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ABSTRACT

Second in a series of five, the course consists of the history and principles of the micrometer. The student must have mastered the skills offered in Introduction to Measurement and the Use of Scaled Instruments--9225.01. Techniques in reading and using the micrometer, checking, adjusting, and calibrating the micrometer are topics covered. Extensive lab work and practice will be included to make the student proficient and accurate in its use. The guide outlines 10 instructional blocks totaling 135 hours: (1) history of measurement with the micrometer, (2) the parts of a micrometer, (3) the principle of measurement with a micrometer, (4) techniques of reading the micrometer scales, (5) techniques in using the micrometer, (6) how to adjust and calibrate the micrometer, (7) types and styles of micrometers, (8) application of special purpose micrometers, (9) accessories used with micrometers, and (10) posttest. Adequate laboratory time, actual experience on aircraft and other equipment, and audiovisual aids are provided. Textbooks and manuals are listed along with other references in the bibliography. A posttest sample concludes the document. (MW)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

Course Outline
MICROMETER INSTRUMENTS
(Aviation Quality Control 1 - 9225)

Department 48 - Course 9225.02

CE002057

DADE COUNTY PUBLIC SCHOOLS

DIVISION OF INSTRUCTION • 1971

D A D E C O U N T Y P U B L I C S C H O O L S
1 4 1 0 N O R T H E A S T S E C O N D A V E N U E
M I A M I, F L O R I D A 33132

Course Outline

AVIATION QUALITY CONTROL 1 - 9225
(Micrometer Instruments)

Department 48 - Course 9225.02

the division of

VOCATIONAL, TECHNICAL AND ADULT EDUCATION

Published by the Dade County School Board

Course Description

9225	48	9225.02	Micrometer Instruments
State Category Number	County Dept. Number	County Course Number	Course Title

This quinmester course consists of the history and principles of the micrometer. Techniques in reading and using the micrometer, checking, adjusting and calibrating the micrometer are also covered. Extensive lab work and practice will be included in this course to make the student proficient and accurate in its use.

Indicator of Success: The student must have taken Course No. 9?25.01, "Introduction to Measurement and the Use of Scaled Instruments".

Clock hours: 135

PREFACE

The following quinmester course outline is entitled "Micrometer Instruments". This is the second quinmester course of the eleventh year. There will be three more quinmesters as follows:

9225.03 Gage Blocks and Dial Indicators
9225.04 High Amplification Instruments
9225.05 Calibration of Measuring Instruments

This course will serve as a guide to the high school student who wishes to pursue the highly exacting field of checking, gaging and measuring parts to insure quality and reliability of the finished product.

Fundamentals of dimensional metrology involving linear measurement with micrometer instruments will be covered in nine blocks of work in approximately 135 hours.

Prerequisite for this course is Course No. 9225.01 entitled "Introduction to Measurement and the Use of Scaled Instruments".

Adequate laboratory time and actual experience on aircraft and other equipment will be provided to develop skills in the student. The student is expected to be proficient in, not just familiar with these techniques.

Motion picture films, color slides and transparancies will be used to help apply the techniques needed in this course.

Study periods, group discussions and extensive use of textbooks, laboratory and training manuals will be used. These are listed along with the other references and periodicals in the bibliography.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the Quinmester Advisory Committee, and the Vocational Teacher Education Service, and has been approved by the Dade County Vocational Curriculum Committee.

TABLE OF CONTENTS
with Suggested Hourly Breakdown

GOALS

The aviation quality control student must be able to:

1. Develop skills in the use of close tolerance measurements.
2. Develop the attitudes of patience and persistence to gain maximum accuracy.
3. Develop the habits of cleanliness of person and work area.
4. Be aware of the responsibility involved in his chosen work.
5. Maintain the standards required for the field.
6. Control quality of the finished product.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - HISTORY OF MEASUREMENT WITH THE MICROMETER

The student must be able to:

1. Recite the history of the micrometer.
2. Explain how the first micrometers were designed.
3. Give an account as to how they were used.

BLOCK II - THE PARTS OF A MICROMETER

The student must be able to:

1. Demonstrate his ability to disassemble a micrometer.
2. Name each part and explain its function.
3. Demonstrate his ability to properly assemble a micrometer.

BLOCK III - THE PRINCIPLE OF HOW A MICROMETER MEASURES

The student must be able to:

1. Recite the principles of measuring with the micrometer.
2. Compare screw thread amplification to vernier scale amplification.

BLOCK IV - TECHNIQUES OF READING THE MICROMETER SCALES

The student must be able to:

1. Read micrometer barrel and thimble scales by measuring 10 prepared samples.
2. Read micrometer vernier scales by measuring 10 prepared samples.
3. Read a metric micrometer scale by measuring 10 prepared samples.

BLOCK V - TECHNIQUES IN USING THE MICROMETER

The student must be able to:

1. Demonstrate the technique of centralizing a micrometer.
2. Demonstrate the techniques of rocking over center.

3. Demonstrate his knowledge of micrometer measurement and handling by accurately measuring to one mil, 10 prepared samples under 1 inch.
4. Demonstrate his ability to handle larger micrometers by accurately measuring to 1 mil, 10 prepared samples over 1 inch.

BLOCK VI - HOW TO ADJUST AND CALIBRATE THE MICROMETER

The student must be able to:

1. Fill out inspection reports showing the proper procedure for calibrating a micrometer.
2. Write in list form on back of inspection report the 10 steps of calibrating and adjusting a micrometer.
3. Clean and lubricate a micrometer.
4. Demonstrate use of gage blocks as micrometer setting standards.
5. Accurately calibrate at least one micrometer.

BLOCK VII - TYPES AND STYLES OF MICROMETERS

The student must be able to:

1. Demonstrate his ability to make proper measurements with an inside micrometer by accurately measuring to 1 mil, 10 prepared inside diameter parts of various sizes; then filling out an inspection report.
2. Demonstrate his ability to make proper measurements with a depth micrometer by accurately measuring to 1 mil the depth of ten prepared samples of various depth; then filling out an inspection report.
3. Calibrate at least one inside micrometer and fill out the proper inspection report.
4. Calibrate at least one depth micrometer and fill out the proper inspection report.

BLOCK VIII - APPLICATION OF SPECIAL PURPOSE MICROMETERS

The student must be able to:

1. Demonstrate the application of as many special purpose micrometers as available in the lab.

BLOCK IX - ACCESSORIES USED WITH MICROMETERS

The student must be able to:

1. Demonstrate use of ball or small hole gages by measuring at least 10 small holes of various sizes within the range of available gage set.
2. Demonstrate use of telescoping gages by measuring at least 10 parts involving inside measurement within the range of available set, and filling out inspection report.

Course Outline

AVIATION QUALITY CONTROL 1 - 9225
(Micrometer Instruments)

Department 48 - Course 9225.02

I. HISTORY OF MEASUREMENT WITH THE MICROMETER

A. The Invention of the Micrometer

B. The First Micrometers and Their Uses
1. James Watts micrometer
2. William Gascigne's micrometer
3. Henry Maudslay's micrometer
4. The Palmer micrometer

II. THE PARTS OF A MICROMETER

A. The Frame
1. The function of the micrometer frame
2. Types and styles of frames
3. Material and construction of micrometer frames

B. The Barrel
1. The function of the barrel of a micrometer
2. Engraving styles used on a micrometer barrel
3. Variation in barrel sizes

C. The Thimble
1. The function of the thimble of a micrometer
2. Sizes and engraving styles of thimble scales

D. The Ratchet
1. The function of the ratchet on a micrometer
2. The click-stop and slip clutch style ratchet
3. Construction of the ratchet mechanism

E. The Anvil
1. The function of the anvil of a micrometer
2. Different styles of anvils and their uses

II. THE PARTS OF A MICROMETER (Contd.)

F. The Spindle
   1. The function of the spindle of a micrometer
   2. Materials from which spindles are made
   3. Types and styles of spindles

III. THE PRINCIPLE OF MEASUREMENT WITH A MICROMETER

A. The Screw Thread as a Means of Amplification

B. The Thread Pitch of a Micrometer

C. Micrometer Range

IV. TECHNIQUES OF READING THE MICROMETER SCALES

A. Scales on the Barrel

B. Scales on the Thimble
   1. Readings to 1 mil
   2. Direct readings to 1 mil

C. Vernier Scales
   1. Principle of the vernier scale
   2. Where the scale is located
   3. Reading the vernier micrometer scale

D. Reading the Scales on a Metric Micrometer

V. TECHNIQUES IN USING THE MICROMETER

A. Proper Hand Holding Techniques

B. Use of Bench Holding Fixtures
   1. Bench vises
   2. Magnetic V blocks

C. Using the Ratchet Versus Feel on the Thimble

D. Centralizing the Micrometer

V. TECHNIQUES IN USING THE MICROMETER (Contd.)

E. Rocking over Center to Find Maximum Diameter

F. How to Avoid Parallex Errors

G. Proper Care and Work Precautions in Using the Micrometer

VI. HOW TO ADJUST AND CALIBRATE THE MICROMETER

A. Use of Standards
   1. The micrometer standard
   2. Gage blocks

B. Adjustments for Thread Wear

C. Checking for Parallelism Between Anvil and Spindle Contact Surfaces

D. Proper Procedure in Filling Out Necessary Forms
   1. Calibration chart
   2. Inspection report
   3. Tags
   4. Work sheets
   5. Work orders

E. Techniques of Cleaning and Lubricating a Micrometer
   1. Solvent to be used
   2. Use of compressed air
   3. Lubricants to be used

VII. TYPES AND STYLES OF MICROMETERS

A. The Inside Micrometer
   1. Different styles of inside micrometers
   2. Techniques in measuring with the inside micrometer
      a. Judging the proper feel
      b. Finding the maximum diameter
      c. Centralizing
   3. Proper reading of the inside micrometer scales

VII. TYPES AND STYLES OF MICROMETERS (Contd.)

4. Calibrating the inside micrometer
   a. Using an accurate outside micrometer
   b. Gage block set-up
5. Care and work precautions in using the inside micrometer

B. The Depth Micrometer
1. Parts of a depth micrometer
   a. The base and its purpose as a reference point
   b. Rod size and its effect on accuracy
2. Techniques in measuring with the depth micrometer
3. Proper reading of the depth micrometer scales
4. Techniques in calibrating the depth micrometer
5. Care and work precautions in using the depth micrometer

VIII. APPLICATION OF SPECIAL PURPOSE MICROMETERS

A. Dial Indicating Types

B. Removable Anvil Types

C. Disc Anvil Types

D. "V" Anvil Types

E. Thread Measuring Types

F. Digital or Direct Reading Types

IX. ACCESSORIES USED WITH MICROMETERS

A. Telescoping Gages
1. Type and method of measurement provided
2. Accuracy and precision to be expected
3. Ranges of telescoping gage sets
4. Techniques in measuring with the telescoping gage
5. Care and work precautions in working with the telescoping gage

IX. ACCESSORIES USED WITH MICROMETERS (Contd.)

B. The Small Hole Gage
   1. Function of the small hole gage
   2. Accuracy and precision of the small hole gage
   3. Ranges of small hole gage sets
   4. Techniques in using the small hole gage
   5. Care and work precautions to be applied

X. QUINMESTER POST TEST

BIBLIOGRAPHY
(Micrometer Instruments)

Basic Reference:

1. Busch, Ted. Fundamentals of Dimensional Metrology, Wilkie Brothers Foundation. Albany New York: Delmar Publishers, Inc., 1966. The above consists of a text of 428 pages and a lab workbook of 226 pages.

Supplementary References:

2. Juran, J.M. Quality Control Handbook. 2nd ed. New York: McGraw Hill Book Co., Inc., 1951. Pp. 800.

3. Kennedy, Clifford W., and Andrews, Donald E. Inspecting and Gaging. New York: Industrial Press, Inc., 1967. Pp. 590.

Films:

1. Black Granite Gages. 16mm. 19 min. Color. Sound. 1969. "Do-All" Company.

2. Micrometer. #1-10447. 16mm. 15 min. B/W. Sound. Lindsey Hopkins Materials Laboratory.

3. Precisely So. #1-13109. 16mm. 20 min. B/W. Sound. Lindsey Hopkins Materials Laboratory.

4. Profile in Precision. 20 min. Color. Sound. 1969. Brown & Sharp Manufacturing Company.

5. Tools and Rules for Precision Measuring, The. 16mm. 38 min. B/W. 1969. L.S. Starrett Co.

A P P E N D I X

Quinmester Post Test Sample

QUINMESTER POST TEST
(Micrometer Instruments)

Name_____Date_____Score_____

1. Every measurement requires three elements, what are they?

2. It is recommended that we lay our instruments and parts on a shop cloth, other than keeping things clean, what are some more reasons for doing this?

3. Regardless of overall size the range of a micrometer is usually limited to _____inch.

4. The pitch of the thread on a micrometer spindle is_____.

5. Do outside micrometers obey Abbe's law? Yes or No.

6. What is the discrimination of the micrometer?

7. What is the reliability of the micrometer?

8. What are the correct names for the contact points of the micrometer? a._____b._____

9. The scales on the thimble of a micrometer are in _____ mil.

10. What is meant by the term "centralizing" a micrometer?

11. How would you check for parallelism of the micrometer contact points?

12. What is the reason (name two) for not leaving the contact points of a micrometer in the closed position?

13. Do you or do you not have to centralize a depth micrometer?

14. Explain how you would calibrate a depth micrometer.

15. Is the small hole gage considered a reliable instrument?

16. A gage, used with an outside micrometer, for measuring holes greater than 1/2 inch diameter is called a _____ gage.

17. What is the accepted temperature for standard measurement? (circle the correct answer)
    1. 20 deg. F
    2. 68 deg. C
    3. 20 deg. C
    4. 70 deg. F

18. What physical phenomenon is now accepted as the international unit of measurement?

ANSWER KEY TO QUINMESTER POST TEST
(Micrometer Instruments)

1. 1. Object being measured
   2. Standard of length
   3. Means for comparison

2. 1. Cushion delicate instruments
   2. Benches pick up micro-chips of metal that will scratch instruments and parts

3. One

4. 40

5. Yes

6. .1 mil or .0001 inch

7. .2 mil or .0002 inch

8. a. Spindle b. Anvil

9. One

10. Setting the instrument perpendicular to the axis of the part

11. Explore surfaces with a bearing ball
    Use optical flats
    Check light through gap with points set at approximately .1 or .2 mil.

12. 1. Corrosion 2. Stress the instrument

13. No

14. Use a set-up with gage blocks on a surface plate

15. No

16. Telescoping gage

17. No. 3. 20 deg. C

18. The light wave