

NASA METROLOGY INFORMATION SYSTEM - A NEMS SUBSYSTEM

Earl S. German, Jr., and Frederick A. Kern
Langley Research Center

and

Rick Yow and Ellen Peterson
Planning Research Corporation

ABSTRACT

The NASA Metrology Information Systems (NMIS) is being developed as a standardized tool in managing the NASA field Centers' instrument calibration programs. This system, as defined by the NASA Metrology and Calibration Workshop, will function as a subsystem of the newly developed NASA Equipment Management System (NEMS). The Metrology Information System is designed to utilize and update applicable NEMS data fields for controlled property and to function as a stand alone system for noncontrolled property. The NMIS provides automatic instrument calibration recall control, instrument historical performance data storage and analysis, calibration and repair labor and parts cost data, and instrument user and location data. Nineteen standardized reports have been developed to analyze calibration system operations.

INTRODUCTION

The National Aeronautics and Space Administration has conducted an annual workshop on metrology and calibration since 1977. The objectives of these workshops were to ensure effective support for NASA's technical programs, to identify areas where greater efficiency and economy could be achieved, and to provide a unification of field Center objectives and responsibilities. The workshops, under the sponsorship of NASA Headquarters' Office of Chief Engineer, included representatives from Headquarters, each field Center, support service contractors, and invited guests from other agencies such as the National Bureau of Standards and the Department of Defense. For the past 2 years the workshop has been held in conjunction with the Department of Energy's Standards Laboratories Manager's Conference.

The activities of these workshops have resulted in: (1) A unification of responsibilities and objectives through the development of an agency-wide management instruction, NMI 5330.9; (2) the development of a document describing the calibration capabilities of each Center; (3) an increase in the level of communications between Center metrologists concerning management techniques, calibration techniques, hardware, automatic calibration systems, software, and procedures; (4) NASA-wide labels for calibration, limited calibration and standards identification; and (5) the utilization and sharing of calibration resources between government agencies. However, the individual Center's

metrology programs still had significant differences--particularly in the procedures used to track instrument calibration histories, manpower usage, and calibration laboratory performance. For example, Center metrology programs ranged from the simple instrument calibration with minimal documentation and no instrument recall program to a system containing several thousand instruments in recall and a sophisticated instrument and calibration laboratory performance documentation system.

Since 1979, the Supply and Equipment Management Branch of NASA Headquarters has briefed each workshop on the NASA Equipment Management System (NEMS) being developed for agency-wide use. During the development, several standard data elements, which are output products of the calibration laboratory, were defined and installed in NEMS. However, these elements did not provide the Center metrologist with all the data required to evaluate calibration laboratory performance, metrology system efficiency, and instrument performance. During the sixth workshop held at the Johnson Space Center in October 1982, the group made the decision to develop a NASA-wide computerized management and information system designed specifically to support the field Centers' calibration programs. Since the NEMS contained a number of data elements required by the Center metrologists, this agency-wide system would be developed as a subsystem of NEMS. The first planning and development meeting was held at the Kennedy Space Center in February 1983, with the objective to define the core data elements required for the subsystem. From a review of the NEMS data elements, 25 elements were identified as required (fig. 1). Twelve additional data elements (fig. 2) unique to the subsystem were developed. A second meeting was held at the Jet Propulsion Laboratory in April 1983, to finalize core data elements, data element definitions, input document elements, and to begin to define output reports required. The Langley Research Center was selected as the lead Center to develop this subsystem with funding provided in July 1983, and program analyst and programmer contracted for in October 1983.

DESCRIPTION OF SYSTEM

The NASA Metrology Information System (NMIS) is an agency-wide automated data processing system designed to improve the field Centers' instrument service programs, provide for automatic calibration recall of all or selected instruments, and to standardize the data base necessary to support and evaluate the effectiveness of these programs. Although the NMIS is designed to function as a subsystem of the NEMS, it can function as a stand alone system if necessary. The data base necessary to track, report, and summarize both instrument historical and metrology system performance is maintained under the ADABAS Data Base Management System (DBMS). The software is written in NATURAL, the ADABAS on-line interactive processing language, and COM-LETE, a teleprocessing monitor, which allows the user additional flexibility for ad hoc data query capability. The NMIS has been designed to operate on the IBM 4341 OS/MVS compatible computer. The system uses either the IBM 3270 protocol terminal or an IBM personal computer for performing on-line transactions, conducting ad hoc inquiries, and other system operations. These

terminals will reside in the field Centers' Metrology Control Center which will be responsible for general data entry, report generation, software control, backup and error recovery, and metrology system data flow. The NMIS transaction processing is designed to pre-edit the input data entered through formatted screen displays and then use this data to update the data base. There are 26 transactions developed to add records, modify, or delete records in the data base. Each transaction has data elements and/or table entries which are either mandatory, optional, or not applicable, while other data elements are automatically generated.

The NMIS provides users with statistical summary performance reports, status reports of metrology related NASA controlled and noncontrolled instruments, and reports for monitoring the metrology system activities. These 28 reports are either generated automatically on a scheduled basis ranging from daily to annually or on-request only.

The majority of instruments that will normally be contained in the NMIS will be identified using the NEMS Equipment Control Number (ECN). However, many noncontrolled instruments must also be controlled by the NMIS. Identification of these instruments will be accomplished using a vinyl Metrology Control tag, similar to the NASA ECN, which is 1.35 x 0.6 inches in size. The tag (fig. 3) displays both the easily readable six character number, COO138 for example, and its equivalent bar code in a three of nine format.

METROLOGY CONTROL DOCUMENT

Since the field Centers' metrology programs have developed independently according to the specific missions, operational procedures and supporting documentation such as instrument work orders and on-site shipping forms are necessarily different. In order for the NMIS to function on an agency-wide level, certain segments of the Centers' procedures and documentation must be standardized. During two meetings held at the Kennedy Space Center and the Jet Propulsion Laboratory in 1983, a single form was conceptually developed and agreed upon by the participants. During the development of the NMIS Design Document, this Metrology Control Document (figs. 4, 5, and 6) was further developed to satisfy specific data element requirements for the instrument history and performance analysis reports.

This form consists of five sections. The user information section and the background information section are computer preprinted from data in the NMIS data base. The background information section contains labor, parts, and outside service cost data. Most important, however, is the "condition received" and "action taken" blocks which list the codes for the last "X" times serviced up to a maximum of eight times. This will allow the Metrologist to easily identify an instrument which is either unstable, misapplied, or used in an environment which could be degrading the performance. The user-technical monitor area section provides instructions and technical approval for the required work. The calibration-repair information section contains data blocks which are completed by the personnel of

the performing organization. This data will be entered into the NMIS when the service work is completed. The local data section provides an area for use by the individual Centers to satisfy requirements particular to their metrology programs only. The reverse side of the Metrology Control Document is used by the performing organization to enter specific instrument service data as required by the individual Center's documentation procedures.

TABLES

The NMIS contains seven tables (fig. 7) that are unique to the system while utilizing five NEMS tables. These tables are used to provide necessary data for updating transactions and generating reports. Each table has a data element in the NEMS and/or NMIS equipment files as its key. A brief description of each table follows.

Table 20, Recall Identification Table (fig. 8), provides the keys to identify instruments according to a predetermined instrument classification. For example, standards are classified as Reference Standard (R), Transfer Standard (T), and Working Standard (W). In Situ Calibration (I) identifies those instruments requiring testing in the facility as opposed to those requiring calibration (C) in the laboratory.

Table 30, Condition Received Table (fig. 9), defines the operating condition of the equipment received by the performing organization. Analysis of this type of data provides information needed to adjust instrument recall calibration intervals and evaluate the overall effectiveness of a Center's metrology program. The codes A to I were developed from a consensus of the NASA Centers' representatives. Codes J to Z allow the individual Centers to define condition codes unique to their Center's operation.

Table 45, Action Requested Table (fig. 10), defines the instrument service requested by the user. Codes A to J were required by the majority of the Centers and codes K to Z provide for service requests that are unique to the individual Center's operation.

Table 50, Action Taken Table (fig. 11), defines the actions that were actually performed in completing the instrument service. This list of codes is very detailed and currently provides for only one Center unique code. This data enables detailed analyses of the structure of the work performed by the performing organization.

Table 50, Measurement Discipline Table (fig. 12), defines 13 work discipline areas into which work is divided. Codes N to Z are provided to allow the individual Centers to add disciplines that are unique to their operations. This data will allow for detailed analyses of the workload according to measurement disciplines.

Table 75, Performing Organization Table (fig. 13), provides identification of the organization performing the work. For example, Code E identifies that work was performed on a Center's Reference Standards by the National Bureau of Standards as opposed to those sent to a standards laboratory (Code D), or another government laboratory (Code G). Codes I to Z are established as Center unique to allow Centers having more than one identifiable calibration laboratory to track individual performing organization performance. For example, LaRC has eight organizations performing such work. This table also includes calibration and repair labor rates for each of the codes to calculate instrument and calibration repair costs.

Table 40, Transaction Number Table (fig. 14), lists the transaction codes identified for the operation of the NMIS.

The NEMS contains five tables used by the NMIS (fig. 15). However, since the NMIS will not have a centralized data base, Table 252, NASA Installation Number Table, will not be significant.

Table 40, Manufacturer's Code Table, contains codes assigned in the Federal Cataloging Handbooks, H-4 series, identifying each manufacturer. Additionally the code "XXXXX" is used when the manufacturer is known but the code needs to be assigned and the code "ZZZZZ" is used when the manufacturer is unknown.

Table 78, Custodian Account Number Table, contains the property custodian account numbers and custodian numbers, names, mail codes, and organizational codes required for property management.

Table 90, User Number Table, contains user numbers and names for employees at each Center. Some Centers' table 90 will also contain names of contractor employees.

Table 102, Building Number Table, contains the numbers and names of buildings where equipment is located.

NMIS REPORTS

Through a coordinated effort of the workshop, 18 reports (fig. 16) were developed to monitor instrument and calibration laboratory performance. Since the detailed development began in October 1983, 10 additional reports (fig. 17) have been developed. The frequency of individual issuance, determined by consensus of projected Center usage, varies from a daily generation to a yearly generation with nine reports issued by request only. Additionally, if the standard frequency report issuance schedule does not meet a particular Center's needs, provisions are made to easily change the frequency.

A brief description of each report follows.

ECN Calibration Master List (Report 001).- This report lists, in Equipment Control Number (ECN) sequence, all instruments contained in NMIS. Each record shows ECN, item name, manufacturer's name, model number, date calibration due, measurement discipline, performing organization for last service, and recall identifier. Report prints total number of line items. This report is generated quarterly and has no other selection criteria.

Calibration User List - ECN Sequence (Report 002).- This report lists all instruments in the system sequenced by custodian account number, user number, and ECN. Each record lists ECN, item name, manufacturer's name, model number, date NASA acquired, calibration interval, date calibration due, last eight condition received codes, measurement discipline, performing organization for last service, and recall identifier. This report provides the total number of instruments in each user account, each custodian account, and the grand total. Other report selection criteria provided include user number and custodian account number.

Calibration User List - Item Name Sequence (Report 003).- This report contains the same data as Report 002. However, it is sequenced by item name, manufacturer's name, and model number as opposed to the ECN sequence of Report 002. This report is issued on request only. No other selection criteria is provided.

Calibration Item Name List (Report 004).- This report sequences the instruments in the NMIS by item name and list manufacturer's name, model number, date NASA acquired, ECN, custodian account number, user name, calibration interval, last eight condition received codes, recall identifier, and date calibration due. Additional selection criteria include item name, item name - manufacturer's name, and item name - manufacturer's name - model number. This report lists the total number of named instruments for each manufacturer, the total number of named instruments and the grand total number of instruments. This report is issued annually.

Calibration Model Number List (Report 005).- This report lists instruments sequenced by model number, manufacturer's name, item name, and ECN. It contains manufacturer's name, item name, ECN, date NASA acquired, cost, custodian account number, user number, calibration interval, last eight condition received codes, recall identifier code, and date calibration due. Additional selection criteria include manufacturer's model number, manufacturer's name and manufacturer's name - model number. It lists the total number of instruments for each model number and the grand total number of instruments. This report is issued on request only.

Calibration Due List - ECN Sequence (Report 006).- This report lists by custodian account number and user number those instruments due for calibration and can be used as a calibration recall notice (fig. 18). The report is sequenced by each custodian account and user number, date calibration due, and ECN. This report contains item name, manufacturer's name, model number, calibration interval, measurement discipline, and performing organization. The report lists the total number of instruments due for each date, the total

number of instruments by both user and custodian account numbers and the grand total number of instruments due for calibration. Additional selection criteria include date calibration due, date calibration due - custodian account number, date calibration due - custodian account number - user number. This report is issued monthly.

Calibration Due List - Item Name Sequence (Report 007).- This report contains the same information as Report 006. However, it is also sequenced by item name for each custodian account number and user number. The additional section criteria is identical to that of Report 006. This report is issued on request only.

Calibration Due List - Performing Organization Sequence (Report 008).- This report lists the instruments due for calibration by performing organization and is intended to be primarily used by performing organization managers. This report is sequenced by performing organization, measurement discipline, item name, date calibration due, manufacturer's name, and model number. The report also lists ECN and calibration interval. Additional selection criteria are date calibration due and performing organization - date calibration due. This report is issued monthly.

Calibration Overdue List (Report 009).- This report lists those instruments which have not been submitted by a specified date and are overdue for calibration. The report is sequenced by custodian account number, user number, date calibration due, and ECN. It contains the same information as Report 007. It lists the total number of items overdue by user number, custodian account number, and the grand total number of items overdue. Additional selection criteria include custodian account number - date calibration due and user number - date calibration due. This report is issued monthly.

Performing Organization - Due/Overdue Status Report (Report 010).- This report lists the instruments that have not been completed by a specified date. This report is sequenced by performing organization, measurement discipline, date required, and ECN. It also provides manufacturer's name and model number. The report lists total instruments due for a given date, the total instruments due/overdue for each measurement discipline and for each performing organization. There is no other selection criteria. This report is issued on a daily basis.

Hold Status Report (Report 011).- This report lists those instruments which are not being actively processed in the performing organization's laboratory for such reasons as shipped for off-site repair or awaiting repair parts. This report is sequenced by performing organization, transaction date, and ECN. The report lists item name, manufacturer's name, model number, measurement discipline, and action taken code from Table 50. The report provides total number of items for each transaction date, performing organization, and the grand total number of items in the hold status. The additional selection criteria is by performing organization. This report is issued monthly.

Calibration Support Analysis (Report 012).- This report provides a total calibration and repair cost analysis in a year-to-date format and is sequenced by custodian account number, user number, job order number, and ECN. Data provided in this report include item name, labor costs, parts cost, outside service cost, total cost, and date instrument was last serviced. The report provides total cost by user number, custodian account number, and grand total costs for each category. Additional selection criteria is by job order, custodian account number, and user number. This report is issued annually.

Calibration Life Cycle Cost Analysis (Report 013).- This report provides total service costs to date for each instrument. The report is sequenced by item name, manufacturer's name, model number, and ECN. Data listed include date NASA acquired, cost of item, labor cost, parts cost, outside service cost, total cost, and average annual cost. Additional selection criteria include item name - date NASA acquired, item name - manufacturer's name - date NASA acquired, item name - manufacturer's name - date NASA acquired, item name - manufacturer's name - model number - date NASA acquired, and date NASA acquired - all. This report is issued annually.

Production Analysis (Report 014).- This report provides manpower data required for calibration, repair, and total service in hours to the nearest 0.1 hours. The report is sequenced by performing organization, measurement discipline, item name, and model number. The report includes technician identifier, ECN, manufacturer's name, calibration hours, repair hours, total service hours, and date last serviced. The report provides both total hours and total items by measurement discipline and performing organization. Additional selection criteria is by performing organization. This report is issued monthly.

Calibration Weekly Status Report (Report 015).- This report provides the listing of the total number of items completed sequenced by performing organization, measurement discipline, and ECN. The report lists manufacturer's name, model number, initiate date, date calibrated, date last serviced, action taken, and days late. The report provides, by performing organization, the total number of items completed, the total number and percent of items completed within a specified time frame. Additional selection sequence is by performing organization only. This report is issued weekly.

Calibration Maintenance Time Analysis (Report 016).- This report provides data describing the manpower required to service instruments sequenced by manufacturer's name and model number. This report lists total instruments calibrated, repaired, serviced; total calibration, repair and service hours; and average calibration, repair, and service hours. The report also lists the totals for these categories for each instrument manufacturer. Additional selection criteria is by manufacturer's name, and manufacturer's name - model number. This report is issued annually.

Out of Tolerance and Inoperative Instrument Report (017).- This report lists the instruments that were received in the calibration laboratory and coded B, C, D, E, F, or G from the Condition Received Table (Table 30). This report is sequenced by custodian account number, user number, condition received code, item name, manufacturer's name, and model number. Other data listed includes ECN, date NASA acquired, calibration interval, last eight condition received codes, date calibrated, measurement discipline, and performing organization for last service. This report lists the total number of out-of-tolerance and inoperative instruments for each custodian account and user account and the total number of instruments received for these codes for a specified month. Additional selection criteria includes custodian account number - date NASA acquired, user number - date NASA acquired, date NASA acquired - all, manufacturer's name - date NASA acquired, item name - date NASA acquired, manufacturer's name - model number - date NASA acquired, manufacturer's name - item name - date NASA acquired. This report is issued monthly.

Calibration Interval Analysis Report (Report 018).- This report provides data for evaluating the effectiveness of a calibration interval determination program for both calibration and limited calibration actions. The report lists those instruments which were calibrated within +15 days of the scheduled date and have condition received codes which identify instruments received in an operating condition. The report lists the percentage of instruments received in tolerance for both calibration and limited calibration. This report is sequenced by item name, manufacturer's name, model number, and calibration interval. The report contains data including ECN and last eight condition received codes. Additional selection criteria include item name - model number, item name - manufacturer's name - date calibration due and all - date calibration due. This report is issued annually.

Work Action Analysis Report (Report 019).- This report lists the instruments serviced by Action Taken Codes (Table 50) and provides a breakdown of the type of work being performed. This report is sequenced by action taken, performing organization, manufacturer's name and model number. The report lists data including ECN, item name, last eight condition received codes, total service hours, calibration interval, custodian account number, and user number. The report lists the total number of items and service hours for each performing organization and each action taken code. Additional selection criteria includes action taken and performing organization. This report is issued annually.

Property Location Report (Report 020).- This report lists the location of each item and is sequenced by equipment location building, room, and ECN. This report is different from a NEMS equipment location report in that it also includes the noncontrolled instruments while NEMS contains only controlled equipment. The noncontrolled equipment has a metrology number assigned to it for identification control only and not accountability. Data listed include custodian account number, date calibration due, manufacturer's name, model number, and item name. The report lists the total number of items

for each building. Additional selection criteria is equipment location building and custodian account number. This report is issued on request only.

Work Action Analysis Report - Summary File (Report 021).- Since it is not mandatory that all instruments at a field Center be included in the NMIS, the performing organization may be performing instrument service work that is not included in any of the previous analysis reports. This report and Report 105 were created to record specific data in a summary format for uncontrolled items. Report 021 lists by quarter the total number of items serviced for each of the action taken codes. This report lists the previous quarter's data when the second, third, and fourth quarter reports are issued. There is no other selection criteria. This report is issued quarterly.

Metrology File Detail Item List (Report 100).- This report contains the entire data record to date for each instrument contained in NMIS. This report lists all of the data elements identified as required for adequate metrology system control. This report has no additional selection criteria and is issued on request only.

Daily Transaction Report (Report 101).-This report lists the daily transactions in the NMIS and is sequenced by transaction number and ECN. The report also lists reference code, file data element, original entry and revised entry. There is no additional selection criteria and the report is issued daily.

ERROR Codes and Messages (Report 102).- This report lists all error codes and error-code messages used in the NMIS. This report is sequenced by error-code and is issued on request only.

Global Change Report (Report 103).- This report lists the global changes entered into the system and is sequenced by data element number. The report lists the changes from, changes to, data processed, reference code, and number of records changed. There is no additional selection criteria and the report is issued after each transaction and annually.

Metrology Control Document (Report 104).- This report is the Metrology Control Document which is the standard preprinted form for use in the NMIS.

Summary File Detail List (Report 105).- This report provides detailed information for those instruments not controlled by the NMIS but are serviced. This report when combined with Reports 012, 014, and 016 will provide the metrology manager with a more complete metrology system performance analysis. This report is sequenced by performing organization and action taken. The report summarizes data by action taken code such as repair hours, calibrate hours, labor cost year to date, parts cost year to date, outside service cost year to date, total number of instruments calibrated, total number of instruments repaired, and total instruments serviced. Additional selection criteria is by performing organization only. The report is issued quarterly.

Metrology History File Detail List (Report 106).-- This report lists in detail all of the data elements required for an instrument record when stored in the history file. This report is identical to Report 100. This report is issued on request only.

CONCLUDING REMARKS

In 1982 the NASA Metrology and Calibration Workshop made the decision to develop an agency-wide metrology data management system which would operate in concert with the new NASA Equipment Management System (NEMS). The metrology system would be used by field Centers to recall instruments for periodic calibration, to evaluate instrument performance, to summarize and report metrology work performance, and to provide other technical and management data. Two meetings, at the Kennedy Space Center and the Jet Propulsion Laboratory, held in 1983 resulted in the development of the core data elements--some shared with NEMS, some unique to the metrology system. Codes for various work actions were adopted and applicable system tables developed. In addition 18 system output reports were developed. Another of the major accomplishments of these meetings was the preliminary design and adoption of the Metrology Control Document (MCD) and the commitment that each field Center would use it as a source document for the NASA Metrology Information System (NMIS). The Langley Research Center was assigned lead responsibility in the development of NMIS. During detailed development, over a period of 7 months, several additional data elements were identified, 10 additional reports were developed, issuance frequency for reports was established, CRT screen formatting completed, the MCD design completed, and the draft of the NMIS design document compiled and distributed. Planned future activities include a detailed Design Document Review by NASA metrologists at the Langley Research Center (LaRC) in May 1984 and the initial system demonstration scheduled for July 1984 at LaRC. The NMIS is scheduled for installation at LaRC during the last quarter of calendar 1984 with second Center installation initiated in January 1985. Installation plans for the other Centers will be established at the next Metrology and Calibration Workshop to be held in October 1984.

NMIS/NEMS
Data Element

Description

M-10/E-10	* Equipment Control Number (ECN)
M-15/E-12	Old Tag Number
M-90/E-200	* Labor Cost Last Service
M-95/E-202	* Labor Cost Year to Date
M-100/E-204	* Labor Cost to Date
M-105/E-210	* Parts Cost Last Service
M-110/E-212	* Parts Cost Year to Date
M-115/E-214	* Parts Cost to Date
M-120/E-222	* Date Last Serviced
M-125/E-230	* Date Calibrated
M-130/E-232	* Date Calibration Due
M-135/E-30	* Item Name
M-140/E-40	Manufacturer's Code
M-145/E-42	* Manufacturer's Name
M-150/E-44	* Manufacturer's Model Number
M-155/E-46	* Manufacturer's Serial Number
M-160/E-60	* Date NASA Acquired
M-165/E-72	* Acquisition Document Control Number
M-170/E-78	Custodian Account Number
M-175/E-80	* Custodian Number
M-180/E-86	* Custodian Organization Code
M-185/E-90	* User Number
M-190/E-102	* Equipment Location Building
M-195/E-104	* Equipment Location Room
M-210/E-150	* Acquisition Cost

*Indicates identified by metrology workshop.

Figure 1.- NEMS data elements required by NMIS.

<u>Data Element</u>	<u>Description</u>
M-20	Recall Identifier
M-25	Recall Entry Date
M-30	* Condition Received
M-35	* Technician Identifier
M-40	* Calibration Interval
M-45	* Action Requested
M-50	* Action Taken
M-55	* Initiate Date
M-56	Transaction Date
M-57	Date Required
M-60	* Repair Hours
M-65	* Calibrate Hours
M-70	* Measurement Discipline
M-75	* Performing Organization
M-80	* Date Repaired
M-85	* Outside Service Cost Last Service
M-86	* Outside Service Cost Year to Date
M-87	* Outside Service Cost to Date
M-166	Job Order Number
M-200	Date Loaned Out
M-205	Date Loaned Due In
M-400	Reserved for Local Data
M-410	Reference Code
M-420	Transaction Number

*Indicates identified by metrology workshop.

Figure 2.- NMIS unique data elements required.



Figure 3.- NMIS instrument identification tag.

METROLOGY CONTROL DOCUMENT

USER INFORMATION	1. ITEM NAME				2. MANUFACTURER				3. EQUIP. CONTROL NO.			
	4. MODEL NO.			5. SERIAL NO.			6. USER NAME				7. USER ID.	
	8. BLDG. NO.	9. ROOM NO.	10. CUSTODIAN NAME			11. CUS. NO.	12. CUS. ORG.	13. OLD TAG NO.	14. DATE CALIBRATION DUE			
BACKGROUND INFORMATION	1. ACQ. DATE		2. ACQUISITION COST			3. ACQUISITION DOCUMENT NO.			4. CAL. INT.	5. REC. ENTRY DATE	6. DATE LAST SERV.	
	COST	7. LAST SERVICE	8. YEAR TO DATE	9. TOTAL TO DATE	10. CONDITION RECEIVED LAST × TIMES				11. ACTION TAKEN LAST × TIMES			
	LABOR											
	PARTS				12. REP. HRS. LAST × TIMES							
	OUTSIDE SERVICE				13. CAL. HRS. LAST × TIMES							
USER-TM AREA	1. DATE REQ.		2. ACT. REQ.	3. WORK AREA	4. JOB ORDER		5. INITIATE DATE	6. T.M. APPROVAL				
	7. REMARKS											
CALIBRATE-REPAIR INFORMATION	1. JOB PRIORITY	2. ACT. REQ.	ACT. TKN.	4. COND. REC.	5. REP. HRS.	6. CAL. HRS	7. TOTAL HRS.	8. PARTS COST	9. REP. DATE	10. CAL. DATE		
	11. CAL. TECH.	12. REP. TECH	13. OUTSIDE SERVICE COST			14. DATE REC.	15. REMARKS					
	16. LOCAL DATA											

103

Figure 4. NMIS Metrology Control Document - Front Side

17. EQUIPMENT CONTROL NO.

18.

ACCESSORIES RECEIVED

A. POWER CORD	C. PROBES	E. COVER
B. MANUAL	D. LEADS	F. OTHER

19.

STANDARDS & TEST EQUIPMENT USED

A. IDENTIFICATION NO.	B. CAL. DUE DATE	A. IDENTIFICATION NO.	B. CAL. DUE DATE	A. IDENTIFICATION NO.	B. CAL. DUE DATE

20.

ENTER OUT OF TOLERANCE VALUES ONLY

A. TEST IDENTIFICATION	B. FUNCTION TESTED	C. NOM. VALUE	D. INITIAL VALUE	E. TOLERANCE	
				LOW	HIGH

21.

PARTS REPLACED

A. SYMBOL	B. PART NO.	C. SOURCE	D. UNIT COST	E. QUANTITY	F. TOTAL COST	22. DATE TO AWP	23. DATE PARTS RECEIVED

24. REMARKS

G. GRAND TOTAL COST ▶

104

Figure 5. NMIS Metrology Control Document - Back Side

INSTRUCTIONS FOR METROLOGY CONTROL DOCUMENT

NOTE: All dates, machine generated or hand written, are presented as MMDDYY

USER INFORMATION: 1--14 are preprinted upon form generation.

BACKGROUND INFORMATION: 1--13 are preprinted upon form generation.

USER-TM: (TM = technical monitor) User completes 1,2,5, and 8. TM completed 3,4, and 6, makes any necessary changes to 1,2,5, and 8, and certifies approval by signing 7.

2. ACTION REQUIRED CODES

"A" = acceptance test
"B" = special test
"C" = calibration
"D" = decontaminate/clean
"E" = limited calibration
"F" = functional check
"G" = maintenance
"H" = modify
"I" = repair
"J" = other
"K thru Z" center unique & maintained

4. WORK AREA CODES

"A" = acoustics, vibration, shock
"B" = pressure & vacuum
"C" = chemical & analytical
"D" = dimensional
"E" = electrical/electronic
"F" = frequency stds. & counters
"G" = radiometry & photometry
"H" = temperature & humidity
"I" = ionizing radiation
"J" = microwave & RF
"K" = oscilloscopes, waveform, video & communications
"L" = liquid & gas flow
"M" = mass, force, & torque
"N thru Z" center unique & maintained

CALIBRATION-REPAIR INFORMATION: 1 -- 15 completed by appropriate personnel in servicing organization or as local options dictate.
5,6,7 -- complete to XX.X manhours.
8 -- rounded to whole dollars from block 21- G.
13 -- rounded to whole dollar.

3. ACTION TAKEN CODES

"A" = acceptance test
"B" = special test
"C" = calibrated
"D" = decontaminated/cleaned
"E" = center unique
"F" = functional check
"G" = shipped for off site repair
"H" = hold (AWP, manuals, etc.)
"I" = returned to user unserviced
"J" = reject-beyond economical repair
"K" = reject-shipped for off site repair
"L" = limited calibration
"M" = maintenance
"N" = modified
"O" = other
"P" = adjusted-limited calibration
"Q" = adjusted-calibrated
"R" = repaired
"S" = repaired-limited calibration
"T" = repaired-calibrated
"U" = clean-adjust-limited calibration
"V" = clean-adjust-calibrate
"W" = clean-limited calibration
"X" = clean-calibrate
"Y" = clean-calibrate
"Z" = clean-repair-calibrate

4. CONDITION RECEIVED CODES

"A" = operative-in tolerance
"B" = operative-out of tolerance $\leq 1X$
"C" = operative-out of tolerance $> 1X \leq 2X$
"D" = operative-out of tolerance $> 2X \leq 4X$
"E" = operative-out of tolerance $> 4X$
"F" = operative-out of tolerance indeterminate
"G" = inoperative
"H" = not determined/applicable
"I" = other-see remarks
"J thru Z" center unique & maintained

LOCAL DATA: This section may be used, at local option, for any purpose desired. Any required programming is local responsibility.

REVERSE: General instrument service information. This section will be completed by servicing organization or as local procedures dictate.

Block 17 -- Equipment Control Number must be completed manually.

Figure 6.- Instructions for completing Metrology Control Document.

<u>Table Number</u>	<u>Table Name</u>
20	Recall Identification Table
30	Condition Received Table
45	Action Requested Table
50	Action Taken Table
70	Measurement Discipline Table
75	Performing Organization Table
420	Transaction Number Table

Figure 7.- NMIS tables required

<u>Code</u>	<u>Description</u>
C	Calibration
F	Functional test
I	<u>In situ</u> calibration
N	Non recall
P	Preventive maintenance
R	Reference standard
S	Personal safety
T	Transfer standard
W	Working standard

Figure 8.- NMIS recall identification codes--
Table 20.

<u>Code</u>	<u>Description</u>
A	Operative - in tolerance
B	Operative - out of tolerance $\leq 1x$
C	Operative - out of tolerance $> 1x \leq 2x$
D	Operative - out of tolerance $> 2x \leq 4x$
E	Operative - out of tolerance $> 4x$
F	Operative - out of tolerance - indeterminable
G	Inoperative
H	Not determined - not applicable
I	Other - see remarks
J-Z	Remaining values Center unique and maintained

Figure 9.- NMIS instrument condition received codes--Table 30.

<u>Code</u>	<u>Description</u>
A	Acceptance test
B	Special test
C	Calibration
D	Decontaminate/clean
E	Limited calibration
F	Functional check
G	Maintenance
H	Modify
I	Repair
J	Other
K-Z	Remaining values Center unique and maintained

Figure 10.- NMIS action requested codes--Table 45.

<u>Code</u>	<u>Description</u>	<u>Code</u>	<u>Description</u>
A	Acceptance test	N	Modified
B	Special test	O	Other
C	Calibrated	P	Adjusted - limited calibration
D	Decontaminated - cleaned	Q	Adjusted - calibrated
E	Center unique	R	Required
F	Functional check	S	Repaired - limited calibration
G	Shipped for off-site repair	T	Repaired - calibrated
H	Hold (awaiting parts, manuals, etc.)	U	Cleaned - adjusted - limited calibration
I	Returned to user unserviced	V	Cleaned - adjusted - calibrated
J	Reject - BER (beyond economical repair)	W	Cleaned - limited calibration
K	Reject - shipped for off-site repair	X	Cleaned - calibrated
L	Limited calibration	Y	Cleaned - repaired - limited calibration
M	Maintenance	Z	Cleaned - repaired - calibrated

Figure 11.- Action taken codes--Table 50.

<u>Code</u>	<u>Description</u>
A	Acoustics, vibration, shock
B	Pressure and vacuum
C	Chemical and analytical
D	Dimensional
E	Electrical/Electronic
F	Frequency standards and counters
G	Radiometry and photometry
H	Temperature and humidity
I	Ionizing radiation
J	Microwave and RF
K	Oscilloscopes, waveform, video, and communications
L	Liquid and gas flow
M	Mass, force, and torque
N-Z	Remaining values Center unique and maintained

Figure 12.- NMIS measurement discipline codes--Table 50.

<u>Code</u>	<u>Description</u>
A	Calibration/repair laboratory
B	Repair laboratory
C	Calibration laboratory
D	Standards laboratory
E	National Bureau of Standards
F	NBS map
G	Government primary laboratory (other than NBS)
H	NASA map
I-Z	Remaining values Center unique and maintained

Figure 13.- NMIS performing organization codes--Table 75.

<u>Transaction Number</u>	<u>Transaction Name</u>
01	Receipt of New Instrument by Inspecting Facility
02	Receipt of New Instrument by Receiving Facility
03	Receive Instrument for Recall
04	Return of Record from History File
05	Retagging
33	New Performing Organization
34	Send to Calibration
35	Send to Service
36	Return from Calibration
37	Return from Service
38	Cost (change)
39	Custodian Account (change)
40	User Number (change)
41	Instrument Location (change)
42	Loan Pool Out
43	Loan Pool Returned
44	Record Data (change)
45	Global (change)
46	Calibration Interval Adjustment
47	Factory Repair/Service
48	Recall Identifier
66	Modify Performing Organization
67	Lost Tag
68	Excess (broken)
69	Decontrol (removal of tag)
99	Discontinue Performing Organization

Figure 14.- NMIS transaction number codes--Table 420.

<u>Table Number</u>	<u>Table Name</u>
40	Manufacturer's Code Table
78	Custodian Account Number Table
90	User Number Table
102	Building Number Table
252	NASA Installation Number Table

Figure 15.- NEMS tables used by NMIS.

<u>Report Number</u>	<u>Report Name</u>	<u>Frequency</u>
001	ECN Calibration Master List	Quarterly
002	Calibration User List - ECN Sequence	On Request
003	Calibration User List - Item Name Sequence	On Request
004	Calibration Item Name List	Annually
005	Calibration Model Number List	On Request
006	Calibration Due List - ECN Sequence	Monthly
007	Calibration Due List - Item Name Sequence	On Request
008	Calibration Due List - Performing Organization Sequence	Monthly
009	Calibration Overdue List	Monthly
010	Performing Organization Due/Overdue Status Report	Daily
011	Hold Status Report	Monthly
012	Calibration Support Analysis	Annually
013	Calibration Life Cycle Cost Analysis	Annually
014	Production Analysis	Monthly
015	Calibration Weekly Status Report	Weekly
016	Calibration/Maintenance Time Analysis	Annually
017	Out-of-Tolerance and Inoperative Instrument Report	Monthly
018	Calibration Interval Analysis Report	Annually

Figure 16.- NMIS reports developed by metrology workshop.

<u>Report Number</u>	<u>Report Name</u>	<u>Frequency</u>
019	Work Action Analysis Report	Annually
020	Property Location Report	On Request
021	Work Action Analysis Report - Summary File	Quarterly
100	Detail Item List	On Request
101	Daily Transaction Report	Daily
102	Error Codes and Messages	On Request
103	Global Change Report	Annually
104	Metrology Control Document	On Request
105	Summary File Detail List	On Request
106	Metrology History File Detail List	On Request

Figure 17.- Additional NMIS reports required.

REPORT NO: 006

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
INSTALLATION NAME
NASA METROLOGY INFORMATION SYSTEM
CALIBRATION DUE LIST - ECN SEQUENCE

PAGE ZZ9
RUN DATE MM/DD/YY

SEQUENCED BY: CUSTODIAN ACCOUNT NUMBER
USER NUMBER
DATE CALIBRATION DUE
ECN

CUSTODIAN ACCOUNT NUMBER, NAME, M/S: XXXXX, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX, XXXXXXX
USER NUMBER, NAME, M/S: XXXXXX, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX, XXXXXXX

<u>DATE</u> <u>CAL DUE</u>	<u>ECN</u>	<u>ITEM NAME</u>	<u>MANUFACTURER'S NAME</u>	<u>MANUFACTURER'S</u> <u>MODEL NUMBER</u>	<u>CAL</u> <u>INT</u>	<u>MEAS</u> <u>DISC</u>	<u>PERF</u> <u>ORG</u>
999999	XXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	99	X	X

after change in Date Calibration Due:

TOTAL NUMBER OF ITEMS DUE: ZZ,ZZ9

after change in User Number:

TOTAL NUMBER OF ITEMS: ZZ,ZZ9

after change in Custodian Account Number:

TOTAL NUMBER OF ITEMS: ZZ,ZZ9

GRAND TOTAL NUMBER OF ITEMS: ZZ,ZZ9

1. Sequence: Custodian Account Number (M-170)
User Number (M-185)
Date Calibration Due (M-130)
ECN (M-10)
2. Page Break: User Number
Custodian Account Number
Maximum Number of Lines Per Page
3. Section Break: Date Calibration Due
4. Total Level: for Date Calibration Due
for User Number
for Custodian Account Number
Grand Total
5. Selection Criteria: Date Cal Due
Date Cal Due/Custodian Account Number
Date Cal Due/Custodian Account Number/
User Number
All
6. Distribution:
7. Frequency: Monthly

112

Figure 18.- Format of instrument calibration due report.