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Technical Report



**Standard Software Interfaces  
For CEMS Relative Accuracy  
Test Audit Data**



ANSI/ISA-TR77.81.05, Standard Software Interfaces for CEMS Relative Accuracy Test Audit Data

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## Preface

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## **Foreword**

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Continuous Emission Monitoring Systems (CEMS) Relative Accuracy Test Audit (RATA) Data is needed for reporting to the Environmental Protection Agency (EPA) to comply with 40 CFR 75 regulations. This technical report provides guidance for facilitating the exchange of RATA data to comply with 40 CFR 75 requirements.

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## **Abstract**

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This technical report provides guidance for facilitating the exchange of RATA data to comply with 40 CFR 75 requirements.

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## **Key Words**

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Continuous Emission Monitoring Systems (CEMS), Relative Accuracy Test Audit (RATA), Data Acquisition and Handling Systems (DAHS), Source tester, Certification.



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# 1 Scope

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This technical report identifies the continuous emission monitoring system (CEMS) relative accuracy test audit (RATA) data that must be exchanged between source testers and source owners/operators for electronic reporting to the EPA to comply with 40 CFR 75 regulations. Electronic data exchange can facilitate the transfer of RATA data between the source tester and the CEMS's data acquisition and handling system (DAHS).

Data file record structures and a methodology for accurate and efficient exchange of RATA data between source testers and source owners/operators for compliance with the 40 CFR 75 CEMS regulations are presented.

The analogous electronic data exchange for 40 CFR 75 affected units electing to follow the Appendix D & E requirements has not been addressed since the data file record structures were not defined in final form at the time this technical report was prepared.

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# 2 Purpose

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The goal of this technical report is to promote a means to facilitate the accurate and cost effective exchange of relative accuracy test audit data to comply with 40 CFR 75 requirements.

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# 3 Definitions

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**3.1 automated data acquisition and handling system:** See data acquisition and handling system (DAHS).

**3.2 bias:** A systematic error, resulting in measurements that will be either consistently low or high relative to the reference value. (Reference 40 CFR 72.2)

**3.3 bias adjustment factor (BAF):** A multiplier applied to the hourly average CEMS monitor values reported as required by 40 CFR 75. The BAF is calculated as specified in Appendix A, 7.6.5 of 40 CFR 75 when a RATA results in a failure of the bias test for the respective pollutant concentration or flow monitor. When a RATA results in passing the bias test for a monitor, a BAF of 1.0 is applied to the hourly average monitor values. (Reference 40 CFR 75)

**3.4 bias test:** A test for the presence of bias in the CEMS monitoring system, conducted during a RATA, as specified by Appendix A, 7.6.4 of 40 CFR 75.

**3.5 continuous emission monitoring system (CEMS):** The equipment required by 40 CFR 75 that is used to sample, analyze, measure, and provide (by readings taken at least once every 15 minutes) a permanent record of emissions expressed in pounds per hour (lb/hr) for sulfur dioxide

and in pounds per million British thermal units (lb/MBtu) for nitrogen oxides. The following systems are components in a continuous emission monitoring system:

- a) Sulfur dioxide (SO<sub>2</sub>) pollutant concentration monitor
- b) Flow monitor
- c) Nitrogen oxides (NO<sub>x</sub>) pollutant concentration monitor
- d) Diluent gas monitor — oxygen (O<sub>2</sub>) or carbon dioxide (CO<sub>2</sub>)
- e) Moisture monitor — when such monitoring is required by 40 CFR 75
- f) Data acquisition and handling system (Reference 40 CFR 72.2)

**3.6 data acquisition and handling system (DAHS):** That component of the CEM system, continuous opacity monitoring system (COMS), or other emission monitoring system approved by the EPA Administrator for use in the Acid Rain Program, designed to interpret and convert individual output signals from the pollutant concentration monitors, flow monitors, diluent gas monitors, opacity monitors, and other component parts of the monitoring system to produce a continuous record of the measured parameters in the measurement units required by 40 CFR 75. (Reference 40 CFR 72.2)

**3.7 EPA:** The United States Environmental Protection Agency. (Reference 40 CFR 72.2)

**3.8 pollutant concentration monitor:** That component of the CEM system that measures the concentration of a pollutant in a unit's flue gas. (Reference 40 CFR 72.2)

**3.9 reference method (RM):** Any direct test method of sampling and analyzing for an air pollutant as specified in 40 CFR 60, Appendix A. (Reference 40 CFR 72.2)

**3.10 relative accuracy (RA):** A statistic designed to provide a measure of the systematic and random errors associated with data from continuous emission monitoring systems and expressed as the absolute mean difference between the pollutant concentration or volumetric flow measured by the pollutant concentration or flow monitor and the value determined by the applicable reference method(s) plus the 2.5 percent confidence coefficient of a series of tests divided by the mean of the reference method tests, see 40 CFR 75, Appendix A, 7.3 for the calculation. (Reference 40 CFR 72.2)

**3.11 relative accuracy test audit (RATA):** A series of reference method tests performed to determine the relative accuracy, presence of bias, and bias adjustment factor for flow monitors and pollutant concentration monitors as required by 40 CFR 75. RATAs are performed for the CO<sub>2</sub> concentration, NO<sub>x</sub> emissions' rate, SO<sub>2</sub> concentration, and stack flue gas volumetric flow rate. See 40 CFR 75, Appendix A, 3.3 for relative accuracy test requirements.

**3.12 unit load:** The total (i.e., gross) output of a unit (or source) in any calendar year (or other specified time period) produced by combusting a given heat input of fuel, expressed in terms of (1) the total electrical generation (MWe) for use within the plant and for sale or (2) the total steam flow (in lb/hr x 1000) produced by the unit or source. (Reference 40 CFR 72.2 and 72.3)

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## 4 CEMS RATA reporting

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For a typical CEMS installation, RATAs must be performed for at least three pollutant concentration monitors (CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>) at normal unit (boiler) load and for volumetric flow

monitors at each of three unit (boiler) loads. Testers may conduct as many runs as desired per RATA. However, they must conduct a minimum of 9 runs and can only discard up to 3 runs in calculating relative accuracy. The discarded runs must still be reported. Typically 12 runs are conducted for each gas pollutant monitor and at each load for a flow monitor. A RATA must be performed on each CEMS once or twice annually depending on the relative accuracy of the monitors calculated at the last RATA. Because installations may have only primary monitors, or both primary and backup monitors, sources typically report from 54 to 144 test run data sets per RATA.

Per 40 CFR 75, CEMS RATA data and results are required to be reported electronically to the EPA. The Electronic Data Reporting (EDR) Instruction defines an Electronic File Format (EFF) for reporting the data to the EPA, including the various record types for reporting specific data to the agency.

In practice, the 40 CFR 75 regulations require the use of a computer-based DAHS to manage, store, and produce reports from the database that must be maintained by the source owner. Similarly, it is assumed that source testers use a computer-based data acquisition system (DAS) to automatically collect the reference method (RM) test run data during the RATA and perform the necessary calculations to prepare the data and results in the engineering units and precision required by 40 CFR 75.

RATAs are not only a quality assurance test of the CEMS but have an impact on the reporting of emissions through application of the bias test and bias adjustment factor.

Field experience has shown instances where manual entry of RATA data can lead to errors in reporting or application of 40 CFR 75 regulations. These errors can be costly and difficult to detect. Thus manual entry of RATA data should be minimized.

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## **5 EDR record types for RATA data**

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Record Type 610 contains RATA test data that is determined by a source tester applying the appropriate RM to audit the accuracy of the CEMS as required by 40 CFR 75. Record Type 610 also contains data from CEMS monitor values collected during RATA test runs.

The results of the RATA may be calculated by the DAHS itself or externally and electronically reported using Record Type 611. However, both RATA test run data and results (Record Types 610 and 611 respectively) must be reported to the EPA in EDR files prepared by the DAHS.

EPA instructions further clarify that the RATA data must be included in the EDR files submitted with the certification application as well as in subsequent quarterly EDR files when a RATA has occurred.

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## **6 CEM DAHS type**

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There are two known configurations of continuous emission monitoring (CEM) DAHS that must be considered for the desired electronic exchange of RATA data to occur. Other configurations

that require additional manual intervention to prepare certification or quarterly EDR files are not considered because the additional manual steps required conflict with the goal of this report. System type numbers are assigned to simplify the discussion and application of the proposed data interchange formats.

In a Type 1 System, the CEM DAHS calculates the RATA results based on data received from the source tester. Therefore the RM data for each test run must be imported into the DAHS where the calculation and preparation of the results for reporting to EPA are completed.

In a Type 2 System, the monitor values from the CEM DAHS and the RM data are used by the source tester to calculate the RATA results. For the desired electronic data exchange to occur, the monitor values must be exported from the DAHS and imported by the source tester's DAS where the calculations are completed. The source tester's DAS must then export the results for importing by the source owner's CEM DAHS. The DAHS then prepares the final electronic data report for submittal to EPA. According to instructions from EPA, the resulting source tester's file of Type 610 and 611 records must be electronically merged into the certification or quarterly EDR file.

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## 7 RATA data exchange

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Prior to the start of the RM testing, the source tester's DAS clock must be synchronized with the source owner's DAHS clock. RM testing is then conducted. When test runs are completed, use [Figure 1 or 2](#) (for DAHS Type 1 or 2 respectively) as a procedural guide for the data exchange. As the final step, the EDR files are then prepared for submittal of the data and results to the EPA.

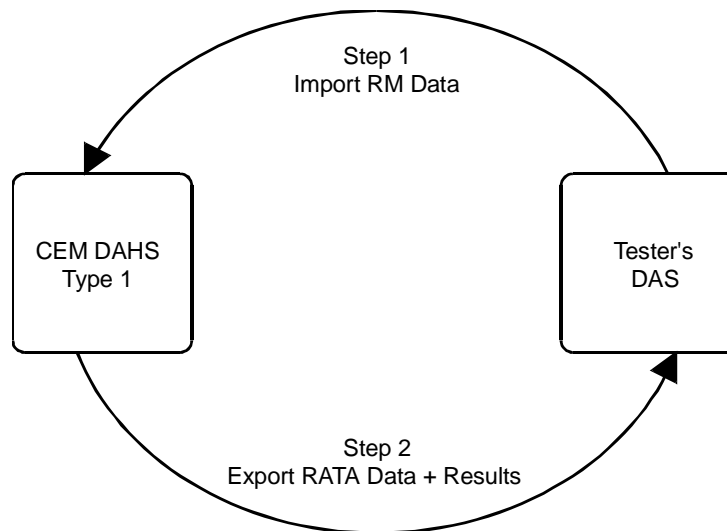
**NOTE** — Other quality assurance measures are required of source owners prior to submittal of certification or quarterly EDR files to the EPA. These measures are not discussed here because they are beyond the scope of this technical report.

Annex B contains the proposed data file record structures and data elements for a Type 1 DAHS - RATA data exchange. Similarly Annex C applies to the Type 2 DAHS. The proposed data file format and record structure is based on the EPA's EDR Instruction -Version 1.1.

The proposed data file format is intended to be flexible so that data from a single RATA test (e.g., low load flow) or multiple RATA tests (e.g., CO<sub>2</sub>, flow, NO<sub>x</sub>, and SO<sub>2</sub> at normal unit load) can be included in the same file. The EDR Instruction specifies the use of an *ASCII* flat file composed of varying length records. The records in the file must be sorted in the order required by the EDR Instruction. Each is defined or ended by carriage return-line feed pairs (*ASCII* characters 13 and 10 respectively). The file is terminated with an *ASCII* end-of-file character (*ASCII* decimal code 26, or Control-Z) following all records.

For a Type 1 DAHS, the RM data, including the dates and times of each test run, are imported into the DAHS (see [Figure 1](#), Step 1). See Annex B.1 for a complete listing of required data elements for Step 1. The DAHS then retrieves the corresponding CEMS value from its database and calculates the resulting RA and BAF.

The complete set of test data and results can then be exported (see [Figure 1](#), Step 2) to the source tester for verification of results and record-keeping purposes. See Annex B.2 for a complete listing of required data elements for Step 2.



**Figure 1 — Type 1 CEMS DAHS data flow diagram**

For a Type 2 DAHS, the CEMS monitor value data must be retrieved (or exported) from the DAHS database for the corresponding period of the RM test runs (see [Figure 2](#), Step 1).

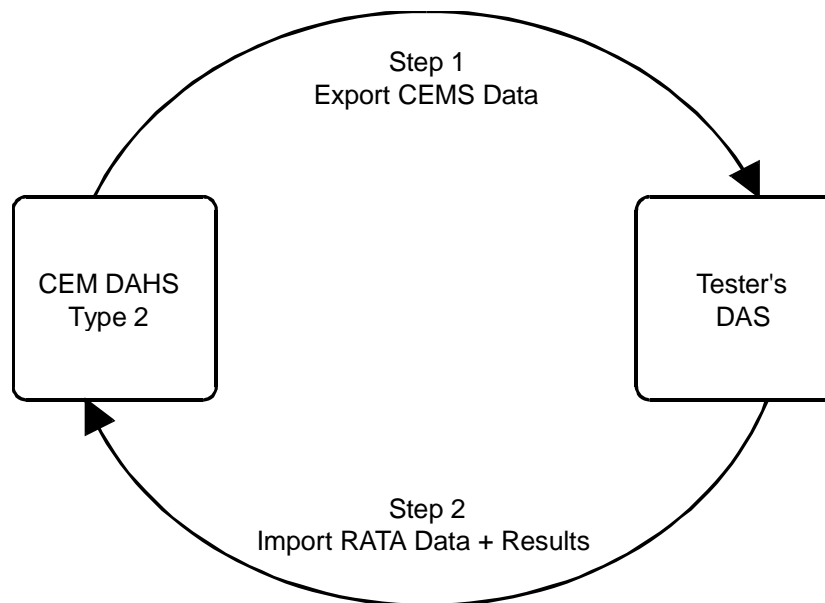
If real-time CEMS monitor value data transfer from the DAHS to the source tester's DAS is available, [Figure 2](#), Step 1 and Annex C.1 can be ignored since the data transfer occurs by other means. This would be the case, for example, when a network connection exists between the CEM DAHS and the DAS, so that the DAS can read and store the CEM monitor data values in real time concurrent with RM testing.

If real-time CEMS monitor value data transfer from the DAHS to the source tester's DAS is not available, then at least two options are feasible:

- a) manual entry of the start/end dates and times into the DAHS; or
- b) some other means of synchronization (e.g., a marker signal input to the CEM DAHS) is necessary to export the CEMS monitor value data with proper time correlation for each RM test run.

(In this case [Figure 2](#), Step 1 applies; refer to Annex C.1 for a complete listing of records and required data elements.)

After receiving the CEM monitor data value, the DAS then retrieves the corresponding RM value, calculates the RA, performs the bias test, and calculates the BAF. This completes Figure 2- Step 1.



**Figure 2 — Type 2 CEM DAHS data flow diagram**

The complete set of test data and results can then be imported (see [Figure 2](#), Step 2) into the CEM DAHS from the source tester's DAS for record-keeping and reporting purposes. See Annex C.2 for a complete listing of records and required data elements for Step 2.

**NOTE** — Inclusion of the 500 series of EDR Record Types is optional as shown in Annex C.2 based on site-specific requirements. The need for these records is unrelated to electronic exchange of RATA data and is beyond the scope of this technical report.

Also, each DAHS should include printing functions to generate RATA data hard-copy reports of the following:

- a) CEMS test run monitor values
- b) RM test run data
- c) RATA results

for use by source testers and owners/operators during the testing, for on-site record keeping, and for demand reporting to the regulatory agencies.

End users of the CEM DAHS should be able to generate both intermediate and final reports as needed during and after RATA testing. The reports should present an image of the electronically reportable data and results in an easy-to-read format suitable for an end user to verify accuracy and completeness. A simple printout of the EDR Record Types 610 and 611 in the EDR format is inadequate for use by most end users.

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## 8 Recommendations

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Source owners, CEM DAHS vendors, and source testers are encouraged to voluntarily adopt the electronic exchange of RATA data based on this technical report and then incorporate the necessary functions into their systems, including the following:

- a) DAHS vendors should include in each 40 CFR 75 CEM DAHS a function to electronically exchange RATA data with source testers.
- b) Source testers should include a function in their DAS to electronically exchange RATA data with owners/operators.
- c) Each CEM DAHS should include printing functions to generate RATA data hard copy reports for verification and reporting purposes as described in [Section 7](#).

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## 9 Conclusion

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Electronic exchange of RATA data between source testers and source owners is technically achievable and highly recommended.

Implementing the recommendations of this technical report will improve the compliance efforts of the source owners by reducing the chances of human error, which can result in incorrect reporting of RATA data and application of results.

While an economic evaluation of the cost and benefits are beyond the scope of this technical report, electronic exchange of RATA data should be viewed as advantageous by source owners, regulators, and other parties affected by the application of the 40 CFR 75 regulations.



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## Annex A — References

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### ENVIRONMENTAL PROTECTION AGENCY (EPA)

Electronic Data Reporting Instruction - Version 1.1

**Available from: National Center for Environmental Publications and Information (NCEPI)**

26 West Martin Luther King Drive  
Cincinnati, OH 45268

Tel. (513) 569-7985

### UNITED STATES CODE OF FEDERAL REGULATIONS

Title 40          Protection of Environments

Part 60

Part 72, Section 2 (72.2)

Part 72, Section 3 (72.3)

Part 75, including Appendices A and B

**Available from: Superintendent of Documents**

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## Annex B — RATA data exchange - Type 1 System

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### B.1 Data file record structures — DAHS-Read / DAS-Write

The owner's DAHS must include a utility program to read (import), and the source tester's DAS must include a utility program to write (export) an *ASCII* file based on the following file and record structure.

#### Header record

Record type code: 100 (Required)

Data elements: All as listed in the EDR Instruction.

#### RATA and bias test data records (Required)

Record type code: 610 (Required)

Data elements:

- Unit ID/Common stack ID
- Monitoring system ID
- Start date
- Start time
- End date
- End time
- Units of measure
- Value from reference method
- Run number
- Test run included in calculating RA and bias
- Operating level

#### NOTES

1. Refer to EPA EDR Instruction - Version 1.1, Table 4 for the start column, units of measure, range, field length, and format specifications for each data element.
2. The above list of data elements is a selected subset of Record Types 610 or 611 requirements. Only those records and data elements required for data exchange are listed. Data elements (fields) not listed above should be filled with blank spaces.

### B.2 Data file record structures — DAHS-Write / DAS-Read

The owner's DAHS must include a utility program to write (export), and the source tester's DAS must include a utility program to read (import) an *ASCII* file based on the following file and record structure.

**Header Record (Required)**

Record type code: 100

Data elements: All as listed in the EDR Instruction.

**RATA and bias test data records (Required)**

Record type code: 610

Data elements:

- Unit ID/Common stack ID
- Monitoring system ID
- Start date
- Start time
- End date
- End time
- Units of measure
- CEMS monitor value
- Run number
- Test run included in calculating RA and bias
- Operating level

**RATA and bias test results records (Required)**

Record type code: 611

Data elements:

- Unit ID/Common stack ID
- Monitoring system ID
- Date
- Time
- Reference method used
- Units of measure
- Arithmetic mean of CEMS values
- Arithmetic mean of reference method values
- Standard deviation of the difference data
- Confidence coefficient
- Relative accuracy
- Tabulated t-value (bias test)
- Bias adjustment factor
- Operating level

**NOTE** — Refer to notes in Annex B.1.

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## Annex C — RATA data exchange - Type 2 System

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### C.1 Data file record structures — DAHS-Write / DAS-Read

The owner's DAHS must include a utility program to write (export), and the source tester's DAS must include a utility program to read (import) an *ASC//* file based on the following file and record structure.

#### Header Record (Required)

Record type code: 100

Data elements: All as listed in the EDR Instruction.

#### RATA and bias test data records (Required)

Record type code: 610

Data elements:

Fields required are as follows:

- Unit ID/Common stack ID
- Monitoring system ID
- Start date
- Start time
- End date
- End time
- Units of measure
- CEMS monitor value
- Run number
- Operating level

#### NOTES

1. Refer to EPA EDR Instruction - Version 1.1, Tables 3 and 4 for the start column, units of measure, range, field length, and format specifications for each data element.
2. The previous list of data elements is a selected subset of Record Types 610 or 611 requirements. Only those records and data elements required for data exchange are listed. Data elements (fields) not listed should be filled with blank spaces.

### C.2 Data file record structures — DAHS-Read / DAS-Write

The owner's DAHS must include a utility program to read (import), and the source tester's DAS must include a utility program to write (export) an *ASC//* file based on the following file and record structure.

## **Header Record (Required)**

Record type code: 100

Data elements: All as listed in the EDR Instruction.

## **Monitoring plan records (Optional)**

Record type code: 500

Record type code: 501

Record type code: 510

Record type code: 520

## **RATA and bias test data records (Required)**

Record type code: 610

Data elements:

- Unit ID/Common stack ID
- Monitoring system ID
- Start date
- Start time
- End date
- End time
- Units of measure
- Value from CEMS system being tested
- Average gross unit load during the test

## **RATA and bias test data records (Required)**


Record type code: 611

Data elements:

- Unit ID/Common stack ID
- Monitoring system ID
- Date
- Time
- Reference method used
- Units of measure
- Arithmetic mean of CEMS values
- Arithmetic mean of reference method values
- Arithmetic mean of the difference data
- Standard deviation of the difference data
- Confidence coefficient
- Relative accuracy
- Tabulated t-value (bias test)
- Bias adjustment factor
- Operating level

**NOTE** — Refer to notes in Annex C.1.





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