A STUDY OF THE KNOWLEDGE AND SKILLS
REQUIRED OF WELDERS IN THE
DALLAS-FORT WORTH AREA

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A STUDY OF THE KNOWLEDGE AND SKILLS REQUIRED OF WELDERS IN THE DALLAS-FORT WORTH AREA

THESIS

Presented to the Graduate Council of the North Texas State University in Partial Fulfillment of the Requirements

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By

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Denton, Texas
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CHAPTER I

INTRODUCTION

One of the metal industries' most flourishing areas of work is centered around the various facets of welding. Many technological advances have been made in the field of welding. This is possibly due to the many technological advances made possible by new metallurgical developments. The skills and abilities of welders are probably being challenged more now than ever before. Consequently, the metals industry has continued to grow, creating a vast demand for skilled welders. Industrial arts welding courses are designed to provide students an opportunity to explore and develop the required techniques and skills of welding. For any course of study in welding to include the essentials necessary to achieve these goals, the industrial arts curriculum should be closely related to current industrial practices.

Therefore, the objective of this study is to determine what knowledge and skills are being required of welders currently employed in the Dallas Metropolitan Area, and to what extent these may be incorporated and taught in industrial arts welding classes.
Statement of the Problem

This study was designed to identify the knowledge and skills that welders employed in certain areas of manufacturing and fabrication in the Dallas-Fort Worth, Texas Metropolitan Area should possess.

In order to solve the stated problem, answers for the following questions were sought.

1. What kind of education and experience is required of prospective welders?
2. Is union membership a requirement for prospective welders?
3. What types of admission tests are administered to a prospective employee entering the field of welding?
4. How much emphasis is placed on admission tests given to prospective employees entering the field of welding?
5. How much emphasis is placed upon knowledge and skills in the use of welding equipment and machinery?
6. Is there a requirement concerning certification of skilled welders?
7. Do firms have an in-service training program?
8. What is the length of in-service training programs?

It is believed that this study provides pertinent and current information that may be useful in developing criteria for evaluating and revising industrial arts welding courses.
Method of Procedure

In seeking answers to the questions mentioned in the statement of the problem, the following procedures were followed to determine the knowledge and skills required of welders in the Dallas Metropolitan Area. A sampling of manufacturing firms employing welders was taken from five sources.

2. A portion of a printed series provided by the Dallas Chamber of Commerce entitled *Non-Manufacturing Firms in Dallas County with Over 100 Employees* (4).
4. A portion of a printed series provided by the Dallas Chamber of Commerce entitled *Manufacturing Firms in Dallas Standard Metropolitan Area with Over 25 Employees* (3).
5. A list of cities in the Dallas-Fort Worth area obtained from the *Texas Almanac* (5).

A list was secured of ninety-five firms which employed welders. A letter was mailed to these ninety-five firms explaining briefly the purpose of the study and inquiring whether or not they would participate in the study by completing and returning a questionnaire (Appendix A). Of the ninety-five firms contacted, 87, or 91.5 per cent, returned the enclosed post cards (Appendix B). Eighty-five of the firms returning the cards indicated that they did employ
welders and would complete and return a questionnaire. Two firms returning the card did not employ welders, and eight indicated they did employ welders but would not participate in the study.

The questionnaire (Appendix D) and a letter of explanation (Appendix C) were directed to the eighty-five firms, and forty-six were returned within two weeks. A follow-up letter (Appendix B) was then directed to the remaining thirty-nine firms, resulting in the return of nineteen more questionnaires. A total of sixty-five, or 73.5 per cent of the original eighty-five firms, returned the questionnaires, sixty-two of which were usable.

Sources of Data

The data used in this study were obtained from questionnaires completed and returned by sixty-two firms in the Dallas-Fort Worth, Texas area.

Limitations of the Study

Of the sixty-five questionnaires returned, sixty-two, or 95.2 per cent, were usable for the purpose of this study. Therefore, the study was limited to sixty-two firms in the Dallas-Fort Worth area. The study was further limited in that, upon occasions, no response was made to certain items on the questionnaires. Three firms failed to respond to two items, four firms did not respond to three items, and six firms omitted a response on one item of the questionnaire.
Due to the omissions to certain items on the questionnaire, some of the totals in the tabulated data will not result in a total of 100 per cent.

This study was made with further limitations. They were as follows:

1. The study was limited to four job classifications of welding, which are categorized in the *Dictionary of Occupational Titles* (8), and are as follows:
   - 810-810.88 Arc welders
   - 811-813.88 Gas welders
   - 812-813.885 Combination arc and gas welders
   - 816-816.88 Flame cutters and gas cutters

2. A further limitation of this study was that it was concerned with knowledge, skills, and training required by firms in the Dallas-Fort Worth, Texas Metropolitan Area.

3. This study was limited to sixty-two metal manufacturing and fabricating firms which were involved in the production or repairing of metal products.

Organization of the Study

Chapter I of the study includes an introduction, statement of the problem, purpose of the study, method of procedure, sources of data, limitations of the study, organization of the study, definition of terms, and related studies.

Chapter II presents the general qualifications and duties of welders as indicated by the participating firms. Chapter III is devoted to the job opportunities for an individual
seeking employment in the area of welding in one of the four job classifications listed, as well as future employment opportunities in the area.

Chapter IV compares the industrial arts welding curriculum with the requirements of the metals industry. Chapter V consists of a summary, conclusions, and recommendations made in view of the findings of the study.

Definition of Terms

The following terms are defined to keep ambiguity to a minimum in this study.

**Curriculum** as used in this study, will refer to the total offerings provided by the school.

**Industrial Arts** as used in this study, will refer to that phase of general education that provides the opportunity for students, both boys and girls, to explore the materials, tools, and processes of industry.

**Sampling** will refer to the number of firms chosen from various sources that would have likely employed welders, and which included ninety-five firms in the Dallas-Fort Worth, Texas Area.

**Qualifications** as will be used in this study will refer to the characteristics which make an individual suitable for a job, as indicated by the participating firms.

**Knowledge and skills** as used in this study will refer to competency in the application of the principles and concepts of welding and the use of welding equipment and machinery.
Metallurgy as used in this study will refer to the science of extracting metals from their ores and preparing them for man's use.

The Dallas-Fort Worth Metropolitan Area refers to the cities of Dallas and Fort Worth and surrounding areas located in Denton, Collin, Tarrant, Dallas, Johnson, Ellis and Rockwall counties.

Welder will refer to an individual whose occupation is welding.

Welding as used in this study will refer to the art of fastening metals together by means of interfusing the metals.

Arc Welder does welding work by fusing two metals together using an electric arc as the source of heat.

Gas Welder does welding work by using a fuel combination of the two gases, oxygen and acetylene, to fuse two metals together.

Participating firms refers to the sixty-two firms of the original sampling that returned questionnaires completed in such a manner that made them usable for the purpose of this study.

Related Studies

Wied's (9) study concerned itself with the job prerequisites for female employees in the electronics industry in the Dallas Area. The data presented by Wied were collected from information supplied through a sampling of industries and agencies in the Dallas Metropolitan Area. The data indicated that employment opportunities for female employees
in electronics were increasing more rapidly than the number of workers being trained for positions. Wied recommended that young women should be encouraged to take electricity-electronics courses in high school. Further recommendations were that high schools should foster an awareness of the opportunities in the electronics industry for women and that studies in other occupational fields for women be investigated.

Craghead (2) conducted a study of the knowledge and skills required of draftsmen in the manufacturing and non-manufacturing firms in the Dallas-Fort Worth, Texas area. This study indicated that most of the draftsmen at some time, participated in the actual design of a product. This study further indicated that larger firms that employed more draftsmen used less equipment than the smaller firms that employed fewer draftsmen. Also indicated in this study was that the employment demands for trained draftsmen are steadily increasing.

Bodine's (1) study referred to the employment requirements for prospective technicians in selected industries in Pittsburg, Kansas. The study indicated that the prospective technician needed to have a high school education involving knowledge of the tools, materials, and processes of industry as related to the particular job functions.
CHAPTER BIBLIOGRAPHY


4. Dallas Chamber of Commerce, Non-Manufacturing Firms in Dallas County with Over 100 Employees, A Report of Non-Manufacturing Firms in Dallas, Dallas, Dallas Chamber of Commerce, 1968.


CHAPTER II

GENERAL QUALIFICATIONS REQUIRED OF 1,975 WELDERS
IN SIXTY-TWO PARTICIPATING FIRMS

The sixty-two firms participating in this study employed over 55,000 people. Of this number 1,975 were welders. These firms ranged in size from small firms which employed two welders to the largest firm which employed 175 welders. This chapter will present data indicating general qualifications required of welders in the Dallas-Fort Worth, Texas Metropolitan Area as indicated by the sixty-two participating firms or employers.

General Qualifications of Welders

Some of the general qualifications deemed necessary by the participating firms for prospective welders are shown in Table I. The data shown in Table I represent the number and per cent of firms, as well as the number and per cent of welders employed by the participating firms.

As shown in Table I, sixteen, or 25.8 per cent of the firms, indicated that they did require previous on-the-job experience as a prerequisite for employment. This 25.8 per cent of the firms employed 17.2 per cent of the welders. Twenty-eight, or 45.1 per cent of the firms which employed
47.3 per cent of the welders, indicated they preferred their prospective welders have previous on-the-job work experience. Sixteen, or 25.8 per cent of the firms, indicated that they desired to employ welders with previous work experience while only two, or 3.2 per cent of the firms, indicated that it did not matter whether or not the prospective welder had previous work experience.

**TABLE I**

**GENERAL QUALIFICATIONS REQUIRED OF 1,975 WELDERS IN SIXTY-TWO PARTICIPATING FIRMS**

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Firms</th>
<th>Welders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firms requiring welders to have previous on-the-job work experience</td>
<td>16</td>
<td>340</td>
</tr>
<tr>
<td>Firms desiring welders to have previous on-the-job work experience</td>
<td>16</td>
<td>525</td>
</tr>
<tr>
<td>Firms preferring that welders have previous on-the-job work experience</td>
<td>28</td>
<td>935</td>
</tr>
<tr>
<td>Firms not requiring welders to have previous work experience</td>
<td>2</td>
<td>175</td>
</tr>
</tbody>
</table>

**Age Requirements**

Age was not a crucial factor in employment in the welding field in the Dallas-Fort Worth, Texas Metropolitan Area,
as age requirements vary with different firms.

Table II indicates the age limit requirements set by each of the participating firms. There was a contrast between the firms employing twenty-five, or fewer persons, and the firms employing one hundred or more persons.

TABLE II

AGE REQUIREMENTS OF FIRMS EMPLOYING WELDERS IN THE DALLAS METROPOLITAN AREA

<table>
<thead>
<tr>
<th>Age</th>
<th>Age Requirements</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Preferred</th>
<th>Per Cent of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>16</td>
<td>16</td>
<td></td>
<td></td>
<td>25.8</td>
</tr>
<tr>
<td>17</td>
<td>8</td>
<td>9</td>
<td></td>
<td></td>
<td>12.9</td>
</tr>
<tr>
<td>18</td>
<td>25</td>
<td>25</td>
<td></td>
<td></td>
<td>40.3</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1.6</td>
</tr>
<tr>
<td>20</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
<td>9.6</td>
</tr>
<tr>
<td>21</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>4.8</td>
</tr>
<tr>
<td>22</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>4.8</td>
</tr>
<tr>
<td>23</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td>14.5</td>
</tr>
<tr>
<td>24</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>19.3</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td>40.3</td>
</tr>
<tr>
<td>26</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>16.1</td>
</tr>
<tr>
<td>27</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>9.6</td>
</tr>
<tr>
<td>28</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1.6</td>
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<td>30</td>
<td>23</td>
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<td>37.0</td>
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<td>35</td>
<td>23</td>
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<td></td>
<td></td>
<td>19.3</td>
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<tr>
<td>40</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>19.3</td>
</tr>
<tr>
<td>45</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>12.9</td>
</tr>
<tr>
<td>50</td>
<td>8</td>
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<td></td>
<td></td>
<td>6.2</td>
</tr>
<tr>
<td>55</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>4.8</td>
</tr>
<tr>
<td>65</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

The larger firms indicated no critical preference to age, whereas the smaller firms indicated an explicit preference for welders between the ages of twenty-four and thirty-five. Of the seven minimum age requirements indicated by the firms,
twenty-five, or 40.3 per cent of the firms, showed a preference for hiring prospective welders at the minimum age of eighteen. Ages forty and forty-five were indicated as being the maximum ages most often considered when hiring welders, while three firms indicated that their maximum employment age was sixty-five. The preferred age most often sought was twenty-five.

Education Requirements

The educational requirements for welders varied with the particular type of job skill. Table III indicates the educational level the prospective welder employee should have attained in order to apply for employment as a welder in the Dallas-Fort Worth Metropolitan Area, as expressed by the participating firms.

TABLE III

EDUCATIONAL REQUIREMENTS FOR EMPLOYEES DESIRED BY SIXTY-TWO FIRMS

<table>
<thead>
<tr>
<th>Educational Attainments Required</th>
<th>Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Elementary school</td>
<td>-</td>
</tr>
<tr>
<td>Junior high school</td>
<td>-</td>
</tr>
<tr>
<td>Some high school</td>
<td>16</td>
</tr>
<tr>
<td>High school graduate</td>
<td>19</td>
</tr>
<tr>
<td>Technical school</td>
<td>-</td>
</tr>
<tr>
<td>Some college</td>
<td>-</td>
</tr>
<tr>
<td>No preference</td>
<td>27</td>
</tr>
</tbody>
</table>
The data presented in Table III were indicative of the firms that set a definite level of education as being important in respect to hiring welders. The importance of educational requirements varied to some degree with the different firms. Nineteen, or 30 per cent of the firms, indicated that a high school diploma was required for employment, while sixteen, or 27 per cent of the firms, required the prospective to have some high school training. In contrast, twenty-seven, or 43 per cent of the firms, indicated no particular preference for educational attainment in hiring prospective welders. Three larger firms indicated they had found that there was a noticeable difference between high school graduates and nongraduates and employees with less education in respect to the length of time required to train the welders to meet certification requirements. On the other hand, the three employers found very little or no difference between high school graduates and nongraduates in training them for non-code welding skills. Therefore, the three employers and four administrators of two large welding and technical schools concluded that in many instances general education was not necessarily a factor in determining efficiency and work quality in job classifications for non-code welders. The employers indicated there was a remarkable difference when training prospective welders to meet code certification requirements for more technical job skills, which could be attributed to the attainment of a general education.
The general consensus found among the nineteen firms, as well as pertinent information gained through the interviews, was that in hiring code welders employers generally have a preference for high school graduates due to the fact that they usually can be trained to perform a broad range of job skills in less training time.

Certification Requirements

Thirty-three, or 53.2 per cent of the firms, indicated that no certification was needed by prospective employees for the four job classifications in this study. Two firms specified that the employee must attend a sixty-hour in-plant certification training program. This certification consisted of specialized training in any one of the four job classifications used in this study.

Required Knowledge of Welding Fundamentals and Welding Equipment and Machinery

The welding field, like many other industrial areas of work, has undergone many new and revolutionary changes. Therefore, it has become necessary for one to become fully aware of the new skills and related information needed to keep abreast, as well as the mastery in operation of the conventional as well as new equipment and machinery.

Table IV indicates the importance of specified related subject matter to the field of welding as indicated by the sixty-two participating firms. The importance of different
areas of subject matter varied greatly with the firms, due to their differences in nature of work. Forty, or 64.5 per cent of the firms, indicated that blueprint reading (pipe,

<table>
<thead>
<tr>
<th>Area of Study</th>
<th>Extremely Important</th>
<th>Per Cent of Firms</th>
<th>Very Important</th>
<th>Per Cent of Firms</th>
<th>Unimportant</th>
<th>Per Cent of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Pipe drafting and blueprint reading</td>
<td>45</td>
<td>73</td>
<td>16</td>
<td>25</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>B. Structural drafting and blueprint reading</td>
<td>45</td>
<td>73</td>
<td>14</td>
<td>22.4</td>
<td>3</td>
<td>4.6</td>
</tr>
<tr>
<td>C. Machine drafting and blueprint reading</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>9.7</td>
<td>56</td>
<td>90.3</td>
</tr>
<tr>
<td>D. Addition and subtraction of whole numbers</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>9.7</td>
<td>56</td>
<td>90.3</td>
</tr>
<tr>
<td>E. Multiplication and division of whole numbers</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>9.7</td>
<td>56</td>
<td>90.3</td>
</tr>
<tr>
<td>F. Addition and subtraction of fractions</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>9.7</td>
<td>56</td>
<td>90.3</td>
</tr>
<tr>
<td>G. Multiplication and division of fractions</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>13</td>
<td>54</td>
<td>87.0</td>
</tr>
<tr>
<td>H. Basic trigonometry functions</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1.6</td>
<td>61</td>
<td>98.4</td>
</tr>
<tr>
<td>I. Plane geometry functions</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>62</td>
<td>100</td>
</tr>
<tr>
<td>J. Solid geometry functions</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>62</td>
<td>100</td>
</tr>
<tr>
<td>K. Basic metallurgy as applied to welding</td>
<td>56</td>
<td>90.3</td>
<td>6</td>
<td>9.7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>L. Strength and stress of materials and weldments</td>
<td>56</td>
<td>90.3</td>
<td>6</td>
<td>9.7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M. Shop and industrial safety</td>
<td>56</td>
<td>90.3</td>
<td>6</td>
<td>9.7</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
structural, and machine drafting) was extremely important for prospective welders to be familiar with in anticipating employment as welders. Fifty-six, or 90.3 per cent of the firms, indicated that a knowledge of basic metallurgy, strength and stress of materials, and shop and industrial safety were also extremely important for prospective welders. Six, or 9 per cent of the firms, indicated that basic mathematics, trigonometry, plane geometry, and solid geometry were very important as related information applicable to the field of welding.

Table V presents data that indicate use of welding equipment and machinery in the sixty-two firms by 1,975 welders. Each firm indicated that prospective welder employees are required to have a knowledge of the operation of the equipment and machinery utilized by the individual firms. The data show that forty-two, or 67.7 per cent of the firms, used A.C. arc welding units. The D.C. welding units were used by twenty, or 32.2 per cent of the firms, while thirty, or 48.3 per cent of the firms, used oxyacetylene welding units. The M.I.G. and T.I.G. (metal-inert gas and tungsten-inert gas) welding units were reported to be used by forty-eight, or 77.4 per cent of the firms. Resistance welding units were reported to be used by fifty-one, or 82.2 per cent of the firms. Submerged welding was reported as being done by five, or 8 per cent of the firms. The various pieces of metal cutting equipment were reported as being used by fifty-seven, or 91.9 per cent of the firms. Thirty-one, or 50 per cent of the firms, reported
the use of preheating and postheating furnaces. Ten, or 16.1 per cent, of the smaller firms reported using forges. Sandblasting equipment was reported as being used by seventeen, or

TABLE V
EQUIPMENT AND MACHINERY USED BY WELDERS AS INDICATED BY THE PARTICIPATING FIRMS

<table>
<thead>
<tr>
<th>Types of Welding Equipment and Machinery Used:</th>
<th>Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>A. A.C. arc welding unit</td>
<td>42</td>
</tr>
<tr>
<td>B. D.C. arc welding unit</td>
<td>20</td>
</tr>
<tr>
<td>C. Oxyacetylene welding unit</td>
<td>30</td>
</tr>
<tr>
<td>D. M.I.G. welding unit</td>
<td>48</td>
</tr>
<tr>
<td>E. T.I.G. welding unit</td>
<td>4</td>
</tr>
<tr>
<td>F. Resistance welding unit</td>
<td>51</td>
</tr>
<tr>
<td>G. Submersive welding units</td>
<td>5</td>
</tr>
<tr>
<td>H. Metal cutting equipment</td>
<td>57</td>
</tr>
<tr>
<td>I. Preheating and postheating furnaces</td>
<td>31</td>
</tr>
<tr>
<td>J. Forges</td>
<td>10</td>
</tr>
<tr>
<td>K. Sandblasting equipment</td>
<td>17</td>
</tr>
<tr>
<td>L. Overhead crane and/or heavy duty hoists</td>
<td>0</td>
</tr>
<tr>
<td>M. Jigs and fixtures</td>
<td>62</td>
</tr>
<tr>
<td>N. Heavy duty power tools</td>
<td>0</td>
</tr>
<tr>
<td>O. Weld inspecting and testing equipment</td>
<td>22</td>
</tr>
</tbody>
</table>

27.4 per cent of the firms. None of the firms required a knowledge in the use of overhead and heavy duty power tools. All sixty-two firms reported welders used jigs and fixtures. Test equipment was reported as being used by twenty-two, or 33.7 per cent of the firms.
Table VI presents data regarding general shop practices required in the sixty-two firms by 1,975 welders. The shop practice required most was the use of basic hand tools, being required by 100 per cent of the firms. Blueprint reading was reported as being required by twenty-six, or 41.9 per cent of the firms. Eighteen, or 29 per cent of the firms, required welders to do basic sheet metal work. Drill press operation was reported as being required of welders by twelve, or 19.3 per cent of the firms, and none of the firms indicated requiring a knowledge of the techniques of precision measurement.

### TABLE VI

**GENERAL SHOP PRACTICES REQUIRED OF WELDERS IN THE DALLAS-FORT WORTH METROPOLITAN AREA AS INDICATED BY THE PARTICIPATING FIRMS**

<table>
<thead>
<tr>
<th>General Shop Practices Required</th>
<th>Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>Use of basic hand tools</td>
<td>62</td>
</tr>
<tr>
<td>Blueprint reading</td>
<td>26</td>
</tr>
<tr>
<td>Drill press operation</td>
<td>12</td>
</tr>
<tr>
<td>Techniques of precision</td>
<td>-</td>
</tr>
<tr>
<td>measurement</td>
<td></td>
</tr>
<tr>
<td>Basic sheet metal work</td>
<td>18</td>
</tr>
</tbody>
</table>
Table VII presents data pertaining to the various types of welding processes used by welders in the sixty-two participating firms and the percentage of work done in the various welding positions while using those processes. Twenty-eight firms employing oxyacetylene welders indicated that 85 per cent of the work was done in the flat position, 10 per cent in the vertical position, 7 per cent in the horizontal position and 3 per cent in the overhead position. The metal and carbon-arc welding process was reported as being used by sixty, or 96.7 per cent of the firms. The data show the flat position was used 80 per cent of the time, the vertical

<table>
<thead>
<tr>
<th>Welding Processes</th>
<th>Number of Firms</th>
<th>Positions and Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxyacetylene welding</td>
<td>28</td>
<td>85.0 10.0 7.0 3.0</td>
</tr>
<tr>
<td>Metal-arc welding</td>
<td>60</td>
<td>80.0 8.0 10.0 2.0</td>
</tr>
<tr>
<td>Gas tungsten-arc welding (T.I.G.)</td>
<td>43</td>
<td>80.0 5.0 10.0 5.0</td>
</tr>
<tr>
<td>Gas metal-arc welding (M.I.G.)</td>
<td>43</td>
<td>80.0 5.0 10.0 5.0</td>
</tr>
<tr>
<td>Carbon-arc welding</td>
<td>60</td>
<td>80.0 8.0 10.0 2.0</td>
</tr>
<tr>
<td>Resistance spot welding</td>
<td>62</td>
<td>99.0 - 1.0 -</td>
</tr>
<tr>
<td>Atomic hydrogen welding</td>
<td>8</td>
<td>93.0 2.0 5.0 -</td>
</tr>
<tr>
<td>Plasma-arc welding</td>
<td>3</td>
<td>91.3 4.1 8.2 3.8 -</td>
</tr>
<tr>
<td>Submerged-arc welding</td>
<td>5</td>
<td>91.3 4.1 8.2 3.8 5.4</td>
</tr>
</tbody>
</table>
position 8 per cent of the time, and the horizontal position 10 per cent of the time, while the overhead welding was done only 2 per cent of the time. The M.I.G. and T.I.G. welding processes were reported as being used by forty-three, or 69.3 per cent of the firms. The position most often used was the flat position which was reported as being used 80 per cent of the time. All sixty-two firms reported using the resistance weld process. This process was used 90 per cent of the time in the flat position and 1 per cent in the horizontal position. The atomic hydrogen welding process was used by eight, or 9.3 per cent of the firms. This welding process was used 93 per cent of the time in the flat position, 2 per cent in the vertical and overhead positions respectively, and 5 per cent in the horizontal position. Five, or 8 per cent of the firms, reported using the submersive welding process in the flat position 4.1 per cent of the time, the horizontal position 82.3 per cent, the vertical position 8.2 per cent, and the overhead position 5.4 per cent of the time. Three, or 4.9 per cent of the firms, indicated using the plasma-arc welding process 91.3 per cent of the time in the flat position, and 3.8 per cent in the horizontal position.
CHAPTER III

JOB OPPORTUNITIES FOR MEN SEEKING EMPLOYMENT
IN THE FIELD OF WELDING

Due to the rapid growth in the metal manufacturing and fabrication industries, numerous employment opportunities have been made available in the Dallas-Fort Worth, Texas Metropolitan Areas. In 1963, two billion dollars worth of metal fabrication and manufactured products were produced in the Dallas-Fort Worth Areas. Since 1963 the various metal products firms, both large and small, have continued to prosper in growth and sales.

If the present growth trends continue, 25 per cent of the state’s metal manufacturing and fabrication output will be provided by the Dallas-Fort Worth Metropolitan Area firms by 1975. At this rate of growth the approximate twenty-five thousand employees will enlarge to over fifty thousand people. With regard to the figures, and considering the economic and social changes, this study attempts to obtain answers to some questions in regard to persons being employed as welders in the metals industry (1).

Current Employment

This study concentrated on four specific job classifications of welders who work in the metal industries. The
sixty-two firms contacted were utilized for this study according to number of employees. The larger firms offered more large types of occupational areas, whereas the smaller firms were concerned in the main in repairing products, rather than the actual manufacture or fabrication of specific products.

Table VIII indicates the number of welders employed in four specific job classifications. Also shown in this table

<table>
<thead>
<tr>
<th>Job Title</th>
<th>Present Employees</th>
<th>5-year Projection</th>
<th>Total 1974</th>
<th>Per Cent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc welders</td>
<td>1,323</td>
<td>4,125</td>
<td>5,448</td>
<td>411.9</td>
</tr>
<tr>
<td>Gas welders</td>
<td>290</td>
<td>1,210</td>
<td>1,500</td>
<td>517.2</td>
</tr>
<tr>
<td>Combination arc and gas welders</td>
<td>141</td>
<td>516</td>
<td>627</td>
<td>444.6</td>
</tr>
<tr>
<td>Flame cutters and arc cutters</td>
<td>221</td>
<td>715</td>
<td>936</td>
<td>423.5</td>
</tr>
</tbody>
</table>

is the projected growth pattern to 1974. The number of men employed by the participating firms was 1,323 arc welders, 290 gas welders, 141 combination arc and gas welders, and 221 flame and arc cutters. All the firms anticipated future expansion and planned to add 4,125 arc welders, 1,210 gas welders, 516 combination arc and gas welders, and 715 flame and arc cutters.
The metals firms employing fifty welders or less were the most numerous. According to estimates made by the Dallas Chamber of Commerce and Texas Employment Commission, there were over 225 firms engaged in the business of manufacturing and fabrication of metal products in the Dallas Metropolitan Area in May 1967 (2). More recently, they estimated there were 328 firms in the metals industry as of September, 1968.

The small firms, as well as the larger firms, anticipated a growth pattern which would double their facilities within the next five years. Much of the growth in the larger firms was related to expansion in the firms. The smaller firms in many instances were subcontractors to the larger firms. Technological breakthroughs and new innovations in the metals field are more reasons for a portion of the rapid growth in this field of work.

Types of Admission Tests

As reported by the participating firms some type of admission test is given to the majority of the welders working in the field of welding. Table IX presents the percentage of firms administering the various types of tests used.

The tests most often used were the practical, skill, and physical examination. A physical examination was required by all of the firms. Seventy-five per cent of the firms used skills tests for all four job classifications. A practical
test was preferred by 50 per cent of the firms, which they administered at their plants. Two employers indicated on the checklist that prospective code welder employees for pressure-vessel type work were sent to a sixty-hour training school with a reduction in starting wages, and upon successful completion of the training they were offered a position. The standardized tests used differed with each firm due to the nature of work in which each firm was engaged. The standardized tests used were developed by the following welding associations and societies: The American Society of Mechanical Engineers---Boiler and Pressure Vessel Code, The American Welding Society---Code for Arc and Gas Welding in Building Construction, and The American Petroleum Institute---Standard for Field Welding of Pipe Lines.

**TABLE IX**

THE PERCENTAGE OF EMPLOYERS ADMINISTERING THE VARIOUS TYPES OF ADMISSION TESTS

<table>
<thead>
<tr>
<th>Types of Admission Tests</th>
<th>Firms</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per Cent</td>
</tr>
<tr>
<td>Practical Test</td>
<td>31</td>
<td>50.0</td>
</tr>
<tr>
<td>Standardized Test</td>
<td>3</td>
<td>4.8</td>
</tr>
<tr>
<td>Skills Test</td>
<td>47</td>
<td>75.8</td>
</tr>
<tr>
<td>Oral Test</td>
<td>5</td>
<td>8.0</td>
</tr>
<tr>
<td>Physical Examination</td>
<td>62</td>
<td>100.0</td>
</tr>
</tbody>
</table>
CHAPTER BIBLIOGRAPHY


CHAPTER IV

COMPARISON OF INDUSTRIAL ARTS WELDING CURRICULUM
TO REQUIREMENTS OF METALS INDUSTRY

This chapter presents a comparison of the courses offered in the public schools with the employment requirements of prospective welders by the metals industry.

Curriculum Offerings in High School
Welding Courses

In general, the sequence in industrial arts is primarily designed to provide the average citizen with knowledge and skills necessary for safe, pleasant, and effective living in the age of new metals innovation. The overall objective is important to all persons regardless of their ultimate goals in education. The courses are important, however, for general education as well as providing exploratory experience for an individual who is in the process of making an occupational choice.

The basic welding courses offered in the public high schools present a general knowledge of welding and metal fundamentals with applications of theories by performing productive work of projects. Courses in basic welding involving the study of oxyacetylene and electric welding equipment, in some instances are offered separately in relation to degree
of difficulty of course content and with local conditions as a determinant in presentation of the material.

Course offerings in welding vary throughout the state of Texas, in regard to the number of courses offered or the number of units offered. The Texas Education Agency provides schools throughout the state with an option or an opportunity to offer the following number of units in welding: one-half unit, one unit, one and one-half units, or two units.

Welding courses in the public schools of Texas are usually presented in somewhat the following manner: (a) orientation and safety instructions regarding proper use of oxyacetylene and electric welding equipment; (b) presentation of subject matter covering the operation and safe handling of welding equipment; (c) instructional presentation covering welding materials and weldable metals; (d) laboratory practice and welding techniques employing the use of exercises involving welding in the flat, vertical, horizontal, and overhead positions with specific application to the various weld joints (butt, tee, lap, and corner); (e) instructional presentation covering the principles involved in welding and soldering of non-ferrous materials, and (f) instructional presentation involving the application of the techniques and processes in industry.

The Texas Education Agency gives the following course descriptions of the basic instructional levels of the welding courses offered in the public schools.
Oxy-acetylene Welding--This course begins with orientation and safety instruction followed by practice in the laboratory. When test welds meet acceptable standards, productive work on projects begins. Oxy-acetylene welding and cutting is simple in principle but has numerous special applications and variations in technique (1, p. 123).

The grade level of the course should be grades 10 through 12, although local conditions may suggest a different grade placement.

The course in oxyacetylene welding should include topics such as production, safety in the handling and use of oxygen and acetylene, regulators and generators, chemistry of oxy-acetylene flame, care of welding and cutting blow pipes, and welding materials and weldable metals. Also included are welding exercises permitting the student to learn the different welding techniques and positions of welding.

Electric welding is presented by much the same procedure as oxyacetylene welding. The subject matter and skills content include: direct and alternating current generators, their operation and adjustment; electrodes; metallic arc welding techniques; applications of electric welding in industry; testing welded joints; safety precautions and devices. The course provides the student an opportunity to study, to some degree, the fundamentals of electric welding and the application of theories by performing varied welding exercises and constructing, or assembling, individual or group projects (1).
The course in electric welding involves a study of welding principles and their concepts in depth. Certain learning experiences should be incorporated in this course such as occupational information, metal identification, design of simple projects, as well as materials and procedures applied in fabrication.

The courses offered in the public schools are generally called basic welding and are to be offered between grades 10 and 12. The courses are not designed to be vocational in nature and should not be confused with the vocational course offerings because they contribute to the general education of the student. It does provide the student with an opportunity to find out if he is suited for work in the field of welding and to determine the level at which he should prepare himself as a specialist, engineer, or maintenance employee. Regardless of the student's aspirations, the one course, or possibly four courses, in basic oxyacetylene welding and electric welding offer excellent preparation.

Course Offerings Compared to Requirements of Metals Industry

In analyzing the basic welding curriculum in the public schools and studying the knowledge and skills requirements for the four job classifications surveyed in this study, it would seem that the welding curriculum established in the public schools of Texas surpasses the basic requirements of industry.
The welders in each classification were required to possess a broad knowledge of the welding field. The welders in most cases were required to be proficient in the use of oxyacetylene and electric welding equipment (arc and gas), metal cutting equipment, jigs and fixtures, and power tools. Necessary also was a basic knowledge of inert gas welding equipment (metal-inert gas and tungsten-inert gas) and an intelligent understanding of the operation of resistance welding equipment and test and inspection equipment.

Additional knowledge requirements of arc welders, gas welders, combination arc and gas welders, and flame and arc cutters consist of being able to read simple blueprints, being able to weld in the various positions, and being familiar with the various welding processes. Welders were also required in many instances to possess a general knowledge of certain welding shop practices such as: use of basic hand tools, drill press operation, techniques of precision measurements, and a knowledge of basic sheet metal work.

Industrial arts courses, like courses in many other areas of general education, cannot meet in every detail the exact requirements set by the various areas of the industrial market. It would appear as though the existing welding curriculum offered in the public schools of Texas is meeting and surpassing in respect to the basic requirements set forth by the metals industry in the Dallas-Fort Worth area.
CHAPTER BIBLIOGRAPHY

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The primary purpose of this study was to collect data concerning knowledge and skills required of welders entering the field of welding in four job classifications in the Dallas-Fort Worth Metropolitan Area. These classifications were arc welders, gas welders, combination arc and gas welders, and flame and arc cutters. The data were also to be used as a basis for developing and possibly revising the basic welding curriculum in the public schools.

A questionnaire was utilized in obtaining the data for this study. Personnel directors of sixty-two firms in the Dallas-Fort Worth Metropolitan Area completed the questionnaires by expressing their opinions concerning the requirements and opportunities for employment in welding.

Data and information needed for the study were secured and the study was organized as follows: Chapter I includes an introduction, statement of the problem, purpose of the study, method of procedure, sources of data, limitations of the study, organization of the study, definition of terms and a review of three related studies; Chapter II presents
data concerning the general qualifications and duties required of welders as indicated by the participating firms; Chapter III presents data concerning the job opportunities for men seeking employment in the area of welding; and in Chapter IV an analysis of the questionnaire was made and compared to the welding curriculum approved by the Texas Education Agency.

Findings

The findings represent a broad area of data which were collected through a questionnaire, interviews, and telephone conversations.

1. There were 1,323 arc welders, 290 gas welders, 141 combination arc and gas welders, and 221 flame and arc cutters employed by sixty-two metals firms in the Dallas-Fort Worth Metropolitan Area.

2. The anticipated five-year needs for the establishments were 4,125 arc welders, 1,210 gas welders, 516 combination arc and gas welders, and 221 flame and arc cutters.

3. The personnel department of each firm was responsible for employment of welders.

4. Admission tests were administered by all the firms. Practical test, skills test, and physical examination were considered the most important tests.

5. Twenty-eight, or 45.1 per cent of the firms, preferred the prospective welder have previous work experience.

6. Thirty-three firms did not require prospective
employees to be certified as a prerequisite for employment as a welder. Two firms specified the employee must attend a sixty-hour in-plant certification training program.

7. The age requirements for welders entering the welding field ranged from a minimum age of sixteen to a maximum age of sixty-five specified by three firms, while other firms did not specify a maximum age.

8. Twenty-seven firms indicated no preference to the educational attainments of their prospective welders, while nineteen firms preferred high school graduates, and sixteen firms indicated a preference for welders with at least some high school training.

9. The high school curriculum offers a wide variety of experiences in the area of welding.

10. The following courses or subject matter were found to be of extreme importance as basic knowledge for prospective welders: blueprint reading involving structural, pipe, and machine drafting; strength and stress of materials and weldments; and shop and industrial safety.

11. The equipment and machinery used by welders in the establishments participating in this study were alternating and direct current arc welding units, oxyacetylene, metal and tungsten, resistance, and submersive welding units. Metal cutting equipment, preheating and postheating furnaces, sandblasting equipment, jigs and fixtures, and test and inspection equipment were used to a great extent.
12. The general shop practices most often required were the use of basic hand tools, blueprint reading, and basic sheet metal work.

13. Both the large and small diversified metals firms in the Dallas-Fort Worth Metropolitan Area are in great need of welders in each of the job classifications surveyed in this study.

Conclusions

The following conclusions are derived from a study of the findings.

1. Employment opportunities do exist for a wide range of age groups for welders.

2. Young men who take welding courses in high school have a better understanding of industry and should be better satisfied with the job.

3. The basic welding curriculum offered in the public schools can be of benefit to many young men in an introduction to a possible vocation upon graduation from high school.

4. The more welding training an individual can receive increases his chances in obtaining a better position in the metals and welding industries.

5. An employee who has taken welding courses will probably spend less time in in-service training and will qualify for a job requiring more skill.
Recommendations

Based upon the findings and conclusions of the study, the following recommendations are presented:

1. Data presented in this study should be used for revising course content in basic welding courses offered in the public schools in the Dallas-Fort Worth Area.

2. Young men should be encouraged to take welding courses in high school.

3. In programs designed to explore welding, emphasis should be placed upon an understanding of skills involved in the various position welds.

4. In programs designed to explore welding, emphasis should be placed upon the use of alternating and direct current welding units, metal cutting equipment, resistance welding equipment, inert-gas welding equipment, gas welding equipment, and techniques of identifying and testing metals and welds.

5. In programs designed to explore welding, some degree of emphasis be placed upon working from blueprints.

6. Students in welding acquire an understanding of the various welding processes and their applications in industry.

7. Students in welding acquire an understanding of basic sheet metal work, and use of basic metalworking hand tools.

8. The high schools foster an awareness of the opportunities in the metal and welding industry for young men.

9. Similar studies in other occupational fields for men be investigated.
10. Future studies in welding with specific regards to the Dallas-Fort Worth Metropolitan Area be conducted periodically in order to maintain current and up-to-date information for use in reviewing and revising programs designed to explore the field of welding.
APPENDIX A

June 27, 1969

Attention: Director of Personnel

Dear Sir:

At present I am engaged in a Master's degree program in the area of Industrial Arts at North Texas State University. For my research problem, I plan to conduct a study to identify the skills and characteristics that employers in the Dallas-Fort Worth area require of their welders. The main purpose of this study is to obtain concrete data upon which criteria for developing up-to-date and effective welding programs in our educational institutions may be built.

Enclosed is a stamped, self-addressed card inquiring whether your company employs welders and, if so, whether you would participate in this study by completing and returning a questionnaire that would be mailed to you on a future date.

If you do not employ welders, please indicate this and return the card to me, so I may remove your name from the mailing list of selected firms to be included in this study. If you do employ welders, please return the card so I will know whether you will participate in the study.

Your cooperation will be greatly appreciated.

Sincerely,

Franklin D. Slaughter
Graduate Student
APPENDIX B

Company Name ________________________________
Company Address ____________________________
            City ___________ Zip Code ______

This company employs welders ...yes ( )
no ( )

If your company does employ welders:

We would be willing to participate in
this study by completing and return-
ing a questionnaire. ( )

We would not be willing to participate. ( )

Signature:____________________________________
APPENDIX C

July 11, 1969

Attention: Director of Personnel

Dear Sir:

On June 27, I mailed to you a letter inquiring if your firm employed welders and, if so, whether or not you would participate in a study designed to determine the knowledge and skills you consider important for your welders to possess. Thank you for returning the card indicating that you do employ welders and that you would participate in the study by completing and returning a questionnaire.

Enclosed you will find a questionnaire and a return envelope. Please complete the questionnaire and return it as soon as possible.

Thank you for your willingness to cooperate.

Sincerely,

Franklin D. Slaughter
Graduate Student

Enclosure
APPENDIX D

A STUDY OF THE KNOWLEDGE AND SKILLS REQUIRED
OF WELDERS IN THE DALLAS-FORT WORTH AREA

Directions: Please supply the information requested by checking (✓) the appropriate response or by writing the information in the blanks. Please answer all questions.

Name of firm:__________________________________________

Principal product(s) or type of product(s) of your firm:

1. How many people do you employ at this location? ______

2. Of the job classifications listed below, which ones are represented in your firm?

( ) Arc welders
( ) Gas welders
( ) Flame cutters
( ) Combination arc welders and flame cutters

3. Of the job classifications represented in your firm, how many are employed in each classification?

a. ______ Arc welders
b. ______ Gas welders
c. ______ Flame cutters
d. ______ Combination arc welders and flame cutters

4. Do you anticipate an increase in the number of welders that you will employ in the next five years? Yes ( ) No ( )

If the answer is yes, how many?

a. ______ Arc welders
b. ______ Gas welders
c. ______ Flame cutters
d. ______ Combination arc welders and flame cutters
5. What are the age requirements for a person entering the field of welding? Minimum age ___ Maximum age ___ Preferred age ___

6. Is certification required of a person entering the field of welding in your firm? Yes ( ) No ( )

7. What types of admission tests are administered to a prospective employee entering the field of welding?
   a. ( ) Skills test
   b. ( ) Practical test
   c. ( ) Standardized test
   d. ( ) Oral test
   e. ( ) Physical examination
   f. ( ) Other (please specify) ______________________

8. If you do not administer some form of test, how do you determine whether or not the prospective welder is qualified?

9. Are in-service training programs conducted in your firm for a person entering the field of welding? Yes ( ) No ( )
   a. ( ) On-the-job training program
   b. ( ) Apprenticeship program
   c. ( ) Classroom instruction
   d. ( ) Tuition assisted evening classes
   e. ( ) Other (please specify) ______________________

10. Is previous on-the-job experience as a welder a requirement for employment as a welder with your firm? Yes ( ) No ( )
    If the answer is no, is previous experience
    a. ( ) Desired
    b. ( ) Preferred
    c. ( ) Does not matter
11. Which one of the following general educational attainments does your firm require of a person entering the field of welding?

a. ( ) Elementary  
b. ( ) Junior high school  
c. ( ) Some high school  
d. ( ) High school graduate  
e. ( ) Vocational school  
f. ( ) Technical school  
g. ( ) Some college  
h. ( ) Other (please specify) ____________________________

12. Please check (✓) the appropriate box to show the importance of the subject to the welders you employ.

<table>
<thead>
<tr>
<th>Area of Study</th>
<th>Extremely important</th>
<th>Very important</th>
<th>Unimportant</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Pipe drafting and blueprint reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Structural drafting and blueprint reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Machine drafting and blueprint reading</td>
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<tr>
<td>D. Addition and subtraction of whole numbers</td>
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<td>E. Multiplication and division of whole numbers</td>
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<td>F. Addition and subtraction of fractions</td>
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<td>I. Solid geometry</td>
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<td>K. Strength and stress of materials and weldments</td>
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<td>L. Shop and industrial safety</td>
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</tr>
<tr>
<td>M. Others:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
13. Do you consider one specific area of education (other than welding), such as mathematics or physics, to be important as part of the welder's background? Yes ( ) No ( )
If so, what specific area? ____________________________

14. A knowledge of what type welding equipment and machinery is required by your firm of a person entering the field of welding?

a. ( ) A.C. arc welding unit
b. ( ) D.C. arc welding unit
c. ( ) Oxyacetylene welding unit
d. ( ) MIG welding unit
e. ( ) TIG welding unit
f. ( ) Resistance welding unit
g. ( ) Submersive welding unit
h. ( ) Metal cutting equipment
i. ( ) Preheating and postheating furnaces
j. ( ) Forges
k. ( ) Sandblasting equipment
l. ( ) Overhead crane and/or heavy duty hoists
m. ( ) Jigs and fixtures
n. ( ) Heavy duty power tools
o. ( ) Weld inspecting and testing equipment

15. A knowledge of what type general shop practices is required by your firms of a person entering the welding field?

a. ( ) Use of basic hand tools
b. ( ) Blueprint reading
c. ( ) Drill press operation
d. ( ) Techniques of precision measurement
e. ( ) Basic sheet metal work
f. ( ) Other (please specify) ____________________________
16. Please show the percentage of welding done in each position.

<table>
<thead>
<tr>
<th>Flat</th>
<th>Vertical</th>
<th>Horizontal</th>
<th>Overhead</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Oxyacetylene welding</td>
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<td>B. Metal-arc welding</td>
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<td>C. Gas metal-arc welding (MIG)</td>
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<td>D. Gas tungsten-arc welding (TIG)</td>
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<td>E. Carbon-arc welding</td>
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<td>F. Resistance spot welding</td>
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<td>G. Atomic hydrogen welding</td>
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<td>H. Plasma arc welding</td>
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<td>I. Thermit welding</td>
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<tr>
<td>J. Submerged arc welding</td>
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</table>

17. In your opinion how can the high school welding courses aid prospective welding employees in the various job classifications?

a. Reduces time spent in in-service training program.
   ( ) Yes
   ( ) Sometimes
   ( ) No

b. Familiarizes with general aspects of welding.
   ( ) Yes
   ( ) Sometimes
   ( ) No

c. Reduces early termination with job.
   ( ) Yes
   ( ) Sometimes
   ( ) No

18. Additional comments:
APPENDIX E

July 18, 1969

(Director of Personnel)
(Company)

Dear Sir:

On July 11, I mailed to you a questionnaire regarding welders employed by your company which you agreed to complete and return. As of this date, I have not received your copy.

Would you please fill out and return the questionnaire to me as soon as possible. If you find that you cannot locate it or that it has been misplaced, please advise and I will be glad to forward another copy to you. If you have returned the questionnaire and I have not yet received it, thank you for your promptness.

Your cooperation in this study is very much appreciated.

Very sincerely,

Franklin D. Slaughter
Graduate Student
BIBLIOGRAPHY
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Books


Reports


Dallas Chamber of Commerce, "Non-Manufacturing Firms in Dallas County with Over 100 Employees," portion of unpublished series, Dallas, Dallas Chamber of Commerce, 1968.


Public Documents


Unpublished Materials
