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Standard Practice for Planning and Safe Operation of a Spectrochemical Laboratory[1]

This standard is issued under the fixed designation E 416; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the general planning of a spectrochemical laboratory, the equipment necessary for efficient operation of such a laboratory, and recommended safety precautions to be considered. Principal equipment housed in such a laboratory may include optical emission spectrographs, vacuum and air-path optical emission spectrometers, plasma emission spectrometers, X-ray emission spectrometers, X-ray diffractometers, and atomic absorption and flame emission spectrophotometers.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

E 50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials

E 115 Practice for Photographic Processing in Optical Emission Spectrographic Analysis[3]

E 406 Practice for Using Controlled Atmospheres in Spectrochemical Analysis

E 528 Practice for Grounding Basic Optical Emission Spectrochemical Equipment[3]

3. Significance and Use

3.1 While considerations for spectrochemical equipment are a prime concern to spectroscopists, it is quite likely other analytical equipment and other chemical and physical laboratories will be in contiguous space. Therefore, the proximity of these other laboratories should be a primary concern in the location and design of a spectrochemical laboratory.

3.2 The safety and health of all individuals working in any laboratory facility is of primary importance. Therefore, the design of the laboratory and the equipment used therein should include the latest recommendations of safety and health experts. In addition, all laboratory facilities should meet all of the safety and health standards of federal, state, and local authorities.

3.3 This practice will be useful for plant managers, architects, design or construction engineers, or anyone involved with the design, construction, or remodeling of laboratory facilities. Purchasing agents, chief spectroscopists, or anyone responsible for the purchase and location of new equipment will also find this practice useful.

4. Location

4.1 The general location of the laboratory depends primarily on whether it is to serve as a research, commercial, government, or a production facility. The laboratory should preferably be near the organization it serves or near the principal source of samples. If this is not possible, consideration should be given to a means of rapid transportation of samples from the source to the laboratory. Vibration, dust, fumes, noise, humidity, and temperature fluctuations should be at a minimum to ensure maximum capabilities, precision, and employee health. These factors will be considered later.

5. Arrangement

5.1 *Space Allocation*—The arrangement of the rooms for spectrochemical analysis shall provide easy access, semi-privacy, and secondary exits. Space for additions and modifications to equipment should be considered. The chief spectroscopist should be consulted on any laboratory planning, whether a large area or a small addition is under consideration.

5.2 *Optical Emission Spectrographic and Spectrometric Equipment*—The equipment will consist of various combinations of excitation sources, spectrographs or spectrometers, excitation stands, and in some cases, gas-handling apparatus and special sample holders that are described in the various spectrochemical methods. If possible, this equipment should be

[1] This practice is under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores and Related Materials and is the direct responsibility of Subcommittee E01.20 on Fundamental Practices.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Withdrawn.

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placed in an instrument laboratory away from the more corrosive atmosphere of a general chemical laboratory to avoid salt coating of optics and the corrosion of electrical components.

5.3 *Photographic Processing Equipment*—Photographic instruments will require a darkroom and equipment as described in Practice E 115. A refrigerator or freezer is desirable for film or plate storage. The spectrochemical darkroom shall not be shared with other facilities.

5.4 *Measuring and Calculating Equipment*—A microphotometer will be required in those installations using films or plates. This equipment is best housed in a separate room where the lights can be dimmed. Film viewers, calculating boards, desk calculators, microprocessors, and computer terminals will be required, depending upon the size and scope of the installation.

5.5 *Plasma Spectrometers*—Inductively coupled, d-c, and microwave-induced plasma spectrometers should be placed in an instrument laboratory separate from the general chemical laboratory for the same reasons outlined in 5.2.

5.6 *X-Ray and Optical Emission Instruments*—Place this equipment near the general chemical laboratory, but not in the same room. Avoid placing X-ray equipment in the same room with optical emission and inductively coupled plasma equipment in order to prevent radio-frequency electrical disturbances to the X-ray equipment. Federal, state, and local regulations with regard to shielding, safety interlock switches, and other devices for the control of radiation should be observed when laboratory space is designed for this equipment.

5.6.1 Instruments sensitive to electric line surges or line noise should be isolated from electrical lines serving furnaces, motors, or other surge-producing equipment. Electrical line filters or autotransformers may help reduce or eliminate electrical noise.

5.7 *Atomic Absorption and Flame Emission Spectrophotometric Equipment*—Atomic absorption spectrophotometers and flame photometers should be placed in a separate area adjacent to the general chemical laboratory. However, if space is limited, they could be placed in the general chemical laboratory.

5.8 *Sample Preparation*—A separate room for sample preparation should be provided with adequate space for such items as a bench grinder, lathe, drill press, cut-off machine, milling machine, button-melting furnace, electric mortar and pestle, screening and mixing equipment, briquetting press, electrode shaper, band saw, belt sander, and various hand tools. A low-power binocular microscope should be available to facilitate the removal of foreign material from matrix materials. The sample preparation room and each piece of dust-producing equipment should be provided with adequate dust removal to prevent the accumulation of potentially harmful dust and noxious fumes.

5.9 *Chemical Facilities*—The spectroscopist may require many of the facilities of the chemical laboratory; therefore, ideally, he/she should have available a chemical bench, sink, hot plate, oven, muffle furnace, fume hood, analytical balance, chemical glassware, etc.

5.10 *Workbench*—The spectroscopist will ordinarily require storage cabinets for chemicals, reference materials, and samples at a workbench provided with a dental amalgamator for mixing specimens and reference materials. This workbench should be near the spectrochemical equipment.

5.11 *Storage*—Space should be provided for storing reference materials, samples that must be retained, reference films and plates, strip charts, record books, report sheets, computer data, etc.

5.12 *Communication*—Telephone, teletype, pneumatic tube, a computer data-handling system, or similar systems shall be provided for transmitting samples or results, as required.

6. Construction

6.1 *Walls, Floors, and Work Surfaces*—Walls, floors, and work surfaces shall be finished with materials that are easily cleaned and maintained. Paints used on walls and laboratory furniture as well as materials used for work surfaces and floor coverings shall be resistant to the chemicals used in the laboratory. Laboratories that determine microgram or smaller quantities of elements should incorporate safeguards to prevent sample contamination from wall paints, work surfaces, floor cleaning compounds, etc.

6.2 *Insulation*:

6.2.1 Acoustical walls and ceilings are desirable for noise control and to eliminate or reduce potential hazards to hearing. The room noise level shall be reduced to or below the level required by applicable regulations.

6.2.2 The walls and ceilings should be heat-insulated so that an air-conditioning unit of minimum size satisfies the requirements.

6.2.3 The enclosure should be well sealed to prevent entrance of dust and corrosive materials.

6.3 *Air Conditioning*—An air-conditioned laboratory is necessary to ensure maximum precision of photographic and electronic recording instruments, but particularly for vacuum and air-path optical emission spectrometers. Low humidity will reduce absorption of water vapor by specimens that must be powdered and mixed homogeneously. A dry atmosphere will also reduce "spitting" and improve the burn in a d-c arc, or even a spark excitation, and reduce leakage of charge from the capacitors in the electronics of an optical emission spectrometer. The relative humidity shall be held constant at some value between 35 and 50 %, and, if possible, within ±1 %. For older instruments, it may be necessary to hold the temperature within ±0.5°C at some value between 21 and 24°C (70 and 75°F). For newer instruments, the recommendation of the manufacturer should be observed. The air-filtering system shall be maintained at designed efficiency to prevent contamination from adjacent laboratories.

6.4 *Vibration*—Vibration shall be minimized in spectrochemical laboratories and other support laboratories by good construction and by isolation from vibrating machinery. In addition, shock mounts and vibration dampeners may be required for analytical balances, microphotometers, spectrographs, and for optical and X-ray emission spectrometers.

6.5 *Darkroom*—Light-colored walls are recommended for the darkroom, which needs to be light-tight. A maze entrance painted with a flat black paint or weatherstripped doors are

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