CHEMICAL MANUFACTURERS ASSOCIATION

August 13, 1987

TO: FUGITIVE EMISSIONS GUIDANCE USER

The use of EPA's Synthetic Organic Chemical Manufacturers Industry (SOCMI) emission factors to prediet leaks from process equipment, i.e., fugitive emissions, has caused a great deal of concern at many plants that handle toxic materials. Emission estimates based on these factors are frequently so high they dominate plant emission estimates, causing plants to face more complex permitting requirements and heightened public concerns. The attached "Guidance for Estimating Fugitive Emissions" was prepared by CMA to:

- Help plants better understand fugitive emissions estimating techniques, their uses and underlying assumptions, and

- Provide a framework for cost effectively obtaining more accurate individual plant estimates and simultaneously generating a much needed data base.

This document illustrates ways of estimating fugitive emissions that may be used for SARA reporting requirements, other regulatory requirements -- such as state emission inventories -- and plant emission inventories. It provides comprehensive, technically sound guidance on how to collect leak rate data. Methods discussed range from simplistic procedures, such as those based on EPA emission factors, to more accurate ones requiring field testing. CMA urges the use of this guidance to cost effectively collect screening and bagging data. Use of this common procedure will yield data that can be incorporated by CMA into an industry-wide data base. This data base will provide a substantive basis to justify more accurate emission estimates and to identify ways to reduce fugitive emissions.

If you plan to use the protocol to estimate fugitive emissions, please call Alice R. Mayer, CMA, (202) 887-1176, to become part of the data collection network. All company data will be handled as confidential and you will be furnished current copies of the guidance as we update it.

Member company representatives are also available to discuss implementation of your company program. Call Alice Mayer if you would like such assistance.

We look forward to working with you in this worthwhile CMA advocacy program.

Sincerely,

Robert A. Roland
President

CWH 000001691

Formerly Manufacturing Chemists Association—Serving the Chemical Industry Since 1872
2501 M Street, NW • Washington, DC 20037 • Telephone 202/887-1100 • Telex 89617 (CMA WSH)

CMA GUIDANCE FOR ESTIMATING FUGITIVE EMISSIONS

PLEASE NOTE:

This is an evergreen document that is designed to be modified and improved as more is learned about fugitive emissions. This document is not approved by the Environmental Protection Agency. It is being widely circulated as guidance to CMA members wishing to do fugitive emission leak rate testing. It is important for companies to use a common protocol to establish a common industry data base. Your comments on any issues as they relate to this guidance are encouraged and welcome. If you are planning a fugitive emissions testing program, please contact CMA at (202) 887-1176 to obtain the latest updates to this protocol. Comments and data should be submitted to CMA, Environmental Division, 2501 M Street, N.W., Washington D.C. 20037.

July, 1987

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CMA GUIDANCE FOR ESTIMATING FUGITIVE EMISSIONS

I. INTRODUCTION

A. Background

The Environmental Protection Agency's (EPA) fugitive emission factors for the synthetic organic chemical manufacturing industry (SOCMI) were developed to estimate leaks from a "typical" or "average" hydrocarbon plant. However, these factors have not been adjusted to account for such important features as process design, operation, maintenance practices, and occupational health standards. When fugitive emissions are estimated for a chemical plant using EPA's SOCMI factors for emission inventory development, air toxics requirements, or other reporting requirements, the results often raise many concerns. In some cases, the estimates are orders-of-magnitude too high. Even though the use of other EPA proposed factors (i.e., leak/no leak, stratified) may give somewhat lower estimates than the SOCMI factors, they are based on many of the same assumptions and will also overestimate emissions. As a result, many methods have been developed by industry to more accurately estimate fugitive emissions. More data are needed to demonstrate the effectiveness of industry control practices and to validate more accurate emission estimation techniques.

B. Objectives

The Chemical Manufacturers Association (CMA) is recommending a fugitive emissions testing protocol for member companies wishing to do mass leak rate testing.

There are two reasons why CMA recommends this protocol for industry use:

1. The protocol gives plants guidance on cost effective, technically sound fugitive emission estimates.

2. It provides for data consistency between plants so that a large data base can be compiled which will support the individual plant results and make a comprehensive fugitive emission analysis possible.

This protocol reflects current data needed to provide a technically sound basis for individual plant testing. However, as the industry data base from these tests grows, CMA anticipates that revisions will be possible. It is in each plant's interest to submit data to the common data base and to be alert for changes in test procedures.

This protocol is the start of a major data acquisition program by CMA. It will provide the data collection consistency for a database to validate techniques that will more accurately estimate fugitive emissions. More accurate estimates are needed to evaluate the effectiveness of possible control options. The ultimate goals of this initiative are: 1) to develop emission factors or equations that will provide more realistic emission estimates than current methods and 2) to quantify the effects of various equipment and operating practices on fugitive emissions.

The purpose of this protocol is to guide plants interested in developing process specific fugitive emissions estimates. This protocol is based mainly on the EPA Method 21 field "screening" technique (Appendix A) supplemented by emission rate measurement or estimation methods (Appendix B) to estimate process specific fugitive emissions. In many cases, it may be possible to use these study results to validate existing relationships between actual leak concentrations recorded during screening and mass emission rates, or to develop new ones. The validated relationships could be used with leak concentration screening data to estimate actual process specific fugitive emissions.

A copy of the results of all emission rate tests should be forwarded to Alice R. Mayer, CMA, 2501 M Street, NW, Washington, DC 20037. Data should include the compilation of response factor-adjusted screening values (concentration), along with the associated equipment parameters. In addition, the response factor-adjusted screening values (concentration) and associated bagged emission rate, along with the associated equipment parameters should be provided. These data will be maintained as confidential, and will be combined for future analysis and/or reporting. If you have any questions, please call Alice Mayer at 202/887-1176.

II. PREPARATION FOR TESTING

The key to a successful test, which is acceptable to regulatory agencies, is likely to be preplanning. Read and understand all aspects of this protocol. Be sure all equipment and personnel are ready and that the operating unit is prepared for the tests before field testing begins.

Important. Have all questions answered by appropriate parties (Appendix C). Determine the appropriate test program scope. Understand the important features of the process to be tested and get all personnel and test equipment ready. Be sure appropriate regulatory agencies are nate

included in the planning for the test program and notified prior to the tests. Be sure that only normal process maintenance is done on the process to be tested.

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A. Process/Equipment Selection

The test scope and resource requirements will depend on the process to be tested. Field and lab equipment cannot be specified until it is known what chemicals may be leaking. Equipment accessibility for both screening and emission rate testing may affect the scope and credibility of the test.

The most important consideration in any fugitive emission testing program is process selection. Careful pre-test review is required to insure that test results will be useful. This may mean that the materials handled are toxic, the process represents the appropriate process conditions (temperature, pressure, etc.), there is a sufficient number of components of each type, the process is representative of other processes within the company, etc. Regulatory considerations are also important and may include SARA emission reporting requirements, air toxics evaluations, non-attainment emission inventory reporting, permit reporting requirements, employee exposure concerns, etc. At a minimum, the calculated potential fugitive emissions based on EPA SOCMI emission factors (Appendix D) should be considered as a gauge against which potential test benefits may be ascertained.

When assessing the potential benefits of testing different equipment types, two additional facts should be considered: 1) where actual emissions from one component type only are determined, other relatively small emitter component types may become far more important based on SOCMI calculations, and 2) for equipment types where there are relatively few components (i.e., open-ended lines, relief valves, etc.), the best and most valid approach may be to emission test each component screened.

Equipment accessibility is a critical consideration in process selection to insure that the results of the study have credibility. For example, in many processes flanges are not accessible due to location or insulation covering. For study completeness and credibility, it may be necessary to screen all accessible flanges and a percentage of inaccessible flanges. For processes with large numbers of components, a partial screening of all components based on random selection and a percentage of inaccessible components may be adequate. It may seem appealing to test only a randomly selected partial sample. However, from a practical standpoint, it will generally be better to test all accessible equipment of the types (i.e., valves, pumps, pressure relief valves, etc.) selected for analysis. This is true for several reasons: 1) total cost for complete screening may not be greater than for partial screening when added costs for selecting and locating chosen components is included, 2) increased emission reductions are possible when all components are screened, and 3) test credibility is improved.

The objective of sampling inaccessible components is to demonstrate equivalence to accessible components of the same type. CMA recommends that "inaccessible" be broken down into two categories: 1) not easy to get to and 2) unsafe to monitor. We recommend that components that are unsafe to monitor not be tested.

B. Test Equipment

The field screening instrument and the laboratory procedures must be specified based on the chemicals and concentrations of interest. The screening instrument chosen should be accurate in the range of interest and should have the lowest practical detection limit. Test procedures must be specified for both gas and liquid catch analyses. (Note: Gas bag samples sent to the lab will generally have concentrations well below the screening concentration numbers.)

Although it is possible to test using one field screening instrument, it is recommended that two be used -- one for the screening team and one for the emission measurement team. The field screening instruments should be calibrated using one or more certified span gases of appropriate concentration. For example, for small concentration ranges of interest, one span gas at 50% of the anticipated maximum concentration may be appropriate. For larger ranges, two span gases at 20% and 80% of the anticipated range may be appropriate. (These span gases will also be used for daily calibration during field testing.) Span gases not used for more than six months should be reanalyzed. Span gases should be chosen to support the monitoring instrument of choice and should be consistent with the chemical to be monitored. (Commercial span gases are methane, hexane and isobutylene.)

The response factors of the instrument for the process chemicals of interest must be determined. For the Organic Vapor Analyzer (OVA), the response factor is the ratio of the OVA reading for a gas of known concentration to the OVA reading for the same concentration of the calibration gas. Many response factors are published, and these can be used if validated. If no published response factors can be found, these factors must be determined in the lab. Response factor determinations should be made at several concentrations (at least three) because they are often very concentration-dependent. These determinations can be used to arrive at an average response factor or multiple response factors, based on the data. Care should be taken to determine the response factors over the range of concentrations expected in the field.

It must be noted that in developing or validating a relationship between screening value and mass emission rate, the screening value must be adjusted to reflect the actual concentration of total organics. Guidance on how to handle mixtures is given in Appendix G.

Detailed discussion of emission rate measurement methods is included in Appendix B. Examples of these methods include vacuum, blow-through, building ventilation sampling, screening value correlation, etc.

Data sheets should be made up to record screening data, field emission rate testing data, lab analyses, equipment variables, work practices/procedures and other data that may be appropriate (Appendix F). It is desirable to require personnel collecting or analyzing data to sign data sheets to preserve the chain of custody. The easiest way to do this is to keep data sheets and samples together.

C. Personnel

The number and training of the people required for the test depends on the situation. Fugitive emissions testing is complex and requires attention to detail, care in following the test method, proper use of field instruments, proper instrument calibration, etc. The importance of proper personnel training cannot be overemphasized. Generally speaking, three to five people will be required for the field testing. The field screening team could require two people -- one to do the screening and one to record the data. At least one of these should be knowledgeable enough about the process to record such information as process material concentrations or to identify equipment clearly enough that this kind of information can be identified later.

The mass emission rate tests can be done by one person, but can go much faster when there are two. (A second person is generally required when moving equipment, and that person can deliver samples to the lab.)

One person may be able to provide enough lab support, but you may need more.

The intensive nature of this type of program must not be underestimated. Multiple instruments and types of instruments as well as adequate number and training of testing personnel are highly recommended.

D. Avoid Changes in Maintenance/Repair Practices

To obtain valid and credible results, it is important that no unusual maintenance or repair be done before field testing. The process should not be pretested, and process people should be told to continue normal practices. A process should not be tested within a couple of weeks of shutdown, even if no maintenance was done during the shutdown.

E. Notify EPA and/or State Agency

All appropriate agencies should be notified of the test at least 30 days in advance and given the opportunity to observe. Details of the chosen test protocol should be provided to the observing agency before the test. It is a good idea to have completed all preparation steps discussed earlier before giving this notice. It is advisable to discuss the protocol and see if other data or constraints are desirable. Any deviations from this protocol should be discussed.

III. FIELD TESTING USING SCREENING AND EMISSION RATE TESTING METHODS

This testing is generally an EPA Method 21 screening adjusted to actual chemical concentration (Appendix A), supplemented by emission rate testing by methods described in Appendices B-1 and B-2. The points discussed below are expansions or clarifications of these procedures. It must be noted that use of alternate instruments may require extensive effort when flame ionization detectors, ultraviolet, or infared instruments will not work for the chemical of concern. The instrument chosen should read concentrations over the expected range.

A. Calibration Checks

The screening instruments should be checked against the calibration standard(s) at least twice a day (i.e., morning and night). The same span gas(es) discussed earlier in the section on test equipment can be used. Three equipment pieces found to have non-zero screening values in the testing should be periodically rescreened over the test period (i.e., three times a day) as a quality control measure and as a check on process stability.

B. Screening

Leak checks will be made by bringing the probe tip as close as possible to the "seam" where a leak could occur. The highest instrument reading will be manually recorded for all components where a non-zero reading is observed. The reading must also be converted to concentration. All components with zero screening values will be counted, and data for these components will be recorded as well. A detailed discussion of "zero" screening value is included in Appendix H and should be read and understood before finalizing a test plan. A percentage of inaccessible components should also be screened as discussed previously.

C. Mass Emission Rate Testing

The need to collect some emission rate data cannot be overemphasized. It stems from the fact that EPA does not accept the validity of their own screening value/leak rate correlations for individual plants. The combined industry data base that will result from leak rate validation may eventually lead to EPA acceptance. However, any plant that does not do the validation is on its own and will very likely be forced to use some form of emission factors which will not give an accurate estimate.

The screening team will tag all components with non-zero screening values. A separate team may do the mass emission testing, or the same team may do the emission testing after completing the screening, although this is not recommended. The number and type of components to be mass emission tested cannot be predetermined but depends on such things as screening results, time availability, and data variability (see Appendix E-2). Data variability will be difficult to assess in the field. To optimize the likelihood of getting enough data, components with extreme screening values (i.e., relatively high and relatively low) are better to mass emission test than components with mid-range screening values. A small sample of sources screening at "zero" should also be tested. The need to mass emission test zero screening values decreases with increasing sensitivity on the measuring instrument. Emission testing of components with "off scale" screening values will also be necessary if any such components are observed.

The objective of the emission testing is to verify or develop a function relating mass leak rate to concentration of total organics for the process being tested. Functions have been published by EPA in their development documents (Appendix B-4). This published information gives a basis for comparison.

Testing done using this protocol will eventually provide enough data to make it possible for CMA to develop and validate these functions, but presently it is important that individual plants collect sufficient emission data to validate existing functions for all equipment types, and to develop them for equipment such as open-ended lines or relief valves.

Note, also, that published correlations cannot be used for components with off-scale screening values. As a result, components with off-scale screening values require special attention. Efforts should be made through instrument modification or recalibration to obtain a valid screening value. All components with off-scale screening should be emission tested. However, if this is not practical for a particular equipment type, a sufficient number should be emission tested to determine an average emission rate for that equipment type (i.e., liquid valves, gas valves, etc.). Guidance on adequate sample size is included in Appendix E.

The emission rate testing team should rescreen components before and after testing. If later data analyses show that more emission rate measurements are desirable, additional emission tests may need to be done in the future. If equipment is identified with permanent tags and these are left on components, this may help to locate more future emission test candidates. However, experience has shown that changes in leakage occur over time, even without intervention, and significant rescreening to find additional emission measurement candidates may be required for future tests. It is always better to get enough data the first time.

Before collecting bagged samples, the appropriateness of the bag material should be determined by testing. Cheap material such as polyethylene may be adequate, but do not rely on a vendors word for it. Samples containing appropriate compounds should be bagged and tested with the field instrument over time to verify sample stability in the bag.

The liquid condensate and bagged samples should be marked and delivered to the lab for analysis. It is generally desirable to keep the data sheets with the samples. It is important to analyze perishable samples (i.e., reactive, permeable, condensible, etc.) quickly.

Assuming that analysis will be done on-site, quality assurance measures that were taken using plant procedures should be outlined. Quality assurance measures should be spelled out for contractors as well.

Accounting for emissions from dripping equipment should be done on a case-by-case basis. Not all drips become air emissions. How these emissions are estimated should be justified.

D. Field Data Reduction

Again, converting the field instrument screening readings to actual chemical concentrations is an important step because of the large differences in the response factors of different chemicals. Failure to do so could add several orders of magnitude of variability to industry-wide data. Recommendations on how to handle mixture response factor conversions are included in Appendix G. Copies of all raw data, including lab analyses, should be retained.

IV. DATA ANALYSIS

The objectives of the data analysis will be 1) to determine the mass emission rate of fugitive emissions from the specific process and 2) to validate existing, or determine new, process specific fugitive emission factors relating screening concentration to mass emission rate for appropriate component classes. To achieve these objectives, there are several ways the data could be analyzed depending principally on ease of analysis and adequacy of data.

Mass leak rates from individual components can be estimated in several ways including:

1. They can be measured by an emission testing method (screening and mass emission rate determination) and applied to the total process through development and application of a process specific function (Appendix E).

2. They can be estimated from measured concentration values obtained during the screening phase and EPA functions relating concentration value to mass leak rate. These equations are included in Appendix B-4 and must be validated as part of the test program. For details on validation, see Appendix E-2.

3. They can be estimated using various forms of EPA emission factors such as those for components with screening values above and below 10,000 ppm. (Appendix D).

4. They can be estimated using multiple component emission studies to validate the summation of single component emissions (Appendix B-3).

CMA hopes that sufficient data will be collected to enable future use of Method 2 above for all equipment types without the need for individual plant validation. This will require a better understanding of the importance of individual plant variables, such as line size, on the screening concentration/leak rate correlations. Individual plant validation emission tests should provide the data required to accomplish this.

Ultimately, CMA hopes that enough data on equipment and operating procedures will be accumulated to minimize the need even for screening data. (This would allow more accurate prediction of future emissions from a proposed plant, as an example.) However, for the foreseeable future, any plant that does not want to accept the high emission estimates associated with using some form of EPA emission factor, is faced with the need to both screen and emission test. It may be desirable to use a combination of approaches on a given process (i.e., one approach for liquid valves, another for gas valves, a third approach for pumps, etc.).