

**PLAINTIFF'S  
EXHIBIT**

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Aluminum Company of America  
INDUSTRIAL HYGIENE HANDBOOK

Chapter I

The Industrial Hygiene Program

**Purpose**

The main purpose of an industrial hygiene program is to prevent occupational diseases and disabilities. In order to meet this aim, factual information regarding potential health hazards in all working areas is collected according to a regular schedule. With these data management may be kept currently informed on those conditions which are satisfactory and those which require additional control measures.

**IH Committee**

An industrial hygiene program at one of Alcoa's Works generally begins with the Works Manager placing the responsibility for industrial hygiene problems. This responsibility usually falls to a committee rather than to an individual. The committee consists of senior representatives from the major departments of a plant, for example: Production, Engineering, Metallurgy, Personnel, Medical, Safety and Analytical Chemistry Departments. The chief chemist is an important member on almost every committee because the responsibility for collecting and disseminating data on environmental conditions will logically fall to him. He is often appointed as the committee's chairman.

**The Preliminary Survey**

The industrial hygiene committee's first task is to organize a definite program. This usually involves three distinct steps: A Preliminary Survey, a General Evaluation Survey, and a Continuous Follow-Up Survey. The purpose of the preliminary survey is to determine the areas of potential health hazard. To a large extent an industrial hygiene program is based on the results of a preliminary survey of plant materials, processes and activities. This survey serves to define the areas of interest, that is, areas of potential hazard requiring further environmental study.

**Flow Sheet**

The preliminary survey begins with a compilation of basic data concerning materials and processes in the plant and concludes with a plant inspection tour. The compilation may consist of an annotated plant map or word outline. Production center analyses and process flow sheets are effective. They should contain information relative to environmental health such as actual processes or operations, locations, raw materials used and their rates of consumption, potential exposures, existing control measures and their effectiveness, and other pertinent data. The more data the better.

**Plant Inspection**

After the basic data have been prepared, the interested parties begin their tour of the plant. If possible the tour should follow the normal flow of materials. The information needed for a proper evaluation of working conditions is noted on the flow sheet. Such information should give answers to questions such as: Are the working conditions obviously good or bad? Have there been complaints from the employees? Has there been a history of occupational illness in any area? Are there any recommendations for further study? Are there areas where dust, vapors or gases are produced? If so, what are the probable contaminants? Do we have criteria for these hazardous

materials? How effective is the housekeeping? How is the temperature, the lighting, the noise? Are there any radiation hazards? What types of protective equipment are used? Are they the right type? Such is the kind of information desired. Because the General Survey is based on the findings of the Preliminary Survey a rather extensive amount of data is necessary. Assistance with both of these surveys is available from the Pittsburgh Industrial Hygiene Division.

### The General Survey

The purpose of the general survey is to evaluate potential hazards detected in the preliminary survey and to provide data for their engineering control, if necessary. Evaluation may be accomplished by one or more of several methods: measuring the response in the individual, measuring toxic materials in his body fluids, or by measuring his environment.

### Methods of Evaluation

Measurement of the individual's response is the surest means of telling if an environmental hazard exists. Unfortunately, exposures to excessive concentrations of toxic materials can result in impaired performance or disability which are sometimes permanent. Therefore, by the time the individual's responses are measurable, irreparable damage may already have been done. An evaluation based on human responses is not consistent with preventive medicine and ordinarily is to be discouraged.

### Environmental Measurements

Some toxic substances can be measured in an individual's body fluids before any damage is done to him. Such substances are relatively few and the means of collecting samples of body fluids for their measurement are, at the least, inconvenient. Therefore, in most cases an evaluation of exposures to toxic materials must be based on an evaluation of the employee's environment. When a potential hazard exists, when the degree of exposure is not apparent to the senses, when we cannot measure the amounts of toxic substances absorbed by employees, then we must measure the amounts of airborne contaminants in the environment and, from this, estimate the exposure.

### Preparation for Sampling

A certain amount of preparation is necessary before conducting a general survey. Once it has been decided that atmospheric samples are required, based on information in the preliminary survey, it becomes necessary to know how many samples should be taken; where; when; for how long; with what equipment. Most of the answers to these questions can be determined by further reference to the results of the preliminary survey.

### Extent of Sampling

During the general survey most areas in which toxic materials are used should be sampled. This means that a relatively large number of samples are necessary to establish a base line at the inauguration of an industrial hygiene program. It is important that there should be a sufficient number of samples collected at each operation to obtain a true picture of the exposure. In follow-up investigations simple visual inspections or infrequent air samples are usually sufficient to determine if the previously measured safe conditions have been maintained.

### Sampling Methods and Equipment

The sampling methods and equipment and the analytical techniques used depend on a great number of factors involving environmental conditions and the material sought. Specific information on sampling and analysis are found in Chapters IV and V.

## Follow-up Surveys

After the general survey it is very important that continual surveillance be kept throughout the plant. Industrial hygiene exposures change along with the constantly changing activities within a plant. It is therefore necessary to prepare a definite schedule for subsequent surveys.

→ Follow-up surveys do not involve the detail of a general survey and will require much less work. Preparing a schedule for follow-up work requires a study of the results of the general survey. From this it is possible to rate all areas within the plant according to the degree of hazard as indicated by the type of operation, general conditions, control measures and the associated atmospheric concentrations. Areas of little or no hazard may be set up for an annual or semi-annual visual inspection. In areas where the hazard potential is somewhat greater, air sampling might be scheduled semiannually or annually. In areas of greater hazard monthly sampling may be indicated. The frequency of inspection and sampling will vary from plant to plant. No arbitrary minimum or maximum number can be stated here. It is best determined by the plant personnel who are familiar with their operations and the hazards associated with them. ★

## Modification of Survey

The follow-up survey is a continuous operation geared to plant activity. As the survey progresses, over a period of months and years, some sampling stations may be discontinued, some may be sampled more frequently. Locations initially requiring only a visual inspection may later require air sampling and vice versa. New sampling stations may be added as new processes and materials are added. The follow-up survey schedule is not static but always changing, keeping up with the changes in activities and conditions within a plant. The Works Purchasing Department can be very helpful to the industrial hygiene committee in their follow-up work. Requisitions for all new process materials, if routed to the committee, can be scrutinized to determine if there is a possibility of new health hazards being introduced.

## Disposition of Data

All data accumulated during preliminary, general and follow-up surveys should be reviewed and interpreted by the committee. On the basis of the review the committee points out the problem areas, determines if control measures are necessary and decides on the action to be taken. Problems often have obvious solutions and can be resolved within the committee. Since the group consists of representatives from all areas of the plant (including the Engineering Department) the responsibility for instigating corrective measures can be assigned to the man or men most logically associated with the problem. In difficult cases where action on a solution requires a top management decision, the facts of the case and the committee's recommendations are turned over to the Works Manager. It may be worthy of mention here that the Pittsburgh Industrial Hygiene Division is always ready to offer its assistance to the committee whether it be for fact finding, evaluation or devising methods of control.

## Forms and Data Sheets

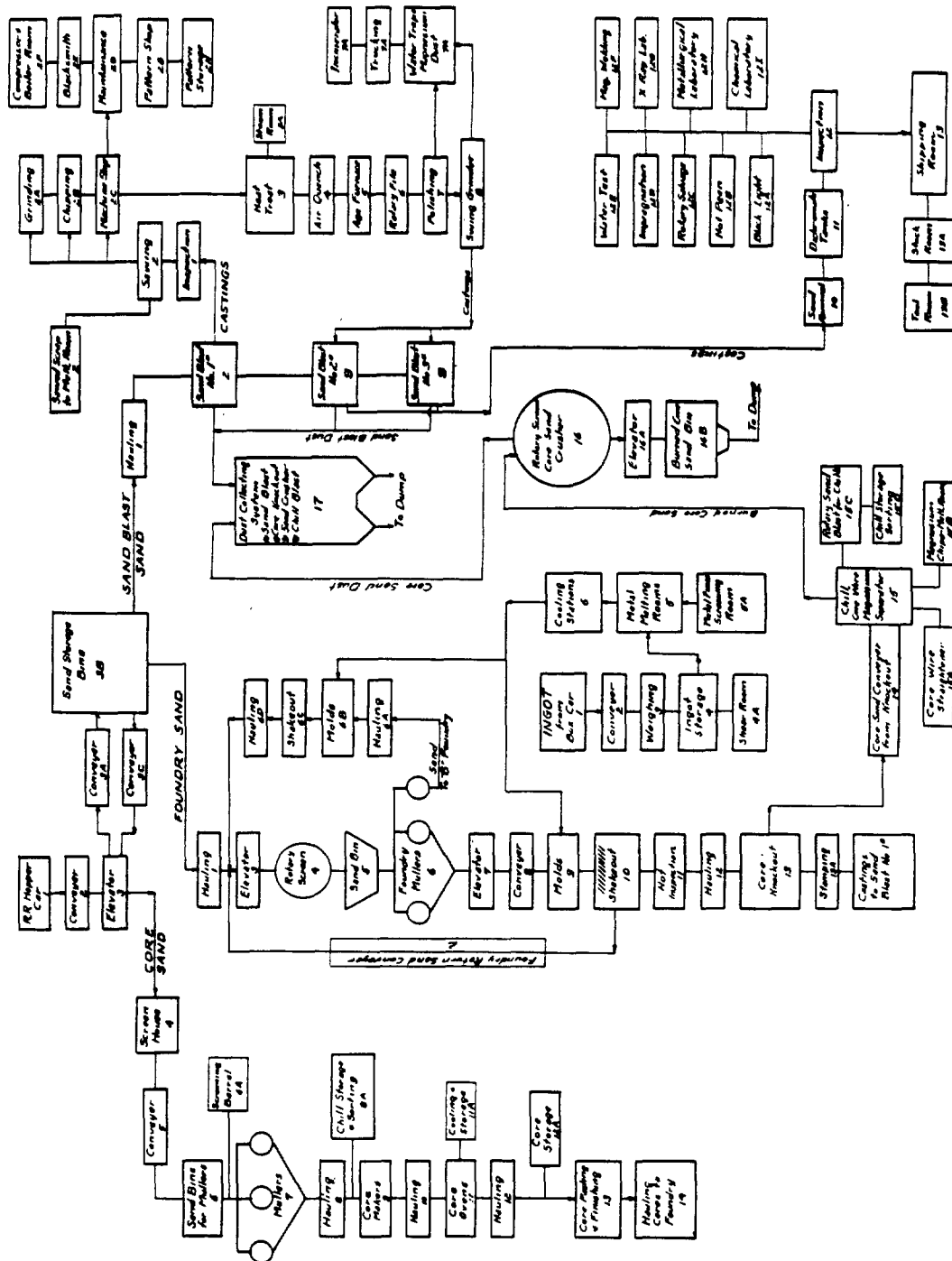
When gathering data for committee action it is convenient and desirable to have standard forms and data sheets for recording the required information. The pertinent data required at different locations vary; therefore, rather than use company-wide, standard forms, the plants are better able to determine their individual needs. Because certain basic information is required at all locations, typical forms are illustrated here. Examples 1.1 and 1.2 show two ways in which data for the Preliminary Survey have been recorded. A sampling schedule for a General Survey showing sampling locations and the contaminants to be determined is illustrated in Example 1.3. Data sheets for the sampler and analyst are shown in Example 1.4. (It is important to note that complete and properly maintained data sheets are admissible as evidence in compensation cases.) Ordinarily the committee is not concerned with the detail on the sampling and analytical data sheet unless there are questions concerning the results of specific samples. The only data of interest to them are the ★

# Example 1.1

## EXAMPLE OF DATA COMPILED DURING PRELIMINARY SURVEY

(Flowsheet Type)

### MATERIALS FLOW SHEET - BUFFALO FOUNDRY



## Example 1.2

### EXAMPLE OF DATA COMPILED DURING PRELIMINARY SURVEY

(Tabulation Type)

#### A REPORT ON THE USE OF MATERIALS IN RELATION TO THE POSSIBLE DEVELOPMENT OF HAZARDOUS CONDITIONS AT THE BUFFALO FOUNDRY

##### Melting Room

| <u>Dow 230 Flux</u> |        | <u>Dow 310 Flux</u> |       |
|---------------------|--------|---------------------|-------|
| KCl                 | 55.15% | KCl                 | 20%   |
| CaF <sub>2</sub>    | 1.99%  | CaF <sub>2</sub>    | 17%   |
| BaCl <sub>2</sub>   | 7.46%  | MgCl <sub>2</sub>   | 43%   |
| MgCl <sub>2</sub>   | 28.75% | MgO                 | 17.5% |
| NaCl                | 1.04%  | Na <sub>2</sub> O   | 0.5%  |
| MgO                 | 1.00%  |                     |       |
| H <sub>2</sub> O    | 4.61%  |                     |       |

The Dow 230 flux is used in melting magnesium and is used at temperatures up to 1400°F. The Dow 310 flux is a refining flux and may be subjected to temperatures around 1700-1800°F.

Melting is done in pot type furnaces heated with fuel oil. There are no hoods over the furnaces but a high ceiling with open windows at the top provides the ventilation.

##### Heat Treating Department

Sulfur-dioxide Gas (Cylinder)

Industrial Gas - 50% manufactured and 50% natural gas

A concentration of 0.5-1% sulfur dioxide gas is maintained in the heat-treating furnaces.

The present exhaust system appears to be adequate as no odor of sulfur dioxide gas can be detected in the working area.

When the metal is removed from the furnaces and air quenched, there is a slight contamination of sulfur dioxide.

The ageing oven is an automatically controlled, recirculating, gas fired oven having an exhaust system at the back of the furnace which allows the gases to be vented through a stack to the roof.

When the oven is started cold, the doors at the front of the oven are left slightly open for about five to ten minutes to prevent a possible explosion from any accumulated unburned gas.

date, location, analytical results and pertinent remarks. This information is compiled on a form such as shown in Example 1.5. When there is no need for immediately reporting air sampling information, it is tabulated at regular intervals, or just prior to meetings, to provide a basis for industrial hygiene committee discussions.

#### Reports of Occupational Exposure

It is also necessary for the central industrial hygiene unit to know the incidence of occupational disease throughout the company. Knowledge of exposures to harmful materials is important in enabling it to prevent the development of serious and widespread problems. It is therefore most important that all visits to plant dispensaries involving injury due to an occupational exposure be reported to the Pittsburgh Industrial Hygiene Division. The exposures may involve dermatitis, eye irritation, respiratory tract irritation, systemic poisoning, noise deafness, etc. ★

#### Monthly Reporting

Reports should be forwarded monthly to Dr. L. V. Cralley, Pittsburgh Office. A suggested form for this report is shown in Example 1.6. If there are no exposures for the month the report should be marked "no exposures" and forwarded. It is desirable that all reports be routed to all members of the plant industrial hygiene committee in order that the central unit may have the advantage of their comments and suggestions. ★

#### Personnel Training

The training of the individual who makes the environmental studies and collects data for the committee should be broad. The main requisites are a sound technical background and the ability to get along well with people. The remainder of the training is best obtained on the job. He must become familiar with operations in the plant and learn exactly what is being done at any particular location and why it is done in that manner. He will be expected, of course, to become proficient in the mechanics of collecting and analyzing the contaminants found in his plant. He will train himself to recognize hazards, real and potential, and to determine when conditions are normal and abnormal. He will become alert to changes in the plant, learn what materials are currently being used. He will become suspicious of areas with poor housekeeping and expect to find other hazardous conditions in areas where one is found. Above all else he must use tact and diplomacy in his associations with the employees and their supervisory personnel.

#### Relationship between Sampler & Employees

A few words might be said at this point about the relationship between the sampler and the employees. As the industrial hygienist collects samples in a plant he is bound to arouse natural curiosities. This is especially true at the start of a program. What the sampler tells the employees about his activities depends on policy set by the Works Manager and his staff. However, there are a few general comments that are appropriate here. By ignoring questions, the sampler creates resentment that will, at the least, cost him the loss of the employee's cooperation during the collection of the air sample. This cooperation is quite important if a true evaluation of a working environment is to be obtained. The employees should be given an explanation, but only in brief and general terms. They might be told that a routine test is being made, or that ventilation requirements are being determined. No reference should be made to specific toxic materials or their effects. The reason for brief and evasive replies is not deception, per se, rather it is to prevent any undue fears in the employees themselves. An air sample is collected purely as a precautionary measure. If the sample shows that the environment is safe, no good could have come from giving full information to the employees about the evaluation which could cause unnecessary alarm. On the other hand, when excessive concentrations are found, engineering controls or protective equipment are in order. These corrective measures will eliminate the cause for concern.

Example 1.3

EXAMPLE OF A FOLLOW-UP SCHEDULE FOR A GENERAL SURVEY

Industrial Hygiene  
General Survey, Follow-up Schedule

| Station | Operation                  | Contaminant                    | Method of Evaluation    | No of Samples | Frequency, No. of Months |
|---------|----------------------------|--------------------------------|-------------------------|---------------|--------------------------|
| 1       | Furnace Fluxing            | Cl <sub>2</sub> , HCl          | Air Sample              | 2             | 6                        |
| 2       | Ladle Fluxing              | Cl <sub>2</sub> , HCl          | Air Sample              | 2             | 6                        |
| 3       | Rotary Barrel              | Dust                           | Inspection              | -             | 3                        |
| 4       | Molding                    | Dust, SiO <sub>2</sub>         | Inspection              | -             | 3                        |
| 5       | Shakeout                   | Dust, SiO <sub>2</sub>         | Air Sample              | 2             | 12                       |
| 6       | Knockout                   | Dust, SiO <sub>2</sub>         | Air Sample              | 2             | 6                        |
| 7       | Sand Blast                 | Dust, SiO <sub>2</sub>         | Air Sample              | 2             | 6                        |
| 8       | Annealing Furnaces         | CO                             | Air Sample              | 2             | 4                        |
| 9       | Caustic Etch               | NaOH                           | Inspection, Smoke Tubes | -             | 3                        |
| 10      | Degreasing                 | Trichlorethylene               | Air Sample              | 2             | 4                        |
| 11      | Alumilite                  | H <sub>2</sub> SO <sub>4</sub> | Inspection, Smoke Tube  | -             | 3                        |
| 12      | Chromium Plating           | CrO <sub>3</sub>               | Inspection, Smoke Tube  | -             | 3                        |
| 13      | Grinding Al                | Dust                           | Air Sample              | 2             | 6                        |
| 14      | Buffing Al                 | Dust                           | Air Sample              | 2             | 6                        |
| 15      | Lacquering Foil            | Combustible Vapors             | Air Sample, CCI*        | 1             | 3                        |
| 16      | Melting and Pouring Babbit | Pb                             | Air Sample              | 2             | 6                        |
| 17      | Brazing Carbonyl           | Cd                             | Air Sample              | 2             | 12                       |

\*CCI = Combustible Gas Indicator