTIMATED TIME: 2.5 hours

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The learner should know how to set-up, calibrate, and use a Coleman MAS-50 Mercury Analyzer for the determination of mercury in wastewater and wastewater treatment plant effluents

ENTRY LEVEL BEHAVIOR: The learner must be able to:

1. Perform basic mathematical computations (addition, subtraction, multiplication, and division)
2. Handle solutions of acids and bases safely
3. Bore holes in rubber stoppers and bend and cut glass tubing safely
4. Understand the terms liter, milliliter, gram, milligram
5. Perform weighings on an analytical and on a trip balance
6. Use ordinary laboratory glassware such as beakers, flasks, graduated cylinders, volumetric flasks, burettes, volumetric and graduated pipettes.
7. Clean laboratory glassware
8. Prepare chemical solutions

A. INSTRUCTIONAL OBJECTIVE

1. Terminal Behavior - The learner will determine the mercury content of several standard solutions and typical samples of treatment plant effluents.

2. Conditions - The learner will have the use of the attached EMP and all chemicals and equipment listed in it.

3. Accepted Performance - The use of proper technique in performing the test will be judged by the instructor.

B. INSTRUCTIONAL RESOURCES

2. XT-92 Slide sequence on the method covering both the chemical and spectrophotometric sections, over heads covering the control locations on the MAS-50 instrument.

C. INSTRUCTIONAL APPROACH (Sequencing)

1. Classroom - Have the students read each section of the EMP. Cover the operation of the instrument. Explain the difference between flameless atomic absorption and the normal operation of atomic absorption. Explain the advantage and disadvantage of each type.

2. Laboratory - Supply the learner with all necessary glassware and reagents. Have the students turn on the instrument in order to begin warm-up. Unless the sample being used is an effluent sample, the heating times can be omitted. Consequently, the students should begin the chemical procedure immediately after turning on the instrument. During the 15-minute standing time in the chemical procedure the students should be able to further acquaint themselves with the instrument and ask any questions.

3. Classroom - Discuss the laboratory performance of the learner.
A PROTOTYPE FOR DEVELOPMENT OF ROUTINE OPERATIONAL PROCEDURES for the DETERMINATION OF POTASSIUM USING FLAME PHOTOMETRY as applied in WASTEWATER TREATMENT FACILITIES and in the MONITORING OF EFFLUENT WASTEWATERS INSTRUCTIONAL PACKAGE WORKSHEET

National Training and Operational Technology Center Municipal Operations and Training Division Office of Water Program Operations U.S. Environmental Protection Agency
F. Determination of Potassium Using Flame Photometry

1. Two alternate methods of potassium analysis are provided in the Federal Register, Wednesday, December 1, 1976, Part II, table 1. In both methods, the first step is digestion. The digestion procedure is given in Methods for Chemical Analysis of Water & Wastes, pg. 83, par. 4.1.4), 1974. The analysis phase of the first of the two alternate procedures is atomic absorption, and is given in the same manual, pg. 143. The analysis phase of the second of the two alternate procedures is colorimetric (cobaltinitrite), and is given in Standard Methods, 14th ed, Method 317B, pg 235.

2. The method presented in the associated effluent monitoring procedure (EMP) was taken from Standard Methods, 14th ed, Method 317A, pg 234, and from the Beckman Instrument Manual.

3. The learners will prepare calibration standards, graphs, and analyze a sample provided by the instructor.
GUIDELINES FOR INSTRUCTIONAL PACKAGE WORKSHEET

SUBJECT MATTER: Determination of Potassium Using Flame Photometry

UNIT OF INSTRUCTION:

LESSON NUMBER: 1 of 1

ESTIMATED TIME: 3 hours

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The learner will need to know how to perform this determination if it is required by his/her wastewater treatment plant permit.

ENTRY LEVEL BEHAVIOR: The learner must be able to:

1. Perform weighings on an analytical balance.
2. Perform weighings on a trip balance.
3. Handle solutions of acids safely.
4. Use pH sensitive paper.
5. Prepare a desiccator for use.
6. Use a hotplate safely.
7. Subtract numbers.
8. Use a pipet.
9. Transfer solids from a weighing boat to a volumetric flask and dilute to the mark.
10. Use wrenches to tighten gas line fittings.
11. Safely anchor cylinders of compressed gases.
12. Use a drying oven.
13. Use a funnel and filter paper to filter a solution.
15. Prepare a calibration graph. See the Effluent Monitoring Procedure on the Preparation of Calibration Graphs, CH.IN.cg.EMP.1a.1.77.

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior - The learner will determine the potassium content of a sample prepared by the instructor, and will exhibit proper technique during the procedure.

2. Conditions - The learner will have the use of all chemicals and equipment in the EMP.

3. Accepted Performance - Use of proper technique will be judged by the instructor. The potassium concentration found by the learner should be within plus or minus 5% of the true value as determined by the instructor.

B. INSTRUCTIONAL RESOURCES:

1. Available Media: Twenty-four unassembled 2 x 2 slides.

2. Suggested Media: None.
C. INSTRUCTIONAL APPROACH (SEQUENCING):

1. Prior to the start of this laboratory session, the instructor should place about 3 g of potassium chloride in a small beaker, dry it at 110°C for one hour, and cool it in a desiccator. One beaker is needed for each two students since the experiment will be done in pairs.

Glassware should be cleaned as described in Section A.1 of the EMP.

Balances and the Beckman Model B spectrophotometer with flame photometry attachments should be in working order.

Hydrogen and oxygen cylinders should be attached to the instrument.

The proper phototube should be in the instrument.

Desiccant in the instrument should be checked.

A sample of effluent should be on hand (approximately 50 ml per pair of students) and the potassium concentration determined by the instructor. Or, the instructor may prefer to prepare a deionized water sample of potassium chloride.

2. About two hours prior to the start of this laboratory session, the instructor should turn on the instrument for warm-up, and do steps A.3.2 through A.3.5 in the EMP.

The instructor should also pre-set all gauges on the instrument and gas cylinders as described in F.2.3 through F.2.16; i.e., just before doing step F.2.17, only the main valves on the two cylinders need to be opened (oxygen first, then hydrogen) by the students.

3. Classroom discussion (using 2 x 2 slides) about general principles involved in absorbance and emission spectroscopy; contrast the two phenomena. Discuss the component parts of a flame photometer.

4. Laboratory instructions about safety connected with use of flame photometers (e.g., properly anchored gas tanks, dangers of being burned by the flame).

5. Have the learners do steps B.2.4 through B.2.8.

6. Tell the learners to take a minute to read steps B.2.9 and B.2.10.

7. Tell the learners what the expected potassium concentration in the effluent or synthetic sample is. (This will dictate which potassium standards are prepared by the learners (the intermediate B.3, or standard B.4)).

8. Have the learners prepare the intermediate (B.3.1 through B.3.3) or standard (B.4.1 through B.4.3) potassium solutions.

9. In connection with Section C, the synthetic sample would not have to be digested or filtered. The effluent sample may have to be, at the judgment of the instructor.
C. INSTRUCTIONAL APPROACH (Continued):

10. Tell the learners. Section D has already been done; i.e., you have turned the instrument on.

11. Have the learners do steps E.2. through E.8.

12. Have the learners do steps F.1.1. through F.1.4.

13. Have the learners familiarize themselves with figures 1, 2, and 3 in the EMP.

14. Have the learners turn on the main cylinder valves (oxygen first, then hydrogen) and then do steps F.2.18. through F.2.52. Do not have them do F.2.48. if another pair of learners is to use the instrument. (It is even desirable to leave the instrument on overnight if it will be used the next day.)

15. Classroom - have the learners do Section G. Discuss possible sources of error if the Accepted Performance has not been achieved.

D. IPW-EQUIPMENT AND SUPPLY REQUIREMENTS

For each pair of students:

1. One Beckman Model B spectrophotometer with flame photometry attachments.
2. One oxygen cylinder and one hydrogen cylinder with pressure regulators.
3. One pack of matches to light the instrument.
4. One plastic squeeze bottle of deionized water.
5. Two pairs of safety glasses.
6. Two laboratory aprons.
7. One pencil or pen.
8. One 12 inch ruler.
9. One analytical balance.
10. One grease pencil.
11. One 100 ml pipet.
12. One 10 ml graduated pipet.
13. One pipet bulb.
14. One 1 liter volumetric flask.
15. Six 100 ml volumetric flasks.
16. Eight 5 ml glass beakers (supplied with the instrument) or eight 5 ml plastic disposable beakers.

For the class as a whole:

One desiccator large enough to hold the small beakers of potassium chloride; one beaker for each pair of students.
E. IPW REAGENT REQUIREMENTS

For each pair of students:

1. One beaker containing 3 g. of potassium chloride.
A PROTOTYPE FOR DEVELOPMENT OF
ROUTINE OPERATIONAL PROCEDURES

for the

DETERMINATION OF SODIUM USING FLAME PHOTOMETRY

as applied in

WASTEWATER TREATMENT FACILITIES
and in the
MONITORING OF EFFLUENT WASTEWATERS

INSTRUCTIONAL PACKAGE WORKSHEET

National Training and Operational Technology Center
Municipal Operations and Training Division
Office of Water Program Operations
U.S. Environmental Protection Agency
PART II  INSTRUCTIONAL PACKAGE WORKSHEET

8. Determination of Sodium Using Flame Photometry

1. An alternate method of sodium analysis is provided in the Federal Register, Wednesday, December 1, 1976, Part II, table 1. It is digestion followed by atomic absorption. The digestion phase of the procedure is given in Methods for Chemical Analysis of Water & Wastes, pg. 83, par. 4.1.4), 1974. The analysis phase of the procedure is given in the same manual, pg. 147.

2. The method presented in the associated effluent monitoring procedure (EMP) was taken from Standard Methods, 14th ed, Method 320A, pg. 250, and from the Beckman Instrument Manual.

3. The learners will prepare calibration standards, graphs and analyze a sample provided by the instructor.
SUBJECT MATTER: Determination of Sodium Using Flame Photometry

UNIT OF INSTRUCTION:

LESSON NUMBER: 1 of 1

ESTIMATED TIME: 3 hours

JUSTIFICATION FOR THIS INSTRUCTIONAL OBJECTIVE: The learner will need to know how to perform this determination if it is required by his/her wastewater treatment plant permit.

ENTRY LEVEL BEHAVIOR: The learner must be able to:

1. Perform weighings on an analytical balance
2. Perform weighings on a trip balance
3. Handle solutions of acids safely
4. Use pH sensitive paper
5. Prepare a desiccator for use
6. Use a hotplate safely
7. Subtract numbers
8. Use a pipet
9. Transfer solids from a weighing boat to a volumetric flask and dilute to the mark.
10. Use wrenches to tighten gas line fittings
11. Safely anchor cylinders of compressed gases
12. Use a drying oven
13. Use a funnel and filter paper to filter a solution
14. Operate gas pressure regulators
15. Prepare a calibration graph. See the Effluent Monitoring Procedure on the Preparation of Calibration Graphs, CH.IN.cg.EMP.1a.1.77.

A. INSTRUCTIONAL OBJECTIVE:

1. Terminal Behavior - The learner will determine the sodium content of a sample prepared by the instructor, and will exhibit proper technique during the procedure.

2. Conditions - The learner will have the use of all chemicals and equipment in the EMP.

3. Accepted Performance - Use of proper technique will be judged by the instructor. The sodium concentration found by the learner should be within plus or minus 5% of the true value as determined by the instructor.

B. INSTRUCTIONAL RESOURCES:

1. Available Media: Twenty-four unassembled 2 x 2 slides
2. Suggested Media: None.
C. INSTRUCTIONAL APPROACH (SEQUENCING):

1. Prior to the start of this laboratory session, the instructor should place about 3 g of sodium chloride in a small beaker, dry it at 110°C for one hour, and cool it in a desiccator. One beaker is needed for each two students since the experiment will be done in pairs.

Glassware should be cleaned as described in Section A.1. of the EMP.

Balances and the Beckman Model B spectrophotometer with flame photometry attachments should be in working order.

Hydrogen and oxygen cylinders should be attached to the instrument.

The proper phototube should be in the instrument.

Desiccant in the instrument should be checked.

A sample of effluent should be on hand (approximately 50 ml per pair of students) and the sodium concentration determined by the instructor. Or, the instructor may prefer to prepare a deionized water sample of sodium chloride.

2. About two hours prior to the start of this laboratory session, the instructor should turn on the instrument for warm-up, and do steps A.3.2. through A.3.5. in the EMP.

The instructor should also pre-set all gauges on the instrument and gas cylinders as described in F.2.3. through F.2.16.; i.e., just before doing step F.2.17, only the main valves on the two cylinders need to be opened (oxygen first, then hydrogen) by the students.

3. Classroom - discussion (using 2 x 2 slides) about general principles involved in absorption and emission spectroscopy; contrast the two phenomena. Discuss the component parts of a flame photometer.

4. Laboratory - instructions about safety connected with use of flame photometers (e.g., properly anchored gas tanks, dangers of being burned by the flame).

5. Have the learners do steps B.2.4. through B.2.8.

6. Tell the learners to take a minute to read steps B.2.9. and B.2.10.

7. Tell the learners what the expected sodium concentration in the effluent or synthetic sample is. (This will dictate which sodium standards are prepared by the learners (the intermediate B.3., or standard B.4.).

8. Have the learners prepare the intermediate (B.3.1. through B.3.3.) or standard (B.4.1. through B.4.3.) sodium solutions.

9. In connection with Section C, the synthetic sample would not have to be digested or filtered. The effluent sample may have to be, at the judgement of the instructor.
C. INSTRUCTIONAL APPROACH (Continued):

10. Tell the learners Section D has already been done; i.e., you have turned the instrument on.

11. Have the learners do steps E.2. through E.8.

12. Have the learners do steps F.1.1. through F.1.4.

13. Have the learners familiarize themselves with figures 1, 2, and 3 in the EMP.

14. Have the learners turn on the main cylinder valves (oxygen first, then hydrogen) and then do steps F.2.18. through F.2.52. Do not have them do F.2.48. if another pair of learners is to use the instrument. (It is even desirable to leave the instrument on overnight if it will be used the next day.)

15. Classroom - have the learners do Section G. Discuss possible sources of error if the Accepted Performance has not been achieved.

D. IPW EQUIPMENT AND SUPPLY REQUIREMENTS

For each pair of students:

1. One Beckman Model B spectrophotometer with flame photometry attachments.
2. One oxygen cylinder and one hydrogen cylinder with pressure regulators.
3. One pack of matches to light the instrument.
4. One plastic squeeze bottle of deionized water.
5. Two pairs of safety glasses.
6. Two laboratory aprons.
7. One pencil or pen.
8. One 12" inch ruler.
9. One analytical balance.
10. One grease pencil.
11. One 100 ml pipet.
12. One 10 ml graduated pipet.
13. One pipet bulb.
14. One 1 liter volumetric flask.
15. Six 100 ml volumetric flasks.
16. Eight 5 ml glass beakers (supplied with the instrument) or eight 5 ml plastic disposable beakers.

For the class as a whole:

One desiccator large enough to hold the small beakers of sodium chloride; one beaker for each pair of students.
IPW REAGENT REQUIREMENTS

For each pair of students:

1. One beaker containing 3 g. of sodium chloride.