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OPINIONS OF AIR FORCE MAINTENANCE PERSONNEL ABOUT CONVENTIONAL --ETC(U)
JUL 78 D L THOMAS, R C JOHNSON, J J DALEZMAN
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This final report was submitted by Advanced Systems Division, Air Force Human Resources Laboratory, Wright-Patterson Air Force Base, Ohio 45433, under project 1710, with HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235.

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This technical report has been reviewed and is approved for publication.

GORDON A. ECKSTRAND, Director
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Commander

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1. REPORT NUMBER AFHRL-TR-78-32	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) OPINIONS OF AIR FORCE MAINTENANCE PERSONNEL ABOUT CONVENTIONAL TECHNICAL ORDERS.	5. TYPE OF REPORT & PERIOD COVERED Final rept. June 1974 - March 1978	6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) Donald L. Thomas Robert C. Johnson Joseph J. Dalezman	8. CONTRACT OR GRANT NUMBER(s)	9. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62205F 17100429	
10. PERFORMING ORGANIZATION NAME AND ADDRESS Advanced Systems Division Air Force Human Resources Laboratory Wright-Patterson Air Force Base, Ohio 45433	11. CONTROLLING OFFICE NAME AND ADDRESS HQ Air Force Human Resources Laboratory (AFSC) Brooks Air Force Base, Texas 78235	12. REPORT DATE July 1978	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 1222p.	13. NUMBER OF PAGES 24	15. SECURITY CLASS. (of this report) Unclassified	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)			
18. SUPPLEMENTARY NOTES			
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) job guide manuals maintenance manuals technical manuals technical orders			
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report examined the adequacy of current Air Force technical orders (TOs) as training and job performance aids by utilizing the opinion survey method. A questionnaire measured the attitudes of C-141 aircraft maintenance technicians and personnel toward conventional TOs in order to identify problems with their use and usability. The questionnaire and procedures used were identical to those of a survey conducted in 1962. The results of the present survey indicated that the subject technicians generally identified the same problems with TOs as were identified in the field study conducted 13 years earlier; i.e., TOs frequently were difficult to understand, did not allow for easy information access, and did not provide necessary on-the-job information. The technicians in the sample suggested that TOs should provide specific step-by-step job-related instructions supported by detailed illustrations.			

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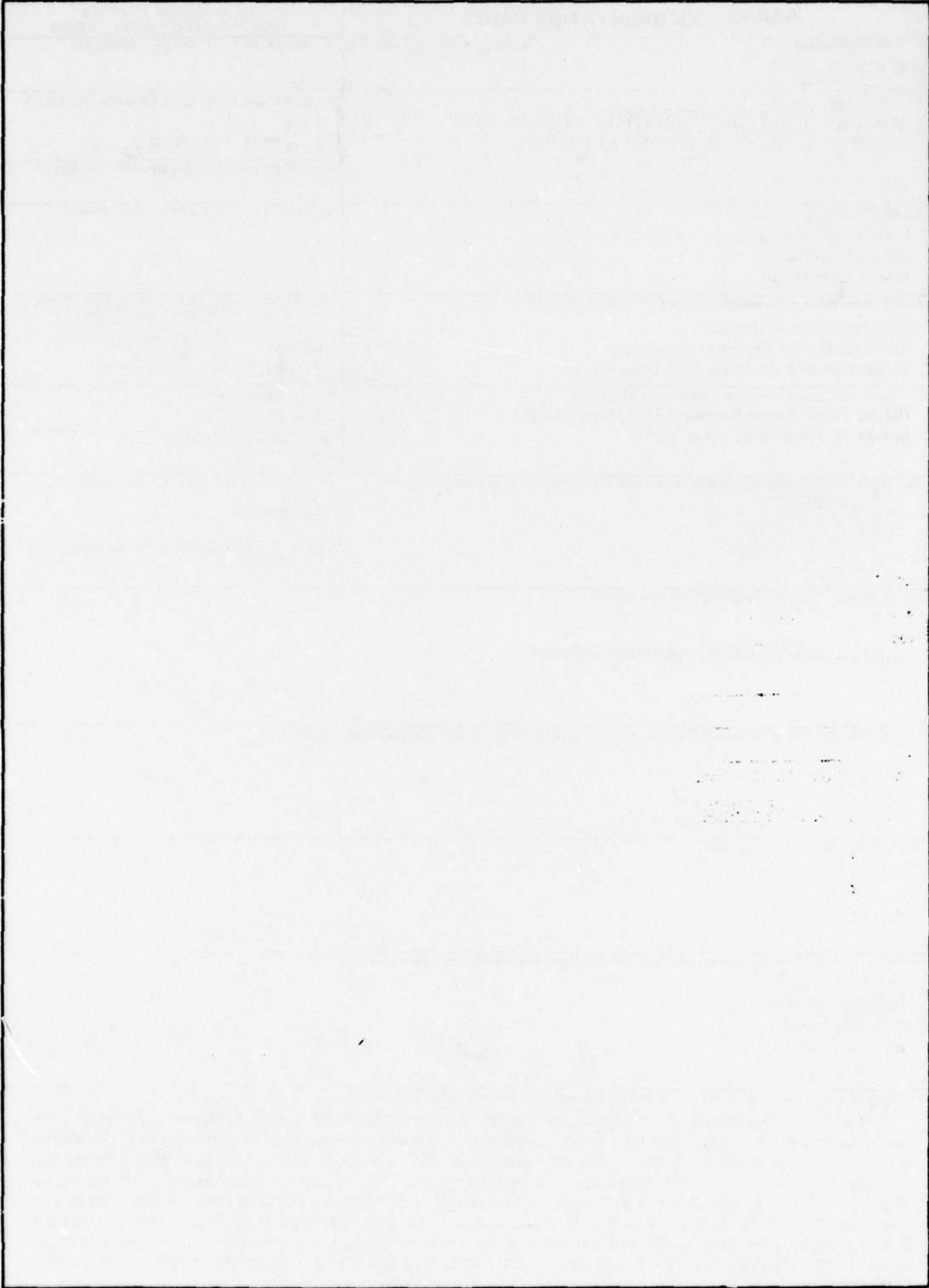
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PREFACE

This study was planned and conducted by personnel of the Personnel and Training Requirements Branch, Advanced Systems Division of the Air Force Human Resources Laboratory, Wright-Patterson Air Force Base, Ohio. The work was accomplished under project 1710, Training for Advanced Air Force Systems; task 171004, Improving Air Force Maintenance. Dr. Ross L. Morgan was the project scientist, Mr. Robert C. Johnson was the task scientist, and Dr. Donald L. Thomas was the principal investigator.

The authors would like to express their appreciation to Colonel Jean Hixson, USAFR, for her assistance in evaluating and interpreting the data and to Miss Deborah J. Martin for her assistance in reducing the data. Appreciation is also expressed to Mr. Les Hall of Charleston Air Force Base, South Carolina, and Mr. Walter Ewalt of Norton Air Force Base, California, for their assistance in administering the questionnaires.

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OPINIONS OF AIR FORCE MAINTENANCE PERSONNEL ABOUT CONVENTIONAL TECHNICAL ORDERS

I. INTRODUCTION

Maintenance technicians and personnel have frequently expressed their dissatisfaction with conventional technical orders (TOs). A common complaint of maintenance personnel is that conventional TOs are difficult to understand and use. The present study attempted to examine empirically the basis for such complaints in order to gain insights as to how TOs can be improved.

Previously, Losee, Allen, Stroud, and Ver Hulst (1962) analyzed the Air Force maintenance technical data system. They examined all phases of the TO system, including the preparation, production, distribution, evaluation, and verification processes. The procedure used in that study included the use of a questionnaire to measure the attitudes of technicians toward technical orders. The present study was designed to replicate the questionnaire portion of the Losee et al. (1962) study.

The Losee et al. (1962) questionnaire examined the opinions and attitudes of maintenance technicians toward TOs. Issues of concern in the study were the readability, usability, acceptability frequency of use, etc. of TOs. The questionnaire was administered to 2,300 technicians in 19 different Air Force organizations. The basic findings were that (a) TOs were used as a primary training text, and (b) TOs needed to be reorganized or restructured in order to be more comprehensible and useful. The results also suggested that such a reorganization could be accomplished by using step-by-step instructions and detailed illustrations instead of the conventional TO format that presents technical data in long paragraphs with few supporting illustrations. In addition, maintenance personnel believed that TOs in the form of checklists, work cards, and/or pocket size books would be more effective maintenance reference sources (see Losee et al., 1962, Section II, pp. 14-17).

Purpose

The purpose of the present study was to measure the attitudes of maintenance technicians toward conventional TOs prior to their replacement by an improved technical manual system, called job guides. The intent of the

questionnaire was to determine whether attitudes have changed since the Losee et al. (1962) survey and whether the technical order problems identified in that study still exist.¹ The major questions of interest in this study were the following:

1. Have the problems with TOs changed or remained the same as in 1962?
2. What, if any, improvements have occurred in TOs since 1962?
3. How can TOs be improved?

II. METHOD

The subjects for the present study were 248 flight-line and shop technicians assigned to maintain C-141 aircraft at Charleston Air Force Base, South Carolina, and Norton Air Force Base, California. Each maintenance squadron (organizational, field, and avionics) provided approximately 40 technicians. These subjects were representative of the squadrons in terms of AFSC, grade levels, and experience levels. This sample was somewhat more restrictive than the Losee et al. (1962) sample which also included personnel assigned to depot maintenance.

This study employed the same questionnaire and procedures used by Losee et al. (1962, pp. 14-17). The only major modification was the use of a smaller and more restricted sample. All technicians were briefed on the questionnaire prior to presentation. The data were collected in June 1975.

The data were summarized as in the Losee et al. (1962) survey by determining the percentage of technicians selecting each alternative for each

¹Data for this study were collected in June 1975. The conventional TOs for the C-141 which provided the basis for responses to this survey were replaced in September 1975 with an improved type of technical data called job guides. A second survey was conducted after implementation of the job guides to determine if they could provide satisfactory solutions to the problems identified in the present study and the Losee et al. (1962) study. For information on an evaluation of the C-141 job guide program see Johnson, Thomas, and Martin (1977).

multiple-choice question. Each question and alternative is listed in Appendix A with a graph of the results. The graphs portray the data from both the 1962 study and the present study.

III. RESULTS

Results for each question from both the 1962 and present 1975 studies are provided in Appendix A. Each figure includes a listing of the question and the response alternatives. The data are broken down further by experience level (3, 5, or 7 level) and type of squadron (line or shop). The questions referred to below correspond in numbering with those used in Appendix A, permitting easy reference. In this section only highlights of the key findings will be discussed.

Survey Findings

Overall the results of the 1962 and 1975 surveys were similar and for many questions were almost identical. This is of great importance because it indicates there was little change in attitudes about TOs from 1962 to 1975.

The relationship between training and TOs was examined by questions 5, 6, 9, and 11 (see Appendix A). As in the 1962 study, the present survey found that Air Force technical schools and "on-the-job training" relied heavily on TOs as training texts. In fact, a slight increase in the use of the TO as a training text was indicated from 1962 to 1975 (see question 5). The judged necessity or value of TOs for training was found to be high in both studies (see question 6).

Several aspects of the data, however, suggested that TOs were not fulfilling important and vital maintenance functions. In 1962, 32% of the technicians reported that TOs were fine as is (see question 10 I); by 1975, that figure had dwindled to 13%. In 1962, 51% of the maintenance personnel surveyed indicated that TOs were adequate for troubleshooting, while the 1975 only 37% so indicated (see question 10 L). Not surprisingly, estimates of TO use in troubleshooting tasks declined by 10% to 15% (see question 9). This was accompanied by an increase in the judged need for TO improvement: 66% said yes to such a need in 1962; 79% in 1975 (see question 7).

Questions 2, 3, and 10 pertained to the type of information TOs should provide. The maintenance technicians consistently rated the following as critically needed information: (a) step-by-step written instructions, (b) detailed pictures or

illustrations, and (c) detailed explanations (words and Illustrations). The indicated need for such information rose by about 10% from 1962 to 1975.

Based on the responses to question 10, there was an indication of an increased need from 1962 to 1975 to reorganize TOs; that is, to make them more useful and relevant for training and for job task performance. The basic complaints about TOs were: (a) they were too theoretical and did not provide instructions about how to do a job; and (b) not enough information or explanation was provided, especially as task complexity increased.

Finally, it should be noted that the reported need for use of TOs has increased substantially from 1962 to 1975. In 1975, 69% of the maintenance personnel referred to TOs 11 times or more per week as compared to 46% for 1962 (see question 12).

In summary, the survey found that technicians expressed a strong need for a good TO that would serve both as a training and on-the-job performance aid. Based on the opinions expressed in this and the Losee et al. (1962) survey, the observation can be made that conventional TOs do not fulfill adequately the needs of maintenance technicians and personnel.

IV. DISCUSSION AND RECOMMENDATIONS

This study has provided information on the uses of conventional TOs and the attitudes of technicians toward them. However, in applying these findings, it should be noted that the findings are based upon the subjective opinions of technicians assigned to maintenance of the C-141. As such, they may or may not reflect the true facts or realities about TOs in the operational environment. Also, the present study surveyed only technicians assigned to maintenance of the C-141. It is believed that the C-141 TOs are typical of conventional TOs and that the results can be generalized to other similar technical data; however, this assertion was not tested.

Overall the present findings closely paralleled the results found by the Losee et al. (1962) survey. The results of these opinion surveys indicated that maintenance technicians and personnel need TOs that will serve both a training and an on-the-job performance function.

The most disturbing finding was the high degree of expressed dissatisfaction with conventional

TOs, both in the 1962 and 1975 survey. If anything, the degree of dissatisfaction has increased over the years. This observation is based on the decrease in percentage of technicians who reported that TOs were (a) adequate as is and/or (b) adequate for troubleshooting. Overall the opinions of maintenance personnel suggest that TOs have not improved much over a 13-year period and may have deteriorated. An alternate interpretation of this finding is that the complexity of the equipment may have increased with a consequent need for more complete TOs and more detailed troubleshooting instructions, while the quality of the TOs may not have improved correspondingly.

Both the Losee et al. (1962) study and the present study found that TOs were not meeting important and specific maintenance needs. The consensus of the maintenance technicians surveyed was that TOs should be reorganized and/or restructured to make them more understandable, useful, and relevant. The technicians suggested that this could be accomplished by having TOs provide (a) more detailed information (both verbally and pictorially) and (b) more information on "how to do a job."

From the study it can be concluded that the two most basic problems with TOs are the type of information provided and the organization. The key is to make maintenance technical data more comprehensible, relevant to the job, and easily accessible. *Opinions of maintenance technicians and personnel suggested that the primary need is for step-by-step information detailing how to do a particular job. In essence, the stress should be less on theoretical and more on pragmatic job-related information. In addition, there was an expressed desire for more detailed illustrations. Any modification of TOs should incorporate the above as basic principles or guidelines, while still providing sufficient theoretical information for use in training.*

Over the past decade, new maintenance manual systems designed to fulfill the above needs have been developed and researched experimentally. An example is the job guide manual (JGM) system. It provides both detailed step-by-step instructions and illustrations on how to do a specific task. The information in JGM is presented both verbally and

in illustrations, is easy to comprehend, and is task oriented.

The conventional TOs for the on-equipment maintenance of the C-141 were replaced by the JGM system at Charleston and Norton Air Force Bases in September 1975. The initial reaction to the JGMs by maintenance personnel has been highly favorable. A description of the C-141 JGM program and the results of a study to evaluate the acceptance and usability of the data are presented in Johnson, Thomas, and Martin (1977).

V. SUMMARY

The findings of this study indicate that the problems associated with the use of conventional TOs still exist. Conventional TOs frequently are incomplete, are written in difficult to understand language, and generally do not provide specific task steps. In addition, they frequently are poorly organized, making location of information difficult. It was suggested that a manual system utilizing detailed step-by-step instructions and illustrations would reduce substantially or eliminate the aforementioned TO problems. The job guide manual system developed for the C-141 was offered as an example of a good alternative to conventional TOs.

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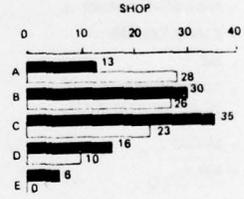
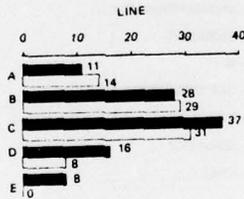
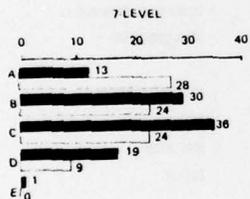
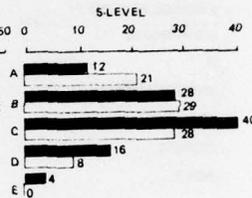
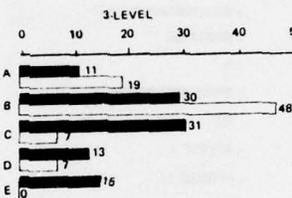
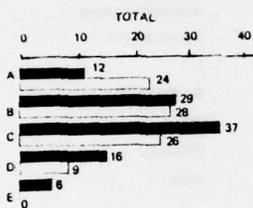
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- Losee, J.E., Allen, R.H., Stroud, J.W., & Ver Hulst, J. *A study of the Air Force maintenance technical data system.* AMRL-TDR-62-85, AD-288 636. Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratories, August 1962.

APPENDIX A: SUMMARY OF RESPONSES TO QUESTIONNAIRE

1. When required to work on a piece of equipment with which you are unfamiliar, what percentage of the total job time do you generally spend seeking information? _____

KEY

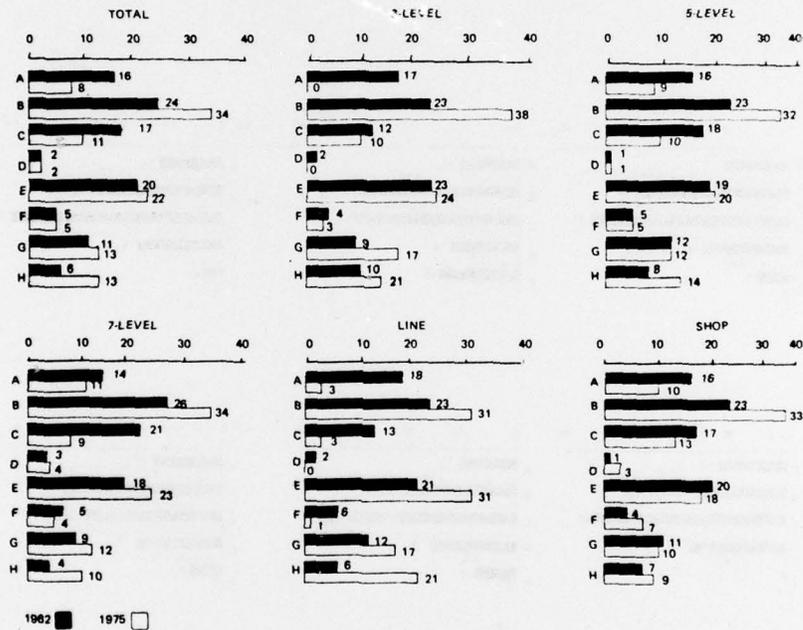
- a = More than 50%
- b = 25 - 50%
- c = 10 - 25%
- d = Less than 10%
- e = Ask Somebody Else



1962 1975

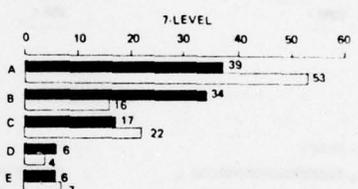
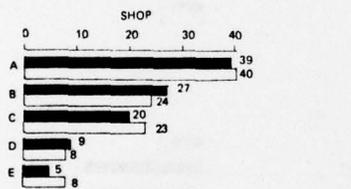
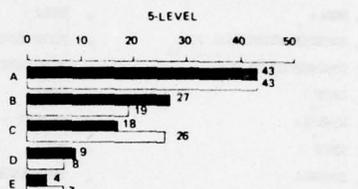
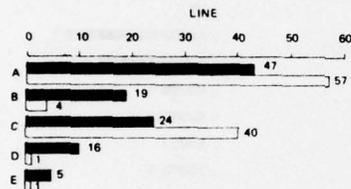
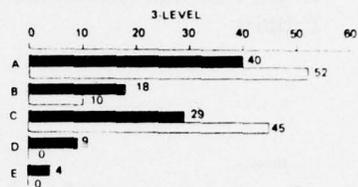
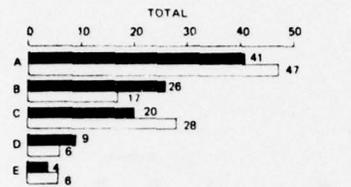
2. If you could have only one of the following from the TO system to do your job, which would you select?

- A Description and theory of operation
- B Step-by-step written instructions
- C Schematics
- D Data flow diagrams
- E Pictures showing step-by-step procedures
- F Wiring diagrams
- G Illustrated parts breakdown
- H Work cards



3. Which of the following changes would do most to improve the part of the TO system you use in doing your job?

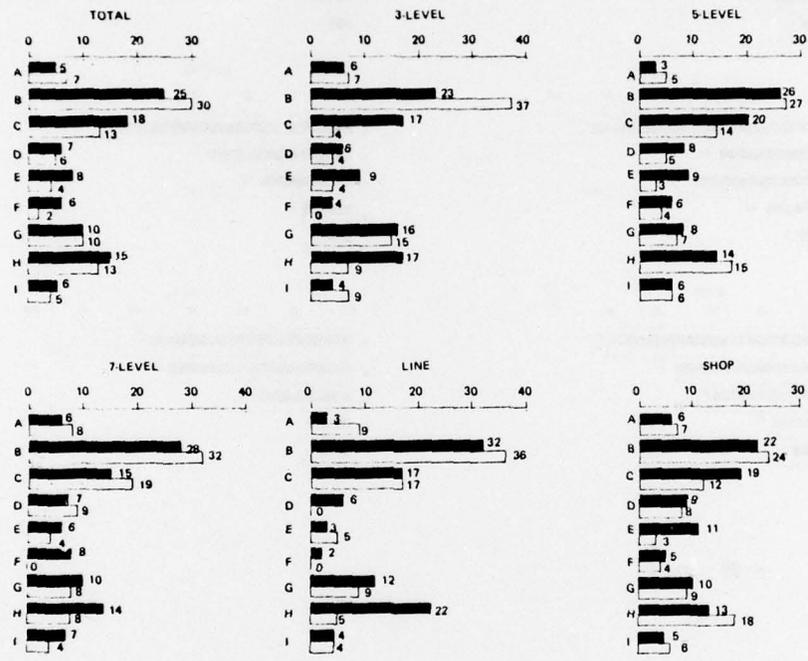
- A More detailed explanations (words and pictures)
- B More specific data (voltages, waveforms, tolerances)
- C Less information on "How it works," and more on "How to do the job."
- D More theory of operation and less detailed work instructions.
- E Other



1962 ■ 1975 □

4. Indicate, in order of use (1, 2, 3, etc.,) the TO you refer to most frequently in your day-to-day work?

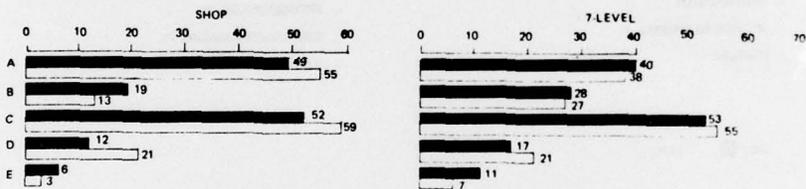
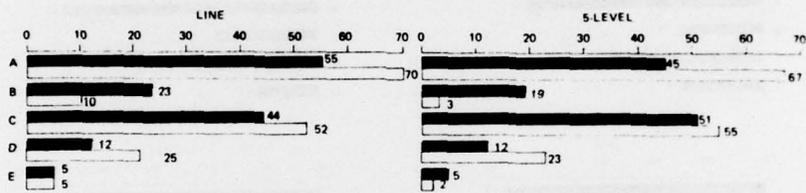
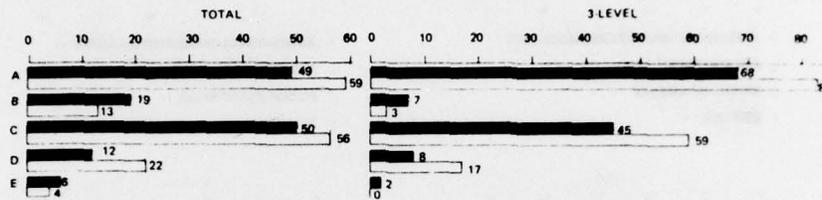
- A 00 series, General Publications
- B Dash -2 series, Organizational Maintenance
- C Dash -4 series, Illustrated Parts Breakdown
- D Field Maintenance Instruction – Airborne Equipment
- E Operation and Service Inst., Ground Equipment
- F Overhaul Inst., – Components
- G Dash -6, Inspection Requirements
- H -06, Work Unit Code Manual
- I Other



1962 1975

5. Indicate which of the following, in your experience, actually used the TO as the principal training text during the course. (Select as many as apply.)

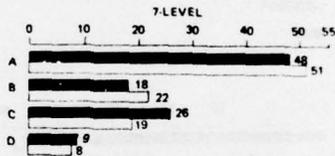
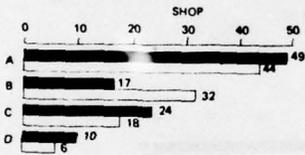
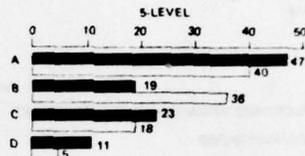
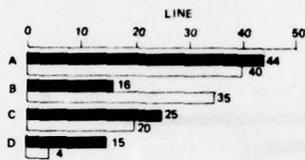
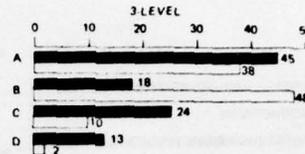
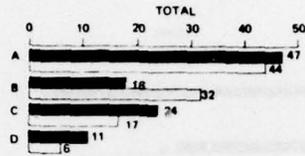
- A AF Technical School
- B Mobile Training Unit
- C OJT
- D Informal Base Training Classes
- E Factory Training School



1962 1975

6. What is your opinion of the value of the TO as a training device?

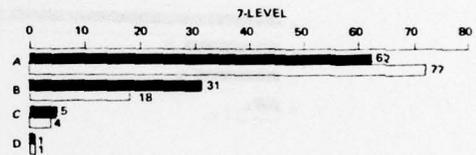
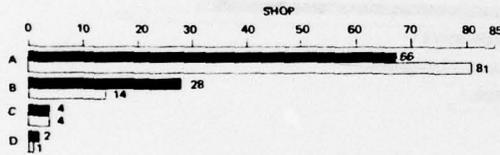
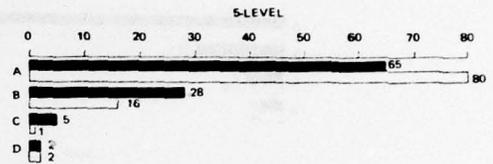
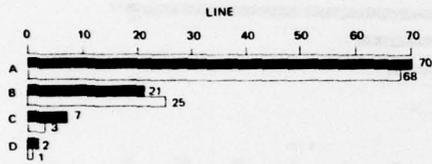
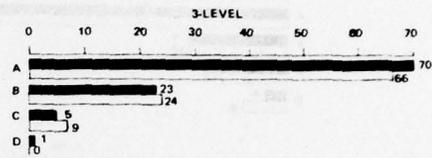
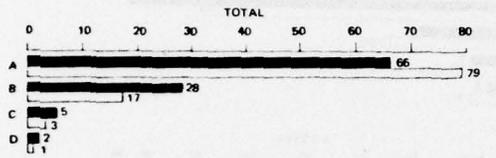
- A Absolutely necessary, but should be improved
- B Serves a useful purpose, but should be improved
- C Necessary for training, but it would be handier if the training information were in one book and the work information in another.
- D Absolutely necessary, just fine the way it is



1962 1975

7. Are all of the TO which you need in your job readily available and accessible for your use?

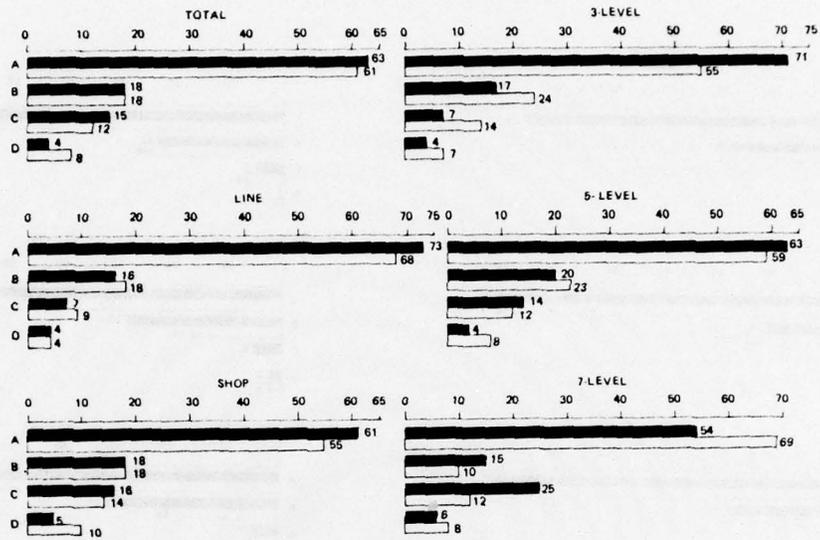
- A Yes
- B No – some essential TO are not too available
- C No – TO file is too far from my work
- D Yes – I use my personal copy of needed TOs



1962 1974

8. Are the TO which you use up-to-date, accurate, and compatible with the equipment which you maintain?

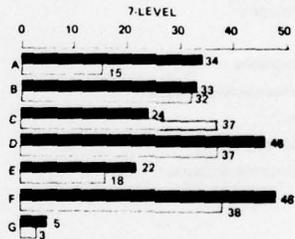
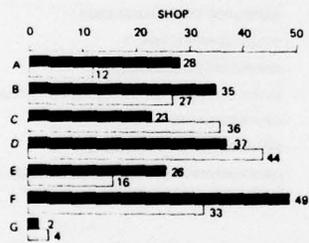
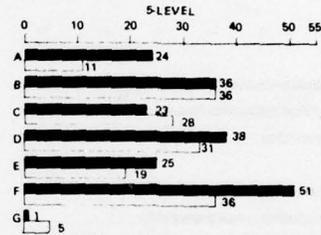
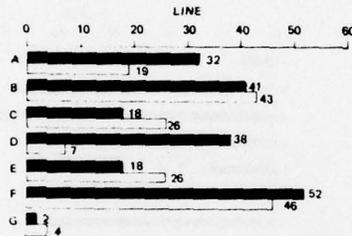
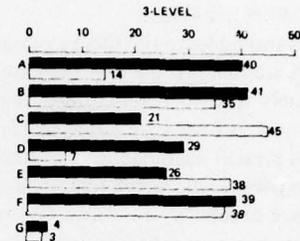
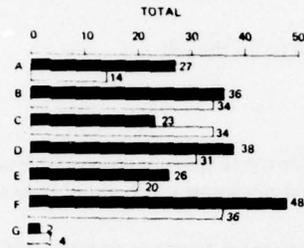
- A Yes
- B No – but good enough for my work
- C No – and this causes me a great deal of trouble
- D Yes – with the exception of (Specify TO)



1962 1976

9. What two purposes do you use TO for most frequently?

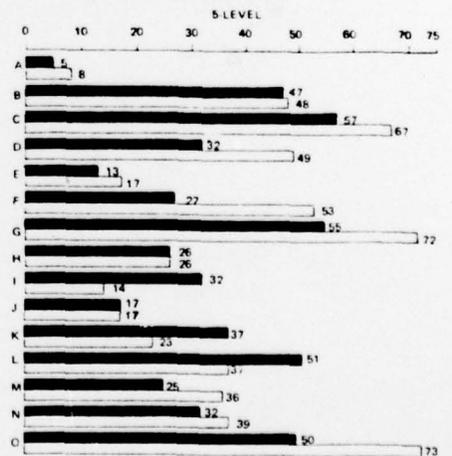
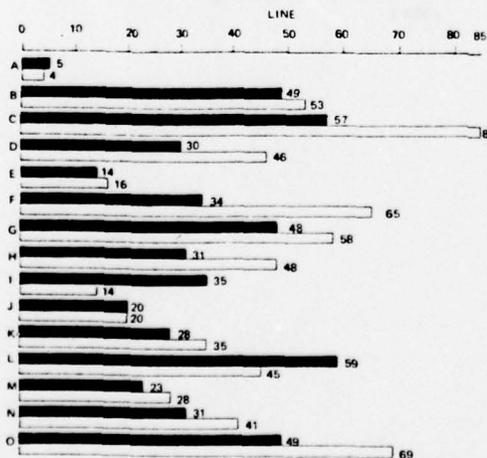
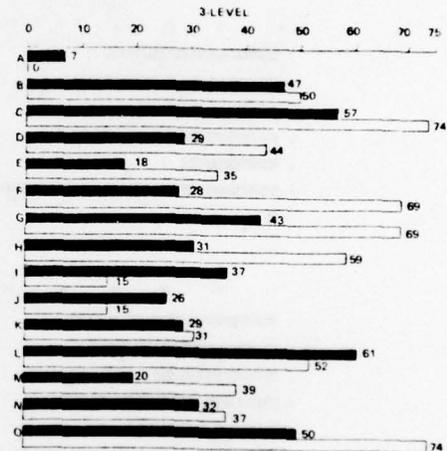
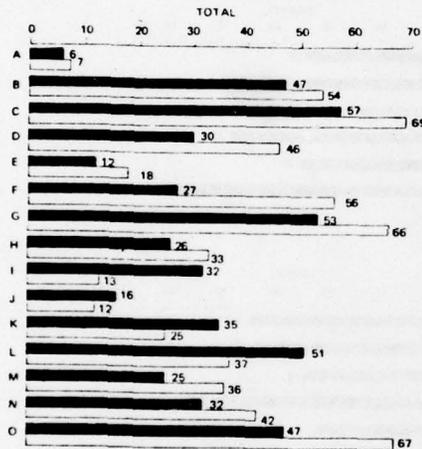
- A Training and familiarization
- B Reference (to find out how it works or where it is located)
- C Step-by-step performance (how to do the job)
- D Troubleshooting
- E Information on how to repair or replace components
- F Part number information
- G Other

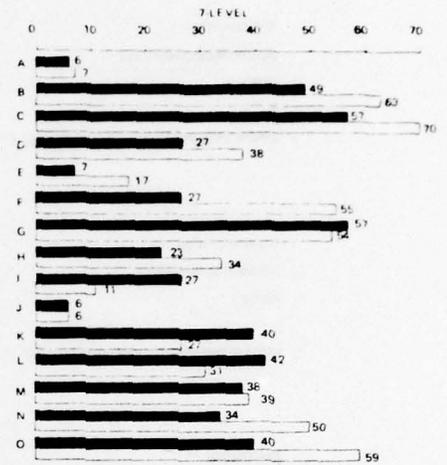
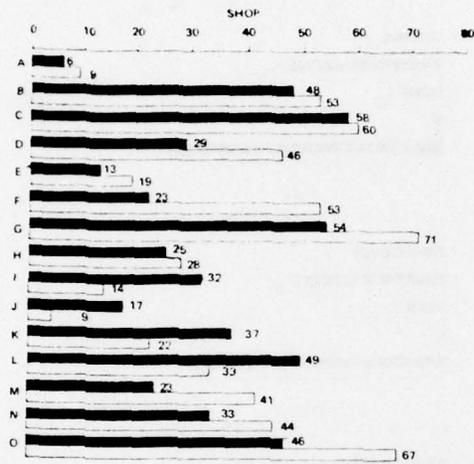


1962 1975

10. Considering the requirements of your job and your experience with the AF Maintenance TO system, mark each of the following statements indicating whether you mostly agree (A), or mostly disagree (D).

- A TOs are too simple
- B Different TOs say the same things over and over
- C TOs would be more useful if they had more pictures
- D It is very difficult to find the information I need
- E TOs are too complicated for me to understand
- F TOs are too big and thick to use on my job
- G TOs explain the simpler things adequately but fail to provide sufficient information as things get more complicated
- H TOs should leave the theory out and just tell me how to do the job
- I TOs are fine just the way they are
- J I rarely refer to TOs in doing my job
- K Some TOs I need are not available
- L TOs present adequate troubleshooting information for me to quickly correct malfunctions
- M The people who wrote maintenance TOs evidently did not know much about maintenance
- N I have to refer to too many TOs to get my job done
- O Some better numbering system for TOs would make it easier to use or to find what I need

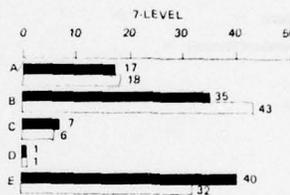
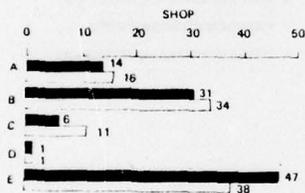
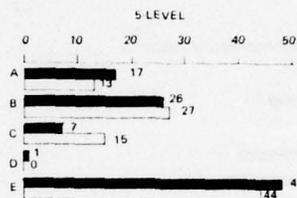
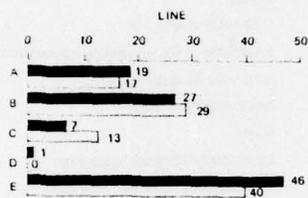
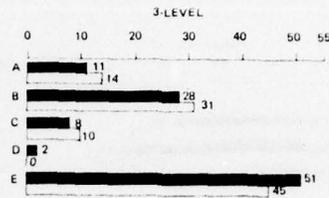
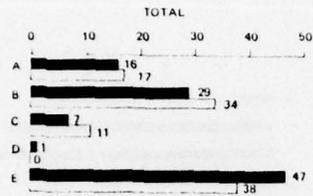




Percent Agreeing
 1962 1975

11. For what level of understanding do you feel maintenance TOs are written?

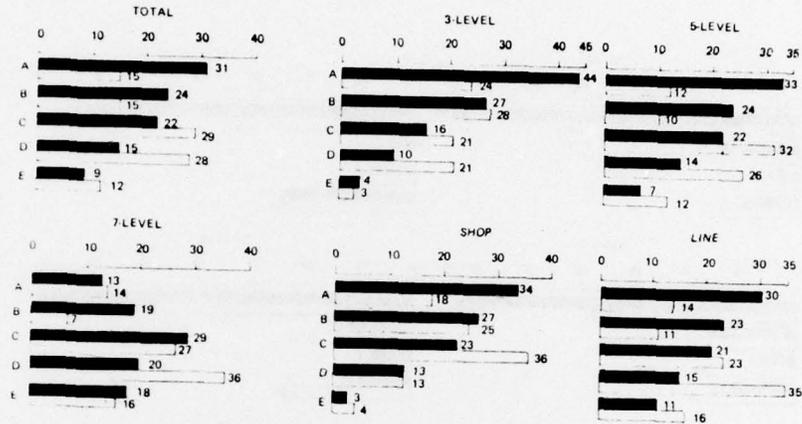
- A 7 Skill level and above
- B 5 Skill level
- C 3 Skill level
- D 1 Skill level
- E All Skill levels



1962 1976

12. How many times during the average work week do you refer to a maintenance TO in getting your job done?

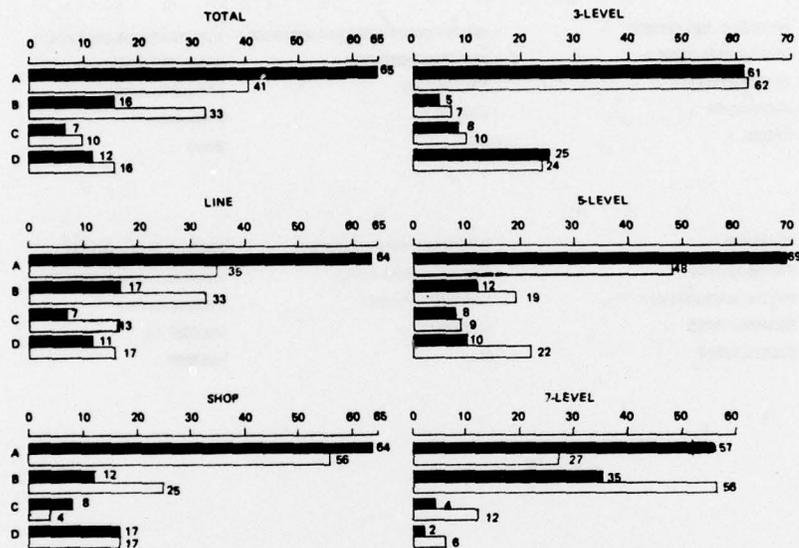
- A 1-5 times
- B 5-10 times
- C 10-20 times
- D 20-50 times
- E More than 50 times



1962 1975

13. When you find an error or incorrect procedure in a TO or work card, what do you do?

- A Tell my supervisor
- B Make out and submit an AFTO Form 22
- C Ignore it, since it does not do any good to report it,
- D I have never seen an error in a TO



1982 1976