The Common Competency Identification project was conducted to find common occupational competencies across 19 technical and industrial occupational areas that provide a foundation for reevaluation of the delivery of trade and industrial (T&I) education. Instructors from the nine occupational areas accounting for the largest number of programs in the T&I area participated in an all-morning brainstorming session with vocational administrators, tech prep coordinators, and staff from the University of Missouri. They heard presentations about issues facing T&I and developed draft lists of competencies for the nine largest T&I areas. In the afternoon, each instructor reviewed the 19 T&I occupational profiles developed during the brainstorming session to identify competencies relevant to his or her own occupational area. Based on the information provided by the instructors, revised competency lists were developed and later reevaluated at a 2-day meeting of the instructors. (Appendixes constituting the largest part of this document contain the following: presentations and results from the initial meeting; draft competencies resulting from the initial analysis of materials generated by the first meeting; revised competency lists resulting from the instructors' review of the initial analysis; and a final presentation and questions submitted to the project advisory committee.) (MN)
Common Competency Identification
RFP 94-133-110-5

Project Goals, Methodology, Results and Recommendations

Instructional Materials Laboratory
University of Missouri-Columbia
10 London Hall
Columbia, MO 65211
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June 1994
Project Goals

The goal of the Common Competency Identification project (RFP 94-133-110-5) was to identify the common occupational competencies across the 19 technical/industrial occupational areas. Identifying these common skills, according to the project's Request for Funding Proposal, should provide a better understanding of the structure of T & I education programs and allow for re-evaluation of T & I education's delivery system.

Project Methodology

Instructors from nine occupational areas were selected to form the committee that would identify the common competencies. These areas were: air conditioning, heating, and refrigeration; auto collision technology; auto mechanics; building trades; drafting; electrical trades; electronics; machine shop; and welding. The rationale in choosing these nine areas was that they comprised the largest number of programs in the T & I area, and that most of the common competencies across the T & I area would probably come from these nine occupational areas.

An advisory committee consisting of the above instructors, vocational administrators, tech prep coordinators, DESE staff, and IML personnel was also created. The committee's function was to provide guidance for the project and to evaluate the results of the common competency identification carried out by the instructors. (Appendix A contains a listing of committee members on page A-1.)

The entire advisory committee met for half a day at the beginning of the project to discuss the project goals. Pat Muenks, Industrial Education supervisor, DESE: outlined the issues facing vocational education and the T & I area (including enrollment and placement figures) (Appendix A, pages A-3 through A-5); discussed the stages the project would need to progress through for completion (Appendix A, page A-6); and presented possible implications for the project's outcomes (Appendix A, page A-7). The committee then participated in a brainstorming session to identify additional related issues that might have an affect on the project (Appendix A, pages A-9 and A-10). Over lunch, instructors, administrators and tech prep coordinators discussed their primary concerns involving T & I programs (Appendix A, page A-11).

In the afternoon, the instructors met to determine which competencies their areas had in common with the other T & I areas. Each instructor was given a set of the 19 T & I occupational area profiles. These profiles were: air conditioning, heating, and refrigeration; auto collision technology; auto mechanics; building maintenance; building trades; cabinet making; commercial art; cosmetology; diesel mechanic; drafting; electronics; electrical trades; food service worker; machine shop; masonry; offset lithography; plumbing; small engines; and welding. The instructors worked
through the profiles one at a time, marking the competencies on each profile that they also teach in their own areas.

Next, the results of the instructors' work were compiled into tables, one table for each competency profile. DESE and IML staff then met to analyze the results. First, the 19 occupational areas were divided into cluster areas, based on the Missouri Trade and Technical Association's cluster areas (Appendix B, page B-2). For the purposes of this project, the graphics and manufacturing clusters were combined, and an "other" cluster was created for four occupational areas (commercial art, cosmetology, food service and offset lithography) that did not seem to have as much in common as the other 15 occupational areas did. The other clusters from the MTTA design remained essentially the same. Thus, there are five clusters for this project: construction, manufacturing (includes graphics), service, transportation and "other" (see Appendix B, page B-3).

Based on the information provided by the instructors, the competencies listed on the 19 T & I profiles were then divided into three groupings based on the degree to which they were common across the 19 occupational areas (Appendix B, pages B-5). The first group contains those competencies that are common to all (or most) of the T & I occupational areas. It represents those skills that are most basic to T & I programs and that are viewed as common in all occupational areas. The content of this group includes: blueprints/plans/diagrams; careers/orientation; documentation; electricity; measurement; safety; and tools. (Lists of specific competencies for these seven areas are in Appendix B, pages B-7 through B-24). The next group contains those competencies that are common in at least two occupational areas, but that are excluded from the first group because they do not extend across a sufficient number of occupational areas. Fourteen occupational areas share tasks in common with a minimum of one other occupational area. These shared competencies cross over cluster boundaries. This grouping could be further studied to determine how skills might be organized by categories along occupational clusters. (Lists of the competencies for this group are in Appendix B, pages B-26 through B-44). The third group contains those competencies that are related only within the clusters. (Lists of the competencies for this group are in Appendix B, pages B-46 through B-53).

In summary of the committee's initial analysis, 1117 (roughly 45 percent) of the 2,459 competencies contained on the 19 T & I profiles were originally identified as having some commonality across occupational areas, based on the written competency statements. Additional analysis of each competency was conducted to determine further relationships.

The additional analysis took place at a two-day meeting of the instructors from the advisory committee, with the result being three revised groups of competencies (Appendix C, page C-2). The lists were examined competency by competency, with
the instructors revising and moving competencies from one list to another as necessary. Out of the first group, which included those competencies that extended across all T & I areas, the instructors developed basic competency statements that combined related statements from the original profiles (Appendix C, pages C-4 through C-7). The instructors then examined those competencies in group two that are common to at least two occupational areas to determine the degree to which clusters share common skills or tasks. There are only two clusters, transportation and service, that appear to cross over into one another. For example, these two clusters share competencies related to electrical systems and air conditioning systems. (See Appendix C, pages C-9 through C-12, for a list of the competencies.)

The third group, which contains those competencies that are common to only occupational areas within the same cluster, was also revised (Appendix C, pages C-14 through C-22). Thus, the final results from this meeting were: one list of common competencies, created by combining similar competencies from all of the competency profiles; one list of competencies that cut across the transportation and service clusters; and three lists, one for each cluster that contains common competencies within that cluster.

These results were mailed to the advisory committee, and a final meeting for the entire advisory committee was held to determine the implications of this information. At the final meeting, graphs that are the final result of analysis to determine the degree to which there are some common statements were presented. The graphs that pertain to the transportation and service clusters are pictured within this report to illustrate the effect that the identified common competencies have on existing occupational area profiles.
This graph shows the competencies that are common to all T & I occupational areas in the grid pattern at the top of each column. There are 15 common competencies in diesel mechanics, 20 in small engines, 23 in auto collision, 13 in auto mechanics, 12 in air conditioning, and 9 in electronics. Thus, there are 92 common competencies total in these six occupational areas.
This graph shows the competencies that are shared by occupational areas within the transportation and service clusters in the checked pattern. (Note that those competencies that are common across all occupational areas, shown in the last graph, are still shown in outline at the top of the columns.) There are 12 cross-cluster common competencies in diesel mechanics, 4 in small engines, 4 in auto collision, 13 in auto mechanics, 88 in air conditioning, and 24 in electronics. Thus, there are a total of 145 competencies that are common to occupational areas within the transportation and service clusters.
Transportation and Service Clusters: Cluster Level Competencies

This graph shows the competencies that are common to occupational areas within only the transportation cluster in the dotted pattern. (Again, outlines represent the competencies from the last two graphs at the tops of the columns.) There are 98 common cluster competencies in diesel mechanics, 43 in small engines, 36 in auto collision, and 68 in auto mechanics. Thus, the occupational areas in the transportation cluster have a total of 245 competencies in common. The occupational areas in the service cluster (air conditioning and electronics) have no further common competencies beyond those competencies shown in the last two graphs.
Finally, this graph represents those competencies that are so occupationally specific that they need to be taught only in a specific occupational area (shown as a solid bar at the bottom of the columns with competencies from the last three graphs in outline form at the top of the columns). There are 27 occupationally specific competencies in diesel mechanics, 23 in small engines, 129 in auto collision, 50 in auto mechanics, 24 in air conditioning, and 95 in electronics. Thus, there are 348 total competencies in these six occupational areas that would need to be taught only within individual occupational areas.
As these graphs show, within the transportation and service clusters, we identified 482 competencies (roughly 58 percent of the competencies on the six profiles involved) that had some degree of commonality. If these common competencies were organized and presented in some way to students prior to their enrollment in courses in these six areas, instructors in those courses could devote more time to the 42 percent of the competencies that are not common across occupational areas.

The presentation given to the committee at the final meeting, containing these graphs and similar graphs for the other cluster areas, is presented in Appendix D (pages D-1 through D-9). After the committee saw the graphs, they discussed questions related to the project’s outcomes (Appendix D, page D-10).

Project Results

Project results include: the list of issues facing T & I education developed by the committee (Appendix A, pages A-9 and A-10); the list of committee concerns (Appendix A, page A-11); and the lists of competencies created over the course of the project (Appendix C, pages C-4 through C-23). In addition, T & I directors and supervisors in the other 49 states were surveyed to determine whether these other states were engaged in projects similar to this one. Some of them requested and were sent this report. Results from New Jersey can be found in the Missouri Vocational Resource Center.

The committee structure and project timeliness did not permit detailed occupational or task analysis required to identify specific duty bands and competencies within the common and more specific occupational cluster groups. The committee recommends that a curriculum committee be formed to further develop the common competencies, and that separate committees be formed along occupational clusters to further determine cluster-related competencies.

Project Recommendations

As a result of the project, the committee recommends the consideration of the following in future program development:

**With regard to future curriculum development focusing on common skills within T & I:**

1) Provide further definition of the competencies (i.e., break the competencies into tasks). Include both technical and nontechnical instructors in the definition process.
2) Analyze what existing curriculum could be used.
3) Take a practical, modular approach to developing curriculum for the common competencies.
4) Take a multi-level approach that will reach students at different levels.
5) Be non-specific about careers and occupations. Be less concerned about developing curriculum that is solely constructed to support a particular occupational area. Reinforce some of the attitudes and behavior that should be important to all T & I areas.

6) Use applied content.

7) Work across the curriculum. Design curriculum that can be used by all occupational areas.

8) Maximize flexibility. Create curriculum that can be used with other curriculum or stand alone.

9) Analyze transferability of skills. Express the skills learned in such a way that they support multiple pathways, so students can change areas without penalty.

With regard to instruction on the common competencies:

1) Study the time component.

2) Examine the degree to which facilities, equipment, etc. can be shared.

3) Focus on these duty bands first:
   - Orientation (make sure students know what they are getting into, look at career paths)
   - Health and Safety
   - Trade-related Information (including computer-based resources)/Terminology
   - Print Reading and Symbolism
   - Material Sciences

Move on to these more specific duty bands after this first group is mastered:
   - Tools
   - Fasteners
   - Basic Electricity/Electronics
   - Precision Measurement

4) Utilize academic teachers.

With regard to pre-requisites for enrollment in T & I programs:

1) Identify what kinds of skills students should have coming into programs.

2) Identify what is viewed as the essential or critical skill level for admission to programs (vitaly important).

3) Develop a recommended sequence of courses that can be used in counseling students about T & I courses.

4) Insure that recommended courses focus on content, not on course titles, and that they focus on the common competencies.

5) Expose students who wish to enroll in a T & I area to the common competencies modules prior to their enrollment in occupational area courses.

6) Promote career pathways.
Items brought up in discussion that merit further debate include:

1) Explore opportunities to work with other program areas (i.e., agriculture, business, home economics) to develop career pathways, building courses of study that reach across program areas. Content should become more closely defined once the student gets to the junior or senior year in high school and prepares for a specific career.

2) Establish measurable, competency-based entrance tests, based on those skills that the common competency lists indicate a student should have prior to enrolling in T & I classes. These tests should be used to determine individual students' readiness to learn in the T & I classes; they should be diagnostic, not eliminating. The tests would provide instructors with a chance to determine remediation, or to set up developmental courses for students who have not followed the recommended course of study. Such tests would also be helpful in modifying curriculum for special populations.

3) Work toward acceptance of practical arts courses that meet graduation requirements.

4) Identify ways to help teachers who are implementing applied academics understand how their subject matter is used in technical occupations.

5) Integrate talents and resources within T & I education. Consider team teaching, meetings of T & I instructors, joint interdisciplinary projects, and tools and lab sharing.

6) Examine time spent by T & I instructors reinforcing math, science, communication, etc. skills.
APPENDIX A:

Presentations and Results from Initial Meeting
T & I Common Competencies Advisory Committee

Instructors

Francis Barnes
Auto Collision Repair
Lake AVTS

J.D. Boyd
Auto Mechanics
Crowder College

Walter Eudaley
Air Conditioning, Heating, Refrigeration
Poplar Bluff Career Center

Ken Garthe
Electrical Trades
West County AVTS

Jeff Huff
Drafting
South Central AVTS

Bob Jewett
Building Trades
Columbia Career Center

Pete Letterman
Welding
Graff AVTS

Mark Murphy
Electronics
Mexico AVTS

Max Vath
Machine Shop
Rolla Technical Institute

Administrators/Tech Prep Coordinators

Marc Doss
Tech Prep Coordinator
Graff AVTS

Larry Gorsh
Tech Prep Coordinator
Rolla Technical Institute

Wanda McCampbell
Assistant Director
Columbia Career Center

Rick Mihailevich
Tech Prep Coordinator
Linn Technical Institute

Jim Orr
Director
Graff AVTS

Don Walker
Director
Mexico AVTS

Instructional Materials Laboratory/
Department of Elementary and Secondary Education Staff

Kristin Desborough
Project coordinator
IML - UMC

Phyllis Miller
Assistant Director
IML-UMC

Pat Muenks
Supervisor
Industrial Education, DESE

A-1

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Pat Muenks Presentation - First meeting
T & I Common Competencies

Issues Facing Voc Ed and T & I Education

Tech Prep
School to Work Transition
Special Populations
Advancing Technologies
Graduation Standards
Collegiate Entrance Requirements
Facility/Instructional Aides/Curriculum
Recruitment Placement
TIME! TIME! TIME!

Academic and Occupational Credentials
### Trade and Industrial Secondary Enrollments

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### Trade and Industrial Placements

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13

**BEST COPY AVAILABLE**
Trade and Industrial Common Competencies

An Overview

Stage I  Orientation and Overview
   Establish Committee Direction
   Issue Committee Work Assignments
      -Competency Profile Review
      -Input on Design for Integration
      -Proponents

Stage II  IML and DESE Staff Study
   -Analyze Information
   -Draw Assumptions
   -Plot Strategies

Stage III  Instructor Committee Call Back
   -Call Back By Duty or Competency Area
   -Define Degree & Level of Commonality
   -Produce Matrix

Stage IV  Call Back of Original Committee
   -Review Matrix
   -Discuss Integration and Implications
   -Plan of Action
T & I Common Competencies

Implications of Proposed Outcomes

Teach Across Curriculum
Occupational Specialization
Career Education
Technical Course of Study
Prescribe Preparatory Content
Applied Situations for Academic Integration
Refinement of Activity Packets for Self-Directed Learning
Committee Results - First meeting
Related Issues
(Identified by the advisory committee at the first meeting)

Industrial Arts -
Industrial Arts is changing to Industrial Technology, where students are learning less of hands-on skills and more of technical skills that have less direct application within T & I programs.

Career Focus -
Students at an appropriate age need to be exposed to the opportunities that technical careers can provide and to various options available to students in vocational education.

Special Populations -
Instructors need to know how to manage and present instruction and modify curriculum so that special populations learn the skills necessary to succeed in a technical occupation.

College Prep in Technology Fields -
Technology programs need to be available to students who want to pursue a 4-year college education. For example, a future engineering student who wants to take design drafting or CAD should know that this option is open to him/her.

Perceptions -
Some people do not recognize the opportunities that exist for tradespeople, or the benefits of vocational education.

Summer Internship -
Students need year-round training, such as involvement in summer internships or youth apprenticeship programs.

Product -
The training objectives for T & I programs should be established. For instance, should students be able to enter the work force as laborers, as technicians, or at some other level?

Exploration -
Sequential development of courses and career pathways should allow students to explore various technical occupations.

Image -
Public perception of T & I education needs to be improved, not only outside of the school, but also within school buildings among other teachers, administrators, etc.
Counselors -
Counselors need to understand technical occupations and the opportunities that exist for students in these occupations.

Academic Skills -
Students should have attained the basic level academic skills that are required to succeed in T & I programs prior to their enrollment in the courses.

Getting to Junior High Grades -
Career pathways and sequences of courses need to be further developed so that they permit students at the junior high level to explore technical occupation opportunities and let them know what kinds of courses are required to help them succeed in T & I, technical occupations, industry, etc.

Student Motives -
Students should have realistic goals and be enrolled in T & I courses because they have a true interest in a technical career.

Affordable Technology in the Classroom -
T & I courses should have access to the latest technologies being employed in the industries for which they prepare students.

Integrated Academics Applied -
The opportunity to reinforce or apply academics within vocational courses should be seized, and opportunities to work with academic teachers should be explored.

Accommodate Post-Secondary Students -
Articulation agreements should be in place. Adult students should be encouraged, and developmental courses that might be needed by adult students should be offered.

First- and Second-Year Students -
Instruction must be organized to accommodate both first- and second-year students who are enrolled in the same class period.

Employer Recognition of Skills Students Have -
Students' credentials need to be exhibited in such a way that employers recognize and value the training these students have received.

Student Work Attitudes -
T & I programs should help students develop work maturity.
Issues Involving T & I Education
(Identified by the advisory committee at the first meeting)

Administrator/Tech Prep Coordinators

Finances
Selling programs to parents
Making sure students are ready to learn
Designing one-year, two-year exit points
Developing career paths (transferability of skills)

Instructors

Remediation of basic academic skills
Raising program quality
Integrating academics/shared teaching
Teaming with counselors, academic instructors
Students not prepared to learn academically (reading, math)
Defining specific prerequisite skills
Testing to insure prerequisite skills
Meeting standards for industry certification
Working with academic teachers to educate them about T & I
Defining course of study that extends to home schools
Eliminating scheduling problems
Establishing a work-bound focus
Pacing instruction (not necessarily passing students on to graduate with class in 12 years)
Building enabling competencies at lower grades (technical skills)
Shortening courses (focus solely on essential competencies)
Providing opportunities for remedial instruction
Setting specific class entrance standards (measurable)
Counselor-directed scheduling
APPENDIX B:

Results from Initial Analysis of Material Generated by First Meeting
Cluster Divisions
Common Competencies Project
Program Areas Divided Into Clusters

Construction Cluster:
  - Building Maintenance
  - Building Trades
  - Cabinetmaking
  - Electrical Trades
  - Masonry
  - Plumbing

Manufacturing Cluster:
  - Drafting
  - Machine Shop
  - Welding

Service Cluster
  - Air Conditioning, Heating, Refrigeration
  - Electronics

Transportation Cluster
  - Auto Collision Repair
  - Auto Mechanics
  - Diesel Mechanics
  - Small Engines

“Other” Cluster
  - Commercial Art
  - Cosmetology
  - Food Service
  - Offset Lithography
Competencies By Group
Groups of Competencies: 
First Analysis

Group One: 
Competencies common to all 19 T & I Areas

Seven Divisions:
- Blueprints/plans/diagrams
- Careers/orientation
- Documentation
- Electricity
- Measurement
- Safety
- Tools

Group Two:
Competencies common to at least two program areas

14 Divisions (corresponding to 14 program areas where common competencies were found; other 5 had no common competencies identified beyond those in group one)
- Air conditioning, heating, refrigeration
- Auto collision technology
- Auto mechanic
- Building maintenance
- Building trades
- Cabinet making
- Diesel mechanic
- Drafting
- Electronics
- Electrical trades
- Machine shop
- Plumbing
- Small engines
- Welding

Group Three:
Competencies common only to one cluster area

Three Divisions (corresponding to three clusters that had cluster-related skills):
- Construction
- Manufacturing
- Transportation
Group One Competency Lists, Draft One
Blueprints/Plans/Diagrams, etc.

**Blueprints**
- ET E2. Read and measure from blueprints and specifications
- P B5. Read and interpret a blueprint
- MA F3. Read and interpret an architectural blueprint
- BM A8. Read blueprints
- CM E6. Read a blueprint
- MS D2. Interpret blueprint
- W B1. Read and interpret basic prints
- MS D8. Plan sequence of part layout based on blueprint information
- ET E3. Locate and identify residential construction components
- ET E4. Locate and identify commercial construction components
- BT B2. Interpret blueprint symbols

**Plans/Specifications**
- MA F4. Read and interpret a set of specifications
- MA F5. Read and interpret an electrical plan
- MA F6. Read and interpret a structural plan
- MA F7. Read and interpret a mechanical plan
- MA F8. Read and interpret a site plan
- MA F9. Read and interpret a finish schedule

**Diagrams/Schematics**
- AC D4. Interpret electrical diagrams
- AC F15. Interpret wiring diagram - refrigerator
- AC H21. Interpret wiring diagrams - heating systems
- ELEC B17. Interpret symbols and schematic diagrams
- AC Other Schematics

**Drawings**
- BT B1. Read and interpret working drawings
- ET D7. Demonstrate techniques of sketching and diagramming
- P B6. Sketch plumbing layout
- MA E6. Draw lines and objects to scale
- CM E7. Prepare a layout and cut sheet
- MS D3. Make a sketch from a finished workpiece
- W B3. Construct an exercise(s) using basic print and sketch
- W B4. Make sketches - pictorial and orthographic
- DR C1. Layout drawing
- DR C2. Construct borders and information blocks
- DR C3. Construct freehand sketches
- DR C4. Read and transfer measurements
- DR C5. Letter freehand (letters and numerals)
DR D1. Bisect lines, angles and arcs
DR L2. Produce simple electrical/electronic drawings and schematics
DR O1. Produce a simple detail and assembly drawing applying standard fits and tolerances
DR Q2. Produce representative sheet metal drawings

Symbols
ET E1. Identify trade symbols used in electrical drawings
ET Other Identify electrical symbols and abbreviations
MS D1. Interpret meaning of common drafting symbols
W B2. Interpret welding symbols, abbreviations and joint designs

Scales
MA F1. Read and interpret the architect's scale
MA F2. Identify the uses of the engineer's scale

Cost/Materials estimates
ET E5. Estimate and calculate construction costs
MA F10. Estimate the amount of material for a job
CM E8. Estimate materials and costs from a blueprint and/or cut sheet

Tolerances/Dimensions
MS D4. Calculate tolerances and allowances
MS D5. Calculate missing dimensions
MS D6. Use geometric dimensioning and tolerancing
W B5. Interpret structural shapes, sizes and weights

Others
BT B3. Identify the steps of the building process
DR O2. Develop a parts list
Careers/Orientation

Identifying Jobs/Employment Opportunities

<table>
<thead>
<tr>
<th>Code</th>
<th>Identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET</td>
<td>D5.</td>
<td>Identify job classifications and prerequisites for employment</td>
</tr>
<tr>
<td>BM</td>
<td>A1.</td>
<td>Identify building maintenance occupations and related fields</td>
</tr>
<tr>
<td>DR</td>
<td>A4.</td>
<td>Identify drafting occupations and related fields</td>
</tr>
<tr>
<td>AB</td>
<td>A1.</td>
<td>Identify opportunities in the auto body field</td>
</tr>
<tr>
<td>P</td>
<td>B1.</td>
<td>Identify employment opportunities in the plumbing trade</td>
</tr>
<tr>
<td>MA</td>
<td>A1.</td>
<td>Identify employment opportunities in the masonry trade</td>
</tr>
<tr>
<td>CM</td>
<td>A15.</td>
<td>Identify job opportunities in the area of cabinetmaking</td>
</tr>
<tr>
<td>AM</td>
<td>C2.</td>
<td>Identify auto mechanics career opportunities and the duties of a technician</td>
</tr>
<tr>
<td>FS</td>
<td>A1.</td>
<td>Identify career opportunities</td>
</tr>
<tr>
<td>FS</td>
<td>A4.</td>
<td>Identify career ladder</td>
</tr>
</tbody>
</table>

Finding/Keeping a Job

<table>
<thead>
<tr>
<th>Code</th>
<th>Identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>N1.</td>
<td>Identify methods of finding a job</td>
</tr>
<tr>
<td>CA</td>
<td>N2.</td>
<td>Identify methods of finding a school</td>
</tr>
<tr>
<td>CA</td>
<td>O3.</td>
<td>Prepare for job interview</td>
</tr>
<tr>
<td>CA</td>
<td>O4.</td>
<td>Prepare resume</td>
</tr>
<tr>
<td>FS</td>
<td>A7.</td>
<td>Practice job seeking skills</td>
</tr>
<tr>
<td>CA</td>
<td>N3.</td>
<td>Identify methods of keeping a job</td>
</tr>
</tbody>
</table>
Documentation

Manuals/Catalogs/Other Books
AB E2. Use collision manuals
AM B3. Obtain appropriate repair information from shop manuals
DM A5. Use reference books, parts books and charts
W A7. Obtain and use reference books and charts
SE A4. Demonstrate ability to use service manuals, part catalogs and price lists
P B7. Read and interpret catalog information
P B8. Read and interpret specifications
MS D7. Use Machinery's Handbook to plan work

Reports/Orders/Records
AC K1. Fill out service report
AC Other Work Orders
AM B1. Communicate with customers and write repair orders
AC Other Customer Relations
DR A5. Apply recordkeeping procedures
COS f5. Perform procedures for booking appointments

Estimates
AM B2. Estimate time and cost of job and order parts
OL A2. Estimate job costs (space and utilities, labor, and supplies)
OL A3. Compute customer's cost (planning, scheduling)
P B9. Prepare a bill of materials

Understanding Laws/Standards
AC Other OSHA & EPA Laws
BT A13. Identify purposes of building codes, zoning laws, and building permits
P B10. Read and interpret applicable codes
DR A3. Identify American National Standards Institute, Inc. (ANSII) and International Standards Organization (ISO) standards (terminology)
## Electricity Concepts/Theories/Basics

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>K2. Demonstrate knowledge of basic electricity</td>
</tr>
<tr>
<td>AC</td>
<td>D2. Describe the major concepts of electrical theory</td>
</tr>
<tr>
<td>ET</td>
<td>Other Demonstrate knowledge of the basic fundamentals of electricity</td>
</tr>
<tr>
<td>BM</td>
<td>D1. Identify electrical safety practices</td>
</tr>
<tr>
<td>DR</td>
<td>L1. Identify electrical/electronic symbols</td>
</tr>
</tbody>
</table>

### Related Concepts/Theories/Basics

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>N2. Demonstrate an understanding of basic AC theory and operation</td>
</tr>
<tr>
<td>AC</td>
<td>E2. Describe concept of control theory and application</td>
</tr>
<tr>
<td>AC</td>
<td>E18. Describe concept of programmable thermostats</td>
</tr>
<tr>
<td>ELEC</td>
<td>B1. Describe atomic structure and its relationship to electricity</td>
</tr>
<tr>
<td>ELEC</td>
<td>B2. Describe the basic physics of semiconductor materials</td>
</tr>
<tr>
<td>ELEC</td>
<td>B3. Describe the relationship between electrical and magnetic properties</td>
</tr>
<tr>
<td>ELEC</td>
<td>B4. Describe the electrical and magnetic properties of a magnet</td>
</tr>
<tr>
<td>ELEC</td>
<td>B5. Describe the photoelectric effect</td>
</tr>
<tr>
<td>ELEC</td>
<td>B6. Describe the thermocouple effect</td>
</tr>
<tr>
<td>ELEC</td>
<td>B7. Describe the electrical effect of friction</td>
</tr>
<tr>
<td>ELEC</td>
<td>B8. Describe the concept of resistance, voltage and current and how they relate to each other</td>
</tr>
<tr>
<td>ELEC</td>
<td>B9. Describe the concept of capacitance, voltage and current and how they relate to each other</td>
</tr>
<tr>
<td>ELEC</td>
<td>B10. Describe the concept of inductance, voltage and current and how they relate to each other</td>
</tr>
<tr>
<td>ELEC</td>
<td>C1. Describe types of transformers</td>
</tr>
<tr>
<td>ELEC</td>
<td>C2. Determine transformer requirements</td>
</tr>
<tr>
<td>ELEC</td>
<td>C3. Determine rectifier (diode) specifications for specific installations</td>
</tr>
<tr>
<td>ELEC</td>
<td>D2. Describe the operation of junction diodes</td>
</tr>
<tr>
<td>ELEC</td>
<td>D3. Describe the operation of bipolar transistors</td>
</tr>
<tr>
<td>ET</td>
<td>B1. Identify the scientific theory of electricity as it relates to basic chemical, static and magnetic forms</td>
</tr>
<tr>
<td>W</td>
<td>A14. Identify basic power sources</td>
</tr>
<tr>
<td>W</td>
<td>E2. Describe theory of shielded metal arc welding</td>
</tr>
<tr>
<td>W</td>
<td>E3. Identify and select power source and set current for weld procedure</td>
</tr>
<tr>
<td>COS</td>
<td>e3. Give the definition for atoms</td>
</tr>
<tr>
<td>COS</td>
<td>e4. Give the definition for molecules</td>
</tr>
<tr>
<td>COS</td>
<td>e7. Identify the physical properties of matter</td>
</tr>
</tbody>
</table>

### Meters/Other Tools

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE</td>
<td>F1. Read and interpret electrical meters</td>
</tr>
<tr>
<td>ELEC</td>
<td>H2. Describe the operation and demonstrate the use of multimeters; i.e., VOM, EVM or DVM</td>
</tr>
</tbody>
</table>
ET H1. Use a volt ohmmeter
AM D4. Measure volts with a voltmeter or oscilloscope.
ET H2. Use a clamp-on ammeter
AM D5. Measure current with an ammeter.
ET H3. Use a receptacle polarity testing device
ELEC H1. Describe the operation and demonstrate the use of an oscilloscope
AC Other Servomechanisms
AC Other Rheostats
AC Other Magnetic-Electromagnetic Devices
AC Other Calibration Meters
AC Other Motor Controllers (Servos)
AC Other Condenser-Capacitor
AC Other Basic Electronics

Schematics/Tables
SE F2. Read electrical schematics
ET D3. Interpret conduit fill table using the NEC as a reference
ET D4. Identify and comply with local compliance codes

Calculations
ELEC B15. Calculate series and parallel; resistive, capacitive and inductive networks
ELEC B18. Calculate RC time constant circuits
ELEC B11. Solve AC network problems utilizing appropriate theorems and laws
ET B2. Solve problems using Ohm’s law
ET B3. Solve problems using Watt’s law
ET B4. Solve problems using Kirchhoff’s law

Systems
ET F11. Identify parts of a breaker load center
ET G6. Diagram and install a single-pole switching system
ET G7. Diagram and install a three-way switching system
ET G8. Diagram and install a three-way and four-way switching system
ET G9. Diagram and install a GFCI (ground-fault circuit interrupter) system
ET G13. Design and install a residential lighting system
ET G17. Diagram and install a low-voltage system

Circuits
ET Other Determine the current-carrying capacity of circuits
ET Other Size and select circuit conductors, components, devices and outlet boxes
ET Other Divide wiring into circuits according to service and load
ET Other Perform appropriate tests to ensure electrical continuity, compatibility and safety

B-12
AM D1. Check continuity in electrical circuits using test light and voltmeter, oscilloscope, and wiring diagram.
AM D2. Check for shorts, opens, and grounds
AM D3. Measure resistance in electrical circuits using an ohmmeter
BM D4. Wire circuits--115 (15 and 20 amp.) 240--to code
BM D5. Wire low-voltage circuit
AC Other Control Circuits

<table>
<thead>
<tr>
<th>Wiring</th>
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</thead>
<tbody>
<tr>
<td>ET</td>
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<tr>
<td>ET</td>
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<tr>
<td>AC</td>
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<tr>
<td>AC</td>
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<td>AC</td>
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<td>AB</td>
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<tr>
<td>AC</td>
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<tr>
<td>ET</td>
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<tr>
<td>ET</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Test/Diagnose/Troubleshoot</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC D3. Identify and use test equipment</td>
</tr>
<tr>
<td>BM D6. Use electrical test equipment</td>
</tr>
<tr>
<td>DM K3. Perform common diagnostic tests</td>
</tr>
<tr>
<td>AC D6. Test capacitors</td>
</tr>
<tr>
<td>ELEC B13. Identify and test capacitors</td>
</tr>
<tr>
<td>AC D9. Test electrical components</td>
</tr>
<tr>
<td>ELEC B12. Identify and test resistors</td>
</tr>
<tr>
<td>ELEC B14. Identify and test inductors</td>
</tr>
<tr>
<td>ELEC D13. Test diodes</td>
</tr>
<tr>
<td>ELEC D14. Test transistors</td>
</tr>
<tr>
<td>AC Other Troubleshooting or Problem Solving Skills</td>
</tr>
<tr>
<td>AC D5. Trouble shoot complete electrical circuit</td>
</tr>
<tr>
<td>BM D2. Troubleshoot and replace outlets, switches, fuses, breakers and fixtures</td>
</tr>
<tr>
<td>AB S4. Diagnose and repair electrical accessories</td>
</tr>
<tr>
<td>P G27. Thaw frozen pipes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Repair/Replace</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE F4. Test, repair, and/or replace safety interlock</td>
</tr>
<tr>
<td>SE F5. Test, repair, and/or replace charging system components</td>
</tr>
<tr>
<td>SE F6. Test and replace sending units</td>
</tr>
<tr>
<td>SE L1. Test and repair starter solenoid</td>
</tr>
<tr>
<td>DM K6. Repair and/or replace starter</td>
</tr>
<tr>
<td>SE L3. Repair or replace related electrical components including safety devices</td>
</tr>
</tbody>
</table>

B-13
Install, replace and adjust electrical controls
Install and replace solid-state control
Install, repair, replace and adjust time control
Install and replace current relay
Install and replace potential relay
Install and replace control relay
Install and replace transformer
Repair and replace condensor
Repair and replace metering devices
Test and repair electromechanical control devices
Test and repair analog electronic control devices
Test and repair digital electronic control devices
Replace gas water heater thermocouple
Replace electric water heater
Replace electric water heater elements
Replace electric water heater thermostats
Repair or replace charging system components.
Repair or replace lights, sockets, wires, and switches.
Diagnose and repair gauge and warning circuits.
Diagnose and repair electrical accessories (horn, wiper, motor).
Inspect, adjust, and replace sensors, cables, and actuators.
Change light bulbs and perform minor electrical repairs
Service thermal couple and pilot light
Replace thermostats/electrical controls

Describe the major concepts of electric motor theory
Install and replace electric motor
Repair and/or replace electrical motors
Remove, clean, and inspect starter motor and components.
Repair or replace starter motor
Test and repair a DC motor
Test and repair an AC motor (single and polyphase)
Replace motor control devices

Clean and inspect battery clamps, cables, and connectors.
Perform battery condition tests.
Charge and install a battery.
Service a battery
Service battery
Test, service, and/or replace battery
Measurement

Measurement Tools
BT  A3.  Read a rule
MA  E3.  Read a rule
CM  A4.  Read a rule
MA  E4.  Read a spacing rule
MA  E5.  Read a modular rule
AB  B1.  Read a rule, fractional-inch and metric
BM  A7.  Identify measuring instruments
BT  A2.  Identify and use measuring and layout tools
CM  A3.  Identify and use measuring and layout tools
P  B3.  Read measuring devices
DM  A10. Use precision measurement tools
SE  A3.  Demonstrate ability to work accurately with precision tools and instruments
AC  H9.  Adjust metering device
MA  E8.  Set up and adjust the builder's level
MS  B4.  Use calculator to perform mathematical operations

Care for Tools
MS  C1.  Care for precision instruments
SE  B4.  Demonstrate the proper use and care of precision measuring tools and equipment

Measurements
SE  C2.  Measuring bolts and threads, SAE grade and metric
MA  E9.  Lay out footings and foundations
MS  C2.  Measure workpiece with tape measure
MS  C3.  Measure workpiece with pocket rule
MS  C4.  Measure workpiece with slide caliper rule
MS  C5.  Lay out work with combination square
MS  C6.  Transfer measurement with dividers
MS  C7.  Lay out workpiece with hermaphrodite calipers
MS  C8.  Measure workpiece with spring calipers
MS  C9.  Measure workpiece with vernier calipers
MS  C10. Measure workpiece with depth gages
MS  C11. Measure workpiece with micrometers
MS  C12. Measure workpiece with dial calipers
MS  C12. Measure workpiece with telescoping and small hole gages
MS  C14. Check work with gages; i.e., plug and ring gages
MS  C15. Measure workpiece with height gages
MS  C16. Lay out workpiece and measure on surface plate
MS  C17. Measure workpiece on surface plate
Measure workpiece with dial indicators and attachments
Make layout of material for plate, structural and pipe fabrication
Indicate percentage of enlargement or reduction required on photos
Check and record short block measurements.
Check and record component measurements.
Other Reading Micrometers
Other Calipers
Test temperatures
Measure frequency response of amplifiers
Apply geometric dimensioning and tolerancing techniques
Apply basic mathematic principles
Apply basic geometric principles
Apply basic trigonometric principles
Perform general mathematical calculations
Solve basic mathematical calculations
Perform basic mathematical calculations
Demonstrate math & measuring to 1/16" using fractions & decimals
Convert common fraction to decimal fraction and vise versa
Solve basic ratio and proportion problems
Solve problems involving volume and ratios
Calculate measurements of right triangles
Calculate plane geometry/math applications
Apply math to solution of welding problems- whole numbers, fractions, decimals, geometry and trigonometry
Estimate square feet
Calculate square feet
Estimate linear feet
Calculate linear feet
Estimate cubic feet
Calculate board feet
Calculate allowable ampacities for various conductors using the NEC as a reference
Calculate tap drill size with formula and charts
Calculate part and feature dimensions and locations
Calculate feeds and speeds
Calculate sine bar set-up
Convert customary measurements to metric and vice versa
Convert revolutions per minute (RPM) to surface feet per minute (SFPM)
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR</td>
<td>H5. Read and convert measurements</td>
</tr>
<tr>
<td>DR</td>
<td>H3. Identify use and application of dimensioning practices</td>
</tr>
<tr>
<td>DR</td>
<td>H4. Identify tolerancing</td>
</tr>
<tr>
<td>DR</td>
<td>H6. Identify geometric dimensioning and tolerancing techniques</td>
</tr>
<tr>
<td>BT</td>
<td>B4. Estimate labor costs</td>
</tr>
<tr>
<td>FS</td>
<td>B2. Recognize labor costs</td>
</tr>
<tr>
<td>CM</td>
<td>A8. Calculate material costs</td>
</tr>
<tr>
<td>MS</td>
<td>B5. Calculate amount of stock required</td>
</tr>
<tr>
<td>FS</td>
<td>B4. Recognize profits/loss</td>
</tr>
</tbody>
</table>
Safety

**Identify Shop Safety**
- AB D2. Identify general safety rules
- BM A2. Identify safe shop procedures/practices
- DM A2. List shop safety rules and regulations
- MA B1. Complete a safety checklist
- COS A6. Complete safety test

**Inspect Shop For Safety**
- DM A3. Inspect work areas for safe work environment
- MS A4. Inspect work area for safe work environment
- AC A2. Inspect shop for hazards
- P A6. Identify and report potential safety hazards
- W A1. Identify and correct or report safety hazards
- ELEC A2. Identify electrical hazards
- ELEC A6. Identify hazard of RF radiation devices
- W A4. Identify ventilation hazards and take corrective action

**Protective Clothing/Equipment**
- AB D3. Use protective clothing and equipment
- P A9. Wear required safety equipment; i.e., safety glasses, protective clothing, ear plugs, and hard hat
- AM A4. Identify the safe use of protective clothing and equipment
- ET A3. Identify and demonstrate proper personal safety procedures, i.e., clothing, jewelry, personal grooming

**Fire Prevention/Protection**
- ET A4. Identify techniques and practices of fire prevention
- W A2. Identify and utilize proper storage for flammables
- P A13. Practice fire safety when operating heating equipment or hot materials
- AB D4. Identify the proper use of fire protection equipment
- AM A5. Identify the safe use of fire protection equipment
- BM A4. Identify fire safety equipment
- AC A1. Identify types, purposes, and operation of fire extinguishers
- ELEC A1. Identify various types, purposes and operation of fire extinguishers
- P A12. Identify types of fire extinguishers and their proper use
- MA B4. Identify types of fire extinguisher and their uses
- W A3. Identify and demonstrate correct use of fire extinguishers
- FS D9. Use fire extinguishers
- COS A3. Operate a fire extinguisher
First Aid
ET A5. Identify appropriate first aid procedures
BM A3. Identify emergency first aid procedures
FS D10. Use first aid
COS A4. Qualify in basic first aid procedures
COS A5. Pass Red Cross First Aid test
FS D11. Perform Heimlich Maneuver
FS D12. Use CPR

Safety Practices - Various Categories
BM C1. Identify plumbing safety practices
BM D1. Identify electrical safety practices
BM E1. Review carpentry safety practices
BM F1. Identify finishing safety practices
BM H1. Identify masonry safety practices
BM J1. Identify grounds maintenance safety procedures
P A14. Demonstrate safe practices when using flux
ET A2. Identify safe and unsafe practices when working with electricity

Operate Safely - General
DM A1. Operate safely in the workshop
MS A1. Operate safely in the workshop
AC A3. Work cautiously and safely
MA B2. Demonstrate the ability to work safely
COS A1. Demonstrate the ability to work safely
ELEC A3. Identify and practice shop safety
SE A1. Demonstrate proficiency in general safety practices
AC C2. Demonstrate safety procedures and precautions
BT A1. Demonstrate good safety practices
P A1. Demonstrate good safety practices
CM A1. Demonstrate good safety practices
W C1. Demonstrate safety procedures
DR A1. Apply safety policies and procedures

Follow Safety Rules and Regulations
P A5. Observe safety signs and color codes
ET A1. Apply shop rules and regulations
AM A7. Follow Environmental Protection Agency (EPA) and Occupational Safety and Health Act (OSHA) regulations
W A5. Observe and adhere to safety labels

Maintaining Work Area
P A4. Maintain work area properly
Practice clean and orderly work habits (vehicle, tools, and work area)

Demonstrate the ability to keep a clean, orderly and safe work area

Demonstrate the ability to keep a clean, orderly, and safe work area

**Body Mechanics Proper Lifting**

- **FS** D4. Use correct body mechanics
- **P** A2. Demonstrate proper techniques for lifting and carrying
- **MA** B5. Demonstrate proper techniques for lifting and carrying

**Tools (General, Hand, Pneumatic, Power)**

- **AC** C8. Use tools and instruments safely
- **W** A6. Maintain, use and safely work with machines, tools and equipment
- **AB** C1. Demonstrate safe use and maintenance of general hand tools
- **AM** A2. Identify the safe use of hand tools
- **ELEC** A5. Demonstrate safe and proper use of hand tools
- **P** A10. Demonstrate safe procedure when using hand tools
- **AB** C3. Demonstrate safe use and maintenance of electric and pneumatic hand tools
- **BT** A6. Use pneumatic tools safely
- **P** A8. Safely operate fuel-air torch
- **AM** A3. Identify the safe use of power tools
- **P** A11. Demonstrate safe procedures when using power tools
- **ET** A6. Demonstrate safe use of tools and related power equipment
- **AB** C4. Demonstrate safe use and maintenance of electric, pneumatic, and hydraulic equipment
- **MS** G1. Employ power saw safety guidelines consistently
- **MS** K1. Employ grinder safety guidelines consistently
- **MS** K2. Clean and lubricate grinders
- **MS** K3. Select and apply cutting fluids
- **MS** K4. Inspect grinding wheel
- **MS** K5. Balance grinding wheel
- **MS** K6. Select and mount grinding wheel
- **MS** K7. Dress and true machine tool grinding wheel
- **MS** K8. Grind workpiece on magnetic chuck using power feed
- **ELEC** A4. Identify and practice safe soldering methods

**Equipment**

- **AM** A6. Identify the safe use of shop equipment
- **BM** B3. Identify safety rules for erecting scaffolding
- **MA** B6. Demonstrate proper installation and use of scaffolding
- **P** A7. Practice ladder and scaffold safety
<table>
<thead>
<tr>
<th>Code</th>
<th>Code 2</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM</td>
<td>B2.</td>
<td>Identify safety rules for carrying and erecting a ladder</td>
</tr>
<tr>
<td>ET</td>
<td>A7.</td>
<td>Apply techniques of lifting and climbing with ladders</td>
</tr>
<tr>
<td>P</td>
<td>A3.</td>
<td>Exercise extreme caution working around electric lines and equipment</td>
</tr>
<tr>
<td>AB</td>
<td>C5.</td>
<td>Describe proper fitting and jacking techniques</td>
</tr>
<tr>
<td>ELEC</td>
<td>A7.</td>
<td>Demonstrate safe and proper use of AC line operated equipment; i.e., isolation transformers, grounding, GFI</td>
</tr>
<tr>
<td>BM</td>
<td>G1.</td>
<td>Identify safety practices for servicing environmental control systems</td>
</tr>
<tr>
<td>BM</td>
<td>II.</td>
<td>Identify safety practices for servicing grounds maintenance equipment</td>
</tr>
</tbody>
</table>

**Supplies**

<table>
<thead>
<tr>
<th>Code</th>
<th>Code 2</th>
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<tbody>
<tr>
<td>AB</td>
<td>S5.</td>
<td>Use chemicals safely</td>
</tr>
<tr>
<td>AM</td>
<td>A1.</td>
<td>Identify the safe use of chemicals</td>
</tr>
<tr>
<td>AB</td>
<td>D6.</td>
<td>Identify environmental effects of chemicals</td>
</tr>
<tr>
<td>AB</td>
<td>D7.</td>
<td>Identify proper chemical disposal techniques</td>
</tr>
<tr>
<td>AB</td>
<td>D8.</td>
<td>Identify information on and importance of MSD sheets</td>
</tr>
<tr>
<td>AB</td>
<td>D9.</td>
<td>Identify important toxic substances</td>
</tr>
<tr>
<td>FS</td>
<td>D6.</td>
<td>Use and properly store hazardous products</td>
</tr>
<tr>
<td>AC</td>
<td>A5.</td>
<td>Demonstrate knowledge of safe refrigerant handling</td>
</tr>
</tbody>
</table>
## Tools

### Identify

<table>
<thead>
<tr>
<th>Code</th>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE</td>
<td>B1.</td>
<td>Identify common hand tools</td>
</tr>
<tr>
<td>MA</td>
<td>C1.</td>
<td>Identify common hand tools</td>
</tr>
<tr>
<td>BM</td>
<td>A5.</td>
<td>Identify hand tools</td>
</tr>
<tr>
<td>W</td>
<td>A9.</td>
<td>Identify basic hand tools</td>
</tr>
<tr>
<td>CM</td>
<td>A9.</td>
<td>Identify and properly use hand tools</td>
</tr>
<tr>
<td>P</td>
<td>C1.</td>
<td>Identify and use common hand tools</td>
</tr>
<tr>
<td>DM</td>
<td>A4.</td>
<td>Identify and use hand and power tools</td>
</tr>
<tr>
<td>BT</td>
<td>A4.</td>
<td>Identify proper use of power and hand tools</td>
</tr>
<tr>
<td>MA</td>
<td>C2.</td>
<td>Identify common power tools</td>
</tr>
<tr>
<td>BM</td>
<td>A6.</td>
<td>Identify power tools</td>
</tr>
<tr>
<td>SE</td>
<td>B5.</td>
<td>Identify and use related power tools</td>
</tr>
<tr>
<td>P</td>
<td>C2.</td>
<td>Identify and use common power tools</td>
</tr>
<tr>
<td>SE</td>
<td>B3.</td>
<td>Identify precision measuring tools and equipment</td>
</tr>
<tr>
<td>SE</td>
<td>B7.</td>
<td>Identify common cutting tools</td>
</tr>
<tr>
<td>SE</td>
<td>B9.</td>
<td>Identify and use tools to restore threads on fasteners</td>
</tr>
<tr>
<td>AC</td>
<td>C7.</td>
<td>Identify and use related tools and instruments - tubing and connections</td>
</tr>
<tr>
<td>AC</td>
<td>F17.</td>
<td>Identify and use related tools and instruments - domestic refrigeration</td>
</tr>
<tr>
<td>AC</td>
<td>H30.</td>
<td>Identify and use related tools and instruments - commercial cooling/heating</td>
</tr>
</tbody>
</table>

### Selecting

<table>
<thead>
<tr>
<th>Code</th>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>A10.</td>
<td>Select, use and care for hand tools</td>
</tr>
<tr>
<td>MA</td>
<td>C3.</td>
<td>Select and use appropriate hand tools according to the job</td>
</tr>
<tr>
<td>MA</td>
<td>C4.</td>
<td>Select and use appropriate power tools according to the job</td>
</tr>
<tr>
<td>ET</td>
<td>Other</td>
<td>Demonstrate skill in the selection, use and care of electrician’s hand/power tools</td>
</tr>
<tr>
<td>MS</td>
<td>H4.</td>
<td>Select proper drill type based on job requirements</td>
</tr>
</tbody>
</table>

### Care For

<table>
<thead>
<tr>
<th>Code</th>
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<th>Description</th>
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<tbody>
<tr>
<td>MS</td>
<td>L2.</td>
<td>Perform care and maintenance</td>
</tr>
<tr>
<td>SE</td>
<td>A2.</td>
<td>Use proper techniques in the care and use of tools and equipment</td>
</tr>
<tr>
<td>CM</td>
<td>A14.</td>
<td>Maintain/service hand tools</td>
</tr>
<tr>
<td>SE</td>
<td>B2.</td>
<td>Demonstrate the proper use and care of hand tools</td>
</tr>
<tr>
<td>MS</td>
<td>E1.</td>
<td>Use and care for hand tools</td>
</tr>
<tr>
<td>SE</td>
<td>B6.</td>
<td>Demonstrate the proper use and care of related power tools</td>
</tr>
<tr>
<td>CM</td>
<td>B11.</td>
<td>Maintain/service power tools and equipment</td>
</tr>
<tr>
<td>SE</td>
<td>B8.</td>
<td>Demonstrate the proper use and care of cutting tools</td>
</tr>
<tr>
<td>MS</td>
<td>H18.</td>
<td>Sharpen drills with grinding attachments and/or specialized grinders</td>
</tr>
</tbody>
</table>

B-22
MS L3. Inspect grinding wheels
MS L4. Select and mount grinding wheel
MS L5. Dress and true grinding wheel

Safety
MS L1. Employ safety guidelines
W A11. Use power machinery, grinder, drill press and power saw safely/correctly
AC Other Power Tool Safety
AC Other Air Tool Safety
MS H1. Employ drill press safety guidelines consistently

Hand Tools
BT C1. Use Builder's level
ET C3. Set up and use a hacksaw
MS E2. Cut materials with hand hack saw
ET C4. Use a hole punch
ET C5. Use pouch tools
ET C6. Operate brace and bit
MS E3. Bench file/deburr workpiece
MS E6. Cut threads with die
MS E7. Cut threads with hand tap
MS E8. Ream holes with hand reamer
MS E12. Grind using appropriate hand grinder
MS E13. Remove damaged screws
MS E14. Remove broken drills and taps
MS E15. Remove and install dowel pins

Power Tools
ET C7. Operate common electrical power tools
ET C8. Operate common hydraulic power tools
P C13. Operate a reciprocation saw
CM B7. Set up and operate band saw safely and accurately
CM B2. Set up and operate table saw safely and accurately
CM B3. Set up and operate radial arm saw safely and accurately
P C12. Operate a right-angle drill
MS H8. Drill holes to specification using manual feed
CM B4. Set up and operate drill press safely and accurately
MS H3. Set up and clamp workpiece to drill press table
CM B10. Set up and operate bench grinder safely and accurately
MS E9. Dress and true grinding wheels on pedestal/bench grinder
MS E10. Grind and shape tools on pedestal/bench grinder

B-23
Pneumatic Tools

CM A10. Use pneumatic tools safely
CM B1. Demonstrate safe use of portable air/electric tools
Group Two Competency Lists, Draft One

Color Codes:

Blue - Occupations in the CONSTRUCTION Cluster
Peach - Occupations in the MANUFACTURING Cluster
Yellow - Occupations in the SERVICE Cluster
Green - Occupations in the TRANSPORTATION Cluster
Gray - Occupations in the OTHER Cluster
Building Maintenance
Cross-Cluster Common Competencies, Draft One

BM B7. Clean windows
BM C2. Cut and glue plastic pipe
BM C3. Cut and solder copper pipe
BM C4. Cut and thread pipe
BM C5. Form a flare
BM C6. Install a compression fitting
BM C10. Locate and repair leaks in pipes and lines
BM C11. Clean traps, drains and vents
BM C12. Clean and sanitize plumbing fixtures
BM E11. Clean and refinish floors
BM E12. Clean walls
BM F2. Prepare surface for finish
BM F3. Select correct finishing materials
BM F4. Stir or shake finishing materials
BM F7. Apply finish with paint sprayer
BM F8. Clean and properly store finishing equipment and materials
BM G2. Adjust/replace belts
BM G5. Clean and/or replace heating elements
BM G6. Clean condensing unit
BM G7. Clean an evaporator coil
BM G9. Clean and check flues
BM G10. Replace a furnace or cooling filter
BM I2. Change oil, filters, and service breather
BM I3. Remove, service, and replace spark plugs
BM I4. Sharpen and balance blades; lubricate spindle assemblies
BM I5. Select and add fuel
BM I9. Adjust and/or replace belts
BM I11. Service trimmer
BM J8. Identify procedures for use of pesticides
BM Other Chemicals
Building Trades
Cross-Cluster Common Competencies, Draft One

BT A5. Identify and use nails and fasteners
BT A11. Identify methods and materials for thermal insulation
BT C2. Establish elevation reference points from Bench Mark
BT H2. Install chimney flashing
BT H3. Install step flashing
BT H5. Install roof vent
BT H6. Install drip cap
Cabinet Making  
*Cross-Cluster Common Competencies, Draft One*

<table>
<thead>
<tr>
<th>CM</th>
<th>A2.</th>
<th>Demonstrate safe housekeeping practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM</td>
<td>A11.</td>
<td>Identify and use nails and fasteners</td>
</tr>
<tr>
<td>CM</td>
<td>A13.</td>
<td>Identify types and grades of sheet material</td>
</tr>
<tr>
<td>CM</td>
<td>C2.</td>
<td>Lay out, cut, and construct a butt joint</td>
</tr>
<tr>
<td>CM</td>
<td>C5.</td>
<td>Lay out, cut, and construct a lap joint</td>
</tr>
<tr>
<td>CM</td>
<td>D2.</td>
<td>Use clamps (e.g., bar, hand-screw, C. webbing and spring) during gluing operations</td>
</tr>
<tr>
<td>CM</td>
<td>E3.</td>
<td>Draw cabinetmaking plans for a kitchen</td>
</tr>
<tr>
<td>CM</td>
<td>E4.</td>
<td>Draw cabinetmaking plans for a bathroom</td>
</tr>
<tr>
<td>CM</td>
<td>H1.</td>
<td>Identify types and grades of abrasive materials</td>
</tr>
<tr>
<td>CM</td>
<td>H2.</td>
<td>Sand and prepare for finishing</td>
</tr>
<tr>
<td>CM</td>
<td>H3.</td>
<td>Identify stains and application procedures</td>
</tr>
<tr>
<td>CM</td>
<td>H4.</td>
<td>Identify finishes their uses and precautions</td>
</tr>
<tr>
<td>CM</td>
<td>H5.</td>
<td>Apply finishes</td>
</tr>
<tr>
<td>CM</td>
<td>I3.</td>
<td>Apply laminate adhesives</td>
</tr>
</tbody>
</table>
Electrical Trades
Cross-Cluster Common Competencies, Draft One

ET  C1. Cut and ream conduit
ET  C2. Bend conduit to predetermined specifications using conduit bender
ET  F5. Identify common screws, bolts, nuts and nails
ET  F6. Identify common connectors, terminals and lugs
ET  F8. Determine type and size of electrical wire
ET  F13. Apply the use of trade catalogs and publications
ET  Other Read architectural prints and wiring plans

B-29
Plumbing
Cross-Cluster Common Competencies, Draft One

P  B11. Identify basic framing members
P  C3. Operate a three-way threader (by hand)
P  C4. Operate the drop-head rachet threader (by hand)
P  C5. Operate an adjustable 1-2" rachet threader (by hand)
P  C6. Assemble fittings using two pipe wrenches
P  D6. Construct a soil, waste and vent assembly of PVC-DWV (polyvinyl chloride-drain waste vent)

P  C11. Cut a plastic pipe using handsaw
P  C12. Cut plastic pipe using tubing cutter
P  E1. Construct a soft tubing assembly with flare fittings
P  E2. Construct a soft tubing assembly with compression joints
P  E3. Construct a soft tubing assembly with solder joints
P  E4. Install a water distribution system of galvanized steel
P  E5. Install a water distribution system of hard-drawn copper
P  E6. Install a water distribution system of CPVC (chlorinated polyvinyl chloride)

P  E18. Apply 50/50 solder system
P  E19. Apply 95/5 solder system
P  E20. Apply lead-free solder system
P  E21. Apply sil-braze system
P  E23. Perform an air-pressure test
P  G28. Insulate water lines
P  G29. Repair solder joint
P  H3. Install red-head anchors
P  H4. Hang pipe using wire pipe hooks
P  H5. Hang pipe using perforated straps
P  H6. Hang pipe using clevis hangers
Drafting
Cross-Cluster Common Competencies, Draft One

DR B2. Demonstrate proper use and care of drawing instruments and equipment
DR K2. Produce simple floor plan and elevation drawings
DR N1. Identify structural steel shapes
DR O3. Identify use and application fasteners
DR Q3. Identify sheet metal layout procedures
DR R1. Identify vocabulary
DR R2. Identify hardware and basic functions/operations
DR R4. Store and retrieve data
Machine Shop
Cross-Cluster Common Competencies, Draft One

MS A2. List machine shop safety rules and regulations
MS E4. Mark locations with prick and center punches
MS E5. Locate holes with transfer screws and transfer punches
MS E11. Use abrasives/whetting/polishing/lapping
MS E16. Install a helical coil thread insert
MS E17. Straighten workpiece on arbor press
MS E18. Assemble and disassemble workpiece with arbor press
MS E19. Broach workpiece with broaching tool
MS E20. Assemble and disassemble precision parts
MS F1. Identify types of metals and related materials
MS F5. Perform heat treatment process
MS G2. Perform care and maintenance
MS G3. Select proper blade type for sawing operations and materials
MS G8. Select and apply cutting fluids
MS H2. Perform care and maintenance
MS H6. Set up drill press to obtain calculated feeds and speeds
MS H7. Select and apply cutting fluids
MS H14. Power ream hole to size
MS H15. Use drill jigs and bushings
MS H16. Hand tap hole using drill press
MS I12. Center workpiece in four-jaw chuck
MS I13. Drill holes
MS L6. Set up machine
Welding
Cross-Cluster Common Competencies, Draft One

W  A12.  Properly store electrodes and filler materials
W  A15.  Perform a weld test (destructive/ndestructive)
W  C2.   Identify types of fuels and their application
W  C3.   Handle, make preliminary safety inspection and store cylinders properly
W  C4.   Identify, select and set up oxy-fuel welding and cutting equipment
W  C5.   Light and adjust flame for welding and cutting
W  C6.   Pierce holes and cut slots
W  C7.   Make straight 90 degree and beveled cuts on mild steel plate and pipe
W  C8.   Make circle cuts - off hand and with guide
W  C11.  Run stringer bead and joints with filler metal in vertical position
W  C13.  Run stringer bead and joints with filler metal in vertical position
W  C14.  Run stringer bead and joints with filler metal in overhead position
W  C16.  Braze weld cast iron
W  C17.  Prepare weld for testing and pass visual test
W  C18.  Identify welding and cutting problems, their causes, and take corrective action
W  C19.  Identify and select correct welding brazing rod
W  D2.   Prepare material for weld procedure
W  E1.   Demonstrate safety procedures
W  E4.   Identify and make proper electrode selection for base material and material thickness
W  E5.   Identify joint design and prepare material for weld procedure
W  E6.   Identify welding problems, their causes and take corrective action
W  E10.  Build pad of beads in horizontal position with E-6010 or E-6011
W  K1.   Demonstrate safety procedures
W  K2.   Set up and operate plasma cutting equipment
W  K3.   Lay out and make straight line cuts on nonferrous metal
W  K4.   Lay out and make bevel cuts on nonferrous metal
W  K5.   Layout and make circular cuts on nonferrous metal
W  K6.   Layout and make pattern cuts on nonferrous metal
W  K8.   Lay out and cut square and round solid stock on nonferrous metal
W  K9.   Identify, select and safely handle cutting grass
W  L1.   Demonstrate safety procedures
W  L2.   Identify the classification and physical properties of ferrous and nonferrous metals
W  L3.   Identify and apply principles of preheating and postheating
W  K6.   Layout and make pattern cuts on nonferrous metal
### Air Conditioning, Heating, and Refrigeration
#### Cross-Cluster Common Competencies, Draft One

<table>
<thead>
<tr>
<th>AC</th>
<th>A4.</th>
<th>Demonstrate removal procedures from an electrical conductor</th>
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<tbody>
<tr>
<td>AC</td>
<td>B1.</td>
<td>Identify principles of refrigeration</td>
</tr>
<tr>
<td>AC</td>
<td>B2.</td>
<td>Use high and low manifold gauge</td>
</tr>
<tr>
<td>AC</td>
<td>B3.</td>
<td>Leak-test and evacuate system</td>
</tr>
<tr>
<td>AC</td>
<td>B4.</td>
<td>Identify sealed system components</td>
</tr>
<tr>
<td>AC</td>
<td>B5.</td>
<td>Identify sealed system accessories</td>
</tr>
<tr>
<td>AC</td>
<td>B6.</td>
<td>Resolve high and low suction discharge pressure problems</td>
</tr>
<tr>
<td>AC</td>
<td>C1.</td>
<td>Identify different types of tubing and fittings</td>
</tr>
<tr>
<td>AC</td>
<td>C2.</td>
<td>Install, repair and replace copper tubing</td>
</tr>
<tr>
<td>AC</td>
<td>C3.</td>
<td>Install, repair and replace aluminum tubing</td>
</tr>
<tr>
<td>AC</td>
<td>C4.</td>
<td>Install and replace plastic tubing and pipe</td>
</tr>
<tr>
<td>AC</td>
<td>C5.</td>
<td>Braze tubing</td>
</tr>
<tr>
<td>AC</td>
<td>C6.</td>
<td>Install and replace temperature pressure control</td>
</tr>
<tr>
<td>AC</td>
<td>C7.</td>
<td>Adjust temperature pressure control</td>
</tr>
<tr>
<td>AC</td>
<td>C8.</td>
<td>Replace, calibrate and adjust temperature control</td>
</tr>
<tr>
<td>AC</td>
<td>C9.</td>
<td>Install and replace water regulating valve</td>
</tr>
<tr>
<td>AC</td>
<td>C10.</td>
<td>Adjust water regulating valve</td>
</tr>
<tr>
<td>AC</td>
<td>C11.</td>
<td>Install and replace oil pressure safety control</td>
</tr>
<tr>
<td>AC</td>
<td>C12.</td>
<td>Install and replace pneumatic controls</td>
</tr>
<tr>
<td>AC</td>
<td>C13.</td>
<td>Install, replace, and repair magnetic starter and components</td>
</tr>
<tr>
<td>AC</td>
<td>C14.</td>
<td>Test compressor efficiency</td>
</tr>
<tr>
<td>AC</td>
<td>C15.</td>
<td>Install and replace compressor</td>
</tr>
<tr>
<td>AC</td>
<td>C16.</td>
<td>Install and replace access valve</td>
</tr>
<tr>
<td>AC</td>
<td>C17.</td>
<td>Repair and replace evaporator</td>
</tr>
<tr>
<td>AC</td>
<td>C18.</td>
<td>Replace components of defrost system</td>
</tr>
<tr>
<td>AC</td>
<td>C19.</td>
<td>Replace temperature controls</td>
</tr>
<tr>
<td>AC</td>
<td>C20.</td>
<td>Replace heaters</td>
</tr>
<tr>
<td>AC</td>
<td>C21.</td>
<td>Perform cleanup of a contaminated system</td>
</tr>
<tr>
<td>AC</td>
<td>C22.</td>
<td>Charge refrigeration system</td>
</tr>
<tr>
<td>AC</td>
<td>C23.</td>
<td>Perform preventative maintenance</td>
</tr>
<tr>
<td>AC</td>
<td>C24.</td>
<td>Check and adjust air flow</td>
</tr>
<tr>
<td>AC</td>
<td>C25.</td>
<td>Test compressor efficiency</td>
</tr>
<tr>
<td>AC</td>
<td>C26.</td>
<td>Install, replace and repair compressor</td>
</tr>
<tr>
<td>AC</td>
<td>C27.</td>
<td>Install and replace condensing unit</td>
</tr>
<tr>
<td>AC</td>
<td>C28.</td>
<td>Install, repair and replace stem-type valve</td>
</tr>
<tr>
<td>AC</td>
<td>C29.</td>
<td>Install, replace and test control valves</td>
</tr>
<tr>
<td>AC</td>
<td>C30.</td>
<td>Repair and replace condensor</td>
</tr>
<tr>
<td>AC</td>
<td>C31.</td>
<td>Repair and replace evaporator</td>
</tr>
<tr>
<td>AC</td>
<td>C32.</td>
<td>Replace and repair metering device</td>
</tr>
<tr>
<td>AC</td>
<td>C33.</td>
<td>Adjust metering device</td>
</tr>
<tr>
<td>AC</td>
<td>C34.</td>
<td>Replace defrost system components</td>
</tr>
</tbody>
</table>

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B-34
AC G11. Replace heaters
AC G12. Perform cleanup of a contaminated system
AC G13. Charge refrigeration system
AC G14. Check and adjust air flow
AC G15. Identify and use related tools and instruments - commercial refrigeration
AC G16. Pump down unit
AC G17. Perform preventative maintenance
AC H2. Test compressor efficiency
AC H3. Install and replace compressor
AC H4. Install and replace condensing unit
AC H5. Repair and replace condenser
AC H6. Repair and replace evaporator
AC H7. Install, replace and test control valves
AC H8. Replace and repair metering devices
AC H10. Perform cleanup of a contaminated system
AC H11. Charge air conditioning system
AC H12. Check capacity of cooling system
AC H14. Describe operation of a heat pump
AC H16. Check capacity of heat pump
AC H17. Replace defrost system components - heat pump
AC H20. Identify and describe operation of heating system components
AC H23. Check and adjust air flow
AC H25. Repair, replace and service electronic air cleaner
AC H26. Perform preventative maintenance
AC H27. Pump down unit
AC H28. Remove and replace drier cartridge
AC H29. Clean, repair and maintain cooling tower
AC I1. Perform systematic problem solving of an air system
AC I2. Perform systematic problem solving of an electrical system
AC I3. Perform systematic problem solving of a fuel system
AC I4. Perform systematic problem solving of a refrigerant system
AC J1. Interpret psychrometric chart
AC J2. Solve psychrometric problems
AC J4. Describe concept of air treatment
AC J5. Describe concept of heat loss and heat gain factors
Electronics
Cross-Cluster Common Competencies, Draft One

ELEC B16. Identify and replace parts and components on printed circuit boards and chassis
ELEC B19. Describe and identify filter networks
ELEC D1. Identify schematic design symbols for semiconductor devices
ELEC D4. Construct circuits using bipolar transistors
ELEC D5. Describe the basic operation of a JFET
ELEC D6. Describe the basic operation of a MOSFET
ELEC D7. Describe the basic operation of a UJT
ELEC D8. Describe the basic operation of a PUT
ELEC D9. Describe the basic operation of a DIAC
ELEC D10. Describe the basic operation of a SCR
ELEC D11. Describe the basic operation of a TRIAC
ELEC D12. Describe the basic operation of a VDR
ELEC D17. Demonstrate the proper replacement techniques for semiconductor devices
ELEC F1. Describe the basic operation of oscillators
ELEC H3. Describe the operation and demonstrate the use of signal generators; i.e., audio, RF or function
ELEC I2. Identify the levels of computer languages
ELEC I3. Describe the purpose of operating systems
ELEC I4. Analyze simple programs using computer instruction sets
ELEC J2. Identify types of photodetectors and emitters
ELEC K1. Identify and convert number systems and codes for binary, hex, octal and BCD
ELEC K2. Identify and describe the operation of basic logic gates
ELEC K3. Develop truth tables defining circuit design
ELEC L7. Explain the proper connection of Delta and Wye motor connections
ELEC L8. Describe the operation of motor speed control
ELEC L9. Describe the operation of programmable controllers
ELEC M1. Breadboard circuits
ELEC M3. Solder/desolder circuits
ELEC M4. Select and install proper components for specific use
ELEC M5. Repair printed circuit boards
ELEC N2. Identify problem area by symptom
Auto Collision Common Competencies
Cross-Cluster Common Competencies, Draft One

AB  F1. Identify auto body welding processes
AB  F2. Use MIG welding safety procedures
AB  F3. Set up equipment for MIG welding
AB  F4. Prepare metal for MIG welding
AB  F6. Construct a MIG plug weld
AB  F7. Construct a MIG continuous weld
AB  F10. Identify oxyacetylene welding safety procedures
AB  F11. Set up and use equipment for oxyacetylene welding
AB  F12. Set up and use equipment for oxyacetylene cutting
AB  F13. Use protective clothing and equipment
AB  G2. Clean the exterior surface
AB  M7. Select and apply appropriate primer/primer surfacer/sealant
AB  N1. Identify types of bolts and nuts, US and metric
AB  N2. Identify types of rivets
AB  N3. Identify types of screws
AB  N4. Identify types of clips
AB  S1. Identify electrical system components
AB  V1. Identify air conditioning systems components and service procedures
AB  V2. Replace condenser
AB  V3. Remove and reinstall compressor
AB  V4. Test the system for leaks
AB  V5. Repair leaks in air conditioning system
AB  V6. Evacuate and charge system using vacuum pump or charging system
AB  V7. Check and service air conditioning hoses
AB  V8. Inspect, flush, and replace heater core
AB  Y4. Perform stress relief using heat

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Auto Mechanics
Cross-Cluster Common Competencies, Draft One

AM Q3. Inspect, replace, and adjust drive belts and hoses
AM GG1. Diagnose and performance test A/C systems for problems and determine needed repairs
AM GG2. Clean, inspect, and repair A/C system components
AM GG3. Evacuate and charge A/C system and performance test
AM Other Read Micrometers
Diesel Mechanics
Cross-Cluster Common Competencies, Draft One

DM A8. Identify and select common fasteners
DM D2. Replace and adjust fan and auxiliary belts
DM D3. Replace water filter
DM D7. Replace hoses and clamps
DM F2. Evaluate problem
DM I5. Repair and rethread tapped holes
DM K1. Demonstrate safety procedures and precautions
DM K4. Evaluate test results
DM K5. Interpret schematic
DM K7. Remove and replace battery
DM K8. Remove and replace associated wiring and/or switches
(solenoids/relays/contacts)
DM K10. Use trouble-shooting charts
DM L2. Use cutting torch
DM L3. Weld with arc welder in flat position
DM L4. Braze fittings
DM L5. Braze light gauge flat
DM L6. Weld oxyacetylene flat
DM N3. Remove and replace major components
DM N4. Evacuate and charge system
Small Engines
Cross-Cluster Common Competencies, Draft One

SE A5. Perform tasks within assigned time limits
SE C1. Identify and select related fasteners
SE Q1. Adjust tension and alignment of pulleys and belts
Commercial Art
Cross-Cluster Common Competencies, Draft One

CA A1. Demonstrate proper uses of T-square
CA A2. Demonstrate proper uses of triangles
CA A3. Demonstrate proper uses of drafting knives
CA A4. Demonstrate proper uses of scissors
CA A5. Demonstrate proper uses of tech pens
CA A6. Demonstrate proper uses of sharpeners
CA A7. Demonstrate proper uses of pencils
CA A8. Demonstrate proper uses of erasers
CA A9. Demonstrate proper uses of tapes
CA A10. Demonstrate proper uses of paper
CA A11. Demonstrate proper uses of fixatives
CA A13. Demonstrate proper uses of markers
CA A14. Demonstrate proper uses of ink
CA A15. Demonstrate proper uses of paint
CA A16. Demonstrate proper use of individually selected materials
CA A17. Demonstrate proper use of individually selected equipment
CA A18. Demonstrate proper use of individually selected camera
CA D5. Produce line drawings
CA F1. Prepare rough layouts
CA H1. Identify/illustrate one-point perspective
CA H2. Identify/illustrate two-point perspective
CA H3. Identify/illustrate multi-point perspective
CA N4. Identify methods of growing/improving
CA Q1. Demonstrate handlettering
CA Q3. Produce ruled forms
CA Q4. Produce spot illustration
CA S1. Identify hardware and basic functions/operations
CA S2. Identify software programs and uses
Cosmetology
Cross-Cluster Common Competencies, Draft One

COS B2. Identify essentials of personal grooming
COS C1. Identify types of equipment and implements
COS C2. Demonstrate the ability to operate equipment correctly
COS D1. Identify definitions pertaining to sanitation
COS D9. Identify safety precautions
COS e1. Give the definition for Chemistry
COS e2. Give the definition for matter
COS e5. Explain the forms of matter
COS g2. Read and interpret State Law requirements and regulations
Food Service
Cross-Cluster Common Competencies, Draft One

FS A5. Practice people skills
FS A6. Practice personal grooming
FS B1. Recognize overhead costs
FS C1. Practice personal hygiene
FS C3. Maintain clean facilities
FS D1. Identify hazards
FS D3. Use cutting utensils and equipment safely
FS D5. Use, clean, and maintain vents and exhaust equipment
FS D7. Respond to emergencies
FS E1. Use and clean coffee equipment
FS E4. Use and calibrate thermometers
OL A1. Check specifications and planning
OL B1. Prepare a rough layout
OL O5. Preventive maintenance
Group Three Competency Lists, Draft One

Color Codes:

Blue - CONSTRUCTION Cluster
Peach - MANUFACTURING Cluster
Green - TRANSPORTATION Cluster
Construction Cluster
Common Cluster Competencies, Draft One

BM D3. Bend and connect conduit
BM E4. Repair or install interior door operating hardware
BM E5. Identify procedures for repairing, replacing and/or installing floor coverings
BM E6. Repair, replace and/or install a ceiling system
BM E7. Install wall and/or ceiling insulation
BM E8. Install or replace interior trim
BM F5. Apply finish with brush
BM F6. Apply finish with roller
BM H2. Set forms
BM H5. Pour and finish concrete
BM J4. Prepare soil for seeding/sow seed
BM J6. Mix, apply, and store fertilizer
BM Other Painting in new construction
BM Other Interior finishes
BM Other Exterior finishes
BM Other Staining interior woodwork
BM Other Sealing (varnishing) interior woodwork
CM A12. Identify wood species and grades
CM B6. Set up and operate planer safely and accurately
CM C3. Lay out, cut, and construct a dado joint
CM C6. Lay out, cut, and construct a miter joint
CM D1. Identify various types of wood glues, their uses, and precautions
Manufacturing Cluster
Common Cluster Competencies, Draft One

DR A6. Identify drafting terminology
DR C6. Demonstrate techniques in line construction
DR D2. Construct regular polygons and ellipses
DR D3. Draw tangents to arcs, lines, and circles
DR D5. Divide a line in equal and proportional parts
DR E1. Interpret an orthographic projection (3rd angle)
DR E2. Prepare a multiview freehand (3rd angle)
DR E3. Prepare orthographic drawings (3rd angle)
DR E4. Identify use and application of orthographic drawings (3rd angle)
DR E5. Identify 1st and 3rd angle projection drawings
DR F1. Construct primary auxiliary views
DR F3. Construct secondary auxiliary views
DR F4. Identify use and application of auxiliary views
DR G1. Identify and draw standard sectional views
DR G2. Identify the symbols used to present different materials
DR G3. Identify and use cutting planes
DR G4. Identify and use conventional breaks
DR G5. Identify use and application of sectional views
DR H1. Apply dimensioning practices and techniques to drawings
DR H2. Construct the lines used to dimension drawings
DR J1. Construct isometric drawings
DR J2. Identify diametric, oblique, perspective and trimetric drawings
DR J3. Identify use and application of pictorial drawings
DR M1. Identify piping symbols, fittings, and valves
DR M2. Produce orthographic and isometric drawings
MS B11. Perform angular and simple indexing calculations
MS D9. Plan sequence of machining operations
MS F3. Correlate types of materials to their properties
MS F4. List major cutting tool variables
MS F6. Test workpiece for hardness without hardness tester
MS G4. Cut and weld band saw blades
MS G5. Select and set speeds and feeds on power saw
MS G6. Cut material to length with power hack saw
MS G7. Cut material to length with band saw
MS K11. Grind angular surfaces
MS L3. Calculate coordinates and dimensions of CNC drawing
W L4. Describe and apply principles of metallurgy in annealing, hardening and tempering
W L5. Describe methods of testing metals
W L6. Identify types of ferrous metal by spark test

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Transportation Cluster
Common Cluster Competencies, Draft One

AB K2. Replace energy absorbers
AB Q10. Remove and reinstall heating and air conditioning assembly
AB Q11. Remove and reinstall carpeting
AB Q12. Remove and reinstall seat belts and shoulder harness
AB Q13. Identify supplemental inflatable restraint systems
AB Q14. Diagnose supplemental inflatable restraint systems
AB Q15. Service and repair supplemental inflatable restraint systems
AB R9. Remove and replace a lock cylinder
AB T1. Service a taillight assembly
AB T2. Service a headlight assembly
AB T3. Service mechanical headlights and covers
AB T4. Aim headlights mechanical aiming equipment
AB U1. Remove and replace a radiator
AB U2. Remove, inspect and replace V-Belts
AB U3. Test antifreeze solution
AB U4. Service fan blades and clutches
AB U5. Check and service radiator and heater hoses
AB U6. Inspect, repair, and replace auxiliary oil cooler
AB U7. Inspect, repair, and replace fuel, exhaust, and emissions systems
AB W1. Identify front suspension systems
AB W2. Identify rear suspension systems
AB W3. Remove and reinstall front suspension systems
AB W4. Remove and reinstall rear suspension systems
AB W5. Remove and reinstall front drive train
AB W6. Service suspension systems
AB W7. Identify steering systems
AB W8. Perform four-wheel alignment
AB W9. Perform suspension quick checks
AB W10. Service power steering system
AB W11. Service brake system
AB W12. Identify causes of uneven tire wear
AB W13. Inspect, repair, and replace steering system components
AB X1. Identify vehicle frame construction, conventional and unibody
AB X2. Identify frame and unibody terminology
AM C1. Identify basic function and operation of vehicle mechanical components
AM E3. Jump start a vehicle
AM F1. Diagnose starting system and determine needed repair
AM F3. Repair or replace starter motor components
AM G1. Diagnose starting system and determine needed repair
AM H1. Diagnose lighting system problems and determine needed repairs

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AM J2. Inspect, repair, or replace primary ignition components
AM J5. Perform on-board computer system diagnosis
AM J6. Repair or replace computer system components
AM K1. Diagnose fuel system problems and determine needed repairs
AM K2. Inspect, repair, or replace fuel supply component
AM K6. Repair or replace fuel injection components
AM K8. Diagnose and repair exhaust system problems
AM L6. Clean, inspect/replace air management system
AM L7. Clean, inspect/replace inlet air temperature control
AM L9. Clean, inspect/replace fuel vapor controls
AM M2. Remove and replace engine (front- and rear-wheel drive)
AM Q1. Inspect and repair oil system and components
AM Q2. Perform cooling system tests; determine needed repairs
AM Q4. Replace cooling system components (thermostat, radiator, controllers)
AM Q5. Inspect coolant, drain, flush, and refill cooling system with recommended coolant
AM Q6. Perform oil and lube service on normally aspirated and turbo-charged engines
AM R1. Diagnose and determine needed repairs on steering systems
AM R2. Clean and inspect power and manual steering gear boxes
AM R3. Reassemble, adjust, and install power and manual steering gear boxes
AM R4. Clean and inspect power and manual rack-and-pinion steering rack
AM R5. Reassemble, adjust, and install power and manual rack-and-pinion steering rack
AM R6. Inspect and repair steering columns
AM R7. Inspect and replace steering linkage components
AM R8. Inspect, repair, and replace power steering pumps
AM S1. Diagnose and determine needed repairs on conventional and electric front suspension systems
AM S2. Inspect and repair control arm and spring assemblies on conventional systems
AM S3. Inspect and repair wheel spindles and bearings
AM S4. Inspect and replace shock absorbers and stabilizer bars
AM S5. Diagnose and determine needed repairs on MacPherson Strut assemblies
AM S6. Clean, inspect, and assemble MacPherson strut assemblies
AM T1. Diagnose and determine needed repairs on conventional and electronic rear suspension systems
AM T2. Inspect and replace shock and spring assemblies
AM T3. Inspect and replace MacPherson strut assemblies
AM T4. Inspect and repair suspension linkages and bushings
AM U1. Diagnose and determine needed repairs on conventional and electronic rear suspension systems
AM U2. Set correct alignment angles on front wheels
AM U3. Set correct camber and toe on rear wheels
AM U4. Rotate and balance tire and wheel suspension
AM V1. Diagnose hydraulic brake systems and determine needed repairs
AM V2. Inspect and repair or replace master cylinders and lines of the hydraulic system
AM V3. Inspect and replace switches and valving devices
AM W1. Diagnose and determine needed repairs on drum brake systems
AM W2. Remove, clean, and inspect drum brake assemblies
AM W3. Repair, replace, and adjust drum brake components
AM X1. Diagnose and determine needed repairs on disc brake systems
AM X2. Remove, clean, and inspect disc brake components
AM X3. Repair, replace, and adjust disc brake components
AM Y1. Diagnose and determine needed repairs on power-assist brakes
AM Y2. Repair or replace power brake components
AM Y3. Repair or replace hydra-boost components
AM Y4. Check operation of anti-skid braking systems; adjust or repair according to manufacturer's recommendations
AM BB1. Diagnose and determine needed repairs
AM BB2. Inspect, service, and replace front axle shafts
AM BB3. Inspect, service, and replace drive shafts
AM DD4. Diagnose and determine needed repairs on hub assemblies
AM DD5. Disassemble, clean, and inspect hub assemblies
AM DD6. Reassemble and adjust hub assemblies
AM EE4. Inspect and replace external bushings, seals, and gaskets
AM EE5. Inspect, replace, and align power train mounts
AM GG4. Diagnose and repair automatic and electrical temperature control units.
AM HH1. Diagnose and repair heating system problems and determine needed repairs
AM HH2. Inspect and replace heating system components
DM A9. Identify and select common seals and gaskets
DM B2. Test cooling system
DM B3. Test engine lubrication system
DM B4. Check air intake and/or exhaust system
DM B5. Draw lubrication and/or oil sample
DM B6. Check linkage adjustments
DM B7. Perform visual inspection
DM B8. Replace fuel filters
DM B10. Inspect steering linkage for wear
DM B11. Inspect and adjust brakes
DM C2. Adjust supplementary governing and/or control devices
DM C3. Adjust intake and exhaust valves according to specifications
DM C4. Adjust injectors according to specifications
DM C5. Adjust governor (as applicable)
DM D4. Replace and/or test radiators

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DM D5. Flush cooling system
DM D6. Replace and test thermostat and seals
DM D8. Inspect fan drive assembly and related hardware
DM D9. Replace water pump
DM D10. Test and replace oil cooler
DM D11. Test radiator coolant
DM D12. Recognize proper routing and sizing of cooling lines
DM D13. Pressure test cooling system
DM E2. Test injection nozzles and injectors
DM E3. Time fuel injection pump
DM E4. Bleed fuel system
DM E5. Replace injection nozzles and injectors
DM E6. Test fuel system
DM E7. Identify and install fuel line hoses and connections
DM E8. Inspect turbo charger condition
DM F3. Trouble-shoot overheating and overcooling
DM F4. Trouble-shoot engine vibration
DM F5. Trouble-shoot electrical system
DM F6. Trouble-shoot low and/or high oil pressure
DM F7. Trouble-shoot smoke
DM F8. Trouble-shoot leaks and/or contamination
DM F9. Trouble-shoot hard starting
DM F10. Trouble-shoot high oil consumption
DM F11. Trouble-shoot fuel system
DM F12. Trouble-shoot internal noises
DM F13. Trouble-shoot low power and/or performance
DM F14. Trouble-shoot air system
DM F15. Trouble-shoot low fuel mileage
DM G2. Evaluate oil conditions
DM G3. Replace and inspect oil filter
DM G4. Change engine oil
DM G5. Change transmission and/or differential oils
DM G6. Change power steering fluid
DM G7. Lubricate chassis components
DM G8. Replace transmission and/or differential filters
DM H2. Remove engine
DM H3. Remove injection pump
DM H4. Remove camshaft and bushings
DM H5. Remove cylinder ridge, pistons and liner
DM H6. Remove crankshaft
DM H7. Remove oil pump
DM H8. Remove cylinder head
DM H9. Remove exterior components
DM I2. Clean components

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DM 13. Inspect flywheel
DM 14. Rebuild oil pump
DM 16. Rebuild cylinder heads
DM 17. Rebuild or replace accessories
DM J2. Install camshaft and bushings
DM J3. Install crankshaft
DM J4. Install cylinder liners
DM J5. Install piston on rod
DM J6. Install piston on cylinder
DM J7. Install oil pump
DM J8. Install timing gears
DM J9. Install cylinder heads
DM J10. Install injection pump
DM J11. Install exterior components
DM J14. Tune engine
DM J15. Test run engine
DM J16. Install engine
DM K9. Remove and reinstall generator and/or alternator
DM M1. Identify basic principles of hydraulics
DM M2. Identify basic hydraulic components
DM O3. Remove and replace springs and pins
DM O4. Rebuild steering sector and hydraulic pump
DM O5. Remove and replace king pin
DM O6. Remove and replace steering components
DM O7. Inspect, remove and replace mounted tires
DM P2. Repair cam, wedge and disc brakes
DM P3. Service hydraulic brake system
DM P4. Inspect brake drum and/or rotors using safety specifications
DM P5. Replace spring brake chambers and diaphragms
DM Q2. Remove and replace clutch assembly
DM Q3. Adjust clutch free play
DM Q4. Install throw-out bearing
DM Q5. Remove, adjust and replace drive line
DM Q6. Remove and replace transmission (manual and automatic)
DM Q7. Remove and replace axle shaft
DM Q8. Replace and adjust wheel bearing
DM Q9. Service hubs
DM Q10. Check drive line alignment
DM Q11. Remove and replace differential
SE D1. Test, repair, or replace fuel pump
SE D2. Test, repair, or replace fuel filters and strainers
SE D3. Remove, clean and replace fuel tank shut-off valves, fuel lines, fuel hoses, and connections
SE D6. Adjust fuel mixture and check for air leaks

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SE D7. Service oil-bath air cleaner
SE D9. Service dry-element air cleaner
SE G1. Remove and service spark plug
SE G2. Check ignition timing
SE G3. Test and repair breaker ignition system
SE G4. Test and repair breakerless ignition system
SE G5. Troubleshoot ignition systems
SE H1. Change engine oil and filter
SE H2. Service crankcase breather
SE H3. Inspect, repair, and/or replace pressure lubrication system
SE H5. Locate and repair leaking gasket and seals
SE H7. Select proper oil
SE I1. Service air-cooled system
SE I2. Service liquid-cooling system
SE I3. Remove, inspect, repair, and/or replace water pump
SE I4. Remove, check, and replace thermostat
SE I5. Perform a pressure test on cooling system
SE I6. Remove, check, and replace radiator
SE J1. Service and/or replace a 2-stroke-cycle exhaust system
SE J2. Service and/or replace a 4-stroke exhaust system
SE M1. Troubleshoot the ignition system
SE M2. Troubleshoot the fuel system
SE M3. Troubleshoot compression problems
SE N1. Identify the characteristics of the 4-stroke-cycle engine
SE N2. Describe the operating cycle of the 4-stroke-cycle engine
SE N3. Disassemble a 4-stroke-cycle engine
SE N4. Inspect and service a cylinder
SE N5. Inspect and service the pistons, rings, and connecting rod
SE N6. Inspect and service a crankshaft assembly
SE N7. Inspect and service a valve train assembly
SE N8. Reassemble 4-stroke-cycle engine
SE P1. Identify the component parts of a manual transmission
SE P2. Identify the component parts of a transaxle
SE P3. Identify the component parts of clutch systems
SE P5. Identify the component parts of brake systems
SE Q3. Adjust and replace control cables
SE Q5. Lubricate chassis components
SE Q6. Inspect and adjust brakes
SE Q7. Inspect and adjust clutch
APPENDIX C:

Results from Instructors’ Review of Initial Analysis
Competencies by Group, Revised
Groups of Competencies:
After Instructors' Analysis

**Group One:**
Competencies common to all 19 T & I Areas

*One list of competencies that combines competencies from all 19 profiles, divided into 10 duty bands*

**Group Two:**
Competencies common to two cluster areas:
Transportation and Service

*One Division*

**Group Three:**
Competencies common only to one cluster area

*Three Divisions (corresponding to three clusters that had cluster-related skills):*
- Construction
- Manufacturing
- Transportation
Group One Competency Lists, Revised
Competencies Common to all 19 T & I Occupational Areas

A. Orientation to Trade Occupations

1. Identify job classifications, prerequisites for employment, and career opportunities (AB A1, AM C2, BM A1, CM A15, DR A4, ET D5, FS A1, FS A4, MA A1, P B1)

2. Practice job seeking/job keeping skills (CA N1, CA N2, CA N3, CA O3, CA O4, COS B2, FS A6, FS A7, FS C1)

3. Identify entrepreneurial skills

4. Identify skills necessary for advancement within the industry

B. Health and Safety

1. Identify and apply general occupational safety rules and practices (AB D2, AC A3, AC C2, BM A2, BM C1, BM D1, BM E1, BM F1, BM H1, BM J1, BT A1, CM A1, COS A1, DR A1, DM A1, DM A2, DM K1, EL A3, ET A2, FS D4, MA B1, MA B2, MA B5, MS A1, MS A2, MS L1, P A1, P A2, P A3, SE A1, W C1)

2. Understand environmental protection agency (EPA) and Occupational Safety and Health Act (OSHA) regulations (AM A7, ET A1, P A5, W A5)

3. Complete safety test (COS A6)

4. Identify and demonstrate the safe use of protective clothing and equipment (AB D3, AB F13, AM A4, ET A3, P A9)

5. Identify and correct or report safety hazards (AC A2, DM A3, EL A2, EL A6, FS D1, MS A4, P A6, W A1, W A4)

6. Identify techniques and practices of fire prevention (AB D4, AM A5, BM A4, ET A4, P A13, W A2)

7. Identify and demonstrate correct use of fire extinguishers (AC A1, COS A3, EL A1, FS D9, MA B4, P A12, W A3)

8. Identify appropriate first aid procedures (BM A3, COS A4, COS A5, ET A5, FS D7, FS D10, FS D11, FS D12)
9. Demonstrate the ability to keep a clean, orderly, and safe work area (AM B4, CM A2, COS A2, FS C3, MA B3, P A4)

10. Safely operate oxy-fuel gas torches (AB F10, AB F11, AB F12, DM L2, P A8, W C3, W C4, W C5)

11. Demonstrate safe use and maintenance of hand, electric, pneumatic, and hydraulic equipment (AB C1, AB C3, AB C4, AC C8, AM A2, AM A3, AM A6, BT A6, EL A5, ET A6, P A10, P A11, W A6, W A11)

12. Identify use, disposal, storage, and documentation of chemical materials (AB D5, AB D6, AB D7, AB D8, AB D9, AC A5, AM A1, FS D6)

C. Tools

1. Identify common hand tools, their basic use and maintenance (drill bits and sharpening, AC C7, BM A5, BT A4, CM A9, CM A14, CM D2, DM A4, ET other, ET C3, ET C4, ET C6, MA C1, MA C3, MS E1, MS E2, MS E3, MS L2, P C1, SE A2, SE B1, SE B2, SE B7, SE B8, W A9, W A10)

2. Identify common power tools, their basic use and maintenance (use pedestal grinders for drill bits, BM A6, BT A4, CM A10, CM B1, CM B2, CM B3, CM B4, CM B7, CM B10, DM A4, ET C7, ET C8, MA C2, MA C4, MS E9, MS E10, MS E12, MS G3, MS H1, MS H3, MS H4, MS L2, P C2, P C12, P C13, SE A2, SE B5, SE B6, SE B7, SE B8)

D. Fasteners

1. Identify common types of fasteners and their basic uses (AB N1, AB N2, AB N3, AB N4, BT A5, CM A11, DR O3, DM A8, ET F5, MS H16, SE C1)

2. Identify and use tools to restore threads on fasteners (DM I5, MS E6, MS E7, MS E13, MS E14, MS E15, MS E16, SE B9)

3. Measure bolts and threads, SAE grade and metric (SE C2)

E. Trade-Related Documents


2. Communicate with customers and write service orders (AC other, AC K1, AM B1, COS f5, FS A5)
3. Estimate cost of job (materials, labor) (AM B2, BT B4, CM A8, CM E8, DR O2, ET E5, FS B1, FS B2, FS B4, MA F10, MS B5, OL A2, OL A3, P B9, SE A5)

4. Identify federal/state/county/industry regulating bodies (AC other, BT A13, COS g2, DR A3, P B10)

F. Trade Print Reading and Symbology

1. Interpret trade symbols (BT B2, DR L1, DR M1, ET other, ET E1, ET E3, ET E4, MS D1, W B2)

2. Read and interpret basic prints and diagrams (AC other, AC D4, AC F15, AC H21, BM A8, BT B1, BT B3, CM E6, DR N1, DM K5, EL B17, ET other, ET E2, MA F3, MA F5, MA F6, MA F7, MA F8, MA F9, MS D2, P B5, W B1)

3. Plan job sequence based on prints and/or specifications (MA F4, MS D8)

4. Demonstrate techniques of pictorial and orthographic sketching and diagramming (CM E7, DR B2, DR C1, DR C2, DR C3, DR C5, DR D1, DR E1, DR E2, DR E4, DR E5, DR J1, DR J3, DR L2, DR M2, DR O1, DR Q2, ET D7, MA E6, MS D3, P B6, W B3, W B4)

5. Read and transfer measurement from sketch to product and from product to sketch (DR C4)

6. Read and interpret scale (MA F1, MA F2)

7. Calculate tolerances, dimensions, and allowances (DR H3, DR H4, MS D4, MS D5)

G. Basic Electricity/Electronics

1. Demonstrate knowledge of the basic fundamentals of electricity (AC D2, COS e3, COS e4, COS e7, DM K2, EL B1, ET other)

2. Read and interpret electrical meters (AM D4, AM D5, EL B8, EL H2, ET H1, ET H2, ET H3, SE F1)
H. **Precision Measurement**

1. Use basic math skills (AB B2, AM other, BM other, BT A7, BT A8, BT A9, CM A5, CM A6, CM A7, DR H5, DR S1, DR S2, DR S3, DM A6, MA E1, MA E2, MS B1, MS B2, MS B3, MS B12, MS B13, P B4, W A8)

2. Read a rule, fractional inch and metric (AB B1, BT A3, CM A4, MA E3, MS C2, MS C3, MS C4, P B3)

3. Select and use appropriate tools for required accuracy (MS C5, MS C6, MS C7, MS C8, MS C9, MS C10, MS C11, MS C12, MS C13, MS C14, MS C15, MS C16, MS C17, MS C18, MS C19, SE B3)

4. Demonstrate ability to work accurately with precision tools and instruments (BM A7, BT A2, CM A3, DM A10, SE A3)

5. Demonstrate the proper use and care of precision measuring tools and equipment (MS C1, SE B4)

I. **Material Science**

   Metals  
   Plastics  
   Woods  
   (CM A13, CM H1)

J. **Computer Literacy**
Group Two Competency Lists, Revised

Color Codes:

Pink - TRANSPORTATION and SERVICE Clusters
Transportation and Service Careers
Cross-Cluster Common Competencies, Revised

AC B1. Identify principles of refrigeration
AC B2. Use high and low manifold gauge
AC B3. Leak-test and evacuate system
AC B4. Identify sealed system components
AC B5. Identify sealed system accessories
AC B7. Test temperatures
AC C1. Identify different types of tubing and fittings
AC D3. Identify and use test equipment
AC D5. Trouble shoot complete electrical circuit
AC D6. Test capacitors
AC D8. Describe the major concepts of electric motor theory
AC D9. Test electrical components
AC E2. Describe concept of control theory and application
AC E5. Adjust temperature pressure control
AC E6. Install and replace solid-state control
AC E7. Replace, calibrate and adjust temperature control
AC E8. Install, repair, replace and adjust time control
AC E9. Install and replace water regulating valve
AC E10. Adjust water regulating valve
AC E11. Install and replace oil pressure safety control
AC E12. Install and replace pneumatic controls
AC E13. Install, replace, and repair magnetic starter and components
AC E14. Install and replace current relay
AC E15. Install and replace potential relay
AC E16. Install and replace control relay
AC E17. Install and replace transformer
AC E18. Describe concept of programmable thermostats
AC F2. Test compressor efficiency
AC F3. Install and replace compressor
AC F4. Install and replace access valve
AC F5. Repair and replace condenser
AC F6. Repair and replace evaporator
AC F7. Repair and replace metering devices
AC F8. Replace components of defrost system
AC F9. Replace temperature controls
AC F10. Replace motor control devices
AC F11. Replace heaters
AC F12. Perform cleanup of a contaminated system
AC F13. Charge refrigeration system
AC F14. Perform preventative maintenance

C-9
AC F16. Check and adjust air flow
AC G1. Test compressor efficiency
AC G2. Install, replace and repair compressor
AC G3. Install and replace condensing unit
AC G4. Install, repair and replace stem-type valve
AC G5. Install, replace and test control valves
AC G6. Repair and replace condenser
AC G7. Repair and replace evaporator
AC G8. Replace and repair metering device
AC G9. Adjust metering device
AC G12. Perform cleanup of a contaminated system
AC G13. Charge refrigeration system
AC G14. Check and adjust air flow
AC G15. Identify and use related tools and instruments
AC G16. Pump down unit
AC G17. Perform preventative maintenance
AC G18. Interpret wiring diagram
AC H2. Test compressor efficiency
AC H3. Install and replace compressor
AC H4. Install and replace condensing unit
AC H5. Repair and replace condenser
AC H6. Repair and replace evaporator
AC H7. Install, replace and test control valves
AC H8. Replace and repair metering devices
AC H10. Perform cleanup of a contaminated system
AC H11. Charge air conditioning system
AC H12. Check capacity of cooling system
AC H13. Interpret wiring diagram - cooling system
AC H14. Describe operation of a heat pump
AC H15. Interpret wiring diagram - heat pump
AC H16. Check capacity of heat pump
AC H17. Replace defrost system components - heat pump
AC H20. Identify and describe operation of heating system components
AC H23. Check and adjust air flow
AC H24. Install and replace electric motor
AC H25. Repair, replace and service electronic air cleaner
AC H26. Perform preventative maintenance
AC H27. Pump down unit
AC H28. Remove and replace drier cartridge
AC H29. Clean, repair and maintain cooling tower
AC I1. Perform systematic problem solving of an air system
AC I2. Perform systematic problem solving of an electrical system

C-10
AC I3. Perform systematic problem solving of a fuel system
AC I4. Perform systematic problem solving of a refrigerant system
AC J1. Interpret psychrometric chart
AC J2. Solve psychrometric problems
AC J4. Describe concept of air treatment
AC J5. Describe concept of heat loss and heat gain factors
AC Other Control Circuits
AC Other Servomechanisms
AC Other Rheostats
AC Other Magnetic-Electromagnetic Devices
AC Other Calibration Meters
AC Other Motor Controllers (Servos)
AC Other Condensor-Capacitor
AC Other Basic Electronic
AC Other Troubleshooting or Problem Solving Skills
AB S1. Identify electrical system components
AB S2. Service a battery
AB S3. Splice a wire
AB S4. Diagnose and repair electrical accessories
AM D1. Check continuity in electrical circuits using test light and voltmeter, oscilloscope, and wiring diagram
AM D2. Check for shorts, opens, and grounds
AM D3. Measure resistance in electrical circuits using an ohmmeter
AM E1. Clean and inspect battery clamps, cables, and connectors
AM E2. Perform battery condition tests
AM E4. Charge and install a battery
AM F2. Remove, clean, and inspect starter motor and components
AM G4. Repair or replace charging system components
AM H2. Repair or replace lights, sockets, wires, and switches
AM I1. Diagnose and repair gauge and warning circuits
AM I2. Diagnose and repair electrical accessories (horn, wiper, motor)
AM Q3. Inspect, replace, and adjust drive belts and hoses
AM Ee3. Inspect, adjust, and replace sensors, cables, and actuators
DM D2. Replace and adjust fan and auxiliary belts
DM D3. Replace water filter
DM D7. Replace hoses and clamps
DM F2. Evaluate problem
DM K3. Perform common diagnostic tests
DM K4. Evaluate test results
DM K6. Repair and/or replace starter
DM K7. Remove and replace battery

C-11
DM K8. Remove and replace associated wiring and/or switches (solenoids/relays/contacts)

DM N2. Demonstrate an understanding of basic AC theory and operation

DM N3. Remove and replace major components

DM N4. Evacuate and charge system

EL A4. Identify and practice safe soldering methods

EL B2. Describe the basic physics of semiconductor materials

EL B3. Describe the relationship between electrical and magnetic properties

EL B4. Describe the electrical and magnetic properties of a magnet

EL B5. Describe the photoelectric effect

EL B6. Describe the thermocouple effect

EL B7. Describe the electrical effect of friction

EL B8. Describe the concept of resistance, voltage and current and how they relate to each other

EL B9. Describe the concept of capacitance, voltage and current and how they relate to each other

EL B10. Describe the concept of inductance, voltage and current and how they relate to each other

EL B12. Identify and test resistors

EL B13. Identify and test capacitors

EL B14. Identify and test inductors

EL B15. Calculate series and parallel; resistive, capacitive and inductive networks

EL B18. Calculate RC time constant circuits

EL C1. Describe types of transformers

EL C2. Determine transformer requirements

EL C3. Determine rectifier (diode) specifications for specific installations

EL D1. Identify schematic design symbols for semiconductor devices

EL D13. Test diodes

EL D14. Test transistors

EL H1. Describe the operation and demonstrate the use of an oscilloscope

EL L2. Identify the levels of computer languages

EL M3. Solder/desolder circuits

SE F2. Read electrical schematics

SE F3. Test, service, and/or replace battery

SE L3. Repair or replace related electrical components including safety devices

SE Q1. Adjust tension and alignment of pulleys and belts
Group Three Competency Lists, Revised

Color Codes:

Blue - CONSTRUCTION Cluster
Peach - MANUFACTURING Cluster
Green - TRANSPORTATION Cluster
Construction Cluster
Common Cluster Competencies, Revised

BM B2. Identify safety rules for carrying and erecting a ladder
BM B3. Identify safety rules for erecting scaffolding
BM B7. Clean windows
BM C3. Cut and solder copper pipe
BM D3. Bend and connect conduit
BM E4. Repair or install interior door operating hardware
BM E5. Identify procedures for repairing, replacing and/or installing floor coverings
BM E6. Repair, replace and/or install a ceiling system
BM E7. Install wall and/or ceiling insulation
BM E8. Install or replace interior trim
BM F5. Apply finish with brush
BM F6. Apply finish with roller
BM H2. Set forms
BM H5. Pour and finish concrete
BT C1. Use builder's level
CM A12. Identify wood species and grades
CM B6. Set up and operate planer safely and accurately
CM C3. Lay out, cut, and construct a dado joint
CM C6. Lay out, cut, and construct a miter joint
CM D1. Identify various types of wood glues, their uses, and precautions
ET A7. Apply techniques of lifting and climbing with ladders
ET C5. Use pouch tools
MA B6. Demonstrate proper installation and use of scaffolding
P A7. Practice ladder and scaffold safety
Manufacturing Cluster
Common Cluster Competencies, Revised

DR F1. Construct primary auxiliary views
DR F3. Construct secondary auxiliary views
DR F4. Identify use and application of auxiliary views
DR G1. Identify and draw standard sectional views
DR G2. Identify the symbols used to present different materials
DR G3. Identify and use cutting planes
DR G4. Identify and use conventional breaks
DR G5. Identify use and application of sectional views
DR H1. Apply dimensioning practices and techniques to drawings
DR H2. Construct the lines used to dimension drawings
DR H6. Identify geometric dimensioning and tolerancing techniques
DR H7. Apply geometric dimensioning and tolerancing techniques
MS D9. Plan sequence of machining operations
MS F3. Correlate types of materials to their properties
MS F4. List major cutting tool variables
MS F6. Test workpiece for hardness without hardness tester
MS G4. Cut and weld band saw blades
MS G5. Select and set speeds and feeds on power saw
MS G6. Cut material to length with power hack saw
MS G7. Cut material to length with band saw
MS M3. Calculate coordinates and dimensions of CNC drawing
W B5. Interpret structural shapes, sizes and weights
W C2. Identify types of fuels and their application
W L4. Describe and apply principles of metallurgy in annealing, hardening and tempering
W L5. Describe methods of testing metals
W L6. Identify types of ferrous metal by spark test
Transportation Cluster
Common Cluster Competencies, Revised

AB C5. Describe proper fitting and jacking techniques
AB K2. Replace energy absorbers
AB Q10. Remove and reinstall heating and air conditioning assembly
AB Q11. Remove and reinstall carpeting
AB Q12. Remove and reinstall seat belts and shoulder harness
AB Q13. Identify supplemental inflatable restraint systems
AB Q14. Diagnose supplemental inflatable restraint systems
AB Q15. Service and repair supplemental inflatable restraint systems
AB R9. Remove and replace a lock cylinder
AB T1. Service a taillight assembly
AB T2. Service a headlight assembly
AB T3. Service mechanical headlights and covers
AB T4. Aim headlights mechanical aiming equipment
AB U1. Remove and replace a radiator
AB U2. Remove, inspect and replace V-Belts
AB U3. Test antifreeze solution
AB U4. Service fan blades and clutches
AB U5. Check and service radiator and heater hoses
AB U6. Inspect, repair, and replace auxiliary oil cooler
AB U7. Inspect, repair, and replace fuel, exhaust, and emissions systems
AB V8. Inspect, flush, and replace heater core
AB W1. Identify front suspension systems
AB W2. Identify rear suspension systems
AB W3. Remove and reinstall front suspension systems
AB W4. Remove and reinstall rear suspension systems
AB W5. Remove and reinstall front drive train
AB W6. Service suspension systems
AB W7. Identify steering systems
AB W8. Perform four-wheel alignment
AB W9. Perform suspension quick checks
AB W10. Service power steering system
AB W11. Service brake system
AB W12. Identify causes of uneven tire wear
AB W13. Inspect, repair, and replace steering system components
AB X1. Identify vehicle frame construction, conventional and unibody
AB X2. Identify frame and unibody terminology
AM C1. Identify basic function and operation of vehicle mechanical components
AM E3. Jump start a vehicle
AM F1. Diagnose starting system and determine needed repair
AM F3. Repair or replace starter motor components
AM G1. Diagnose charging system and determine needed repairs
AM H1. Diagnose lighting system problems and determine needed repairs
AM J2. Inspect, repair, or replace primary ignition components
AM J5. Perform on-board computer system diagnosis
AM J6. Repair or replace computer system components
AM K1. Diagnose fuel system problems and determine needed repairs
AM K2. Inspect, repair, or replace fuel supply component
AM K6. Repair or replace fuel injection components
AM K8. Diagnose and repair exhaust system problems
AM L6. Clean, inspect/replace air management system
AM L7. Clean, inspect/replace inlet air temperature control
AM L9. Clean, inspect/replace fuel vapor controls
AM M2. Remove and replace engine (front- and rear-wheel drive)
AM Q1. Inspect and repair oil system and components
AM Q2. Perform cooling system tests; determine needed repairs
AM Q4. Replace cooling system components (thermostat, radiator, controllers)
AM Q5. Inspect coolant, drain, flush, and refill cooling system with recommended coolant
AM Q6. Perform oil and lube service on normally aspirated and turbo-charged engines
AM R1. Diagnose and determine needed repairs on steering systems
AM R2. Clean and inspect power and manual steering gear boxes
AM R3. Reassemble, adjust, and install power and manual steering gear boxes
AM R4. Clean and inspect power and manual rack-and-pinion steering rack
AM R5. Reassemble, adjust, and install power and manual rack-and-pinion steering rack
AM R6. Inspect and repair steering columns

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AM R7. Inspect and replace steering linkage components
AM R8. Inspect, repair, and replace power steering pumps
AM S1. Diagnose and determine needed repairs on conventional and electric front suspension systems
AM S2. Inspect and repair control arm and spring assemblies on conventional systems
AM S3. Inspect and repair wheel spindles and bearings
AM S4. Inspect and replace shock absorbers and stabilizer bars
AM S5. Diagnose and determine needed repairs on MacPherson Strut assemblies
AM S6. Clean, inspect, and assemble MacPherson strut assemblies
AM T1. Diagnose and determine needed repairs on conventional and electronic rear suspension systems
AM T2. Inspect and replace shock and spring assemblies
AM T3. Inspect and replace MacPherson strut assemblies
AM T4. Inspect and repair suspension linkages and bushings
AM U1. Diagnose and determine needed repairs on conventional and electronic rear suspension systems
AM U2. Set correct alignment angles on front wheels
AM U3. Set correct camber and toe on rear wheels
AM U4. Rotate and balance tire and wheel suspension
AM V1. Diagnose hydraulic brake systems and determine needed repairs
AM V2. Inspect and repair or replace master cylinders and lines of the hydraulic system
AM V3. Inspect and replace switches and valving devices
AM W1. Diagnose and determine needed repairs on drum brake systems
AM W2. Remove, clean, and inspect drum brake assemblies
AM W3. Remove, replace, and adjust drum brake components
AM X1. Diagnose and determine needed repairs on disc brake systems
AM X2. Remove, clean, and inspect disc brake components
AM X3. Repair, replace, and adjust disc brake components
AM Y1. Diagnose and determine needed repairs on power-assist brakes
AM Y2. Repair or replace power brake components
AM Y3. Repair or replace hydra-boost components
AM Y4. Check operation of anti-skid braking systems; adjust or repair according to manufacturer's recommendations
AM Bb1. Diagnose and determine needed repairs

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AM Bb2. Inspect, service, and replace front axle shafts
AM Bb3. Inspect, service, and replace drive shafts
AM Dd4. Diagnose and determine needed repairs on hub assemblies
AM Dd5. Disassemble, clean, and inspect hub assemblies
AM Dd6. Reassemble and adjust hub assemblies
AM Ee4. Inspect and replace external bushings, seals, and gaskets
AM Ee5. Inspect, replace, and align power train mounts
AM Gg4. Diagnose and repair automatic and electrical temperature control units
AM Hh1. Diagnose and repair heating system problems and determine needed repairs
AM Hh2. Inspect and replace heating system components
DM A9. Identify and select common seals and gaskets
DM B2. Test cooling system
DM B3. Test engine lubrication system
DM B4. Check air intake and/or exhaust system
DM B5. Draw lubrication and/or oil sample
DM B6. Check linkage adjustments
DM B7. Perform visual inspection
DM B8. Replace fuel filters
DM B10. Inspect steering linkage for wear
DM B11. Inspect and adjust brakes
DM C2. Adjust supplementary governing and/or control devices
DM C3. Adjust intake and exhaust valves according to specifications
DM C4. Adjust injectors according to specifications
DM C5. Adjust governor (as applicable)
DM D4. Replace and/or test radiators
DM D5. Flush cooling system
DM D6. Replace and test thermostat and seals
DM D8. Inspect fan drive assembly and related hardware
DM D9. Replace water pump
DM D10. Test and replace oil cooler
DM D11. Test radiator coolant
DM D12. Recognize proper routing and sizing of cooling lines
DM D13. Pressure test cooling system
DM E2. Test injection nozzles and injectors
DM E3. Time fuel injection pump
DM E4. Bleed fuel system
DM E5. Replace injection nozzles and injectors
DM E6. Test fuel system
DM E7. Identify and install fuel line hoses and connections
DM E8. Inspect turbo charger condition
DM F3. Trouble-shoot overheating and overcooling
DM F4. Trouble-shoot engine vibration
DM F5. Trouble-shoot electrical system
DM F6. Trouble-shoot low and/or high oil pressure
DM F7. Trouble-shoot smoke
DM F8. Trouble-shoot leaks and/or contamination
DM F9. Trouble-shoot hard starting
DM F10. Trouble-shoot high oil consumption
DM F11. Trouble-shoot fuel system
DM F12. Trouble-shoot internal noises
DM F13. Trouble-shoot low power and/or performance
DM F14. Trouble-shoot air system
DM F15. Trouble-shoot low fuel mileage
DM G2. Evaluate oil conditions
DM G3. Replace and inspect oil filter
DM G4. Change engine oil
DM G5. Change transmission and/or differential oils
DM G6. Change power steering fluid
DM G7. Lubricate chassis components
DM G8. Replace transmission and/or differential filters
DM H2. Remove engine
DM H3. Remove injection pump
DM H4. Remove camshaft and bushings
DM H5. Remove cylinder ridge, pistons and liner
DM H6. Remove crankshaft
DM H7. Remove oil pump
DM H8. Remove cylinder head
DM H9. Remove exterior components
DM I2. Clean components
DM I3. Inspect flywheel
DM I4. Rebuild oil pump
DM I6. Rebuild cylinder heads
DM I7. Rebuild or replace accessories
DM J2. Install camshaft and bushings
DM J3. Install crankshaft
DM J4. Install cylinder liners
DM J5. Install piston on rod
DM J6. Install piston on cylinder
DM J7. Install oil pump
DM J8. Install timing gears
DM J9. Install cylinder heads
DM J10. Install injection pump
DM J11. Install exterior components
DM J14. Tune engine
DM J15. Test run engine
DM J16. Install engine
DM K9. Remove and reinstall generator and/or alternator
DM M1. Identify basic principles of hydraulics
DM M2. Identify basic hydraulic components
DM O3. Remove and replace springs and pins
DM O4. Rebuild steering sector and hydraulic pump
DM O5. Remove and replace king pin
DM O6. Remove and replace steering components
DM O7. Inspect, remove and replace mounted tires
DM P2. Repair cam, wedge and disc brakes
DM P3. Service hydraulic brake system
DM P4. Inspect brake drum and/or rotors using safety specifications
DM P5. Replace spring brake chambers and diaphragms
DM Q2. Remove and replace clutch assembly
DM Q3. Adjust clutch free play
DM Q4. Install throw-out bearing
DM Q5. Remove, adjust and replace drive line
DM Q6. Remove and replace transmission (manual and automatic)
DM Q7. Remove and replace axle shaft
DM Q8. Replace and adjust wheel bearing
DM Q9. Service hubs
DM Q10. Check drive line alignment
DM Q11. Remove and replace differential
SE D1. Test, repair, or replace fuel pump
SE D2. Test, repair, or replace fuel filters and strainers
SE D3. Remove, clean and replace fuel tank shut-off valves, fuel lines, fuel hoses, and connections
SE D6. Adjust fuel mixture and check for air leaks
SE D7. Service oil-bath air cleaner
SE D9. Service dry-element air cleaner
SE G1. Remove and service spark plug
SE G2. Check ignition timing
SE G3. Test and repair breaker ignition system
SE G4. Test and repair breakerless ignition system
SE G5. Troubleshoot ignition systems
SE H1. Change engine oil and filter
SE H2. Service crankcase breather
SE H3. Inspect, repair, and/or replace pressure lubrication system
SE H5. Locate and repair leaking gasket and seals
SE H7. Select proper oil
SE I1. Service air-cooled system
SE I2. Service liquid-cooling system
SE I3. Remove, inspect, repair, and/or replace water pump
SE I4. Remove, check, and replace thermostat
SE I5. Perform a pressure test on cooling system
SE I6. Remove, check, and replace radiator
SE J1. Service and/or replace a 2-stroke-cycle exhaust system
SE J2. Service and/or replace a 4-stroke exhaust system
SE M1. Troubleshoot the ignition system
SE M2. Troubleshoot the fuel system
SE M3. Troubleshoot compression problems
SE N1. Identify the characteristics of the 4-stroke-cycle engine
SE N2. Describe the operating cycle of the 4-stroke-cycle engine
SE N3. Disassemble a 4-stroke-cycle engine
SE N4. Inspect and service a cylinder
SE N5. Inspect and service the pistons, rings, and connecting rod
SE N6. Inspect and service a crankshaft assembly
SE N7. Inspect and service a valve train assembly
SE N8. Reassemble 4-stroke-cycle engine
SE P1. Identify the component parts of a manual transmission
SE P2. Identify the component parts of a transaxle
SE P3. Identify the component parts of clutch systems
SE P5. Identify the component parts of brake systems
SE Q3. Adjust and replace control cables
SE Q5. Lubricate chassis components
SE Q6. Inspect and adjust brakes
SE Q7. Inspect and adjust clutch

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APPENDIX D:

Final Presentation and Committee Questions
# Industrial Education

## Common Competencies Project

<table>
<thead>
<tr>
<th>Manufacturing Cluster</th>
<th>Service Cluster</th>
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<tbody>
<tr>
<td>Drafting</td>
<td>Air Conditioning, Heating, Refrigeration</td>
</tr>
<tr>
<td>Machine Shop</td>
<td>Electronics</td>
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<td>Welding</td>
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<thead>
<tr>
<th>Transportation Cluster</th>
<th>Construction Cluster</th>
<th>&quot;Other&quot; Cluster</th>
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</thead>
<tbody>
<tr>
<td>Auto Collision Repair</td>
<td>Building Maintenance</td>
<td>Commercial Art</td>
</tr>
<tr>
<td>Auto Mechanics</td>
<td>Building Trades</td>
<td>Cosmetology</td>
</tr>
<tr>
<td>Diesel Mechanics</td>
<td>Cabinetmaking</td>
<td>Food Service</td>
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<tr>
<td>Small Engines</td>
<td>Electrical Trades</td>
<td>Offset Lithography</td>
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<td></td>
<td>Masonry</td>
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<tr>
<td></td>
<td>Plumbing</td>
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19 Areas
5 Clusters
Establish What These 19 Areas Have In Common

Process:
1. Initial meeting held to outline project
   Instructors examine competency profiles for all 19 areas to see what they have in common with each area
2. DESE and IML meet to determine what patterns instructors' work shows
   Competencies are split up accordingly into lists
3. Instructors meet and make changes to competency lists
4. Competency lists are finalized and sent to instructors for one more review
5. Results are presented at a final project meeting
Transportation and Service Clusters: Common Cluster Level Competencies

- Common
- Cross Cluster
- Cluster
- Profile
Transportation and Service Clusters: Cross Cluster Level Competencies
Transportation and Service Clusters: Cluster Level Competencies
Transportation and Service Clusters
Profile Specific Competencies

- Common
- Cross Cluster
- Cluster
- Profile
Construction Cluster

- Common
- Cross Cluster
- Cluster
- Profile

Graph showing categories such as Building Maintenance, Building Trades, Cabinet making, Electrical Trades, Masonry, and Plumbing.
Manufacturing Cluster
Questions to Advisory Committee, Final Meeting

1. In examining the list of common competencies that can be taught across a significant number of T & I areas, which of those merit more formal development?

2. In general, when looking at T & I, should there be a core set of tasks identified and organized to be taught within a specific time of instruction?

3. Can T & I education benefit by examining the full range of courses offered to students from their junior high through high school grade levels to determine a sequence of course studies that better or best prepare the student for a specific T & I area?

4. Now that those skills that students should possess prior to enrollment in T & I classes have been identified, should measurable, competency-based entrance tests be established to determine individual students' readiness to learn in those classes?

5. In examining the current delivery system, what must exist to allow a full range of student participation and enhance the Tech Prep philosophy?

6. Are there some steps that can be taken to improve program appeal, standards, and quality?