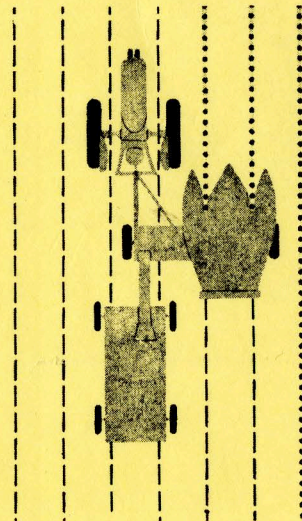
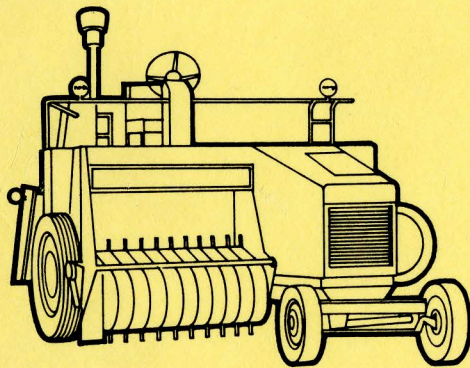
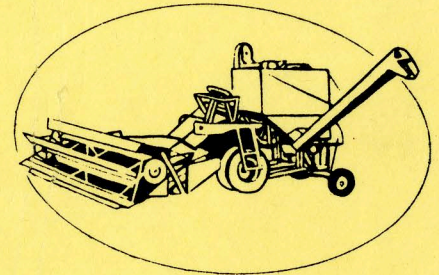


Occupational
Component Analysis
in
Agricultural Mechanization



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OCCUPATIONAL COMPONENT ANALYSIS
IN
AGRICULTURAL MECHANIZATION

A Research Project
of the
Department of Agricultural Education

by

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FOREWORD

This is the second in a series of component analyses designed to provide data on competencies required for beginning employees within each instructional component of the agricultural business and natural resources cluster utilized in Arizona. The first report, Research Report 273, dealing with competencies in ornamental horticulture was completed in 1974. Plans for future analysis include the renewable natural resources and agricultural business components.

The procedure employed in completing this study relies on a small random sample of businesses known to employ people in the job titles studies. The data were collected via personal interview conducted in each business. Special thanks and recognition is due Mr. James Armbruster and Mr. Teddy Goodluck who conducted the personal interviews throughout the state of Arizona.

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INTRODUCTION

Vocational education in agriculture has traditionally emphasized instruction in agricultural mechanics. During the early history of vocational agriculture, instruction in agricultural mechanics was centered around the skills necessary for boys to enter farming. The instructional programs broadened over time because the instructional base as well as the clientele of vocational agriculture changed. Vocational agriculture accepted the charge to prepare students for entry into agriculture, rather than just preparing boys for establishment in farming.

Agriculture, which was one of the earliest recognized occupations for which vocational training was provided, has been broadened to encompass a wider spectrum of occupations. An indication of this broadened scope is implied in the current designation by the United States Office of Education relating to Agriculture/Agribusiness/ and National Resources Education. Included in this employment cluster are seven instructional program areas or components. These components include: (1) Production; (2) Supplies/Service; (3) Mechanics; (4) Products; (5) Ornamental Horticulture; (6) Resources; and (7) Forestry. Each of these components encompasses a large number of individual job titles.

Each component may also include some overlap of competencies. For example, it could safely be assumed that certain competencies related to agricultural mechanics are necessary for both the production and the mechanics components. In designing instructional programs to prepare employees for these areas, educational planners and practitioners must identify the competencies (knowledge, skills, and attitudes) required for entry and advancement within the components. Studies identifying competencies associated with specific job titles within each component have been reported. A notable study of this nature was reported by McClay (1978).

The technique of job analysis has been used for many years to develop a detailed list of duties, operations, and skills necessary to perform a clearly defined, specific job. The results of job analyses are commonly organized into a logical sequence which may be used for teaching, employment, or classification purposes. While this is an accepted practice, it is not well suited for analysis of an instructional component which encompasses many job titles and infinite competencies. The costs in conducting a job analysis is also prohibitive when many job titles are involved. Further, it has never been nor will it likely ever become educationally sound or economically feasible to prepare people for a specific job in vocational education in agriculture. Thus, a modified job analysis technique described as a "component analysis" has been used in agriculture which can encompass many job titles and still be specific enough to provide the necessary competencies required for employment entry in the desired area of endeavor.

The "Ornamental Horticulture" component in Arizona was analyzed and reported by Zurbrick (1974) using the component analysis technique. He reported that employers identified 63 competencies which should be taught in an instructional program for entry into major ornamental horticulture occupations. Another study by Zurbrick (1979) estimated that 2,745 persons needing knowledge and skill in agriculture in Arizona are employed in job titles clustered in the area of agricultural mechanization. This represents approximately eight percent of the total number of persons employed in agriculture in Arizona. The leading job titles, in terms of the number of persons employed, in the instructional program area of agricultural mechanics in Arizona include: farm equipment mechanics, tractor operators, farm equipment welders, and farm equipment partsclerk.

Certain competencies related to agricultural mechanics are also important for selected job titles in agricultural production. The United States Office of Education includes mechanics as part of both the Production component and the Mechanics component. Job titles such as mid-managers and managers in the Production component require selected competencies which would be identical to certain competencies required in job titles in the Mechanics component. This overlapping phenomenon expands the employment opportunities for completers of such instructional programs. Consequently, to design and deliver instructional programs based upon competencies, those competencies in the Agricultural Mechanics component should be identified.

Studies have been completed in various states which identify competencies in agricultural mechanics needed by select groups. For example, a series of studies completed in Iowa by Maxwell (1964), Kahler (1964), Robinson (1964), Hoerner (1966), and Kordick (1967) identified competencies needed in specific job titles. Bishop, et. al. (1973) interviewed employers of 12 mechanic-related job titles in Montana and identified competencies for each.

In appraising competencies needed by teachers of agricultural mechanization, Jacobs (1972), using a national jury of teachers of vocational agriculture, identified 117 competencies as being of "considerable importance" or "absolutely essential". It should be noted that these competencies were so judged by teachers for the preparation of new teachers. Jacobs recommended that the competencies be evaluated by employers actually involved in the agricultural mechanics industry. The competencies thus became the basis for those used in this component analysis.

Geographic differences as well as management practices cause diversity within the industry of agriculture. Those differences, along with variations in curriculum among states, point out the need for each separate state to identify their own basis of curriculum content. Although this replication may, on the surface, appear unnecessary, it does allow for variations in curriculum, curriculum materials, instructional methods, and instructional program design across the states.

The results of a component analysis must identify those competencies which are commonly considered essential by employers who hire persons in job titles in agricultural mechanization. Instructional programs and curriculum materials can then be designed to provide a vehicle for the teaching of these competencies to students. Educational planners and practitioners can use the results of this study to aid students by designing and delivering instructional programs based upon the identified agricultural mechanization competencies. The competencies identified herein could become the performance objectives of an instructional program and could form the base for entry level employment in occupations in agricultural mechanics.

PURPOSE OF STUDY

The purpose of this study was to identify the areas of instruction and competencies required of beginning employees for entry into major mechanics job titles found in the agricultural industry in Arizona. Competencies, encompassing skills, knowledge and attitudes were categorized as "general" or "specific" within the various instruction areas recognized by the American Society of Agricultural Engineers. The job titles in agricultural mechanics used in this study were restricted to those in which the largest number of persons were estimated to have been employed in the state of Arizona in 1977.

The following questions were utilized as a means of guiding the study and assuring the accomplishment of the stated purpose:

1. Which instructional areas, recognized by the American Society of Agricultural Engineers (A.S.A.E.) encompass the greatest number of general competencies expected of beginning employees in major agricultural mechanics job titles in Arizona?
2. Which general competencies are expected of beginning employees in major agricultural mechanics job titles in Arizona?
3. What specific competencies do employers in Arizona expect beginning employees in major agricultural mechanics job titles to be able to perform?
4. Which instructional areas and competencies, both general and specific, are expected of employees in more than one major agricultural mechanics job title in Arizona?

LIMITATIONS

The following factors were considered as limitations of this study. They should be considered when reviewing and generalizing the findings of this study:

1. The evaluation of competencies was limited to randomly selected industry representatives located in the state of Arizona during the Summer of 1979.
2. Results of the study were limited to the job titles of: Mechanic, Service Attendant, Parts Clerk, Welder, and Tractor Operator.

3. Only industry representatives who employed persons in the above job titles were included in the study. Further, each employer evaluated the competencies for only those job titles in which their firm actually employed people.
4. A closed-form survey instrument was used limiting the respondents to the competencies listed on the instrument.
5. The industry representatives were interviewed, thus the reactive effects of the interview may be a limiting factor to this study.
6. The data collection instrument utilized in this study was based upon the instructional areas recognized by the American Society of Agricultural Engineers. One area, namely Food Processing, was deleted from this study.
7. This study was limited to selected specific competencies associated with general competencies in agricultural mechanics. The study did not include human relations competencies.
8. The specific competencies listed on the data collection instrument were not inclusive of all tasks or skills required to accomplish each general competency. Those listed were selected to provide an indication of the type of competence expected by employers.

DEFINITIONS

The following terms, as defined below, were used in conducting and reporting this study:

Closed-form survey instrument: A device for measuring the value of competencies in which respondents were limited to both the number of alternatives and the number of competencies included in the instrument.

Competencies: Includes knowledge, skills and attitudes considered by industry representatives to be prerequisite for beginning employees within specific job titles. In this study, attitudinal competencies were not included.

Component Analysis: A process designed to identify the competencies judged by employers to be necessary for beginning employees in each of several job titles within an occupational component of a particular occupational cluster.

Industry representatives: Includes both employers (businesses) employing persons in major job titles and persons presently employed in such job titles. In this study, only employers were used.

Occupational cluster: A group of recognized occupations having many similarities in basic aptitudes, knowledge and training. The "Agriculture/Agribusiness/Natural Resources" group represents one such cluster.

Occupational component: A sub-category of an occupational cluster encompassing a smaller number of occupations more closely related in basic aptitude, knowledge and training.

Agricultural Mechanics is one of five such components in the "Agriculture/Agribusiness/Natural Resources" cluster recognized in vocational agriculture in Arizona.

General Competency: A descriptive statement of general behaviors that may be required by beginning employees in agricultural mechanics which is associated with an instructional area. For example, the general competency, "to start and safely operate tractors, power units, or small gasoline engines," is associated with the instructional area of Power and Machinery as described by the American Society of Agricultural Engineers.

Specific Competency: Tasks involving knowledge or skills associated with general competencies.

Recommended Competencies: Those specific competencies from the survey instrument that received a mean rating of 2.0 or greater from the industry representatives.

PROCEDURE

Procedures employed in designing and conducting this occupational component analysis in agricultural mechanization are described as they relate to: (1) population and sample, (2) data collection and analysis.

Population and Sample

The job titles selected for inclusion in the study were those previously identified in Arizona and served by the instructional program area of Agricultural Mechanics. Those job titles, in which

employees were presumed to need primary knowledge and/or skill in agricultural mechanics in carrying out their daily routine were included. Further, the list of job titles for study was reduced by selecting only those with 100 or more persons reportedly employed in Arizona. Specifically, the job titles of: (1) Farm Equipment Mechanic, (2) Tractor Operator, (3) Farm Equipment Welder, (4) Farm Equipment Parts Clerk, and (5) Farm Equipment Service Attendant were studied.

Appraisal of the competencies needed by beginning employees in each of the job titles was solicited from Arizona employers. The qualified employers were randomly selected from a master directory containing the names and addresses of businesses in Arizona known to employ people in each of the selected job titles. Initially, five employers were randomly selected for each job title. Five employers were considered sufficient sample size based upon the limited variability of evaluations received in previous studies. When contacted, businesses which employed persons in more than one job title were asked to provide an appraisal for each job title in which they had employees. Thus, some job titles received more than five appraisals.

Data Collection and Analysis

The interview instrument containing a list of agricultural mechanic competencies was organized around the classification scheme proposed by the American Society of Agricultural Engineers. The specific competencies were those identified and evaluated in the study conducted by Jacobs (1972).

Personal interviews, arranged and conducted by research assistants from the Department of Agricultural Education, The University of Arizona, were completed with representatives of each selected business on an individual basis. The business representative was asked to indicate if beginning employees in the selected job title(s) in their business would be expected to be able to accomplish the general competency.

If the response was negative, all of the associated specific competencies were considered as "not needed". If the response was affirmative, each of the specific competencies was rated as to its relative importance. The rating was made by employers responding to a four point scale. The scale was used to preclude a neutral response. The scale used included: "essential"; "important"; "useful"; or "not needed". In summarizing and analyzing the responses, "essential" was coded "5"; "important" was given a "3"; "useful" was coded as a "1"; and "not needed" as a "0". This provided an easily perceived ordinal scale for each specific competency.

Mean ratings were calculated for each specific competency where over 50 percent of the employers indicated a beginning employee would be expected to perform the general competency. The mean rating for each specific competency for each job title was used to calculate a mean of means rating for all job titles.

Those specific competencies receiving a mean rating greater than 2.00 were considered to be recommended by the employers and

were so listed for each job title in the text of this report. The recommended competencies received a mean rating greater than the midpoint between "useful" and "important".

FINDINGS

The results of this study are reported in terms of the four specific questions listed under Objectives of the Study. The major job titles in agricultural mechanics included those of: Agricultural Mechanic; Agricultural Service Attendant; Agricultural Welder; Parts Clerk; and Tractor Operator. The job titles of "Maintenance Mechanic" and "Agricultural Engineering Technician" were deleted from this study due to lack of valid, reliable data.

Instructional Areas

The American Society of Agricultural Engineers (1975) listed six instructional areas in agricultural mechanization. The six areas included: Power and Machinery; Structures and Environment; Electric Power and Processing; Soil and Water Management; Agricultural Construction and Maintenance; and Food Processing. In developing the interview schedule for this study after the major job titles had been identified, it was determined that competencies in the instructional area of Food Processing were not germane and were therefore omitted.

Table 1 provides a summary of the recognized instructional areas of agricultural mechanics which employers indicated were necessary for beginning employees in the listed job titles.

TABLE 1 -- Instructional Areas in which Employers Indicated
Beginning Employees in Selected Job Titles Needed
Competencies

Job Titles	Agricultural Mechanics Instructional Areas*				
	Power & Machinery	Structures & Environment	Electric Power & Processing	Soil & Water Management	Agricultural Construction & Maintenance
Agricultural Mechanic - - - - -	X		X		X
Agricultural Service Attendant -	X		X		X
Agricultural Welder - - - - -					X
Agricultural Parts Clerk - - - - -	X				X
Tractor Operator - - - - -	X				

* X indicates more than 50% of employers indicated a need for one or more competencies in the area.

Both agricultural mechanics and agricultural service attendants required competencies in the same instructional areas. The two areas applicable to the greatest number of job titles studied were "Power and Machinery" and "Agricultural Construction and Maintenance". Two of the five instructional areas were not identified by a majority of employers as necessary for beginning employees in any of the job titles studied. These two areas included "Structures and Environment" and "Soil and Water Management".

The answer to question one under specific objectives is that general competencies for beginning employees in agricultural

mechanics job titles were identified in the instructional areas of: "Power and Machinery"; "Electrical Power and Processing"; and "Agricultural Construction and Maintenance".

General Competencies by Job Titles

The second specific question of this study dealt with the identification of general competencies expected of beginning employees in major agricultural mechanics job titles. A total of twenty-four general competencies associated with the instructional areas recognized by the American Society of Agricultural Engineers were included in this study. The number of general competencies included in the study by instructional area is shown in Table 2.

TABLE 2 -- Number of General Competencies by Instructional Areas Included in Study

Instructional Areas	Number of General Competencies
Power and Machinery	6
Structures and Environment	5
Electric Power and Processing	4
Soil and Water Management	3
Agricultural Construction and Maintenance	<u>6</u>
TOTAL	24

Employers were asked if employees beginning with their firm in the respective job titles were expected to carry out the general competencies. The percentage of employers responding positively to each general competency by job titles is shown in Table 3. In addition, Table 3 shows the percentage mean of means for all job titles. Over half of the general competencies showed unanimous agreement by employers as to their need or lack of need for the job titles considered. Nine of the 24 competencies were identified by a majority of employers as expected in their operations. Eleven of the competencies were identified by a majority of employers as needed for one or more job titles. The general competencies most often identified as needed dealt with the operation of power tools.

The "Agricultural Mechanics" job title was considered to need the greatest number of general competencies, with 11 being considered necessary by a majority of the employers. Welders required the fewest number of general competencies considered by employers as necessary.

None of the general competencies were considered to be necessary for all job titles by a majority of all employers responding to each job title. Five general competencies were considered necessary by the majority of the employers to be needed in four of the five job titles.

TABLE 3 -- Percentage of Employers Reported by Job Titles and Overall Indicating General Competencies were Expected of Beginning Employees

General Competencies	JOB TITLES					Mean of Means Overall Job Titles
	Mechanic	Service Attendant	Parts Clerk	Welder	Tractor Operator	
Operate Tractors	100.0	100.0	50.0	66.7	100.0	83.3
Service Engines	100.0	100.0	100.0	-0-	57.1	71.4
Troubleshoot Machinery	90.9	87.5	100.0	16.7	85.7	76.2
Adjust Machinery	54.5	50.0	100.0	33.3	100.0	67.6
Repair Machinery	100.0	100.0	100.0	50.0	57.1	81.4
Plan Annual Maintenance	63.6	62.5	100.0	-0-	28.6	50.9
Operate Power Tools	100.0	100.0	100.0	83.3	42.9	85.2
Repair Power Tools	72.7	62.5	50.0	50.0	14.3	49.9
Weld Using Arc & Oxy-acetylene	81.8	50.0	50.0	100.0	42.9	64.9
Perform Metal Work	72.7	37.5	50.0	83.3	14.3	51.6
Use Working Drawings	36.4	25.0	50.0	50.0	-0-	32.9
Use Concrete & Masonry Units	9.1	-0-	-0-	-0-	-0-	1.8
Install Electrical Wiring	-0-	-0-	-0-	-0-	-0-	-0-
Select & Install Electrical Motors	27.3	12.5	50.0	16.7	-0-	21.3
Practice Electric Safety	-0-	-0-	50.0	16.7	-0-	13.3
Measure Land	27.3	12.5	-0-	-0-	42.9	16.5
Survey Land	-0-	-0-	-0-	-0-	14.3	2.9
Provide for Irrigation	9.1	12.5	-0-	-0-	14.3	7.2
Plan Farmstead Plan.	-0-	-0-	-0-	-0-	-0-	-0-
Plan Buildings	-0-	-0-	-0-	-0-	-0-	-0-

TABLE 3 -- Continued

General Competencies	JOB TITLES					Mean of Means Overall Job Titles
	Mechanic	Service Attendant	Parts Clerk	Welder	Tractor Operator	
Select Bldg. Materials	-0-	-0-	-0-	16.7	-0-	3.3
Plan Environ. Controls	-0-	-0-	-0-	-0-	-0-	-0-
Plan Bldg. Layouts	-0-	-0-	-0-	-0-	-0-	-0-
Service Air Conditioner	81.8	75.0	50.0	-0-	-0-	41.4

Specific Competencies by Job Titles

Twenty-three of the 24 general competencies were further analyzed through the listing of specific competencies. Thus, the general competency "operate power tools" included such specific competencies as "cut metal stock with power saw" and "press a bearing from a shaft". Employers indicating that a beginning employee needed to be able to perform the general competency were asked to evaluate each of the subsequently listed specific competencies as to their importance. Importance was limited to four choices: essential, important, useful, or not needed. Employers who had indicated that a general competency was not needed were automatically assumed to consider the associated specific competencies as not needed.

The answer to specific question number three must be answered for each of the five job titles separately. Table 4

contains a list of the specific competencies receiving a mean rating in the "important" to "essential" range for a beginning "agricultural mechanic". The specific competencies are listed by general competencies and their importance is ranked according to the mean rating.

Agricultural Mechanic. The general competency "operate tractor, power units or small engines" was not further defined with specific competencies but is listed in Table 4 to show all of the competencies identified for an "agricultural mechanic".

A total of 49 specific competencies were considered by employers as at least "important" for a beginning "agricultural mechanic". It should be pointed out that the specific competencies listed were only those which employers considered important for an agricultural mechanic and, in some cases, additional competencies not listed may be required in order for an employee to perform properly.

Attention should also be called to the specific competencies listed under "servicing an air conditioner". Traditionally, competencies in this area have not been widely taught in agricultural mechanics in Arizona.

Agricultural Service Attendant. Table 5 contains the competencies considered by employers as at least "important" for an agricultural service attendant. A total of 31 specific competencies are listed in Table 5. None of the specific competencies listed under the general competency dealing with "repair,

TABLE 4 -- Mean Ratings and Rank Order of Specific Competencies Collectively Regarded by Employers as "Important" to "Essential" for a Beginning Agricultural Mechanic Listed by General Competencies

<u>Competencies</u> GENERAL/Specific	Mean Rating	Rank Order
OPERATE TRACTOR, POWER UNITS OR SMALL ENGINES		
ADJUST, SERVICE AND MAINTAIN ENGINES		
1. Service dry-type air cleaner filter	4.63	1
2. Repack and adjust wheel bearings	4.45	3
3. Replace diesel engine fuel filter	4.63	1
4. Set ignition points cam or dwell angle	4.09	5
5. Adjust governor linkage to obtain engine speed specification	3.90	6
6. Reface engine valves and seats with grinding equipment	2.72	27
RECOGNIZE MALFUNCTIONS OF POWER UNITS AND MACHINERY		
1. Check and evaluate engine cylinder compression readings	2.72	27
2. Adjust engine valve clearance to specification	3.63	11
3. Adjust engine ignition or injector timing to specification	3.81	8
4. Test for excessive electrical system resistance with volt-ohm meter	2.81	25
5. Identify and replace an inoperative fuel injector nozzle	3.36	17
6. Use a tester to check fuel injector leakage	2.72	27
7. Test hydraulic system for performance output	3.54	15
8. Set carburetor mixture valves with exhaust analyzer	2.36	35
9. Test engine performance with PTO dynamometer	2.27	40
10. Identify a faulty bearing by sound or feel	3.63	11
11. Check radiator pressure cap for seal	3.45	16
ADJUST, SERVICE AND MAINTAIN TILLAGE, PLANTING, FERTILIZING, SPRAYING, HARVESTING AND PROCESSING EQUIPMENT		
1. Calibrate a field sprayer	2.36	35
2. Adjust mounted moldboard plow to field conditions	2.36	35
REMOVE BROKEN OR WORN PARTS, ORDER CORRECT REPLACEMENTS, AND INSTALL NEW PARTS		
1. Read and interpret an ignition circuit diagram for a spark ignition engine	3.00	21
2. Use a parts catalog to identify replacement parts and numbers	3.36	17
3. Install a "U"-joint repair kit	3.90	6

TABLE 4 -- continued

<u>Competencies</u> GENERAL/Specific	Mean Rating	Rank Order
4. Replace hydraulic system "O" rings and seals	4.27	4
5. Rebuild the cutter bar of a mower or swather	2.18	43
6. Identify hydraulic system components from circuit diagram	3.72	9
7. Replace and adjust tapered roller bearing assemblies to specifications	3.63	11
8. Measure a journal or bearing with micrometer	3.36	17
9. Replace an engine-transmission clutch	3.72	9
 PLAN, SCHEDULE AND EXECUTE AN ANNUAL MAINTENANCE PROGRAM INCLUDING PERIODIC INSPECTION, ADJUSTMENT, SHELTER AND STORAGE		
1. Adjust engine clutch linkage to specification	2.63	30
2. Make recommendations for applying specific lubricants	2.09	47
3. Determine the correct size and length of vee belt	2.63	30
4. Complete service record report forms or schedules	2.27	40
5. Evaluate repair cost to determine economics of parts replacement	2.09	47
(7.) Adjust safety clutches	2.36	35
 SELECT AND SAFELY OPERATE HAND AND POWER TOOLS AND EQUIPMENT		
(4.) Mount stock and drill hole with power drill press	3.36	17
5. Press a bearing from a shaft	3.63	11
 REPAIR, MAINTAIN AND RECONDITION POWER TOOLS AND EQUIPMENT		
(2.) Replace wheels on tool grinder	2.09	47
 PERFORM ARC AND OXY-ACETYLENE WELDING OPERATIONS		
1. Select or recommend the proper electrode for welding	2.18	43
2. Set up and use oxy-acetylene welding equipment for cutting or welding purposes	2.63	30
3. Repair iron castings by bronze welding	2.45	34
4. Use distortion controlling techniques in welding	2.36	35
5. Hard surface machinery parts with electric arc, i.e., sub-soiler chisels	2.27	40

TABLE 4 -- continued

<u>Competencies</u> <u>GENERAL/Specific</u>	Mean Rating	Rank Order
PERFORM METAL WORK USING HOT, COLD, AND SHEETMETAL		
(4.) Prepare copper tubing with flare fitting	2.18	43
SERVICE AIR CONDITIONING AND DISTRIBUTION SYSTEMS FOR HEATING AND COOLING		
1. Add refrigerant to system	3.00	21
2. Measure head pressure and vacuum	3.00	21
3. Clean evaporator coils	3.00	21
(5.) Replace expansion valves	2.63	30
6. Determine ampacity of system	2.18	43
7. Check systems for fuel and gas leaks	2.81	25

() Indicates one or more specific competencies preceding the bracketed item were omitted as a result of receiving a mean rating of 2.00 or less.

TABLE 5 -- Mean Ratings and Rank Order of Specific Competencies Collectively Regarded by Employers as "Important" to "Essential" for a Beginning Agricultural Service Attendant Listed by General Competencies

<u>Competencies</u> <u>GENERAL/Specific</u>	Mean Rating	Rank Order
OPERATE TRACTOR, POWER UNITS OR SMALL ENGINES		
ADJUST, SERVICE AND MAINTAIN ENGINES		
1. Service dry-type air cleaner filter	4.25	1
2. Repack and adjust wheel bearings	4.00	3
3. Replace diesel engine fuel filter	4.25	1
4. Set ignition points cam or dwell angle	3.50	6
5. Adjust governor linkage to obtain engine speed specification	3.50	6
6. Reface engine valves and seats with grinding equipment	2.50	22
RECOGNIZE MALFUNCTIONS OF POWER UNITS AND MACHINERY		
1. Check and evaluate engine cylinder compression readings	2.25	30
2. Adjust engine valve clearance to specification	2.50	22
3. Adjust engine ignition or injector timing to specification	2.50	22
4. Test for excessive electrical system resistance with volt-ohm meter	2.50	22
5. Identify and replace an inoperative fuel injector nozzle	3.38	9
6. Use a tester to check fuel injector leakage	3.00	15
7. Test hydraulic system for performance output	3.13	14
(10.) Identify a faulty bearing by sound or feel	3.38	9
11. Check radiator pressure cap for seal	2.88	16
REMOVE BROKEN OR WORN PARTS, ORDER CORRECT REPLACEMENTS, AND INSTALL NEW PARTS		
1. Read and interpret an ignition circuit diagram for a spark ignition engine	2.75	19
2. Use a parts catalog to identify replacement parts and numbers	3.38	9
3. Install a "U"-joint repair kit	3.50	6
4. Replace hydraulic system "O" rings and seals	4.00	3
5. Rebuild the cutter bar of a mower or swather	2.75	19
6. Identify hydraulic system components from circuit diagram	2.75	19
7. Replace and adjust tapered roller bearing assemblies to specifications	3.38	9
8. Measure a journal or bearing with micrometer	3.38	9
9. Replace an engine-transmission clutch	2.88	16

TABLE 5 -- continued

<u>Competencies</u> <u>GENERAL/Specific</u>	Mean Rating	Rank Order
PLAN, SCHEDULE AND EXECUTE AN ANNUAL MAINTENANCE PROGRAM INCLUDING PERIODIC INSPECTION, ADJUSTMENT, SHELTER AND STORAGE		
(2.) Make recommendations for applying specific lubricants	2.38	28
3. Determine the correct size and length of vee belt	2.13	31
4. Complete service record report forms or schedules	2.38	28
SELECT AND SAFELY OPERATE HAND AND POWER TOOLS AND EQUIPMENT		
(4.) Mount stock and drill hole with power drill press	2.88	16
5. Press a bearing from a shaft	4.00	3
REPAIR, MAINTAIN AND RECONDITION POWER TOOLS AND EQUIPMENT		
SERVICE AIR CONDITIONING AND DISTRIBUTION SYSTEMS FOR HEATING AND COOLING		
1. Add refrigerant to system	2.50	22
2. Measure head pressure and vacuum	2.50	22

() Indicates one or more specific competencies preceding the bracketed item were omitted as a result of receiving a mean rating of 2.00 or less.

maintenance and reconditioning of power tools and equipment" were considered important enough to include in Table 5.

The reader should also note the similarity of competencies between those of the service attendant and of the mechanic. All of the competencies listed in Table 5 for the agricultural service attendant are also listed in Table 4 for the agricultural mechanic.

Agricultural Parts Clerk. The competencies identified for a parts clerk in Table 6 were considerably reduced from the previous two job titles. A total of only seven specific competencies were collectively considered as at least "important" for an agricultural parts clerk. There was unanimous agreement by all employers that to "use a parts catalog to identify replacement parts and numbers" was essential.

Two general competencies considered as necessary for parts clerks to perform contained no specific competencies rated higher than "useful". This appears to be a logical rating in that the general competencies were not generally considered part of the parts clerk's job. Some understanding or skill related to the general competency could be useful in carrying out the duties and responsibilities of a parts clerk, but were not important or essential in the minds of employers for entry into the occupation.

Agricultural Welder. Table 7 lists the competencies considered by employers to be important or essential for agricultural welders. As might be expected, all of the specific competencies listed under the general competency of "welding" were considered

TABLE 6 -- Mean Ratings and Rank Order of Specific Competencies Collectively Regarded by Employers as "Important" to "Essential" for Beginning Agricultural Parts Clerk Listed by General Competencies

<u>Competencies</u> GENERAL/Specific	Mean Rating	Rank Order
ADJUST, SERVICE AND MAINTAIN ENGINES		
RECOGNIZE MALFUNCTIONS OF POWER UNITS AND MACHINERY		
ADJUST, SERVICE AND MAINTAIN TILLAGE, PLANTING, FERTILIZING, SPRAYING, HARVESTING AND PROCESSING EQUIPMENT		
REMOVE BROKEN OR WORN PARTS, ORDER CORRECT REPLACEMENTS, AND INSTALL NEW PARTS		
1. Read and interpret an ignition circuit diagram for a spark ignition engine	3.00	3
2. Use a parts catalog to identify replacement parts and numbers	5.00	1
(6.) Identify hydraulic system components from circuit diagram	3.00	3
(8.) Measure a journal or bearing with micrometer	3.00	3
PLAN, SCHEDULE AND EXECUTE AN ANNUAL MAINTENANCE PROGRAM INCLUDING PERIODIC INSPECTION, ADJUSTMENT, SHELTER AND STORAGE		
(2.) Make recommendations for applying specific lubricants	3.00	3
3. Determine the correct size and length of vee belt	4.00	2
SELECT AND SAFELY OPERATE HAND AND POWER TOOLS AND EQUIPMENT		
(5.) Press a bearing from a shaft	3.00	3

() Indicates one or more specific competencies preceding the bracketed item were omitted as a result of receiving a mean rating of 2.00 or less.

TABLE 7 -- Mean Ratings and Rank Order of Specific Competencies Collectively Regarded by Employers as "Important" to "Essential" for Beginning Agricultural Welder Listed by General Competencies

<u>Competencies</u> <u>GENERAL/Specific</u>	Mean Rating	Rank Order
OPERATE TRACTOR, POWER UNITS OR SMALL ENGINES		
REMOVE BROKEN OR WORN PARTS, ORDER CORRECT REPLACEMENTS, AND INSTALL NEW PARTS		
(3.) Install a "U"-joint repair kit	2.17	20
4. Replace hydraulic system "O" rings and seals	2.17	20
(7.) Replace and adjust tapered roller bearing assemblies to specifications	2.17	20
SELECT AND SAFELY OPERATE HAND AND POWER TOOLS AND EQUIPMENT		
(3.) Cut metal stock with power saw	3.17	10
4. Mount stock and drill hole with power drill press	3.17	10
5. Press a bearing from a shaft	3.50	8
REPAIR, MAINTAIN AND RECONDITION POWER TOOLS AND EQUIPMENT		
1. Recondition a twist drill	2.17	20
2. Replace wheels on tool grinders	2.17	20
PERFORM ARC AND OXY-ACETYLENE WELDING OPERATIONS		
1. Select or recommend the proper electrode for welding	5.00	1
2. Set up and use oxy-acetylene welding equipment for cutting or welding purposes	5.00	1
3. Repair iron castings by bronze welding	4.33	3
4. Use distortion controlling techniques in welding	3.67	7
5. Hard surface machinery parts with electric arc, i.e., sub-soiler chisels	4.33	3
6. Produce a gas-tight butt weld in pipe	3.17	10
7. Apply hard surfacing alloy to sweeps with oxy-acetylene torch	4.33	3
8. Cut 90° saddle in steel pipe with a cutting torch	4.33	3
9. Prepare and test a weld specimen using "guided bend" method	2.17	20
10. Weld structural steel with MIG wire feed welder	3.17	10
11. Butt weld aluminum pipe with TIG equipment	2.50	16

TABLE 7 -- continued

<u>Competencies</u>	Mean	Rank
<u>GENERAL/Specific</u>	<u>Rating</u>	<u>Order</u>
PERFORM METAL WORK USING HOT, COLD, AND SHEETMETAL		
(2.) Solder a lock seam with soldering copper	2.33	18
(4.) Prepare copper tubing with flare fitting	3.50	8
5. Silver braze fuel injection lines	2.67	15
6. Cut threads on round stock	2.50	16
7. Join Metal parts with screws or pop rivets	2.33	18
8. Solder a leaking radiator	3.17	10

() Indicates one or more specific competencies preceding the bracketed item were omitted as a result of receiving a mean rating of 2.00 or less.

at least "useful" and are included in Table 7. Two of the specific competencies (number 1 and 2) were considered "essential" by all employers.

In total, 25 specific competencies were considered important for agricultural welders. Judging by the competencies listed, it can be seen that an agricultural welder's duties commonly extend beyond that of electric arc and oxy-acetylene welding as might be found for a welder on an assembly line.

Comparing the general competencies suggested for a welder with those of a mechanic or a service attendant, the difference in duties is rather obvious although not unique. The commonalities tend to be in the general competencies in areas such as welding, repair and maintenance; however, the specific competencies required by employers for the separate job titles vary.

Tractor Operator. Competencies identified for tractor operator are included in Table 8. Seven specific competencies derived from three general competencies are listed. The list, while not extensive, does indicate that employers expect tractor operator to do more than just drive the tractor. Some routine type maintenance is expected along with the abilities to adjust, service and maintain the machinery attached to the tractor.

Commonality of Competencies Among Job Titles

The final question this study was designed to answer deals with the identification of those competencies common to all of the job

TABLE 8 -- Mean Ratings and Rank Order of Specific Competencies Collectively Regarded by Employers as "Important" to "Essential" for Beginning Tractor Operator Listed by General Competencies

Competencies GENERAL/Specific	Mean Rating	Rank Order
OPERATE TRACTOR, POWER UNITS OR SMALL ENGINES		
ADJUST, SERVICE AND MAINTAIN ENGINES		
1. Service dry-type air cleaner filter	2.29	6
(3.) Replace diesel engine fuel filter	2.29	6
RECOGNIZE MALFUNCTIONS OF POWER UNITS AND MACHINERY		
(10.) Identify a faulty bearing by sound or feel	3.29	1
11. Check radiator pressure cap for seal	2.71	3
ADJUST, SERVICE AND MAINTAIN TILLAGE, PLANTING, FERTILIZING, SPRAYING, HARVESTING AND PROCESSING EQUIPMENT		
1. Calibrate a field sprayer	2.57	5
2. Adjust mounted moldboard plow to field conditions	2.71	3
(7.) Adjust a planter/drill for seed and field conditions	2.86	2
REMOVE BROKEN OR WORN PARTS, ORDER CORRECT REPLACEMENTS, AND INSTALL NEW PARTS		

() Indicates that one or more specific competencies preceding the bracketed item were omitted as a result of receiving a mean rating of 2.00 or less.

titles studied. Table 9 displays the five job titles and ten general competencies with specific competencies for which needs were indicated. The check (X) opposite the specific competency indicates that employers believed the competency to be "important" to "essential" for a beginning employee in the respective job title. None of the competencies were recommended by employers for all five job titles. One was recommended for four of the five job titles. A total of 18 competencies were recommended for three job titles. Twenty-three competencies were recommended for only one of the five job titles. The two job titles which had the greatest similarity in recommended competencies were those of "agricultural mechanic" and "service attendant". In fact, all 31 competencies recommended for the "service attendant" were also recommended for the "mechanic".

The general competency considered most common among the listed job titles dealt with "removing broken or worn parts and ordering and installing new parts".

Another way of summarizing the commonality of competencies is to look at the five instructional areas of agricultural mechanics included in this study. The greatest commonality occurred in the instructional areas of "Power and Machinery" and "Agricultural Construction and Maintenance". The only other instructional area containing competencies recommended for more than one job title was that of "Electric Power and Processing".

TABLE 9 -- Commonality of Competencies Considered as "Important" or "Essential" by Employers for Selected Job Titles in Agricultural Mechanics

Competencies GENERAL/Specific	Job Titles				
	Mechanic	Service Attendant	Parts Clerk	Welder	Tractor Operator
ADJUST, SERVICE AND MAINTAIN ENGINES					
1. Service dry-type air cleaner filter	X	X			X
2. Repack and adjust wheel bearings	X	X			
3. Replace diesel engine fuel filter	X	X			X
4. Set ignition points cam or dwell angle	X	X			
5. Adjust governor linkage to obtain engine speed specification	X	X			
6. Reface engine valves and seats with grinding equipment	X	X			
RECOGNIZE MALFUNCTIONS OF POWER UNITS AND MACHINERY					
1. Check and evaluate engine cylinder compression readings	X	X			
2. Adjust engine valve clearance to specification	X	X			
3. Adjust engine ignition or injector timing to specification	X	X			
4. Test for excessive electrical system resistance with volt-ohm meter	X	X			
5. Identify and replace an in-operative fuel injector nozzle	X	X			
6. Use a tester to check fuel injector leakage	X	X			
7. Test hydraulic system for performance output	X	X			
8. Set carburetor mixture valves with exhaust analyzer	X				

TABLE 9 -- Continued

<u>Competencies</u> GENERAL/Specific	Job Titles				
	Mechanic	Service Attendant	Parts Clerk	Welder	Tractor Operator
9. Test engine performance with PTO dynameter	X				
10. Identify a faulty bearing by sound or feel	X	X			X
11. Check radiator pressure cap for seal	X	X			X
ADJUST, SERVICE AND MAINTAIN TILLAGE, PLANTING, FERTILIZING, SPRAYING, HARVESTING AND PROCESSING EQUIPMENT					
1. Calibrate a field sprayer	X				X
2. Adjust mounted moldboard plow to field conditions	X				X
3. Time a hay baler needle and knotter head					
4. Adjust a combine for a specified grain crop					
5. Set up and adjust a baler for customer delivery					
6. Adjust swather steering clutches					
7. Adjust a planter/drill for seed and field conditions					X
PERFORM ARC AND OXY-ACETYLENE WELDING OPERATIONS					
1. Select or recommend the proper electrode for welding	X			X	
2. Set up and use oxy-acetylene welding equipment for cutting or welding purposes	X			X	
3. Repair iron castings by bronze welding	X			X	
4. Use distortion controlling techniques in welding	X			X	

TABLE 9 -- Continued

<u>Competencies</u> <u>GENERAL/Specific</u>	Job Titles				
	Mechanic	Service Attendant	Parts Clerk	Welder	Tractor Operator
5. Hard surface machinery parts with electric arc, i.e. sub-soiler chisels	X			X	
6. Produce a gas-tight butt weld in pipe				X	
7. Apply hard surfacing alloy to sweeps with oxy-acetylene torch				X	
8. Cut 90° saddle in steel pipe with a cutting torch				X	
9. Prepare and test a weld specimen using "guided bend" method				X	
10. Weld structural steel with MIG wire feed welder				X	
11. Butt weld aluminum pipe with TIG equipment				X	
PERFORM METAL WORK USING HOT, COLD, AND SHEETMETAL					
1. Use a spark test to determine carbon content of steel					
2. Solder a lock seam with soldering copper				X	
3. Heat treat tool steel to desired hardness					
4. Prepare copper tubing with flare fitting	X			X	
5. Silver braze fuel injection lines				X	
6. Cut threads on round stock				X	
7. Join metal parts with screws or pop rivets				X	
8. Solder a leaking radiator				X	

TABLE 9 -- Continued

<u>Competencies</u> <u>GENERAL/Specific</u>	Job Titles				
	Mechanic	Service Attendant	Parts Clerk	Welder	Tractor Operator
SERVICE AIR CONDITIONING AND DISTRIBUTION SYSTEMS FOR HEATING AND COOLING					
1. Add refrigerant to system	X	X			
2. Measure head pressure and vacuum	X	X			
3. Clean evaporator coils	X				
4. Measure static pressure in duct					
5. Replace expansion valves	X				
6. Determine ampacity of system	X				
7. Check systems for fuel and gas leaks	X				
REMOVE BROKEN OR WORN PARTS, ORDER CORRECT REPLACEMENTS, AND INSTALL NEW PARTS					
1. Read and interpret an ignition circuit diagram for a spark ignition engine	X	X	X		
2. Use a parts catalog to identify replacement parts and numbers	X	X	X		
3. Install a "U"-joint repair kit	X	X		X	
4. Replace hydraulic system "O" rings and seals	X	X		X	
5. Rebuild the cutter bar of a mower or swather	X	X			
6. Identify hydraulic system components from circuit diagram	X	X	X		
7. Replace and adjust tapered roller bearing assemblies to specifications	X	X		X	
8. Measure a journal or bearing with micrometer	X	X	X		
9. Replace an engine-transmission clutch	X	X			

TABLE 9 -- Continued

<u>Competencies</u> <u>GENERAL/Specific</u>	Job Titles				
	Mechanic	Service Attendant	Parts Clerk	Welder	Tractor Operator
PLAN, SCHEDULE AND EXECUTE AN ANNUAL MAINTENANCE PROGRAM INCLUDING PERIODIC INSPECTION, ADJUSTMENT, SHELTER AND STORAGE					
1. Adjust engine clutch linkage to specification	X				
2. Make recommendations for applying specific lubricants	X	X	X		
3. Determine the correct size and length of vee belt	X	X	X		
4. Complete service record report forms or schedules	X	X			
5. Evaluate repair cost to determine economics of parts replacement	X				
6. Evaluate safety hazards according to OSHA standards					
7. Adjust safety clutches	X				
SELECT AND SAFELY OPERATE HAND AND POWER TOOLS AND EQUIPMENT					
1. Rip stock with a radial arm saw					
2. Cut compound angles with a portable electric saw					
3. Cut metal stock with power saw				X	
4. Mount stock and drill hole with power drill press	X	X		X	
5. Press a bearing from a shaft	X	X	X	X	
6. Make a replacement part with metal lathe					

TABLE 9 -- Continued

<u>Competencies</u> <u>GENERAL/Specific</u>	Job Titles				
	Mechanic	Service Attendant	Parts Clerk	Welder	Tractor Operator
REPAIR, MAINTAIN AND RECONDITION POWER TOOLS AND EQUIPMENT					
1. Recondition a twist drill				X	
2. Replace wheels on tool grinder	X			X	
3. Sharpen a chain saw with a hand file					

X indicates specific competency receiving a mean rating of "Important" to "Essential" by participating employers for the designated job title.

CONCLUSIONS

Based upon the findings of this component analysis, the following conclusions were drawn:

1. Many of the instructional areas recognized by the American Society of Agricultural Engineers (A.S.A.E.) were not needed in preparing persons for employment in major job titles in agricultural mechanics in Arizona. The three instructional areas with competencies common across more than one job title were: "Power and Machinery", "Construction and Maintenance", and "Electric Power and Processing".

2. Far fewer of the competencies considered important by vocational agriculture teachers are actually considered by employers as important for beginning employees in agricultural mechanics job titles in Arizona.
3. Present instructional programs in vocational agriculture in Arizona need to provide instruction dealing with competencies in air conditioning. Specifically, such competencies as: "adding refrigerant", "measuring head pressure and vacuum" and "cleaning evaporator coils" should receive some emphasis.
4. Specialized instructional programs in agricultural mechanics in Arizona must focus on those general and specific competencies in job titles where commonalities exist. Variations or unique competencies should be addressed through on-the-job experiences via the supervised occupational experience program.

RECOMMENDATIONS

The findings and conclusions of this study led to the following recommendations:

1. A need exists to review the competencies with industry representatives for clarification and to determine supporting skills and knowledge. It is recommended

that the degree of perfection to which competencies must be mastered by beginning employees be quantified.

2. Competencies recommended by employers should be used by teachers in preparing individual training plans for students receiving on-the-job training in agricultural mechanics.
3. A specialized instructional program in agricultural mechanics which emphasizes those competencies applicable to similar job titles should be initiated. For example, the competencies needed by an "agricultural mechanic" and an "agricultural service attendant" show enough commonality that an instructional program designed to prepare persons for one or both job titles could be planned and conducted.

OCCUPATIONAL COMPONENT ANALYSIS IN AGRICULTURAL MECHANIZATION

DIRECTIONS: Please check each lettered "competency area" indicating if it is expected of beginning employees in your business or occupation. If it is expected, evaluate each activity listed below the competency as to their importance. Complete a separate form for each job title.

JOB TITLE: _____

Competency Areas: _____ Activities _____

Essential	Important	Useful	Not Needed
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IS SOMEONE EMPLOYEED IN THE ABOVE LISTED JOB TITLE IN YOUR OPERATION EXPECTED:

A. TO START AND SAFELY OPERATE TRACTORS, POWER UNITS OR SMALL GASOLINE ENGINES?

_____ No (Skip to B)
 _____ Yes

B. TO ADJUST, SERVICE AND MAINTAIN SPARK IGNITION, DIESEL ENGINES AND SMALL, SINGLE CYLINDER GASOLINE ENGINES?

_____ No (Skip to C)
 _____ Yes (Evaluate Activities 1-6 below)

1. Service dry-type air cleaner filter
2. Repack and adjust wheel bearings
3. Replace diesel engine fuel filter
4. Set ignition points cam or dwell angle
5. Adjust governor linkage to obtain engine speed specification.
6. Reface engine values and seats with grinding equipment

C. TO RECOGNIZE MALFUNCTIONS OF AGRICULTURAL POWER UNITS AND MACHINERY, DETERMINE CAUSE AND MAKE NECESSARY ADJUSTMENT OR REPAIR TO CORRECT MALFUNCTION?

_____ No (Skip to D)
 _____ Yes (Evaluate activities 1-11 below)

1. Check and evaluate engine cylinder compression readings
2. Adjust engine valve clearance to specifications
3. Adjust engine ignition or injector timing to specification
4. Test for excessive electrical system resistance with volt-ohm meter
5. Identify and replace an inoperative fuel injector nozzle.
6. Use a tester to check fuel injector leakage
7. Test hydraulic system for performance output
8. Set carburetor mixture valves with exhaust analyzer
9. Test engine performance with PTO dynameter.
10. Identify a faulty bearing by sound or feel.
11. Check radiator pressure cap for seal.

D. TO ADJUST, SERVICE AND MAINTAIN TILLAGE, PLANTING, FERTILIZING, SPRAYING, HARVESTING AND PROCESSING EQUIPMENT TO KEEP IT OPERATING EFFICIENTLY UNDER NORMAL CONDITIONS?

_____ No (Skip to E)
 _____ Yes (Evaluate activities 1-7 below)

Competency Areas:	Activities	Essential	Important	Useful	Not Needed
	1. Calibrate a field sprayer.				
	2. Adjust mounted moldboard plow to field conditions.				
	3. Time a hay baler needle and knotter head				
	4. Adjust a combine for a specified grain crop.				
	5. Set up and adjust a baler for customer delivery.				
	6. Adjust swather steering clutches				
	7. Adjust a planter/drill for seed and field conditions				

E. TO REMOVE BROKEN OR WORN PARTS, ORDER CORRECT REPLACEMENTS, INSTALL NEW PARTS AND SATISFACTORILY OPERATE POWER UNITS OR MACHINERY?

No (Skip to F)
 Yes (Evaluate activities 1-9 below)

1.	Read and interpret an ignition circuit diagram for a spark ignition engine				
2.	Use a parts catalog to identify replacement parts and numbers.				
3.	Install a "U"-joint repair kit				
4.	Replace hydraulic system "O" rings and seals				
5.	Rebuild the cutter bar of a mower or swather				
6.	Identify hydraulic system components from circuit diagram.				
7.	Replace and adjust tapered roller bearing assemblies to specifications				
8.	Measure a journal or bearing with micrometer				
9.	Replace an engine-transmission clutch.				

F. TO PLAN, SCHEDULE AND EXECUTE AN ANNUAL MAINTENANCE PROGRAM INCLUDING PERIODIC INSPECTION, ADJUSTMENT, SHELTER AND STORAGE FOR POWER UNITS, AND MACHINERY?

No (Skip to G)
 Yes (Evaluate activities 1-7 below)

1.	Adjust engine clutch linkage to specification.				
2.	Make recommendations for applying specific lubricants.				
3.	Determine the correct size and length of vee belt.				
4.	Complete service record report forms or schedules.				
5.	Evaluate repair cost to determine economics of parts replacement				
6.	Evaluate safety hazards according to OSHA standards.				
7.	Adjust safety clutches				

G. TO SELECT AND SAFELY OPERATE HAND AND POWER TOOLS AND EQUIPMENT?

No (Skip to H)
 Yes (Evaluate activities 1-6 below)

Competency Areas:	Activities	Essential	Important	Useful	Not Needed
	1. Rip stock with a radial arm saw.				
	2. Cut compound angles with a portable electric saw				
	3. Cut metal stock with power saw				
	4. Mount stock and drill hole with power drill press.				
	5. Press a bearing from a shaft				
	6. Make a replacement part with metal lathe				
H.	TO REPAIR, MAINTAIN AND RECONDITION POWER TOOLS AND EQUIPMENT?				
	___ No (Skip to I)				
	___ Yes (Evaluate activities 1-3 below)				
	1. Recondition a twist drill.				
	2. Replace wheels on tool grinder				
	3. Sharpen a chain saw with a hand file				
I.	TO PERFORM ARC AND OXYACETYLENE WELDING OPERATIONS?				
	___ No (Skip to J)				
	___ Yes (Evaluate activities 1-11 below)				
	1. Select or recommend the proper electrode for welding				
	2. Set up and use oxyacetylene welding equipment for cutting or welding purposes				
	3. Repair iron castings by bronze welding				
	4. Use distortion controlling techniques in welding				
	5. Hard surface machinery parts with electric arc, i.e., sub-soiler chisels.				
	6. Produce a gas-tight butt weld in pipe.				
	7. Apply hard surfacing alloy to sweeps with oxyacetylene torch				
	8. Cut 90° saddle in steel pipe with a cutting torch.				
	9. Prepare and test a weld specimen using "guided bend" method. . . .				
	10. Weld structural steel with MIG wire feed welder.				
	11. Butt weld aluminum pipe with TIG equipment				
J.	TO PERFORM METAL WORK USING HOT, COLD AND SHEET METALS?				
	___ No (Skip to K)				
	___ Yes (Evaluate activities 1-8 below)				
	1. Use a spark test to determine carbon content of steel.				
	2. Solder a lock seam with soldering copper				
	3. Heat treat tool steel to desired hardness.				
	4. Prepare copper tubing with Flare fitting				
	5. Silver Braze Fuel Injection Lines.				
	6. Cut threads on Round Stock				
	7. Join metal parts with screws or pop rivets				
	8. Solder a leaking radiator.				

Essential	Important	Useful	Not Needed
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Competency Areas: Activities

K. TO PREPARE AND USE BLUEPRINTS AND WORKING DRAWINGS IN THE CONSTRUCTION OF AGRICULTURAL BUILDINGS AND RELATED EQUIPMENT. ALSO, SELECT AND USE PAINTS AND WOOD PRESERVATIVES TO MAINTAIN BUILDINGS AND EQUIPMENT?

_____ No (Skip to L)
 _____ Yes (Evaluate activities 1-4 below)

1. Determine the material cost of a proposed project from a plan.
2. Prepare a working drawing for a construction project
3. Apply paint with spraying equipment.
4. Use a framing square to determine the length and angle cuts for rafters and braces

L. TO SELECT AND USE CONCRETE BUILDING MATERIALS INCLUDING: DESIGNING MIXES, ORDERING MATERIALS, FINISHING CONCRETE AND LAYING MASONRY UNITS?

_____ No (Skip to M)
 _____ Yes (Evaluate activities 1-6 below)

1. Determine materials ratio for concrete using a trial mix
2. Finish a concrete surface.
3. Lay-up corners for a concrete masonry building
4. Construct forms for a reinforced concrete column or wall
5. Calculate material needs for concrete construction project
6. Mix mortar for masonry application

M. TO CALCULATE THE PROPER CIRCUIT LOAD, THE NUMBER OF CIRCUITS AND THE SERVICE ENTRANCE FOR SPECIFIC BUILDINGS?

_____ No (Skip to N)
 _____ Yes (Evaluate activities 1-4 below)

1. Install switches to control lights from more than one location . . .
2. Use power sensing equipment to determine wattage requirements of a system
3. Check a resistor with a volt-ohm meter
4. Measure amperage draw with "amprobe"

N. TO SELECT AND INSTALL ELECTRIC MOTORS AND CONTROLS?

_____ No (Skip to O)
 _____ Yes (Evaluate activities 1-3 below)

1. Install a magnetic starter for a single-phase electric motor
2. Wire a dual voltage electric motor
3. Reverse direction of motor rotation

O. TO SELECT AND INSTALL GROUNDING AND SAFETY EQUIPMENT ACCORDING TO THE NATIONAL ELECTRIC CODE?

_____ No (Skip to P)
 _____ Yes (Evaluate activities 1-3 below)

Competency Areas:	Activities	Essential	Important	Useful	Not Needed
	1. Install a 120V polarized grounded circuit				
	2. Install a 240V 1-phase electric power entrance panel				
	3. Install a Ground Fault Circuit Interrupter				
P.	TO MEASURE LAND AND CALCULATE AREA? <input type="checkbox"/> No (Skip to Q) <input type="checkbox"/> Yes (Evaluate activities 1-2 below)				
	1. Use measuring wheel to determine distance				
	2. Measure lineal distance with steel tape				
Q.	TO DETERMINE DIFFERENCE IN ELEVATION BETWEEN POINTS, SLOPE OF A GRADE LINE AND LOCATION OF CONTOUR LINES USING STANDARD PROCEDURE? <input type="checkbox"/> No (Skip to R) <input type="checkbox"/> Yes (Evaluate activities 1-4 below)				
	1. Stake a ditch to a predetermined slope				
	2. Stake a field for leveling				
	3. Measure elevation differences and plot profiles				
	4. Prepare a contour map of a field				
R.	TO ESTABLISH IRRIGATION SCHEDULE BASED ON SOIL MOISTURE CONTENT AND DISTRIBUTION? <input type="checkbox"/> No (Skip to S) <input type="checkbox"/> Yes (Evaluate activities 1-3 below)				
	1. Adjust sprinkler heads				
	2. Determine pump discharge				
	3. Set syphon tubes				
S.	TO DETERMINE BUILDING AND FACILITIES NEEDS FOR A CONFINEMENT LIVESTOCK PRODUCTION OPERATION? <input type="checkbox"/> No <input type="checkbox"/> Yes				
T.	TO PLAN NEW BUILDING INCLUDING UTILITIES, ELEVATORS, CONVEYOR, AND PRODUCE HANDLING AND PROCESSING EQUIPMENT? <input type="checkbox"/> No <input type="checkbox"/> Yes				
U.	TO SELECT BUILDING MATERIALS FOR SPECIFIC USES? <input type="checkbox"/> No (Skip to V) <input type="checkbox"/> Yes (Evaluate activities 1-4 below)				
	1. Select wood framing materials by strength and grade appreciation . .				
	2. Apply asphalt roofing materials				
	3. Install insulation materials				
	4. Apply metal roofing products				

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