DOCUMENT RESUME

ED 182 701 CS 005 254

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TITLE The Literacy Requirements of an Industrial Maintenance Mechanic on the Job and in a Vocational Training Program.
INSTITUTION Purdue Univ., Lafayette, Ind. Dept. of Education.
SPONS AGENCY Indiana State Dept. of Public Instruction, Indianapolis.; Office of Education (DHEW), Washington, D.C.
PUB DATE Jan 80
NOTE 65p.; For related documents see CS 005 141-142 and CS 005 247-254.

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Adult Basic Education; *Adult Education Programs; *Adult Vocational Education; Basic Skills; Communication Skills; *Job Skills; *Literacy; *Machine Repairmen; Reading Skills; Teaching Methods; Trade and Industrial Education; Vocabulary
IDENTIFIERS *Job Literacy

ABSTRACT

As part of a project that identified the specific literacy skills required in ten occupations, this report provides two levels of instructional information about industrial maintenance mechanics. Factual data are presented in Parts I and II for use in decision making by program developers, administrators, teachers, and counselors. These sections note the specific literacy requirements (reading, writing, listening, speaking, and mathematics) that were identified at three job sites and in three vocational training programs. Part III presents instructional methods/materials that adult basic education teachers can use to develop literacy skills while imparting job related knowledge. The lesson format is based on a directed reading activity and includes vocabulary and concept development, sentence and organizational structure, silent reading, and skill development. Appendixes list the technical vocabulary that industrial maintenance mechanics need to know, the 100 words that represent 45% of the language sampled for the entire project, and occupational literacy requirements for the ten occupations that were studied. (AEA)

THE LITERACY REQUIREMENTS OF AN INDUSTRIAL MAINTENANCE MECHANIC ON THE JOB AND IN A VOCATIONAL TRAINING PROGRAM

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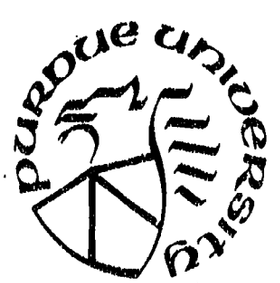

January 1980

This project was completed through grants from the Indiana Department of Public Instruction under Section 309 of the Adult Education Act, P.L. 91-230 and Sections 310 of the Adult Education Act, P.L. 91-230 as amended. The data collection and initial completion of the literacy reports (from which this report was derived) was completed during 1978-79 under Project Number FY-79-8062-P. This report, one of ten, was revised for dissemination during 1979-80 under Project Number FY-80-8075-T.

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The activity which is the subject of this report was supported in part by the U. S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the U. S. Office of Education, and no official endorsement by the U. S. Office of Education should be inferred.

Acknowledgements

In order to conduct this project, the cooperation of approximately 100 individuals in the Greater Lafayette, Indiana, area was required. A grateful acknowledgement is extended to those many individual workers, students, instructors, program directors, union officials, personnel directors, foremen, supervisors, and others who allowed us to work with them and to identify the literacy demands discussed in this report.

The guidance and support of Linda Zeiler and Timothy Wells of the Division of Adult and Community Education of the Indiana State Department of Public Instruction is also gratefully acknowledged.

The editorial expertise provided by Robert Hieb is much appreciated. Finally, many thanks to Shelly Richardson and Ricki Freiman for their secretarial assistance.

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PROJECT ABSTRACT

THE IDENTIFICATION OF LITERACY REQUIREMENTS OF JOBS IN INDUSTRY AND CORRESPONDING VOCATIONAL TRAINING PROGRAMS

1.	Need Addressed:	Meeting the educational needs of adults with minimal literacy skills who wish to enter skilled or semi-skilled occupations.
2.	Population Served:	Adults with minimal literacy skills.
3.	Brief Description:	Specific literacy requirements (reading, writing, listening, speaking, and mathematics) of semi-skilled and skilled occupations in business, industry and vocational training programs were determined. The literacy demands of three work contexts and training programs for each of the ten occupations were analyzed and reported.
4.	Major Objectives:	To provide educators, counselors, and administrators with a description of the literacy requirements of semi-skilled and skilled occupations and training programs to which functionally illiterate adults aspire.
5.	Products:	A description of the literacy requirements necessary to hold a job in each of ten occupations and the corresponding requirements necessary to succeed in vocational training programs which prepare individuals for each of those occupations is provided. A booklet for each of the ten jobs was prepared.

INTRODUCTION

This project was undertaken in response to a need, expressed by adult basic educators and counselors, for information about the specific literacy skills necessary for success in several occupations. The occupations studied had been identified as desirable careers during informal interviews with adults who were enrolled in basic education programs in the Lafayette, Indiana area. Employment counselors and officials of the Office of Career Development confirmed that the occupations identified for study were appropriate. Because Greater Lafayette offers a wide range of occupational and training opportunities, the project staff was able to study both job sites and vocational training sites for each of the following occupations: account clerk, automotive mechanic, draftsman, electrician, heating and air conditioning mechanic, industrial maintenance mechanic, licensed practical nurse, machine tool operator, secretary, and welder.

Purpose and Audience

This report provides descriptive and instructional information to adult educators at two levels. Factual data are presented in Parts I and II for use in decision making by program developers, administrators, lead teachers, and counselors. Part III presents instructional methods and materials and is meant for use by adult basic education teachers. Members of both groups may be interested in the entire report, but in preparing it the project staff attempted to address the needs of the two audiences separately.

Procedures

To identify reading, writing, speaking, listening, mathematics, and other characteristics which are necessary for success both on the job and in the training program, three job sites and three vocational college courses were studied.

Required reading materials from each of the six settings were evaluated using two widely used readability formulas, the Dale-Chall Formula and the Fry Readability Graph. Readability estimates were computer assisted. A minimum 2000 word sample of written language was taken from each site. Special considerations and problems related to reading the technical materials were identified, and the relative use of reading as a work tool and as a learning tool was determined.

To identify speaking and listening requirements, one hour samples of oral language were recorded at each job site and in each vocational college course. Language recorded at each site was rated for its technical and formal qualities, and computer-analyzed to assess vocabulary and syntax. Written and oral language samples were used to develop the Key Technical Vocabulary List found in Appendix A. The combined language samples from all occupations studied were used to develop the Highest Frequency Word List found in Appendix B. A summary of the literacy requirements for all ten occupations studied is found in Appendix C.

Writing samples were obtained at each of the six sites and used to determine the nature of written communication demands on the job and in the vocational training program.

Mathematics demands were determined through surveys of materials from the job sites and classrooms. Instructors and supervisors

responded to a questionnaire about the specific mathematics skills necessary for job and/or training program success.

Important non-literacy characteristics were identified by supervisors who completed a rating scale which asked for their estimate of the importance to job success of such factors as cooperativeness, reliability, and attitude toward work.

The following sections of this report are organized according to the requirements of the job, the requirements of the training program, and instructional recommendations.

PART I

REQUIREMENTS ON THE JOB

Job Sites Studied

The literacy demands placed on one industrial maintenance mechanic at each of three separate job sites were studied. Reading, writing, oral language, and mathematics were the specific literacy skill areas studied. The roles of the three mechanics were similar. Each was responsible for the maintenance and repair of electrical, hydraulic, and pneumatic equipment which was part of the physical plant facility of the firm for which he worked. From each job site representative samples of the reading, writing, and mathematics tasks done on the job were obtained. Samples of oral language were obtained by recording a randomly selected one-hour period of on-the-job verbal interaction. At each job site the mechanic's immediate supervisor completed a questionnaire which was concerned with the importance to job success of eleven worker characteristics. Supervisors were also asked to identify the mathematics skills necessary on the job, and to estimate the amount of time per week that the workers spent using mathematics and reading in their work.

Reading Requirements

The reading requirements of the industrial maintenance mechanic jobs studied were very high. Supervisors indicated that an average of two to five hours per week was spent by the workers reading necessary materials on the job. Reading materials required on the job included installation and service bulletins for sophisticated equipment, engineering handbooks, and operator manuals for electronic controls. The required materials contained sentence/paragraph format paired with tables, figures, and other illustrations.

The style of writing used in most of the materials studied was highly technical. Work orders and informal messages were less technical than the materials noted above, but they involved highly technical concepts and vocabulary. Example I illustrates the technical language encountered at the maintenance mechanic job sites.

EXAMPLE I

Maintenance Mechanic Reading Material

A. "The brake system for the 821 truck is the conventional automotive type drum and shoe. Refer to Figure 2-1. The cast iron drum is mounted on a drive motor armature shaft. The shoes located inside drum are secured to drive unit. The brake is hydraulic actuated by the deadman pedal located in the operator's compartment."
(Raymond Corporation, 1969, p. 2-5)

B. Sequential Steps

"1. Strainer size and mesh of screen is determined by rate of flow and viscosity of fluid. Consult strainer manufacturer for recommendations.

2. Never use a strainer with a built in automatic by-pass on the suction line set to open under 30" Hg. vacuum.

3. Install strainer according to arrows or flow designation.

4. Have strainer accessible for servicing.

5. Use a duples type where shutdown during service is not permitted." (Tuthill Pump Division, p. 3)

The difficulty of the required reading materials was estimated by computer analysis using two widely used readability formulas, the Dale-Chall Formula and the Fry Readability Graph. Because several materials were examined at each job site, and because of variation in the estimates made by the two methods, Table I presents readability levels in terms of ranges of difficulty. A range of eleventh to fifteenth grade level would indicate that the materials evaluated were similar in difficulty to materials used in high school and college.

TABLE I

On-The-Job Readability Estimates

Job Site One	College to college graduate level
Job Site Two	11th grade to college graduate level
Job Site Three	10th grade to college level

Readability formulas do not account for such factors as reader motivation, interest and familiarity with specialized subject matter

and vocabulary. It is likely, therefore, that the mechanics who read successfully from materials in their area of specialization would have trouble reading materials of equal readability from unrelated fields. Military studies indicate that experienced workers were able to successfully use familiar materials several levels above their measured reading abilities (Sticht, 1975). The implications of this evidence for instruction are discussed in Part III of this report.

Special Reading Considerations and Problems

The predominant style of writing found in maintenance mechanic on-the-job reading materials was technical, as was illustrated in Example I. Mechanics who participated in the study reported that most of the reading they did on the job involved finding information for immediate use. The materials used to obtain necessary information took the form of explanatory sentences and paragraphs and accompanying tables, figures and illustrations. Instructions sheets and service manuals were the most often mentioned on-the-job reading materials. Careful, thorough reading of instructions and procedures found in such documents was critical. In every case, the mechanics reported that failure to read required materials would have a negative effect on their work. Example II presents an example of how on-the-job materials pair textual information with tables of related information.

EXAMPLE II

Textual and Tabled Information

6-75 BRUSHES SHOULD BE INSPECTED PERIODICALLY FOR WEAR, SPRING PRESSURE AND FREEDOM OF MOVEMENT IN HOLDERS. IF BRUSHES ARE STICKING, REMOVE, AND CLEAN. REFER TO FIGURE 6-17 FOR MINIMUM BRUSH LENGTHS AND SUGGESTED SPRING PRESSURES. REPLACE BRUSHES AND SPRINGS BELOW SUGGESTED LIMITS.

MOTOR	MINIMUM BRUSH LENGTHS	RECOMMENDED SPRING PRESSURE
DRIVE - PEERLESS 570-835 GV80211	REPLACE BRUSH WHEN ITS PIGTAIL IS 1/8" AWAY FROM HANGING UP ON BRUSH BOX.	APPROX. 20 OUNCES
AUXILIARY - PRESTOLITE 570-419	9/16"	35 TO 40 OUNCES
LIFT - G.E. 570-022	9/16"	APPROX. 26 OUNCES
LIFT - PEERLESS 570-827 GV80211	REPLACE BRUSH WHEN ITS PIGTAIL IS 1/8" AWAY FROM HANGING UP ON BRUSH BOX.	APPROX. 20 OUNCES

FIGURE 6-17 TABLE OF BRUSH LENGTHS AND SPRING PRESSURE

(Raymond Corporation, 1969)

Uses of Reading

From a questionnaire completed by the mechanics themselves, it was concluded that most of the reading done by industrial maintenance mechanics in their work was done to obtain information for immediate use. The mechanics indicated that it was not usually necessary to remember the information for more than a few hours. They also stated that if required to do the same task on the following day, they would read the same instruction sheet or service manual again in order to accomplish the work. In fact, to assure uniformity in maintenance procedures, check lists were often required by the mechanics' employers. Thus, by company policy, some tasks were not entrusted to memory. The amount of time per week spent on work-related reading was estimated by supervisors to average two to five hours per week.

Reading-to-do work (Sticht, et al., 1977) was not the exclusive application of reading on the job, although it was predominant. Occasionally, the mechanics were required to consult a general reference book on some type of equipment. In such cases, reading to learn occurred and the mechanics read to remember information for long periods of time. Both types of reading, reading to do and reading to learn, are discussed in Instructional Recommendations, Part III of this report.

Writing Requirements

The ability to communicate through writing was rated very important by supervisors at two of the job sites, and unimportant by the third supervisor. It was not important that the mechanics be able to write in complete sentences, but it was important that they communicate important information clearly. The style of writing used on the job was

informal and syntactically resembled telegrams; non-essential words were left out. Example III illustrates the concise, abbreviated style of writing used by mechanics on the job.

EXAMPLE III

On-The-Job Writing Style

NATURE OF TROUBLE: "Two lights out"

ACTION TAKEN: "1. Replaced tube in one light fixture. 2. Replaced ballast in light fixture--light operating now, but still need new ceramic end connection."

Legibility was not a factor in writing unless it interfered with communication of information. A wide range of legibility was observed in materials at the job sites.

Mathematics Requirements

The mathematics skills required of maintenance mechanics varied considerably from job site to job site. One supervisor stated that only measurement skills were required for job success, although mathematics skills including geometry and algebra were desirable. The second supervisor indicated that basic computational skills including addition, subtraction, multiplication, and division of whole numbers, working knowledge of the decimal system, and measurement skills were necessary. The third supervisor stated that mathematics skills up to and including trigonometry were required for job success. The estimated amount of work time devoted exclusively to mathematics skills ranged

from less than an hour at the first job site to 20 hours per week at the third site. At the remaining job site, an average of eight to ten hours per week were spent on mathematics-related tasks. Although more time was spent on mathematics-related skills than was spent on tasks requiring reading, all three supervisors rated reading skills to be more important to success on the job than mathematics skills. An excerpt from an on-the-job reference material which illustrates how reading skills and mathematics knowledge are used together in accomplishing work is presented in Example IV.

EXAMPLE IV

Mathematics and Reading Skills Task

"Specifications:

Range: 0-2 G's for standard type, 0-4 G's for "LS" type, or as specified.

Accuracy: + 5% for full range at speeds to 18,000 RPM

Contacts: Continuous ratings:
7A at 125, 250, 460 V. A. C.
for inductive or resistance loads"
(Sharples Equipment, p. 3)

The mathematics skills required, though variable from job site to job site, are generally high for maintenance mechanics. The mechanics studied were required to work with electrical and pneumatic equipment which demanded good facility with mathematics.

Oral Language Requirements

The oral language required at the job sites combined informal speaking styles with job-related technical vocabulary and concepts. Conversation, while sometimes not work-related, focused on tasks as they were being performed. Spoken directions and instructions were observed in the tape recorded language. Example V contains an excerpt of on-the-job language from the maintenance mechanic job sites.

EXAMPLE V

On-The-Job Oral Language

Mechanic: "Do you want to give me a hand there lifting a pump? Very good. Yeah, right there. Well, I'll be down there to find that reclaimed. Is it all right to set that pump right flat on the floor? No use of raising it up?

Co-worker: "I think it's pretty level. I don't think that board will hurt."

Mechanic: "It's so hard to be adjusted because that thing is set up so different."

Oral language skills play an important role in accomplishing work. The above example illustrates how oral communication is applied to problem solving tasks on the job.

Key Non-Literacy Requirements

Supervisory personnel from each participating company rated several worker characteristics according to their importance to job

success in the fields of industrial maintenance mechanics. The following characteristics were rated as very important by the supervisors: cooperativeness, job knowledge, good record of attendance, attitude toward work, and ability to follow spoken and written directions. Important characteristics added to the list by one supervisor included mechanical ability, knowledge of tools, and ability to work without direct supervision. Reading ability and the ability to communicate through speaking and writing were rated as high as the non-literacy characteristics. Mathematical ability was rated less important than the qualities just listed. The significance of supervisor ratings of non-literacy characteristics for ABE instruction is discussed in Part III of this report.

PART II

REQUIREMENTS OF THE VOCATIONAL TRAINING PROGRAM

The Courses Studied

The reading, writing, oral language, and mathematics requirements for three courses in a vocational college industrial maintenance mechanic training program were studied. The courses, Basic Hydraulics and Pneumatics, Air Conditioning and Refrigeration Fundamentals, and D. C. Fundamentals, were determined by the school administration and instructional staff to be representative of the industrial maintenance mechanic program as a whole. In other words, the literacy demands placed on students in other industrial maintenance mechanic courses were judged to be about the same as those presented here.

Each of the courses studied combined the use of readings and lectures with practical projects designed to simulate experiences found in industry. There were many opportunities for students to relate written and spoken information to real materials and activities. Reading, writing, mathematics, and oral language skills were routinely used in classroom learning experineces in all three courses studied.

Reading Requirements

The amount of time spent on reading and other literacy skills is typically higher in training programs than on the job. This is due

to the need to present large quantities of information during a relatively short period of time. In the industrial maintenance mechanic program, the difference between on-the-job and training program reading requirements is qualitative rather than quantitative. That is, the amount of time spent on reading tasks is about the same in both environments, but on the job reading is primarily used to accomplish work. In the training program on the other hand, reading is used more frequently as a tool for learning. The concepts of reading to do and reading to learn (Sticht, 1977) are discussed in the Uses of Reading section, below, and in part III, Instructional Recommendations, of this report.

Instructor estimates of the amount of time per week spent on required reading tasks ranged from two to three hours for the hydraulics/pneumatics course to fourteen hours for the air conditioning refrigeration course.

The style of writing found in vocational training program reading materials was, like that found in on-the-job materials, highly technical. Excerpts from typical training program reading materials are presented in Example VI.

EXAMPLE VI

Vocational Training Program Reading Materials

A. "In hydraulic transmission, energy in the form of pressured liquid flow is transmitted and controlled through piping, to a hydraulic actuator where the work is done." (Parker Hannifin Corp., p. 1-7)

B. "The relief valve and check valve operate in the normal manner previously described. The pump charges the accumulator through the check valve in the body. System pressure is sensed through the orifice in the main valve spool to the pilot valve dart." (Parker Hannifin Corp., p. 10-6)

The levels of readability, or difficulty, of the materials required in the training program were similar to those of the materials found at the job sites. Instructional adjustments were made for the difficulty of the required printed materials. Lectures and laboratory experiences were planned to reinforce textbook material. Thus, the effect of textbook difficulty was balanced and students were helped to acquire job-related information without having to contend with unfamiliar concepts and difficult reading materials simultaneously.

Table II, below, presents the levels of readability for materials used in the three industrial maintenance mechanic courses. As in Part I, estimates are reported as ranges.

TABLE II

Training Program Readability Estimates

Course One	Eleventh grade to college level
Course Two	College to college graduate level
Course Three	Tenth grade to college graduate level

It was noted in Part I of this report that readability formulas do not account for factors such as student motivation, interest, and

familiarity with the subject matter. The notion that motivation, interest, and prior knowledge of subject matter can reduce the perceived difficulty of reading materials is discussed in Part III, Instructional Recommendations.

Special Reading Considerations and Problems

Whereas finding information in texts, tables, figures, and charts for immediate use was the predominant reading skill applied on the job, skill in using reading as a learning tool was predominant in the training program. Neither reading to do nor reading to learn, however, was used exclusively on the job or in the training program.

The training program required a combination of thoroughness and the ability to identify and remember important information. Textbooks contained tables and figures similar to those observed in instructions sheets and service manuals found at the job sites. Training program materials consistently correlated information presented in sentence/paragraph format with illustrations. Laboratory exercises required students to read and follow directions. Typical training program reading materials are depicted in Example VII.

EXAMPLE VII

Training Program Reading Materials

A. Air Conditioning and Refrigeration

"When only one outlet is installed between adjacent feeder ducts, it is assumed that one-half the Btuh capacity delivered through that outlet is supplied from each feeder duct. For example, in Fig. 7-3, Feeder Duct A and Feeder Duct B each supply one-half the Btuh capacity delivered through Outlet 1." (National Environmental Systems Contractors Assn., 1973)

B. Electrical

"H-2120 Humidifiers consist of a pan, electric heaters and a float box, and are shipped unassembled. To field assemble, refer to Fig. 1 or 2 and proceed as follows:

1. Apply sealing compound to the heater pipe threads; screw the heater tightly into the pan." (Johnson Service Company, p. 1)

Uses of Reading

As previously discussed, reading in the training program involved both reading to accomplish work and reading to learn. Reading to do required skill in finding and using information presented in sentence/paragraph format, tables, figures and other graphic formats. Following written directions was also an important ability. Reading to learn required skill in organizing and remembering information which was most often presented via sentence/paragraph expository format combined with illustrations.

Writing Requirements

The requirements for writing in the training program were similar to the requirements of the job. Both settings emphasized communication of important information. Standard formal sentence structure was not expected, nor was a highly legible handwriting style. Typically, a concise abbr[illegible]ated style similar to that used in writing telegrams was used.

Mathematics Requirements

The instructors who participated in the study completed questionnaires which asked for their estimates of the importance to training program success of several mathematics skills. It was indicated that skills ranging from basic computational processes through ability to solve word problems and facility with measurement and the decimal system were necessary. The amount of time per week spent on mathematics-related school work ranged from one hour to fourteen hours per course. This range of time spent on mathematics is similar to the range estimated by on-the-job supervisors.

Oral Language Requirements

The style of oral language recorded during training program lectures was generally informal. The content of the recorded language, however, was highly technical. Comprehension of lectures required some prior knowledge of the subject matter, and attentive listening on the part of the students. The abilities of following verbal directions and taking coherent notes were also important. Students were expected to relate illustrations on chalkboards and in their textbooks to lecture content. At times concrete materials such as scale models were used to

illustrate important concepts. An excerpt from a classroom lecture is presented in Example VIII.

EXAMPLE VIII

Classroom Language

Instructor: ". . . you want to know how much force you need, how much pressure you need to move the force, you can determine that by the formulas. Just looking at the formula, if I varied the pressure, what effect does it have on speed?"

Student: "I don't think any."

Instructor: "It has none, right? Pressure has nothing to do with speed. So don't go changing the release setting if you want to speed up the cylinder."

PART III

INSTRUCTIONAL RECOMMENDATIONS

Project Overview

For industrial maintenance mechanics, reading, writing, oral language, and mathematics skills required on the job and in the vocational training program were generally high.

The levels of reading skills required on the job were estimated to be in the range of upper high school level to college graduate level. In the vocational training program, the estimated readability of required materials extended from tenth grade level to college graduate level. It was noted in previous sections of this report that knowledge of key technical concepts and vocabulary, combined with the familiarity gained through daily use of required reading materials, may reduce the perceived difficulty of reading tasks.

On the job and in the vocational training program, reading was used as a tool for accomplishing work and as a tool for learning. Reading-to-do work was predominant on the job, where reading was used to find information and to check specifications for jobs. Supervisors' estimates of the amount of time maintenance mechanics spent on job-related reading tasks ranged from less than an hour per week to twenty hours per week.

In the vocational training program, reading was used more often as a learning tool than it was on the job. However, reading-to-do tasks, requiring fact finding and following directions (similar to on-the-job tasks), occurred frequently.

Writing requirements for industrial maintenance mechanics were similar to those of other occupations studied. Neither standard sentence structure nor highly legible hand writing was generally required. Conciseness and clarity were emphasized in written work both on the job and in the training program.

Although one on-the-job supervisor rated only basic computational skills to be necessary for job success, the mathematics requirements of both job and training program sites appeared to be high. One supervisor and the three instructors rated computational skills with whole numbers and fractions to be necessary. Measurement and working knowledge of the decimal system were also rated as required. The remaining supervisor stated that mathematics skills including geometry, algebra and trigonometry were necessary to job success at his facility.

The oral language used on the job and in the training program required the ability to make use of oral instructions and directions given by supervisors and instructors. Note taking skills and the ability to relate verbal information to illustrations were necessary in the training program courses.

Job site supervisors were asked to rate several worker characteristics in terms of their importance to job success, and rated the following as very important: good attendance, positive attitude toward work, ability to work cooperatively with others, reading ability, ability to communicate through speaking, and ability to follow both

oral and written directions. One supervisor added trustworthiness, knowledge of tools, and ability to work without direct supervision to the list of very important characteristics. All of these qualities were rated higher than mathematics abilities by the supervisors and in no case was reading ability rated higher than the non-literacy qualities. Two supervisors rated the non-literacy characteristics of cooperativeness, attendance, and attitude toward work higher than job knowledge.

A brief summary of how the literacy requirements of the industrial maintenance mechanic compare to those of the other nine occupations studied is found in Appendix C.

Organization of ABE Lessons

The recommendations which follow are meant to aid teachers and tutors in designing streamlined lessons which develop literacy skills while imparting job-related knowledge. The majority of the literacy information studied in connection with industrial maintenance mechanic jobs and training programs was related to reading. Reading demands were found to be high, and even when mathematics, writing, and oral language skills were used by workers and students, they were used in conjunction with reading. This section, therefore, presents background information and a method of organizing ABE lessons which emphasizes reading. The background information provided deals with the teaching of vocabulary and teaching about text structure and organization. The lesson format is based on a directed reading activity (DRA) and includes vocabulary and concept development, sentence and organizational structure, silent reading, and skill development.

The guiding principle of a DRA method of ABE lesson organization is that words, concepts, and skills must be introduced and practiced in situations and materials that are true to life. For example, words, sentences, tables, and illustrations should be similar to those used on the job or in the training program. It may be possible to teach an interested ABE student the words on the Key Technical Vocabulary List in isolation, but a far better practice is to introduce and practice such words in contexts like those found in occupational reading materials. In the case of ABE lessons, there may be a wide gap between the reading requirements of occupational materials and the reading abilities of the student. Materials which parallel those found on the job and in the training program can be developed by teachers and tutors if time permits. Through paraphrasing sections of textbooks, reference books and manuals, the readability of occupational materials can be reduced so that literacy skills and job-related knowledge can be developed simultaneously.

The value of a DRA approach is that it allows the use of any appropriate reading material in a job-related reading skill development program.

Notes on Teaching Vocabulary

The specialized vocabularies of industrial maintenance mechanics studied are similar. There are many key concepts and words which are common to the maintenance mechanic occupation in general.

The specialized technical words of the Key Technical Vocabulary List should be introduced to ABE students interested in entering the industrial maintenance mechanic field so that both the words and their

meanings are recognized. This implies that the words will be taught in a meaningful context.

Two types of specialized vocabulary words occur in specialized fields such as industrial maintenance. One type of word is unique to the specific field. The term "check valve" has a very specific meaning to persons working with hydraulic equipment, but persons outside of that field probably have never encountered the word. In teaching a word such as "check valve" to ABE students, an illustration of its meaning would be essential.

A second type of word which needs attention in ABE lessons is one which has a common meaning in everyday communication, but which also has a specialized technical meaning. The word "cushion" used as a noun or verb, has clear connotations in everyday usage. In the field of hydraulics, however, "cushion" is used as a noun referring to a device used to slow a piston as it reaches the end of its stroke in a hydraulic cylinder. Multiple meanings like these should be pointed out during reading lessons.

It is important for ABE students to be introduced to common high-frequency words and specialized vocabulary words via contexts which are similar to those found on the job and in the training program. As noted previously, this practice develops basic job-related knowledge and reading ability.

The following are suggestions for teaching vocabulary:

1. Pair the word to be taught with the concept or object that it refers to whenever possible.
2. Introduce the word using an approach which focuses student attention on the word.
3. Be sure that the new word is read in context very soon after it has been taught.
4. Use the general rule that four to six new words per lesson be introduced. Learning and recall are typically most efficient when the number of words taught is in this range.
5. Review vocabulary words frequently.

Sources of job-related vocabulary words and concepts are included in the books cited in the bibliography of this report. The style and level of writing in the listed materials is often highly technical, thus, if time permits, teacher time could be devoted to preparing lower readability materials which parallel high-level passages.

Notes on Teaching About the Structure and Organization of Text

The above suggestions on teaching vocabulary words emphasize meaning; words have little use outside of a meaningful context. In industrial maintenance, even solitary words on a chart or diagram have a meaningful context to a trained individual.

In reading, it is important to be aware of special patterns of organization used by writers. Formal technical reading materials are organized differently from the short stories and novels used in teaching reading to most Americans. The expository style of writing used

in textbooks and other specialized or technical materials is different from the narrative style of stories and novels at several levels of comparison.

At the sentence level, ABE students should learn that expository style often relates cause and effect. Sometimes this relationship is clearly stated as in the sentence in Example IX-A.

EXAMPLE IX

Stated and Unstated Cause and Effect Relationship

A. The motor seized because it ran out of oil.

B. The motor ran out of oil. The motor seized.

Often, however, the relationship is not stated, as in Example IX-B. In such cases, readers who are not expecting cause and effect connections may miss them.

At the paragraph level, writers of expository material often use a format which states the main idea in the first sentence. The last sentence summarizes the paragraph and may connect it to a paragraph that follows. Comprehension and learning can be improved when readers are aware of this organizational technique.

At the chapter level, expository material may contain many valuable aids to efficient reading. Key words are used as headings which introduce important sections. Pictures, diagrams, tables, and figures are used to illustrate important ideas. Introductions and chapter summaries are also available as aids to readers who know how to use them.

ABE students should learn about style factors such as these and use them to enhance comprehension. Efficient readers use their knowledge

of expository style to organize their reading. Awareness of the use of cause and effect makes them sensitive to such relationships. Knowledge of paragraph and chapter organization is used to develop a 'mind set' which is helpful in organizing and remembering important information. Reader-composed questions based on paragraph lead-sentences, headings, pictures, and other graphic aids help readers organize, comprehend and remember what is read.

A directed reading activity, described in the next section, is a system which enables the ABE student to become efficient in using organizational factors as aids to comprehension and memory.

Directed Reading Activity

This system of preparing for efficient reading may be used with individual students or with groups. In groups, it requires very little class time to prepare students for reading assignments. For both individual and group use, it has been demonstrated to enhance reading efficiency and comprehension.

After a review of previously taught, related concepts and assignments, the below procedures should be followed:

I. Develop Readiness for Reading the Assignment.

Purpose: Motivate
Set purposes for reading
Develop vocabulary

Teacher role: Ask Questions -

How familiar is the subject matter and vocabulary to your student?

Teach New Vocabulary -

Be concrete: write out the words as you introduce them. Use examples, such as objects or pictures, point out word relationships; i.e., cardiograph and cardiovascular relate to cardiac - heart. Have your students write the words as they are taught.

Ask Questions to Stimulate Interest -

Focus on titles, pictures, graphs. Relate an anecdote from your own experience or one your students might have had.

II. Direct the Silent Reading of the Assignment

Develop questions from sub-headings, graphs, pictures, and tables. Try to focus on relationships in the assignment. In textbooks, useful questions are often provided by the authors.

Have pupils read silently from 5 to 20 minutes, to find the answers (keeping questions in mind as they read).

Encourage students to ask for help when they are confused. Writing questions down in shorthand form is a good practice when reading is done outside of class.

III. Discuss Student Answers to Questions

Do not restate the questions unless necessary. Students need to remember the questions, or they lose the purpose for reading.

Ask higher level questions to develop comprehension. Have student(s) interpret, draw conclusions, and make inferences as well as recall facts.

IV. Reread as Necessary

When answers demonstrate confusion, have the student reread the appropriate small section to determine the reason for the confusion.

V. Follow-up and Skill Development

Confusion or lack of comprehension may signal a need for extra work on vocabulary, concept building, or word recognition skill.

In this phase of the lesson important mathematics and other skills can be related concretely to the reading assignment.

REMEMBER:

A DRA is a system, a routine, that you want your student(s) to learn to use independently. Remind your students of this--tell them why you use a DRA system. It will help them now and in their future study.

Reading to Accomplish Work

The term, reading to do, has been used in research and development projects done for the U.S. armed forces (Sticht, et al., 1977). Reading to do refers to the use of reading for the purpose of getting work done. It involves following written directions and reading to find information which will be used immediately. Such information need not be learned or remembered. Looking up telephone numbers; finding information in a policy manual; or finding important data in a table, chart, or figure, are examples of reading to do. Preparation of ABE students for reading-to-do tasks, can be incorporated in a directed reading activity lesson.

When lesson materials contain occupationally relevant concepts, ABE students are given important background information which will make higher level training easier. Therefore, lessons should employ materials which are similar in structure and content to those found on the job or in the vocational training program. Paragraphs, tables,

charts, and figures might be used verbatim from on-the-job or instructional materials. Alternatively, such materials might be paraphrased and reduced in difficulty to match student abilities.

Given appropriate materials and a period of orientation to them, the structural and organizational features of the table, chart, figure, paragraph, or chapter, should be pointed out to the student (see Notes on Teaching About Structure and Organization of Text). This is essentially the first step of the DRA described above. When the materials have been introduced, the student should be directed to find a particular fact in the material. In subsequent lessons, the difficulty of information-finding task should be increased.

Skill in following written directions can be developed using a DRA system and materials similar to Example X. Initial activities should contain only one or two steps to follow.

EXAMPLE X

Written Directions

Assembly of Pump

1. Clean all parts thoroughly using great care to eliminate all dirt.
2. Install rotor in pump body.
3. Apply gasket to cover. Use new gasket if old one is damaged.
4. Place idler gear on pin in cover assembly.
5. Place cover assembly with gear on pump.
   (Align matching marks for proper location.)

In information-finding lessons, the emphasis should be on understanding and careful identification of the required fact. Likewise, in lessons on following directions, understanding and careful execution of the required steps must be emphasized.

Reading to Learn Information

Skill in learning printed information for future use is very important in vocational training programs. The reading skills necessary for reading to learn (Sticht, et al., 1977) are taught and systematically practiced in directed reading activity lessons. That is, the use of previewing, attention to graphic and contextual information, and the organizational factors discussed in Notes on Teaching About the Structure and Organization of Text, above, should be practiced and learned during each DRA lesson. Questioning and rereading, also aspects of a DRA, reinforce important learning skills.

Sources of materials for use in reading-to-learn lessons, like those employed in reading-to-do lessons, should be occupationally oriented (see Bibliography). ABE students who receive reading instruction through job-related reading materials develop not only reading skills, but gain important job knowledge as well.

Counseling the ABE Student

ABE students should be made aware of the importance of reliability, cooperation, ability to follow directions, and other factors noted in Part I of this report. On the basis of the responses of supervisors surveyed in this study and previous research (Sticht, 1974), it seems that such characteristics may contribute more to job success than do reading and mathematics skills. Role-play activities which involve

consideration for others and following directions may be a valuable part of ABE lessons designed to prepare adults for employment.

The literacy demands of the maintenance mechanic jobs and training program courses were high. It is, therefore, important that teachers, tutors, and counselors consider the facts presented earlier in this report, the individual students' levels of motivation, and literacy skill development before beginning to prepare the student to enter an industrial maintenance job or vocational training program. Frequency and intensity of lessons, choice of instructional materials, and long-term duration of the instructional program will vary according to the students' literacy skill levels, especially in reading.

This does not mean that students with low level literacy skills should always be discouraged from preparing for an industrial maintenance career. It does suggest, however, that an early and realistic estimate be made of the time and effort required to reach the goal of employment or formal training.

Summary

The literacy demands of industrial maintenance mechanic jobs and training program courses were found to be high. It is probable that individual experience and familiarity with specialized information reduces the perceived demands of job and training program tasks. The extent of such a reduction, however, is not known.

It was observed that the vocational training program for industrial maintenance provided students with experiences that were very similar to on-the-job tasks. Reading materials from the training program presented important basic occupational concepts through texts which were similar in difficulty to materials found at the job sites. Research

supports the practice of reducing readability levels when difficult concepts are presented in written form. However, training program instructors reduced the effect of difficult reading materials by paralleling textbook assignments with laboratory sessions and lectures.

Instructional recommendations emphasized the development of reading skills. Other literacy and non-literacy requirements were recognized as important, but it was clear, even in cases where high level mathematics skills were necessary, that good reading skills were essential.

The recommended approach to ABE reading instruction was a directed reading activity (DRA) because it is systematic, provides for essential skill development and practice, and permits the use of any appropriate reading material. Suggestions were presented for teaching vocabulary and on the use of important structural and organizational factors which are related to reading comprehension and memory.

Two uses of reading, reading to do and reading to learn, were discussed separately, because the skills they require are distinct. Reading to do requires the ability to find information for immediate use; long-term memory is not necessary. Reading to learn requires awareness of organizational factors which aid learning and remembering.

Non-literacy factors were discussed in the section, Counseling the ABE Student, because on-the-job supervisors rated several factors such as attendance and cooperativeness to be more important to job success than reading and mathematics ability, even though the demands for literacy were high for maintenance mechancs on the job.

Finally, it was recommended that, in using the information and recommendations presented in the report, ABE teachers should be well

acquainted with the occupational interest and motivation as well as the literacy skills of their students. The literacy demands of industrial maintenance mechanics, on the jobs and in training program courses, are such that some students may be unable to achieve sufficient skills within a reasonable period of time. Such students might elect to pursue other occupational goals.

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APPENDIX A

TECHNICAL VOCABULARY LIST

This list is based on the total oral and written samples of the language of industrial maintenance mechanics both on the job and in the training program. Words included in the most frequent 1000 words of the Kucera-Francis list (based on adult language) have been deleted. The list was also edited to remove numerals; labels; names of people, places, products, and companies; contractions and possessives; and colloquialisms resulting from the oral language samples.

Some words included in the list are relatively uncommon words that occurred in the total language sample and are not necessarily technical terms. Thus, the list should be treated as a source rather than a criterion. The 83 most common words have been marked with an asterisk.

Total Sample Words = 21,000

Different Words = 3,164

abbreviate
ability
abnormal
abrasive
absorbed
absorbing
absorbs
abuse
ac
accelerate
acceleration
acceptable
accepted
accessible
accessories
accessory
accommodate
accompanying
accomplish
accordingly
accumulate
accumulating
accumulation
accuracy
accurate
accurately
achieve
acid
acting
activates
acts
actual
actuated
actuates
actuating
actuator
actuators
acute
adapted
add
addendum
adding
adds
adequate
adjacent
adjust
adjustable
adjusted
adjusting
adjustment
advanced
advantage
advantaged
advantages
affect
affected
affords
agency
agent
air*
alarm
algebraic
align
aligned
aligning
alignment
alike
allow
allowable
allowed
allowing
allows
alloy
alloying
alloys
alternate
alternated
aluminum
ambient
amounts
amp
amperage
ampere
amperes
amplifies
anchored
angle*
angles
angular
anomaly
antifreeze
antimony
anybody
anyway
anywhere
apart
apparatus
appearance
appliance
appliances
application*
applies
apply
applying
appreciable
apprentice
approached
approaches
approval
approved
approximate*
arbitrarily
arbitrary
arch
arcing
arise
arithmetic
arm
armature
arranged
arrival
article
artificial
assemble
assembly
assigned
assist
assistance
associated
assume
assure
assured
atmosphere
atmospheric
atoms

attach
attached
attaching
attachment
attempted
attract
attraction
auto
automatic
automatically
automobile
automotive
availability
avoid
axis
bacteria
bands
bar
bare
barium
base
baseplate
bases
basically
battery
battle
beam
bearing
bearings
becomes
begin
begins
belongs
bend
bender
bends
beneficial
bias
bimetal
bipolar
bismuth
bit
bite
biwood
blade
blank
bleed
block
blocked
blocking
blocks
blow
blower
blowing
blown
blueprints
boil
boiler
boils
bolts
bonds
books
bore
boring
bored
bottle
bottom
bounce
bowl
box
boxes
bracket
brackets
brake
brakes
braking*
branch
brass
break
breakdown
breaker
breakers
bridge
broken
brush
brushes
btu
btus
bubbles
bucket
buddy
buffing
builds
buildup
built
bulb
bullet
bulleting
bulletins
bullneck
burial
burn
burned
burrs
bushings
busy
butane
button
buy
buying
bypass
cabinet
cadmium
cage
calcium
calculate
calculated
calculating
calculation
calibrated
calls
cam
canister
canvas
cap*
capacities
capacitive
capacitor
capacity
carbon
carefully
carrier
carriers
carry
carrying

casing
cast
casting
catalyst
catch
caused
causes*
causing
caution
cavities
cemented
centerline
centrifugal*
centrifuge
cents
chamber*
chances
changed
changing
chapters
characteristic
charged
charges
charging
chart
chassis
check*
checked
chemical
chemicals
cherry
chilled
chromium
circle
circuit*
circuits
circular
circumference
clamped
clamps
clarified
classes
classification
classified
clean
cleaning
clearance
climates
climb
clock
clockwise
closely
closer
closes
closest
closing
cloth
cloudy
coal
coarse
coarser
coat
cobalt
code
codes
coffee
coil
coiled
coils
coke
collect
collector
collects
colored
column
combination
combustible
combustion
comfort
commercial
commonly
communicate
commutator
compact
comparative
compared
compartment
compensate
compensatory
competence
competition
complaint
completed
completes
complex
compiled
component
components
composition
compound
compress
compressed
compression
compressor*
comprise
computed
concentrate
concerning
condensate
condensation
condense
condenser*
condenses
condition
conditioning
conduct
conduction
conductor
conduit
cone
conjunction
connect
connected*
connecting
connection*
connector
connects
consequent
considerable
considerate
consist
consists
constant
constants
construction

consult
consulting
consumption
contact
contacted
contactor
contactors
contacts*
contain
contained
container
contains
contaminant
contamination
content
continues
continuous
contour
contoured
contribution
controlled
controller*
controlling
controls
convenience
convenient
convention
convert
converted
conveyor
cool
cooled
cooling
cools
copper
core
corners
correct
corrected
correlation
correspond
corrode
corrosion
cotton
counted
counter
coupled
coupler
coupling
cover
covering
covers
crack
cracked
cracks
crankcase
crankshaft
creates
crescent
critical
cross
crystal
cube
cubes
cubic
curie
currently
currents
cursor
curvature
cushion
cushions
customer
cutaway
cuts
cutter
cutterhead
cutters
cycle
cycles
cylinder
cylinders
damage
damaged
damper
dampers
dart
datum
dc
deadman
dear
decrease
decreases
decreasing
defective
defined
definite
deflection*
defrost
defrosted
degrees*
delay
delivery
demand
densities
density
depend
dependence
dependent
depending
depends
depth
depress
depressed
depresses
describe
describes
descriptive
designated
designing
desirable
desired
destroy
detailed
detection
deteriorate
determined*
develop
develops
devented
device*
devices
devise
devised
devises

diagram
diagrams
dial
dials
diameter*
diameters
diametrical
diaphragm
die
dielectric
differential*
difficulties
digit
dilemma
dilutes
dimensions
dinner
directed
directional
directions
dirt
dirty
disadvantage
disagree
disassemble
disc
discharge*
disconnect
discuss*
discussed
discussing
disintegrate
desk
desks
dispenser
displacement
display
disruptive
dissimilar
distorts
distribute
distributor
divided
dividing
dollar
dollars
domestic
doors
dotted
downstream
downtime
dozed
dozen
drag
drain
drained
drains
draw
drawbar
drawing
drawings
drawn
drift
drilled
drink
drip
driven
driver
drivers
drives
driving
drop
dropout
dropped
drops
drum
dry
duct
dull
dump
dumps
dust
dusts
duty
ease
easier
eccentricity
economical
edge
edges
effectively
effectiveness
efficiency
efficient
elbow
electric
electrical*
electrician
electricity
electromagnet
electron
electronic
electrons
element*
elementary
elevators
eliminate
eliminated
eliminates
eliminating
emergency
emersion
emery
employ
employed
employs
encases
enclosed
enclosure
enclosures
encountered
ends
endwise
energize
energized
energizes
energy*
engineers
enlargement
ensure
enter
entering
enters
enthalpy
entirely

equal	exceptional	external	fig,	flattening
equally	excerpt	externally	figured	flavor
equals	excess	extra	filament	flexible
equations	excessive	extreme	fill	flight
equilibrium	excessively	extremely	filled	float*
equipped	exchanger	facing	fillers	flooded
equivalent	excuse	factor	filling	flour
erection	exercised	factory*	fills	flow*
erratic	exerted	facts	filter	flowing
escape	exhausted	failure	filtered	flows
essential	exists	failures	finding	fluctuation
essentially	expands	fairly	finer	fluid*
established	expansion	falls	fingers	fluidic
etc.	expedite	familiar	finish	flux
evaporated	expense	fan	finishing	flywheel
evaporating	expensive	fashioned	fit	foam
evaporated	experiment	faster	fits	foamed
evaporator*	experts	fattened	fitting	follows
eventually	explained	faulty	fittings	fool
everybody	explosion	feature	fixed	foot
everyone	explosive	fed	flame	forced
exact	exposed	feedback	flammable	forged
exactly	exposure	feeder	flare	forks
examine	expressed	feeding	flaring	formation
examples	expression	ferrous	flash	formula*
exceed	extension	fiberglass	flask	formulas
exception	extensively	fields	flat	forth

fortyfive	fuse	glue	guidelines	hence
fourth	fuses	glued	guy	hide
fourths	fusion	gluing	guys	highly
fractional	gage	goes	hack	hinges
frame	gages	gold	halves	hiring
freely	gal.	governing	hammer	hits
freeness	galling	gpm	handle	holders
freerunning	gallons	grade	handles	holding
freezing	gas*	grades	handling	holds
freight	gaseous	gradual	handtight	hole
frequency	gases	gradually	happen	holes
frequently	gasket	graduated	happens	hollows
friction	gasketing	graduation	hardened	hook
frost	gauge*	grain	hardens	hooks
frosting	gear	grainless	harmful	hopefully
frozen	generate	graphic	harsh	horizontal
ft.	generated	gravity	harvest	horsepower
fuel	generates	grease	harvested	housing
fuels	generating	greases	hazardous	hubs
full	generation	grip	heads	humidifier
fully	generator	grooves	heat*	humidity
functions	geographic	grounded	heated	humidostat
fundamental	gets	grounding	heater	hundredth
funnel	girders	grounds	heaters	hurt
furnace	giving	grow	heating	hut
furnished	gland	guess	heavily	hydraulic*
furthermore	glass	guidebar	helical	I-beam

ice	increments	inspected	inward	laying
icemaker	independent	inspecting	iron	lbs.
ideal	index	inspection	isolated	leader
idler	indicate	install	isolating	leading
illustrate	indicates	installation	isolation	leads
illustration	indicating	installed	items	leak
imbedding	indicative	installing	jobs	leakage
immediately	indicator	instance	joint	leaking
immovable	indirect	instruction	joints	leaks
impedence	indoors	instrument	keeps	lean
impelier	inductive	insufficient	kilo	learning
imported	inefficient	insulation	kilogram	leather
imposed	inertia	insulator	kinetic	leaving
imposing	inexhaustible	insure	knocks	lefthand
impossible	inexpensive	integral	knuckles	leg
impractical	infinite	integrally	labels	lengthen
impregnate	initial	intended	ladder	lengthening
improper	initially	intense	lags	lengths
inch	initiated	intensity	laid	lengthwise
inches	initiating	interdependent	lamp	levels
inching	injury	interfere	lapse	lever
includes	inlet	internal	largest	lies
incoming	inner	interrupts	latent	lift*
incorrectly	input	intimate	lathe	lifted
increases	insert	inverted	latitude	lifting
increasing	inserted	invisible	lattice	lighter
increment	inspect	involving	layers	lightest

lights	logarithms	maintaining	melted	minority
limit	logical	maintenance	memory	minus
limiting	loop	majority	merchandise	minute
limits	loosely	manganese	mercury	misalignment
link	loosen	manifold	mesh	mistuned
linkage	loses	manual	meshes	mixed
liquid*	loss	manually	messed	mixture
liquids	lowered	manufacture	metal	mixtures
liquified	lowering	mark	metals	mode
listed	lowest	marketplace	meter*	model
listen	lubricant	markings	metered	models
listing	lubricated	marks	metering	moderate
lists	lubricating	master	meters	modification
lit	lubrication	match	metric	modulate
lithium	lucky	mate	microampere	modulating
load	machine	materials	micrometer	moisture
loaded	machinability	mating	microsecond	molasses
loading	machined	maximum*	milder	mold
loads	machines	meant	milliliter	molecular
locate	magnesium	measure	millimeter	molecules
located	magnet	measured	millivolts	monitoring
locating	magnetic	measurement	mills	monitors
location	magnetism	measures	mine	monometer
locations	magnetized	measuring	mineral	monthly
locker	magnetizing	mechanical*	mines	moreover
locknut	maintain	meets	minimizes	motion
locomotive	maintained	melt	minimum*	motor*

motors	northeastern	opposed	painted	periodic
mounted*	notations	opposite*	pair	periodical
mounting	nozzle	optional	pan*	periods
mover	numeral	ordering	pans	periphery
multiple	numerals	ordinary	paragraph	permanent
multiplication	nutritive	orifice	paragraphs	permeability
multiply	nuts	original	parallel	permit
multiplying	oak	originating	paralleling	permits
multipurpose	object	oscillator	partial	permitting
needle	objective	outdoor	partially	personnel
negative	obtain	outdoors	partition	petroleum
neighborhood	obtaining	outer	part-time	phase
net	occur*	outlet	pass	phases
network	occurs	outlets	passage	phlange
neutral	ohm*	output*	passes	physics
nickel	ohmeter	outward	passing	pick
nicks	ohms	overcome	path	picked
ninety	oil*	overflow	paths	pictorial
nipple	oils	overheating	peak	pieces
nitrogen	opening	overload	peaks	pilot*
no	opens	override	pedal	piloted
nominal	operate*	oxidation	percent	pin
nonfoaming	operated	oxide	percentage	pinion
nonmagnetic	operates	packaged	perform	pins
nonpolluting	operating*	packing	performed	pipe*
nonposition	operative	packings	performing	piped
normally	operator	page	performs	pipeline

pipes	polishing	predominant	proceed	pulley
piping	polyurethane	preferred	processes	pulls
piston*	pop	preheat	produce	pulsating
pistons	pops	premature	produced	pulse
pit	port*	premium	produces	pulses
pitch	portion	presents	producing	pump*
pitches	positioned	preservation	product	pumped
pitting	positioning	preserves	professor	pumping
placing	positions	preset	proficient	pumps
plants	positive	pressures	programmed	punched
plaster	possibility	pressurize	prompt	purposes
plate	possibly	prevent*	proof	push
plates	position	preventing	propane	pushed
platinum	post	preventive	proper*	pushing
please	potential	previous	properly	putting
plug	pound	previously	properties	quantities
plugged	pounds	prices	proportion	quantity
plumb	pour	primary	protect	quarter
plugging	powered	prime	protected	quickly
plus	powers	primer	protecting	races
pneumatic	practical	principally	provides	rack
pocket	practically	principles	providing	radial
pointed	practice	printed	psc	radially
pointing	practices	printing	psi*	radius
poisoning	precise	prior	ptc	raise
polarities	precision	procedure	pull	raised
polarity	predetermined	procedures	pulled	raising

ran	recommend	relative	replacement	resulting
ranges	recommendation	relatively	replacing	retains
rapidity	recommended	relay*	reporting	retard
rapidly	recording	relays	reposition	retarded
rare	recovered	release	represent	retraction
rated	rectangular	released	represents	returning
rating	reduce	releases	reproduced	returns
ratings	reduced	reliability	reproduction	reverse*
ratio	reduces	relief*	require	reversed
reaches	reduction	relieve	requirement	reverses
reaching	reeds	remain	requires	review
reactance	refer	remains	reservoir	revolution
readily	referred	remedied	reset	ribs
readjust	refined	remote	resin	rifle
readjusted	refineries	remotely	resistance*	right
reads	refreezing	removal	resistant	rigid
rearranged	refrigerant*	remove	resisting	rim
receive	refrigeration*	removed	resistor*	ring
receiver	regained	removing	resistors	rise
receivers	regardless	repair	resonance	rises
receives	region	repeat	resonant	rising
receptacle	regular	repeated	respective	rod
recharging	regulates	repel	responds	rods
reciprocal	regulation	repelling	restore	rollers
reciprocate	regulator	repetition	restraining	rooms
recirculate	relations	replace	restricted	root
recognized	relationship	replaced	resultant	roots

rotary	satisfied	secured	setup	shunts
rotate	saturated	securing	severe	shut
rotated	saturation	sediment	severity	shutdown
rotates	sauce	seldom	sewed	shuts
rotating	saving	selected	sewing	sides
rotation	scale	selecting	shaft	sight
rotor	scaled	selection	shafts	signal
rough	scales	self	shape	significant
round	scheduled	selling	sharp	signs
rounded	scoring	semiconduct	sharpness	silver
row	scratch	sends	sheet	silvers
rubber	scratches	sensed	sheepskin	similarly
rugged	screw	senses	shift	simultaneously
rule	screwing	sensible	shifting	sitting
rules	screws*	sensing	shiny	sizes
runner	sea	sensitivity	shipment	sizing
runs	seal*	separate	shipped	skid
ruptured	sealed	separated	shipping	sleeve
rust	sealing	separately	shock	slide
saddle	seals	separation	shoe	sliderule
safe	seasons	sequence	shoes	sliderules
safely	seating	sequenced	shop	slight
safety	seats	serial	shortage	slightly
sag	seconds	serviceability	shortening	slot
sand	sectional	servicing	shorter	slots
sandwich	sections	setting*	shortest	slow
satisfactory	secure	settings	shows	slowing

slugging	specialize	starts	stressed	superheated
slurries	specially	starve	string	supplied
slurry	specifically	stated	strips	supply*
smaller	specification	stations	stroke*	supplying
smooth	specified	staying	stronger	supported
soap	speed*	stays	strongly	supports
soaps	speeds	steam	strontium	supposed
sockets	spend	steel	structural	surfaces
sodium	spin	steels	structure	surgical
soft	spindles	steep	stub	surge
solar	spoilage	stem	stuck	surrounding
sold	spool	stems	stuff	suspended
solder	spot	stick	style	suspension
soldered	spots	sticking	subcooling	switch*
solenoid	springload	stiff	subjected	switched
solid	springs	stopping	substance	switches
solids	sprung	stops	substances	switching
solution	spur	storage	substantial	symbols
solve	stability	store	success	symmetrical
somebody	stable	stored	suction*	symmetry
somewhere	stages	storeroom	sufficient	syphon
sorry	stainless	straighten	suitable	syphoning
source*	stalled	strain	sum	tables
spaces	standing	strainer	summarize	tags
span	standpoint	strains	sump	takes
spear	starch	stray	super	talked
specialist	starting	stream	superheat	talking

talks
tangent
tank*
tanned
tape
taper
taperheaded
tapering
tapers
taps
task
technically
technician
technique
technological
tee
teeth*
television
tells
temp.
temporarily
temporary
tend
tendency
tensioning
tenth
term
terminal
terminals
terminated
terrible
text
textile
thank
thanks
theoretical
thereby
thermal
thermistor
thermodynamic
thermometer
thermostat
thick
thickness
thin
thirty
thorough
thoroughly
thousand*
thousandth
thread
threaded
threads
throat
through
throw
thrust
tight
tighten
tightening
tightly
till
timed
tolerances
tomorrow
tonight
tool
tools
tooth
torque
touch
towards
train
trained
transfer
transferred
transform
transformed
transforming
transistor
transition
transmission
transmitted
transported
travel
traveling
tray
treated
triggered
trigonometry
trimmed
tripped
trips
truck
tube
tubes
tubing
turning
turns
twelve
twenty
twice
twirled
twisted
twisting
ultimately
unassemble
unbalanced
undercut
undercutting
underneath
underside
understood
underwrite
unequal
unidirectional
uniform
unit
units
unity
universal
unknown
unless
unlike
unload
unloaded
unloading
unmodified
unsymmetrical
unwanted
upper
upright
upside
upward
usage

useful
user
u-shaped
usual
utilized
vacuum
valuable
valve*
valves*
vane
vanes
vapor
vaporization
vaporizes
vaporizing
vapors
variable
variation
variations
varied
vary
varying
velocity
vent
vents
vertical
vertically
vibrating
viewing
vinyl
viscosity
visually
volatile
volt*
voltage*
voltmeter
voltmeters
volts
walt
walk
walls
wants
warm
warmth
washers
washes
wasted
watch
waterproof
wave
waves
waveshape
waveshapes
weak
weakly
wear*
wedging
weight
weighted
weightless
welcome
wet
wheel
wheels
whenever
whereas
wick
widely
wider
width
willing
winding
windings
wings
wipe
wiper
wire
wired
wires
wiping
wondering
wood
wooden
wool
workmen
worm
wormgear
wormwheel
worn
worried
worse
wrapped
wrench
wrinkling
yearly
yeast
yesterday
yours
yourself
zero
zinc
zone

APPENDIX B

HIGHEST FREQUENCY WORD LIST

The 100 words on the following page represented 45% of the words used in all the language sampled. This list is based on the combined oral and written language samples from all occupations studied. It shows the words used most frequently by adults in the ten jobs studied and in the vocational training programs corresponding to those jobs.

Total Words	=	180,000
Total Different Words	=	9,000

the	will	your	see
of	one	was	more
to	not	get	these
and	an	has	into
a	there	must	just
is	can	any	them
in	when	he	down
it	out	got	time
for	we	know	about
that	which	then	been
you	what	don't	some
be	do	each	business
or	up	air	how
on	pressure	check	its
are	two	that's	back
I	so	but	over
this	they	system	work
with	here	through	would
as	other	valve	temperature
by	ok	going	same
if	right	well	also
have	no	use	where
all	used	than	now
at	may	it's	only
from	should	go	like

APPENDIX C

SUMMARY OF OCCUPATIONAL LITERACY REQUIREMENTS

This appendix presents a brief summary of the literacy requirements for all ten occupations studied.

SUMMARY OF OCCUPATIONAL LITERACY REQUIREMENTS

	On The Job		Training Program	
	Reading	Mathematics	Reading	Mathematics
Account Clerk	College to college graduate level	addition, subtraction, multiplication, division, decimals, fractions, business machines	11th grade to college graduate	addition, subtraction, multiplication, division, fractions, decimals. algebra
Automotive Mechanic	9th to college graduate level	basic processes, decimals, fractions, measurement	9th to college graduate level	basic processes, decimals, fractions, measurement
Draftsman	10th grade to college graduate	basic processes, through geometry, algebra, trigonometry	9th grade to college level	basic processes, through geometry, algebra, trigonometry
Electrician	college to college graduate level	basic processes, throguh geometry, algebra, trigonometry	10th grade to college graduate level	basic processes, through geometry, algebra, trigonometry
Heating and Air conditioning Mechanic	10th grade to college graduate level	basic processes, decimals, fractions, measurement, algebra	11th grade to college graduate level	basic processes, fractions, decimals, measurement
Industrial Maintenance Mechanic	10th grade to college graduate level	basic processes through trigonometry	10th grade to college graduate level	basic processes, decimals, fractions, measurement
Licensed Practical Nurse	10th grade to college level	addition, and subtraction--more necessary to dispense medication	12th grade to college graduate level	addition and subtraction
Machine Tool Operator	9th to college graduate	basic processes, decimals, measurement	9th grade to college level	basic processes, decimals, measurement
Secretary	College to college graduate level	basic processes, decimals, fractions, business machines	10th grade to college level	basic processes, decimals, business machines
Welder	few materials--reading of single word information required	basic processes, fractions, decimals, measurement	8th grade to college graduate level	basic processes, fractions, decimals, measurement, algebra