The syllabus outlines material for a course two academic years in length (minimum two and one-half hours daily experience) leading to entry-level occupational ability in several welding trade areas. Fourteen units covering arc welding, oxyacetylene welding, cutting, nonfusion processes, inert gas shielded-arc welding, welding cast iron, welding stainless steel, pipe welding, and plasma welding (optional) are presented in a three-column format. The first column lists the topics of instruction for each unit. Cognitive, affective objectives, and behavioral objectives corresponding to the topics are provided in the second column. The third column describes specific teaching activities for presenting the topics. Appended are a resource list of books, a list of audio-visual software with sources, a suggested group of tools and equipment necessary for a trade course in arc and acetylene welding, information on eye safety, and the procedure for obtaining welding certification in New York State. (MS)
TRADE WELDING

syllabus
SYLLABUS
IN TRADE WELDING

THE UNIVERSITY OF THE STATE OF NEW YORK/ THE STATE EDUCATION DEPARTMENT
BUREAU OF OCCUPATIONAL AND CAREER CURRICULUM DEVELOPMENT/ ALBANY, NEW YORK 12234
Regents of the University (with years when terms expire)

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<th>Name</th>
<th>Title</th>
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<td>1978</td>
<td>Alexander J. Allan, Jr., LL.D., Litt.D.</td>
<td></td>
<td>Troy</td>
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<td>1980</td>
<td>Joseph T. King, LL.B.</td>
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<td>1981</td>
<td>Joseph C. Indelicato, M.D.</td>
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<td>1979</td>
<td>Francis W. McGinley, B.S., J.D., LL.D.</td>
<td></td>
<td>Glens Falls</td>
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<td>1983</td>
<td>Harold E. Newcomb, B.A.</td>
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<td>Owego</td>
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<td>1988</td>
<td>Willard A. Genrich, LL.B., L.H.D.</td>
<td></td>
<td>Buffalo</td>
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<td>1982</td>
<td>Emlyn I. Griffith, A.B., J.D.</td>
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<td>Rome</td>
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<td>1977</td>
<td>Genevieve S. Klein, B.S., M.A.</td>
<td></td>
<td>Bayside</td>
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<tr>
<td>1976</td>
<td>Mary Alice Kendall, B.S.</td>
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<td>Irondequoit</td>
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<td>1984</td>
<td>Jorge L. Batista, B.A., J.D.</td>
<td></td>
<td>Bronx</td>
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<tr>
<td>1982</td>
<td>Louis E. Yavner, LL.B.</td>
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<td>New York</td>
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President of the University and Commissioner of Education

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Robert H. Bielefeld

Chief, Bureau of Trade and Technical Education

Carl G. Benenati
The proliferation of course offerings in welding since 1965 has mandated creation of a State standard for this curriculum.

During July 1969, welding instructors Ivan Griffin, Central Technical High School, Syracuse, and Stephen Polniak, Trott Vocational High School, Niagara Falls, met with Edward Shattuck, associate, Bureau of Trade and Technical Education, to construct a topical outline of course content. The following August, a committee comprised of James Kearns, Warren County BOCES; Richard Kelly, Albany (city) Vocational Center; and Hans Weber, Ulster County BOCES, guided and assisted by Joseph Messier, Associate in Vocational Curriculum, expanded the topical outline into this syllabus in trade welding.

The syllabus, like other syllabi, presents required content arranged in some logical, but not necessarily teaching, sequence. Due to the high degree of personal skill which a welder must develop, it does not require that each student become acceptably proficient in every area of the content, but allows individual rates of progress and attendant certification of proficiency in specific trade areas. Neither does it preclude participation by students of other trades in those segments only, which are considered to be part of the job of their journeymen, such as the light gage steel welding performed by carpenters in some areas. These aspects should be carefully considered by the teacher when using the syllabus in developing a course of study.

Excerpts from the USA Standard Practices for Occupational and Educational Eye and Face Protection are included for the teacher's convenience. Information regarding Welder Certification testing, pages 37 through 49, is provided through courtesy of the New York State Department of Transportation.

G. Earl Hay, Chief
Bureau of Occupational and Career Curriculum Development

Gordon E. Van Hooft, Director
Division of Curriculum Development
TO THE TEACHER

This syllabus in trade welding is organized on the basis of a minimum daily experience of 2 1/2 hours, through 2 academic years of 165 teaching days each. The content is devoted mainly to the basic, required arc and acetylene welding and the increasingly important shielded-arc processes, but includes as an optional unit the locally important plasma welding. It is expected that the individual welding instructor will adapt the content to his teaching situation when preparing his course of study.

A three-column format was adopted for this syllabus; the first column consisting of the units of instruction. The second column lists the objectives of the instructional units, divided into two groupings. One group, appearing under the heading "The student should be:" is concerned with background and related knowledge, the acquisition of which must be evaluated subjectively. The second group, titled "The student should be able to:" combines these cognitive and affective values with the more objective psychomotor learning, expressed in performance terms which describe a test of the learning. The final column consists of suggestions intended to aid the teacher in delimiting the depth or breadth of instruction, and to stimulate his ingenuity in varying methodology to meet the needs of every student.

The successful student of the course will possess entry ability in at least one of the trade areas classified and described in the U.S. Office of Education publication, Vocational Education and Occupations:

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<th>Welding and Cutting</th>
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<td>17.230602</td>
<td>Welding and Cutting, Other</td>
<td>17.230699</td>
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Appended to the body of the syllabus is a resource list of books, A/V software, and their sources, a suggested group of tools and equipment necessary for a trade course in arc and acetylene welding, information on eye safety, and the procedure for obtaining welder certification.

Carl G. Benenati, Chief
Bureau of Trade and Technical Education

Robert H. Bielefeld, Director
Division of Occupational Education Instruction
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TRADE WELDING

Unit I — ORIENTATION TO WELDING CAREERS

Instruction

Objectives

Teaching Suggestions

o History of Welding
  - Increasing use of metals
  - Improved technology
    - General
    - Welding

o Career Opportunities
  - Industrial
  - Trade
  - Technical
  - Sales
  - Engineering

o Employment Opportunities
  - National
  - Regional
  - Local

o Shop Organization
  - Daily routine
  - Fire procedures
    - Building evacuation
    - Nature and use of extinguishers
  - Course outline
    - Content
    - Standards of competency
    - Methods of evaluation

The student should be:

- Acquainted with the extent and importance of the welding industry.
- Acquainted with the occupational choices in the welding field.
- Aware of the standard of living possible through welding occupations.
- The student should be able to:
  - Demonstrate by any teacher-designated means an understanding of procedures to be followed and a knowledge of basic rules of school and shop.

Tracing forge-welding from Egyptian jewelry, through Damascus sword blades, to assembled tanks is usually
Films of welding being done in various settings are avail
Screen "want ads," union and industry personnel literature, Department of Labor forecasts, opaque projector (transparencies overhead projection can be less impact).
Handout sheets, clearly and stating the basics involve value. Minor details should be

Handout sheets, clearly and stating the basics involve value. Minor details should be

Handout sheets, clearly and stating the basics involve value. Minor details should be
TRADE WELDING

Objectives

The student should be:

1. Acquainted with the extent and importance of the welding industry.
2. Acquainted with the occupational choices in the welding field.
3. Aware of the standard of living possible through welding occupations.

The student should be able to:

1. Demonstrate by any teacher-designated means an understanding of procedures to be followed and a knowledge of basic rules of school and shop.

Teaching Suggestions

Tracing forge-welding from prehistoric Egyptian jewelry, through strip-welded Damascus sword blades, to modern weld-assembled tanks is usually effective.

Films of welding being done in various settings are available.

Screen "want ads," union and industry personnel literature, and U.S. Department of Labor forecasts in an opaque projector (transparencies for overhead projection can be made but have less impact).

Handout sheets, clearly and concisely stating the basics involved should be of value. Minor details should be covered in discussion.
Unit II — Fundamentals Knowledge

Objectives

The student should be:

Acquainted with the means by which iron and steel are produced.

Aware of the importance of high temperatures in the production of iron and steel.

The student should be able to:

Demonstrate by any teacher-designated means a knowledge of those basic properties of commonly used steels which affect the welding/cutting process.

Demonstrate by any teacher-designated means a basic understanding of the nature of fusion, and the manner in which it is achieved with oxy and arc equipment.

Demonstrate by any teacher-designated means a basic understanding of the nature of non-fusion, how it differs from fusion, and the manner in which brazing and silver soldering is accomplished.

The student should be:

Aware of the welder's ability to separate as well as join metals.

Acquainted with both machine and hand-held equipment.

Teaching Suggestions

A variety of audiovisuals available from many companies.

The student should learn the proper use of both oxy and arc welding. It is only that he know of the difference between oxy and arc welding.

The student should not memorize a list of steels. He should learn the properties of steel at the time it is needed for the course.

The student should be acquainted with the principles of welding in general, but not necessarily with oxy and arc welding.
Objectives

**MENTAL KNOWLEDGE**

- Metallurgy of iron and steel production
- The student should be:
  - Acquainted with the means by which iron and steel are produced.
  - Aware of the importance of high temperatures in the production of iron and steel.

- The student should be able to:
  - Demonstrate by any teacher-designated means a knowledge of those basic properties of commonly used steels which affect the welding/cutting process.
  - Demonstrate by any teacher-designated means a basic understanding of the nature of fusion, and the manner in which it is achieved with oxy and arc equipment.
  - Demonstrate by any teacher-designated means a basic understanding of the nature of non-fusion, how it differs from fusion, and of the manner in which brazing and silver soldering is accomplished.

- The student should be:
  - Aware of the welder's ability to separate as well as join metals.
  - Acquainted with both machine and hand-held equipment.

Teaching Suggestions

- A variety of audiovisual software is available from many commercial sources.

- The student should not be required to memorize a list of steels/properties. He should learn the properties of a specific steel at the time it is used.

- The student should be thoroughly acquainted with the principles of oxy and arc welding. It is necessary only that he know of the existence of resistance welding.
Instruction

- Heat Sources
  - Oxyacetylene
  - Electricity
  - Oxyhydrogen
  - Air/acetylene
  - Air/fuel gas

- Effects of Heat
  - Expansion
  - Contraction
  - Conditioning
    - Hardening
    - Annealing
    - Normalizing
  - Stresses
    - Internal
    - External

Objectives

- The student should be: Acquainted with the various sources of welding energy.

- The student should be able to:
  Demonstrate by any teacher-designated means a thorough understanding of those properties of oxyacetylene and electrical energies which affect the welding process.

- The student should be:
  Aware of the relationship between temperature of metals and their dimensional stability.

- Aware of the different rate (coefficient) of expansion of different metals.

- Aware of the problems involved in heating and cooling cycles, and incorrect welding sequences.

- Acquainted with the processes of heat conditioning.

Teaching Suggestions

- The student should thoroughly understand oxyacetylene and electrical energies. It is sufficient for this student be acquainted with oxyhydrogen, air/acetylene, and air/fuel gas systems.

- Construct a "dial indicator" of plywood and lumber, pro-asbestos. Heat rod.

- Have students make chirping from reinforcing rods.
Objectives

The student should be:
Acquainted with the various sources of welding energy.

The student should be able to:
Demonstrate by any teacher-designated means a thorough understanding of those properties of oxyacetylene and electrical energies which affect the welding process.

The student should be:
Aware of the relationship between temperature of metals and their dimensional stability.
Aware of the different rate (coefficient) of expansion of different metals.
Aware of the problems involved in heating and cooling cycles, and incorrect welding sequences.

Acquainted with the processes of heat conditioning.

Teaching Suggestions

The student should thoroughly understand oxyacetylene and electric arc welding.
It is sufficient for this course that the student be acquainted with the features of oxyhydrogen, air/acetylene, and air/fuel gas systems.

Construct a "dial indicator" from scraps of plywood and lumber, protected by sheet asbestos. Heat rod.

Have students make chipping chisels from reinforcing rods.
Instruction

- Safety
  - Personal
    - Eye protection
    - Skin protection
  - Environmental
    - Ventilation
    - Screening nonwelders
    - Storage
    - Housekeeping
  - Accidents
    - Procedure
    - Reports

- Blueprint Reading and Sketching

Objectives

The student should be able to:

- Demonstrate by personal behavior an appreciation of the need for constant safety procedure.
- Demonstrate by any teacher-selected means an ability to interpret welding drawings and to prepare freehand welding sketches.

Teaching Suggestions

- Display safety films, preferably National Safety Council.
- Anecdotes from the teacher's experience are usually effective.
- The student should be familiar with the requirements of school accident reports and its proper completion.
- The student should not memorize symbols but rather learn the symbol for each type of electrode.
- Make handout sheets explaining the digital electrode class.
- The student must understand the process of setting-up, and of striking an arc.
- The student must understand the relationship between polarity and its role in electrode selection.

Unit III — INTRODUCTION TO ARC WELDING

- Equipment
  - Nomenclature
  - Function

- Fundamental Factors
  - Current setting
  - Length of arc
  - Rate of travel
  - Electrode angle

The student should be:

- Acquainted with the process of setting-up, and of striking an arc.
**Objectives**

The student should be able to:

- Demonstrate by personal behavior an appreciation of the need for constant safety procedure.

- Demonstrate by any teacher-selected means an ability to interpret welding drawings and to prepare freehand welding sketches.

- Demonstrate by any teacher-selected means an ability to name the important parts of arc equipment and a basic understanding of the function of each.

- The student should be acquainted with the process of setting-up, and of striking an arc.

- The student must understand the nature of polarity, and its relationship to electrode selection and job quality.

**Teaching Suggestions**

- Display safety films, posters, and National Safety Council materials.

- Anecdotes from the teacher's industrial experience are usually quite effective.

- The student should be familiar with the school accident report form, the information required, and its possible effects.

- The student should not be required to memorize symbols but rather to learn the symbol for each type weld as it is practiced.

- Make handout sheets explaining A.W.S. digital electrode classifications.
Instruction

- Safety Orientation
  - Eye protection
    - Effect of rays
    - Approved filter plate
    - Head shield
    - Slag removal
      - Hammer and chisel
      - Wire brush
  - Skin protection
    - Sparks
    - Sunburn
    - Synthetic fabrics
    - Protective clothing

- Welding; Student!
  - Flat Position
    - Familiarization with current controls
    - Positioning stock
    - Manipulating electrode and holder
    - Adjusting apparel
    - Striking the arc
    - Running the bead

- Stringer Beads; Flat Position

Objectives

The student should be:

- Aware of the hazards inherent to, or attendant to arc welding.
- Acquainted with required procedures designed to minimize or eliminate the danger involved.

The student should be able to:

- Demonstrate by any teacher-selected means an understanding of the danger-points of arc welding.
- Demonstrate by continual behavior a knowledge of proper safety procedures.
- Demonstrate increasing proficiency in setting up equipment.
- Demonstrate by any teacher-selected means an understanding of the effects of the four Fundamental Factors on the quality of the weld.
- Demonstrate a beginning ability to strike an arc and run a bead.

The student should be:

- Aware of the importance of maintaining uniformity in arc length and rate of travel.

Teaching Suggestions

Note: Eye protection is required for all who are in the vicinity of metal being formed.

The student should be able to:

- Demonstrate the igniting samples of sparks, molten metal, etc.
- Display samples of good and bad welds. Charts depicting various types are available from commercial sources.

At this point the student should experiment with the Four Fundamental Factors.

- The student should learn uniformity by sound as well as appearance.
- It is important that the student be proficient in the use of different electrodes and diameters.
Objectives

The student should be:
Aware of the hazards inherent to, or attendant to arc welding.

Acquainted with required procedures designed to minimize or eliminate the danger involved.

The student should be able to:
Demonstrate by any teacher-selected means an understanding of the danger-points of arc welding.

Demonstrate by continual behavior a knowledge of proper safety procedures.

Demonstrate increasing proficiency in setting up equipment.

Demonstrate by any teacher-selected means an understanding of the effects of the four Fundamental Factors on the quality of the weld.

Demonstrate a beginning ability to strike an arc and run a bead.

The student should be:
Aware of the importance of maintaining uniformity in arc length and rate of travel.

Teaching Suggestions

Note: Eye protection is required by law for all who are in the vicinity of metal being cut or formed.

The student should be aware of the hidden dangers in insulated clothing filled with synthetic fibers.

Demonstrate the inflammability of certain synthetic fibers by igniting samples of the cloth with sparks, molten metal, and flame.

At this point the student should experiment with the four Fundamental Factors.

Display samples of good and of defective welds. Charts depicting weld defects are available from commercial suppliers.

The student should learn to judge bead uniformity by sound as well as by appearance.

It is important that the student become proficient in use of different electrodes and diameters.
Instruction

Padding; Flat Position
- Bead overlap
- Uniform height
- Smooth surface
- Stops and starts

- Corner Weld, Open and Closed; Flat Position
  - Hold to 90° corner
  - Tack ends

- Edge Joint; Flat Position
  - Tack ends
  - Full width weld
    - Uniform bead
    - Maintain existing plate edges
    - Fill craters at end of pass
  - Testing
    - Causes of defects
    - Means of avoiding defects

Objectives

The student should be able to:

Demonstrate an ability to maintain uniform beads.

Demonstrate the ability to re-start an arc achieving total fusion and uniform appearance of the beads.

Demonstrate an ability to adjust current settings for each rod size.

Demonstrate an ability to weld uniformly, with a smooth weld-to-plate transition.

Demonstrate an ability to weld corner and edge joints without overlapping or eroding edges and without leaving craters.

Testing
- Causes of defects
- Means of avoiding defects

The student should be:

Aware of the unfavorable results of slag included in the weld.

Acquainted with the degree of penetration necessary.

Teaching Suggestions

The student should construct approximately 8 in. x 8 in. a nipple welded to one side of an oil or water. Connect to test welds.

The weld may be broken for surface inspection should he need to test welds.
Objectives

The student should be able to:

- Demonstrate an ability to maintain uniform beads.

- Demonstrate the ability to re-start an arc achieving total fusion and uniform appearance of the beads.

- Demonstrate an ability to adjust current settings for each rod size.

- Demonstrate an ability to weld uniformly, with a smooth weld-to-plate transition.

- Demonstrate an ability to weld corner and edge joints without overlapping or eroding edges and without leaving craters.

The student should be:

- Aware of the unfavorable results of slag included in the weld.

- Acquainted with the degree of penetration necessary.

Teaching Suggestions

The student should construct a box, approximately 8 in. x 8 in. x 8 in. with a nipple welded to one side. Fill with oil or water. Connect compressed air to test welds.

The weld may be broken for observation, but surface inspection should suffice for this weld.
/Unit IV — ARC WELDING PRACTICE

Considering the broad scope of the welding industry — space vehicle structures to skyscraper structures to industrial standards — any welding job has instructional value, if an industrial environment and industrial standards are applied.

- Fillet Weld; Lap Joint
  - Single bead
  - Multi bead
    - Bead sequence
  - Weaving the bead
    - Distortion control
  - Testing
    - Aware of the need to clean slag from the weld.

The student should be:

The student should be able to:

- Maintain correct heat settings and electrode angle, and proper bead placement.

Weld plates with one pass.

Weld plates of different thickness.

Demonstrate the ability to manipulate the electrode for "weaving."

- Butt Weld; Square Edge

The student should be:

Aware of the need to clean the weld.

Aware of the nature of "arc blow," and of the problems it creates.

Acquainted with the appearance of proper penetration.

The student should be aware of the effectiveness of this joint, thicker than 1/4 in. must be welded.

Root opening should be equal to diameter of electrode.
Objectives

Teaching Suggestions

WELDING PRACTICE

Roadscope of the welding industry — space vehicle structures to skyscraper structures — as instructional value if an industrial environment and industrial standards are maintained.

Top Joint

The student should be:
AWARE OF THE NEED TO CLEAN SLAG FROM THE WELD.

The student should be able to:
Maintain correct heat settings and electrode angle, and proper bead placement.

Weld plates with one pass.

Weld plates of different thickness.

Demonstrate the ability to manipulate the electrode for "weaving."

Observe:
Welds should have uniform angles and overlap, and smooth transition to plate.

Legs must be uniform.

Beads should be slightly convex.

Demonstrate:
Use of 5 percent nitric acid/alcohol solution to test penetration.

The student should be aware of limited effectiveness of this joint — stock thicker than 1/4 in. must be groove welded.

The student should be:
AWARE OF THE NEED TO CLEAN THE WELD.

Acquainted with the appearance of proper penetration.

Aware of the nature of "arc blow," and of the problems it creates.

ROOT OPENING SHOULD BE EQUAL TO DIAMETER OF ELECTRODE
Instruction

Objectives

The student should be:

- Aware of the need to clean and bevel the plates.
- Demonstrating the ability to interpret trade terms.
- Demonstrating an entry-level ability to clean and bevel the plates.
- Demonstrating the ability to maintain the rod angle and rate of travel necessary to obtain uniform beads.

This procedure requires beads in order to develop weld. Instructor should require the introduction of welding.

The student should be:

- Aware of the gravitational pull on the molten bead and the "freeze" electrodes used to counter it.
- Acquainted with the necessary current settings.
- Demonstrating the ability to maintain the rod angle and rate of travel necessary to obtain uniform beads.

Teaching Suggested

3/16 IN. BACKING}

5/32 IN.
Objectives

Flat Position

The student should be:
- Aware of the need to clean and bevel the plates.

The student should be able to:
- Demonstrate by any teacher-selected means the ability to interpret trade terms.
- Clean and bevel the plates.
- Align the plates, tacking them in the proper sequence.
- Fuse the plates keeping the weld face flat, without undercutting the sidewalls.

The student should be:
- Aware of the gravitational pull on the molten bead, and the "fast freeze" electrodes used to counter it.
- Acquainted with the necessary current settings.

The student should be able to:
- Demonstrate ability to maintain the rod angle and rate of travel necessary to obtain uniform beads.

Teaching Suggestions

This procedure requires close supervision, being the introduction to a more difficult phase of welding.

Instructor should require full length beads in order to develop ability to restart, insuring a smooth continuity of weld.
**Instruction**

- Groove Weld;
  - Horizontal Position
    - Single pass
    - Multi pass
    - Weave

- Stringer Beads;
  - Vertical Position
    - Positioning stock
    - Manipulating electrode and holder
    - Striking an arc
    - Running a bead

**Objectives**

- The student should be:
  - Aware of the critical importance of bead placement and cleaning.
  - Aware of the need to maintain a uniform bead face.
  - Aware of the critical importance of voltage settings in this procedure.

**Teaching Suggestions**

- The student should be able to different thickness.
- Demonstrate "slag trap" its effects on the weld.
Objectives

The student should be:

- Aware of the critical importance of bead placement and cleaning.
- Aware of the need to maintain a uniform bead face.
- Aware of the critical importance of voltage settings in this procedure.

Teaching Suggestions

The student should be able to weld plates of different thickness.

Demonstrate "slag trap" formation and its effects on the weld quality.
Instruction

- Fillet Welds;
  - Vertical Position
    - Stringer bead
    - Padding
    - 3 pass
    - Multi pass

Objectives

The student should be:
- Aware of the tendency to undercut when vertical welding.
- Aware of the increased burn hazards in overhead welding.
- Acquainted with the increased difficulty of welding overhead.

Teaching Suggestion

Manipulative techniques weaving, and progressive should be introduced at Welding should be taught

Demonstrate rod angle and bead sequence.
Objectives:
The student should be:
- Aware of the tendency to undercut when vertical welding.
- Aware of the increased burn hazards in overhead welding.
- Acquainted with the increased difficulty of welding overhead.

Teaching Suggestions:
Manipulative techniques — whipping, weaving, and progressive rod angle — should be introduced at this point. Welding should be taught "vertical-up."

1. IDENTICAL TO VERTICAL STRINGER
2. LONG INVERTED "V" WITH RAPID 1-2-3 PAUSE
3. STRAIGHT WEAVE WITH RAPID 1-2-3 PAUSE

Demonstrate rod angle and manipulation, and bead sequence.
Instruction

- Fillet Welds; Overhead
  - Single pass
  - 3 pass
  - Multi pass

- Groove Weld; Overhead
  - 3 pass
  - Multi pass
  - Backing plate
  - With
  - Without
  - 100 percent melt-through

Objectives

The student should be able to:

Demonstrate an ability to adjust rod angle to meet varying conditions.

The student should be able to:

Demonstrate ability to weld a 100 percent melt-through, without slag inclusions, the inner and outer beads being uniformly smooth.

Teaching Suggestions

This process is the most complex for the student to master.

Teach "keyhole" technique for penetration.
Objectives

The student should be able to:
Determine an ability to adjust rod angle to meet varying conditions.

Teaching Suggestions

This process is the most difficult for the student to master.

Teach "keyhole" technique for root penetration.

The student should be able to:
Demonstrate ability to weld a 100 percent melt-through, without slag inclusions, the inner and outer beads being uniformly smooth.
Introduction

Unit V — INTRODUCTION TO GAS WELDING

Objectives

The student should be able to:

Obtain without difficulty neutral, oxidizing, and carburizing flames.

Demonstrate by any teacher-selected means an understanding of the nature, function, and uses of the three flames.

Demonstrate by any teacher-selected means an ability to interpret AWS classification.

Teaching Suggestion

Note: Safety aspects must be observed.

Films are available to assist in the chemistry of fuel gas.

Excellent films are available from commercial suppliers.

Note: Forehand method is used on plate except for thickness.

Student should be aware that weld metal build-up can be used on plate except for thickness.

Each layer must be well built over the preceding layer at all points of contact.

Equipment

- Nomenclature
- Setting-up
- Function
- Properties of gases
  - Acetylene
  - Natural Gas
  - Propane
- Flame adjustment
- Rod classes

Operating the Oxyacetylene Torch; Flat Position

- Techniques
  - Forehand
  - Backhand
- Operations
  - Puddling (Flat plate)
  - Corner joint
  - Edge joint
  - Lap joint

Using Filler Metal

- Fillet joint
- Lap joint
- Butt joint
- Multiple layer welds

Demonstrate entry-level coordination in two-handed procedure.

Hold filler rod at the correct angle in developing torch and puddle control.

TORCH TIP OSCILLATION
Objectives

The student should be able to:
- Obtain without difficulty neutral, oxidizing, and carburizing flames.
- Demonstrate by any teacher-selected means an understanding of the nature, function, and uses of the three flames.
- Demonstrate by any teacher-selected means an ability to interpret AWS classification.

Teaching Suggestions

Note: Safety aspects must be emphasized.
Films are available to aid in understanding the chemistry of fuel gases.

Excellent films are available from commercial suppliers.
Note: Forehand method should not be used on plate exceeding 1/8-inch thickness.

Student should be aware of the need to build up filler metal 25 percent above the thickness of the parent metal.
Each layer must be well fused to the preceding layer at all points of contact.
Instruction

Unit VI — OXYACETYLENE WELDING PRACTICE

- Oxyacetylene Welding; All Positions
  - Puddling
  - Butt welds
  - Corners
    - Inside
    - Outside
  - Lap welds
  - Multiple layer welds
    - Groove
    - Fillet

- Operations
  - Running a bead
  - Butt welding
    - Light gage steel
    - Heavy gage steel
  - Fillet welding
    - Light gage steel
    - Heavy gage steel

Objectives

The student should be able to:

Demonstrate the ability to control the molten puddle in all positions.

Demonstrate an ability to weld plates of different thickness to field standards of quality.

Demonstrate ability to maintain beads of uniform width.

Demonstrate ability to weld all common thicknesses of steel to field standards of quality.

Teaching Suggestions

Welding the joints should, both with and without use metal.

Both forehand and backhand should be practiced.

Both visual and destructive be used.

The molten puddle should smooth in appearance.

Excessive burn-through should be allowed.

The height of overhead plant adjusted to be 12 inches student's head.

Note: Check clothing for before allowing to begin to weld over.

13
ETYLENE WELDING PRACTICE

Objectives

The student should be able to:

Demonstrate the ability to control the molten puddle in all positions.

Demonstrate an ability to weld plates of different thickness to field standards of quality.

Demonstrate ability to maintain beads of uniform width.

Demonstrate ability to weld all common thicknesses of steel to field standards of quality.

Teaching Suggestions

Welding the joints should be practiced both with and without use of filler metal.

Both forehand and backhand methods should be practiced.

Both visual and destructive tests should be used.

The molten puddle should be clear and smooth in appearance.

Excessive burn-through should not be allowed.

The height of overhead plates should be adjusted to be 12 inches above the student's head.

Note: Check clothing for fire-resistance before allowing the student to begin to weld overhead.
Unit VII — CUTTING

Methods
- Arc
- Oxyacetylene
  - Manual
  - Machine
- Saw
  - Hand
  - Power

Torch Cutting, Manual
- Equipment
  - Nomenclature
  - Function
  - Safety
- Cutting steel
  - Light gage plate
  - Heavy gage plate
- Chamfering steel
- Cutting rivets
- Cutting cast iron
- Cutting pipe
- Gouging
- Piercing

Torch Cutting, Machine
- Machine set-up
  - Leveling track
  - Securing track
- Speed adjustments
- Direction of travel
- Adjusting track and pinions
  - Torch position
  - Torch angle

Objectives

The student should be:
Acquainted with the methods of cutting metals.

The student should be able to:
Demonstrate an entry-level skill in all common cutting procedures.

Demonstrate the ability to select, and set up the equipment needed to flame cut.

Demonstrate the ability to cut all common metals in all standard forms, to field standards of quality.

Demonstrate the ability to set up, adjust, and operate a torch cutting-machine to field standards of quality and the capacity of the machine.

Teaching Suggestions

The student should be made aware of the relative advantages of the mechanical methods of cutting.

The student should be made aware of increased hazards in the cutting process.
Objectives

The student should be:
Acquainted with the methods of cutting metals.

The student should be able to:
Demonstrate an entry-level skill in all common cutting procedures.

Demonstrate the ability to select, and set up the equipment needed to flame cut.

Demonstrate the ability to cut all common metals in all standard forms, to field standards of quality.

Teaching Suggestions

The student should be made aware of the relative advantages of thermal and mechanical methods of cutting metals.

Demonstrate the ability to set up, adjust, and operate a torch cutting-machine to field standards of quality and the capacity of the machine.

The student should be made aware of the increased hazards in the cutting process.
Instruction

- Flame
  - Igniting
  - Adjusting
- Torch tip
  - Removing
  - Cleaning

- Electrode Cutting
  - Equipment
    - Carbon arc
    - Metal electrode
    - Gouging electrode
  - Processes
    - Beveling
    - Piercing

- Power Sawing
  - Equipment
    - Type
      - Hack
      - Band
    - Accessories
  - Set-up
  - Cutting
  - Safety

Objectives

The student should be able to:

Demonstrate ability to ignite and adjust the cutting flame.

Demonstrate ability to remove, clean, and replace the torch tip.

Demonstrate the ability to select, set up, and operate to field standards, all equipment necessary to electrode-cut common materials.

Teaching Suggestions

- The importance of flame and of maintaining a clean torch tip should be emphasized.

- Note: Helmet lens must be #12 to #14 for cutting is critical.

The student should be:

- Acquainted with the function of power hacksaws and bandsaws, and the hazards inherent in their operation.

- Aware of the processes which each type saw can perform.

The student should be able to:

- Demonstrate an ability to set-up and safely operate the power hacksaw for all common cuts.

- Prepare coupons for destructive testing.

The student should be able to:

- Operating the bandsaw, if equipped with this option.
Objectives

The student should be able to:
Demonstrate ability to ignite and adjust the cutting flame.

Demonstrate ability to remove, clean, and replace the torch tip.

Demonstrate the ability to select, set up, and operate to field standards, all equipment necessary to electrode-cut common materials.

The student should be:
Acquainted with the function of power hacksaws and bandsaws, and the hazards inherent in their operation.

Aware of the processes which each type saw can perform.

The student should be able to:
Demonstrate an ability to set-up and safely operate the power hacksaw for all common cuts.

Prepare coupons for destructive testing.

Teaching Suggestions

The importance of flame adjustment, and of maintaining a clean torch tip should be emphasized.

Note: Helmet lens must be changed from #12 to #14 for cutting. Ventilation is critical.

The student should be able to change and adjust blades, but further maintenance is beyond the scope of this course.

The student should be capable of operating the bandsaw, if the shop is equipped with this optional machine.
/Unit VIII — NONFUSION PROCESSES

- Braze Welding
  - Equipment
  - Nomenclature
  - Function
  - Fluxes
    - Function
    - Selection
  - Procedure; Flat Position
    - Lap joint
    - Butt joint
    - Groove joint
    - Fillet joint

- Silver Soldering (Brazing)
  - Equipment
  - Fluxes
  - Procedure
    - Preparing the joint
    - Applying flux
    - Applying heat
    - Applying the metal
      - Lap joint
      - Butt joint
      - Scarf joint

/Unit IX — INERT GAS SHIELDED - ARC WELDING

- Equipment
  - Electrodes
    - Consumable
    - Nonconsumable

The student should be:
- Aware of the fundamental difference between braze welding and brazing.
- Aware of the necessity of maintaining an even puddle.

The student should be able to:
- Demonstrate the ability to interpret the color/temperature relationship effect on fluxing and brass flow.
- Demonstrate the ability to braze weld to acceptable field standards.
- Demonstrate ability to fit the basic joints to field standards of quality.
- Demonstrate the ability to run silver around pipe with 100 percent penetration.
- Demonstrate the ability to join stainless steel to field standards of quality.

Films and pamphlets are several commercial suppl...
IONFUSION PROCESSES

Objectives

The student should be:

Aware of the fundamental difference between braze welding and brazing.

Aware of the necessity of maintaining an even puddle.

The student should be able to:

Demonstrate the ability to interpret the color/temperature relationship effect on fluxing and brass flow.

Demonstrate the ability to braze weld to acceptable field standards.

Demonstrate ability to fit the basic joints to field standards of quality.

Demonstrate the ability to run silver around pipe with 100 percent penetration.

Demonstrate the ability to join stainless steel to field standards of quality.

GAS SHIELDED - ARC WELDING

The student should be:

Acquainted with the equipment and materials used in shielded-arc welding.

Films and pamphlets are available from several commercial suppliers.

Teaching Suggestions

The student should be made aware of the different usage of the terms braze welding and brazing.

The teacher should select visuals which conform to local usage of terms.

Emphasis should be placed on the critical importance of achieving correct metal temperatures.

The student must understand the importance of fitting joints to 0.001-inch tolerance in attaining proper silver adherence.

The student should be cautioned against overheating stainless steel.

Emphasize the need for washing stainless steel joints with hot water after soldering.
Instruction | Objectives | Teaching Suggest
--- | --- | ---
- Shielding gases  
  - Type  
  - Function  
- Accessories  
  - Rectifier  
  - Power sources | The student should be:  
Aware of the function of the shielding gas and characteristics of each type. | The teacher should demonstrate the effects of AC, DCSP, and commercial suppliers' protective films on welding safety. |
| | The student should be able to:  
Demonstrate by any teacher-selected means a basic knowledge of the nature, function, and characteristics of shielded-arc welding. |  |
| | Demonstrate by any teacher-selected means an understanding of the manner in which the different currents affect the weld. |  |
| | Demonstrate an ability to select the current for any teacher-specified metal. |  |
| Process | Safety |  |
- Principles of operation  
  - DC, Reverse Polarity  
  - Electrón and ion flow  
  - Low and high density current  
  - Transition current  
  - DC, Standard Polarity  
  - Melt-off rate  
  - Filler-wire treatment  
  - AC  
  - Open circuit voltage  
  - Pulse-arc  
  - Arc stabilizing coatings  
  - Power sources  
- Metal transfer  
  - Globular  
  - Spray  
- Clothing  
- Shield lens  
- Grounding  
- Ventilation |  |  |
Objectives

The student should be:
AWARE OF THE FUNCTION OF THE SHIELDING GAS AND CHARACTERISTICS OF EACH TYPE.

The student should be able to:
DEMONSTRATE BY ANY TEACHER-SELECTED MEANS A BASIC KNOWLEDGE OF THE NATURE, FUNCTION, AND CHARACTERISTICS OF SHIELDED-ARC WELDING.

DEMONSTRATE AN ABILITY TO SELECT THE CURRENT FOR ANY TEACHER-SPECIFIED METAL.

TEACHING SUGGESTIONS

The teacher should demonstrate the effects of AC, DCSP, and DCRP.

The National Safety Council and some commercial suppliers provide excellent films on welding safety.

DEMONSTRATE AN AWARENESS OF THE GENERAL AND SPECIFIC HAZARDS IN SHIELDED-ARC WELDING AND OF PROCEDURES DESIGNED TO MINIMIZE THEM.
Unit X — Shielded-Arc Welding Practice

- Tungsten Inert Gas (TIG)
  - Setting-up equipment
  - Selecting the electrode
  - Setting current for different metals
    - Heat
    - AC or DC
    - Polarity
- Metallic Inert Gas (MIG)
  - Setting-up equipment
  - Setting current for different metals
  - Selecting shielding gas
  - Selecting filler metal
- Procedures
  - Preparation
  - Positions
    - Butt
    - Lap
    - Fillet
    - Padding
    - Multi-pass
  - Materials
    - Aluminum
    - Magnesium
    - Stainless steel

The student should be able to:
- Demonstrate the ability to select the electrode and adjust the equipment for welding any teacher-selected joint and material.
- Demonstrate the ability to select the gas and filler rod, and adjust the equipment for all MIG procedures.
- Awareness that joint preparation is the same as for arc and oxy welding of a given metal.
- Demonstrate an ability to TIG weld aluminum, magnesium, and stainless steel to field standards of quality.

Teaching Suggestion:
- Students should attain basic skills in oxyacetylene before a...
Objective

The student should be able to:

Demonstrate the ability to select the electrode and adjust the equipment for welding any teacher-selected joint and material.

Teaching Suggestions

Students should attain basic competency in oxyacetylene before attempting TIG.

Demonstrate the ability to select the gas and filler rod, and adjust the equipment for all MIG procedures.

Generally, students find MIG techniques relatively easy to master.

The student should be:

Aware that joint preparation is the same as for arc and oxy welding of a given metal.

Single pass welds should not be used on material of more than 1/4-inch thickness.

Multi-pass layers should be restricted to 3/16-inch thickness.

The student should be able to:

Demonstrate an ability to TIG weld aluminum, magnesium, and stainless steel to field standards of quality.

TIG should be practiced on aluminum, mild steel, and stainless steel, since the characteristics will approximate those of other common metals.
Instruction

Objectives

Teaching Suggestions

Testing
- In process
- Post weld

Unit XI — WELDING CAST IRON

Nature and Properties of Cast Iron
- Expansion characteristics
- Type of metal
- Recognition

Arc Welding of Cast Iron
- Metal preparation
  - Preheating
  - Postheating
  - Controlled cooling
- Electrode selection
  - Machinable
  - Nonmachinable
- Process
  - Bead length
  - Peening

Oxyacetylene Welding of Cast Iron
- Metal preparation
- Equipment selection

The student should be able to:

Demonstrate ability to MIG weld to field standards of quality.

Demonstrate by any teacher-selected means an ability to recognize defective welding, and diagnose and correct the cause.

Demonstrate sufficient knowledge of cast iron metallurgy to select the most effective methods and procedures.

Demonstrate an ability to recognize cast iron.

Demonstrate an ability to select and adjust equipment, prepare the metal, and weld cast iron to field standards of quality by both arc and oxy processes.

Properties of cast iron are only as they affect welding.

The use of the spark test is taught.

Sequence of welds is of importance when welding cast iron on cast iron, size or mass.

Metal preparation is more critical in welding than in arc welding; control of the metal before and after welding is extremely important.
Objectives

The student should be able to:

- Demonstrate ability to MIG weld to field standards of quality.
- Demonstrate by any teacher-selected means an ability to recognize defective welding, and diagnose and correct the cause.
- Demonstrate sufficient knowledge of cast iron metallurgy to select the most effective methods and procedures.
- Demonstrate an ability to recognize cast iron.
- Demonstrate an ability to select and adjust equipment, prepare the metal, and weld cast iron to field standards of quality by both arc and oxy processes.

Teaching Suggestions

- Demonstrate and discuss such common faults as poor joint fit-up or torch angle, excessive weaving or erratic wire feed, dirty wire or base metal, inadequate supply of shielding gas, and low current or voltage.
- Properties of cast iron should be taught only as they affect welding.
- The use of the spark test should be taught.
- Sequence of welds is of vital importance when welding cast iron objects of large size or mass.
- Metal preparation is more critical in oxy welding than in arc welding. Temperature control of the metal before, during, and after welding is extremely important.
**Instruction**

- Torch tip
- Rod
- Flux
- Process
  - Flame adjustment
  - Oxide removal

**Objectives**

**Brazing of Cast Iron**

- Equipment selection
  - Tip
  - Rod
  - Flux
- Metal preparation
- Process
  - Flame adjustment
  - Rod application

The student should be able to:

Demonstrate an ability to braze cast iron to field standards of quality.

Note: Brazing requires cast iron surface.

Teacher should use 16-ga teaching sheet metal welding.

Teacher should use 16-ga teacher should use 16-ga.

Spatter prevention is necessary.

Although current setting

Rod size and current set

### Unit XII — WELDING STAINLESS STEEL

**Arc Welding**

- Selecting rod
- Preparation
  - Spatter proofing
- Current setting
  - Polarity
  - Power
- Identifying metal group
  - Martensitic
  - Austenitic

Demonstrate ability to select and set up arc equipment for welding stainless steels.

Teacher should use 16-ga teaching sheet metal welding.

Spatter prevention is necessary.

Rod size and current set...
Objectives

The student should be able to:
- Demonstrate an ability to braze cast iron to field standards of quality.
- Demonstrate ability to select and set up arc equipment for welding stainless steels.
- Demonstrate the ability to classify by group, samples provided by the teacher, and to adapt welding techniques to the samples' characteristics.

Teaching Suggestions

Note: Flame MUST be neutral. Rod may be used as a puddling stick.

Note: Brazing requires exposure of pure cast iron surfaces.

Preheating and postheating are of critical importance.

Teacher should use 16-ga. metal in teaching sheet metal welding.

Spatter prevention is necessary.

Rod size and current setting are critical.
Instruction

- Procedure
  - Stringer bead
  - Butt
    - Squared
    - Flanged
    - Beveled
  - Lap
  - Corner

Objectives

The student should be able to:

- Demonstrate the ability to weld stainless steels to field standards of quality.

Teaching Suggestions

Note: Arc welding of light steel should be mastered by the student progresses in welding. Procedures those used to weld DCSP power is used.

Pipe welding is considered a difficult process a welder.

Pipe welding is considered a difficult process a welder.

Films on pipe welding are several commercial suppli.

Since only extensive practical competency in pipe welding, the student should ordinarily correct adherence to the tacking sequence.

Unit XIII — PIPE WELDING

Preparation

- Marking
  - Wrap-arounds
  - Contour markers

- Beveling
  - Hand
    - Maintaining angle
  - Machine
    - Tip maintenance

- Slag removal
- Pipe alignment
  - Tacking sequence

Execution

- Pipe setting
  - Roll
  - Fixed
  - Pipe axis
    - Horizontal
    - Vertical

The student should be:

- Acquainted with the common aids to locating cuts and welds.
- Acquainted with accepted procedure in beveling edges.
- Aware of the importance of slag removal, pipe alignment, and adherence to tacking sequence.

The student should be able to:

- Demonstrate ability to set up welding machines for pipe welding.
- Demonstrate proper procedure in manual welding of pipe.
- Since only extensive practical competency in pipe welding should be mastered by the student progresses in welding. Procedures used to weld DCSP power is used.
Objectives

The student should be able to:
- Demonstrate the ability to weld stainless steels to field standards of quality.

The student should be:
- Acquainted with the common aids to locating cuts and welds.
- Acquainted with accepted procedure in beveling edges.
- Aware of the importance of slag removal, pipe alignment, and adherence to tacking sequence.

Teaching Suggestions

Note: Arc welding of light gage mild steel should be mastered before the student progresses to stainless steel. Procedures are similar to those used to weld aluminum except DCSP power is used.

Pipe welding is considered to be the most difficult process a welder must master.

Films on pipe welding are available from several commercial suppliers.

Since only extensive practice can produce trade competency in pipe welding, the student should ordinarily be graded on correctness of procedure rather than quality of weld.
Instruction

Objectives

Teaching Suggestion

- Machine settings
- Rod angle
- Maintaining keyhole
  - 100 percent melt through
- Beat sequence

Note: Joint fit-up may be required.

Templates for joint fit-up from commercial sources.

/Unit XIV — PLASMA WELDING (OPTIONAL UNIT)

o Process
  - Torch types.
    . Transferred
    . Nontransferred
  - Gases
  - Temperature range
    . 6000°F
    . 100,000°F

The student should be:
Acquainted with plasma welding equipment.

The teacher should demonstrate and the effect of both to

Excellent films are available from commercial supplier.

Opaque projection of photographs of craft ground crews, and target shooters wearing h...
SMA WELDING (OPTIONAL UNIT)

Objectives

The student should be:
Acquainted with plasma welding equipment.

The student should be:
Acquainted with the nature of the process.

Aware of the relationship between frequency and resulting temperature.

Aware of the need to protect against hearing loss, as well as against burns and eye injuries.

Teaching Suggestions

Note: Joint fit-up may be added to the course if local job opportunities require.

Templates for joint fit-up are available from commercial sources.

The teacher should demonstrate the use and the effect of both torches.

Excellent films are available from a commercial supplier.

Opaque projection of photos of jet aircraft ground crews, and of claybird and target shooters wearing hearing protectors should have motivational value. Most libraries maintain files of periodicals, some of which (The American Rifleman, June 1969, p.25) contain articles explaining in layman's terms, the cumulative effects of high-level noise.
Instruction

- Base metals
  - Stainless steels
  - Nickel
  - Copper
  - Aluminum
  - Magnesium
  - Dissimilar metals

- Fusion
  - Selecting equipment
  - Setting controls

- Cutting
  - Selecting the torch
  - Setting the controls

Objectives

The student should be able to:

Demonstrate by any teacher-selected means the ability to select equipment and gas, and to set controls for any specific plasma welding operation.

Demonstrate the ability to plasma fuse to field standards of appearance and strength.

Demonstrate an ability to set current and adjust gas flow as necessary to cut to field standards of quality.

Teaching Suggestions

Plasma-welding is becoming sufficiently widespread in certain industries, but inclusion in this syllabus content. It is presented content for use where emotions warrant.
Objectives

The student should be able to:
- Demonstrate by any teacher-selected means the ability to select equipment and gas, and to set controls for any specific plasma welding operation.
- Demonstrate the ability to plasma fuse to field standards of appearance and strength.
- Demonstrate an ability to set current and adjust gas flow as necessary to cut to field standards of quality.

Teaching Suggestions

Plasma welding is becoming more important in certain industries, but as yet is not sufficiently widespread to justify inclusion in this syllabus as required content. It is presented as optional content for use where employment conditions warrant.
RESOURCES

BOOKS


--- *Practical arc welding.* Troy, Ohio. The School.


welding. Troy, Ohio. The School.


ication. Occupational information and training requirements in the field of welding.

Government Printing Office.
FILMS — 16 mm., Sound

Air Reduction Sales
 Structural Welding 15 min. color

Aluminum Company of America
 A Product of Imagination 26 min. color
 How to Weld Aluminum — Torch 17 min. b&w
 How to Weld Aluminum — MIG 20 min. color
 The Story of Aluminum 20 min. color
 Welding Advances with Aluminum 28 min. color

American Society for Metals
 Heat Treatment of Steels 30 min. color
 How Metals Behave 30 min. color
 Iron Carbon Alloys 30 min. color
 Metal Crystals 30 min. color

Armco
 Iron Ore From Labrador 18 min. color

Associated Film Service
 These People Know the Steel Business 30 min. color

Bethlehem Steel Corporation
 The Toughest Inch 28 min. color

Eutectic Welding Alloys, Inc.
 This Is Eutalloy 20 min. color

Lincoln Electric Company
 Design of Arc Welded Structures 15 min. color
 Designing Machinery for Arc Welding 15 min. color
 Flame Cutting 20 min. color
 Magic Wand of Industry — Arc Welding 20 min. color
 Prevention and Control of Distortion in Arc Welding 20 min. color
FILMS — 16 mm., Sound

Air Reduction Sales
  Structural Welding 15 min. color

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  A Product of Imagination 26 min. color
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  Magic Wand of Industry — Arc Welding 20 min. color
  Prevention and Control of Distortion in Arc Welding 20 min. color
Linde Division, Union Carbide Corporation

Braze Welding 12 min. color

Modern Talking Pictures Service

Metallurgy Plus 14 min. color
Story of Stainless Steel 27 min. color
This Is Steel 29 min. color
Zinc Controls Corrosion 38 min. color

Reynolds Metals Company

Aluminum On The March 24 min. color
Aluminum Pipelines 28 min. color
Aluminum Welding 33 min. color

Rothacker Incorporated

Mining for Nickel 45 min. color
Milling and Smelting the Sudbury Ores 54 min. color
Refining Nickel from Sudbury Ores 52 min. color
Refining Copper from Sudbury Ores 39. min. color
Refining Precious Metals 29 min. color

U.S. Bureau of Mines

How to Weld Aluminum 17 min. color
Oxyacetylene, Flame-Master of Metals 19 min. color
Story of Arc Welding 24 min. color

United States Steel Corporation

Hot Rolling of Steel Sheets 7 min. color
Modern Steel Making 23 min. color
Open Hearth Furnace 7 min. color
Research in Steel 26 min. color
Walls without Welds 28 min. color
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<td>Aluminum Pipelines</td>
<td>28 min. color</td>
</tr>
<tr>
<td>Aluminum Welding</td>
<td>33 min. color</td>
</tr>
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<table>
<thead>
<tr>
<th>Rothacker Incorporated</th>
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<tbody>
<tr>
<td>Mining for Nickel</td>
<td>45 min. color</td>
</tr>
<tr>
<td>Milling and Smelting the Sudbury Ores</td>
<td>54 min. color</td>
</tr>
<tr>
<td>Refining Nickel from Sudbury Ores</td>
<td>52 min. color</td>
</tr>
<tr>
<td>Refining Copper from Sudbury Ores</td>
<td>39 min. color</td>
</tr>
<tr>
<td>Refining Precious Metals</td>
<td>29 min. color</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>U.S. Bureau of Mines</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>How to Weld Aluminum</td>
<td>17 min. color</td>
</tr>
<tr>
<td>Oxyacetylene, Flame-Master of Metals</td>
<td>19 min. color</td>
</tr>
<tr>
<td>Story of Arc Welding</td>
<td>24 min. color</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>United States Steel Corporation</th>
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<tbody>
<tr>
<td>Hot Rolling of Steel Sheets</td>
<td>7 min. color</td>
</tr>
<tr>
<td>Modern Steel Making</td>
<td>23 min. color</td>
</tr>
<tr>
<td>Open Heart Furnace</td>
<td>7 min. color</td>
</tr>
<tr>
<td>Research in Steel</td>
<td>26 min. color</td>
</tr>
<tr>
<td>Walls without Welds</td>
<td>28 min. color</td>
</tr>
</tbody>
</table>
CHARTS

Hobart Brothers Training Aids

AC/DC Transformer Rectifier Arc Welder
Types of Welds
Typical Welded Joints
Welding Positions

DEMONSTRATION AIDS

Hobart Brothers Training Aids

Filter plastic panel screen, density #10
Folding welding booth
Plastic sample welds
Plastic welds — good, and defective. Set of 10

TRANSPARENCIES

DCA Educational Products

Arc Welding. Series of 53 multicolored transparencies, with overlays.
Hobart Brothers Training Aids

AC/DC Transformer Rectifier Arc Welder
Types of Welds
 Typical Welded Joints
 Welding Positions

STATION AIDS

Hobart Brothers Training Aids

- Filter plastic panel screen, density #10
- Folding welding booth
- Plastic sample welds
- Plastic welds — good, and defective. Set of 10

PARENCIES

CA Educational Products

Arc Welding. Series of 53 multicolored transparencies, with overlays.
TEACHING AID SOURCES

Air Reduction Sales
P.O. Box 2
Union, New Jersey 02083

Aluminum Company of America
1501 Alcoa Building
Mellon Square
Pittsburgh, Pennsylvania 15219

American Society for Metals
Film Programs, Inc.
2238 Euclid Avenue
Cleveland, Ohio 44115

American Technical Society
848 E. 58th Street
Chicago, Illinois 60637

American Welding Society
345 E. 47th Street
New York, New York 10017

Armco Film Library
703 Curtis Street
Middletown, Ohio 45042

Associated Film Service
660 Grand Avenue
Ridgefield, New Jersey 07657

Bethlehem Steel Corporation
Advertising Division
Bethlehem, Pennsylvania 18016

Compressed Gas Association
11 W. 42nd Street
New York, New York 10017

DCA Educational Products, Inc.
4865 Stenton Avenue
Philadelphia, Pennsylvania 19104

D. Van Nostrand Company
24 W. 40th Street
New York, New York 10018

Delmar Publishers Division
Mountainview Avenue
Albany, New York 12205

Edward R. Pierre c/o
Hiller Electric Company
Appleton, Wisconsin 54911

Eutectic Welding Alloys, Inc.
40-40 172 Second Street
Flushing, New York 11368

Goodheart-Willcox Co., Inc.
18250 Harwood Avenue
Homewood, Illinois 60430

Hobart Trade School
Box EW-157
Troy, Ohio 45373
TEACHING AID SOURCES

Air Reduction Sales
O. Box 2
Union, New Jersey 02083

Aluminum Company of America
501 Alcoa Building
Pittsburgh, Pennsylvania 15219

American Society for Metals
Film Programs, Inc.
238 Euclid Avenue
Cleveland, Ohio 44115

American Technical Society
48 E. 58th Street
Chicago, Illinois 60637

American Welding Society
55 E. 47th Street
New York, New York 10017

Arcco Film Library
3 Curtis Street
Caldwell, Ohio 45042

Associated Film Service
10 Grand Avenue
Edgewood, New Jersey 07657

Bethlehem Steel Corporation
Advertising Division
Bethlehem, Pennsylvania 18016

Compressed Gas Association
11 W. 42nd Street
New York, New York 10017

DCA Educational Products, Inc.
4865 Stenton Avenue
Philadelphia, Pennsylvania 19144

D. Van Nostrand Company
24 W. 40th Street
New York, New York 10018

Delmar Publishers Division
Mountainview Avenue
Albany, New York 12205

Edward R. Pierre c/o
Hiller Electric Company
Appleton, Wisconsin 54911

Eutectic Welding Alloys, Inc.
40-40 172 Second Street
Flushing, New York 11368

Goodheart-Willcox Co., Inc.
18250 Harwood Avenue
Homewood, Illinois 60430

Hobart Trade School
Box EW-157
Troy, Ohio 45373
Lincoln Electric Company
Côit Road
Cleveland, Ohio 44117

Linde Division
Union Carbide Corporation
270 Park Avenue
New York, New York 10017

Power Publications Company
P.O. Box 96
Appleton, Wisconsin 54911

Modern Talking Pictures Service
1212 Avenue of the Americas
New York, New York 10036

Reynolds Aluminum Company
Motion Picture Department
P.O. Box 2346
6603 W. Broad Street
Richmond, Virginia 23218

Rothacker Incorporated
241 W. 17th Street
New York, New York 10011

Smith Welding Equipment
Division of Tescam Corporation
2633 S.E. Fourth Street
Minneapolis, Minnesota 55414

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Theodore Audel & Company Division
H. W. Samson & Company, Inc.
4300 W. 42nd Street
Indianapolis, Indiana 46206

U.S. Atomic Energy Commission
376 Hudson Street
New York, New York 10014

U.S. Bureau of Mines
Department of the Interior — Motion Pictures
4800 Forbes Avenue
Pittsburgh, Pennsylvania 1521

United States Steel Corporation
New York Film Distribution Center
71 Broadway
New York, New York 10006

Westinghouse Film Library
713 Penn Avenue
Pittsburgh, Pennsylvania 1522
The listing does not include those desirable items which can be fabricated in the welding shop in conjunction with the school machine shop, nor those needed for the more sophisticated welding items listed under PERSONAL require one per student; those under STATION, one per welding station; those under GENERAL, one for each class unit of 15 students. The number and type of items of general must conform to legal specifications when so regulated, or be selected with regard to the specific situation.

### PERSONAL

- Apron
- Gloves
- Goggles, flash
- Goggles, safety
- Helmet
- Shoes, safety
- Sleeves

### STATION

#### ARC WELDING

- Arc welding machine
- Motor generator, DC
- Transformer, AC
- Rectifier, AC-DC
- Electrode cable
- Electrode holder
- Ground cable
- Ground clamp
- Terminal lugs (2)
- Hammer, chipping
- Brush, wire

#### OXYACETYLENE WELDING

- Gloves, asbestos
- Goggles, welding
- Hand shield
- Leather cape
- Tank, acetylene
- Tank, oxygen
- Hose, acetylene
- Hose, oxygen
- Cart, gas bottle
- Regulator set, double or single stage
- Torch, welding, with tips
- Torch, cutting, with tips
- Lighter
- Tip cleaner
SUGGESTED MINIMUM EQUIPMENT

Does not include those desirable items which can be fabricated in the welding shop alone or in
with the school machine shop, nor those needed for the more sophisticated welding systems. The
under PERSONAL require one per student; those under STATION, one per welding station; those
one for each class unit of 15 students. The number and type of items of general equipment
to legal specifications when so regulated, or be selected with regard to the specific teaching

<table>
<thead>
<tr>
<th>STATION</th>
<th>GENERAL</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ARC WELDING</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc welding machine</td>
<td></td>
</tr>
<tr>
<td>Motor generator, DC</td>
<td></td>
</tr>
<tr>
<td>Transformer, AC</td>
<td></td>
</tr>
<tr>
<td>Rectifier, AC-DC</td>
<td></td>
</tr>
<tr>
<td>Electrode cable</td>
<td></td>
</tr>
<tr>
<td>Electrode holder</td>
<td></td>
</tr>
<tr>
<td>Ground cable</td>
<td></td>
</tr>
<tr>
<td>Ground clamp</td>
<td></td>
</tr>
<tr>
<td>Terminal lugs (2)</td>
<td></td>
</tr>
<tr>
<td>Hammer, chipping</td>
<td></td>
</tr>
<tr>
<td>Brush, wire</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OXYACETYLENE WELDING</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank, acetylene</td>
<td></td>
</tr>
<tr>
<td>Tank, oxygen</td>
<td></td>
</tr>
<tr>
<td>Hose, acetylene</td>
<td></td>
</tr>
<tr>
<td>Hose, oxygen</td>
<td></td>
</tr>
<tr>
<td>Cart, gas bottle</td>
<td></td>
</tr>
<tr>
<td>Regulator set, double or single stage</td>
<td></td>
</tr>
<tr>
<td>Torch, welding, with tips</td>
<td></td>
</tr>
<tr>
<td>Torch, cutting, with tips</td>
<td></td>
</tr>
<tr>
<td>Lighter</td>
<td></td>
</tr>
<tr>
<td>Tip cleaner</td>
<td></td>
</tr>
<tr>
<td>Cutting machine</td>
<td></td>
</tr>
<tr>
<td>Attachment, circular cutting</td>
<td></td>
</tr>
</tbody>
</table>
WELDING SHOP GENERAL EQUIPMENT

HAND TOOLS

Caliper; inside, 8 in.
Caliper; outside, 8 in.
Centerpunch; set
Chalkline
Chisel; cold, 1/2, 5/8, 3/4
Files; assorted
Hacksaw
Hammer; ball pein, 24 oz., 16 oz.
Hammer; sledge, 4 lb.
Pipe cutter; wheel type, 4 in. capacity
Pipe reamer
Pliers; vise-grip
Pliers; lineman's, 8 in.
Pliers; needle nose, 6 in.
Pliers; slip-joint, 8 in., 10 in.
Plumb bob
Punch; drift, 5/16, 7/16
Punch; pin, 5/16

MACHINES

Drill press; floor mount, tilting
  T-slot table with vise, 450 rpm
  maximum slow speed, w/accessories
Portable drill; 3/8 in. capacity
Portable drill; 1/2 in. capacity
Power grinder; pedestal, 12 in. minimum
Power grinder; portable, 7 in.
Power hacksaw
Testing machine; hydraulic
Bandsaw (optional)

OTHER

Anvil
Bench; layout
Blanket; fire
Booth; welding
Clamp; bar
Clamp; C
Clamp; welding
Dresser; grinding wheel
Extinguishers; Type A and Type B/C
Screens; portable
Solder kits
Stones; marking
Tanks; quenching
Ventilating system
Vise; bench, machinists
WELDING SHOP GENERAL EQUIPMENT.

HAND TOOLS

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe; inside, 8 in.</td>
<td></td>
</tr>
<tr>
<td>Pipe; outside, 8 in.</td>
<td></td>
</tr>
<tr>
<td>Interpunch; set</td>
<td></td>
</tr>
<tr>
<td>V-kline; cold, 1/2, 5/8, 3/4</td>
<td></td>
</tr>
<tr>
<td>Assorted screws</td>
<td></td>
</tr>
<tr>
<td>Hack saw</td>
<td></td>
</tr>
<tr>
<td>Ball pein, 24 oz., 16 oz.</td>
<td></td>
</tr>
<tr>
<td>Sledge, 4 lb.</td>
<td></td>
</tr>
<tr>
<td>Cutter; wheel type, 4 in.</td>
<td>capacity</td>
</tr>
<tr>
<td>Reamer</td>
<td></td>
</tr>
<tr>
<td>Vise-grip</td>
<td></td>
</tr>
<tr>
<td>Lineman's, 8 in.</td>
<td></td>
</tr>
<tr>
<td>Needlenose, 6 in.</td>
<td></td>
</tr>
<tr>
<td>Slip-joint, 8 in., 10 in.</td>
<td></td>
</tr>
<tr>
<td>Bob; drift, 5/16, 7/16</td>
<td></td>
</tr>
<tr>
<td>Pin, 5/16</td>
<td></td>
</tr>
<tr>
<td>Rule; circumference</td>
<td></td>
</tr>
<tr>
<td>Screwdriver; Phillips, set, #0 to #4</td>
<td></td>
</tr>
<tr>
<td>Screwdriver; standard, set, 3/16 x 4 to 3/8 x 15</td>
<td></td>
</tr>
<tr>
<td>Spirit level; aluminum, 24 in.</td>
<td></td>
</tr>
<tr>
<td>Spirit level; aluminum, torpedo</td>
<td></td>
</tr>
<tr>
<td>Square; combination, with centerhead</td>
<td></td>
</tr>
<tr>
<td>Square; framing</td>
<td></td>
</tr>
<tr>
<td>Tape measure; 8 ft., 12 ft., 50 ft.</td>
<td></td>
</tr>
<tr>
<td>Tap and die; set, 1/4 to 1/2 by 16ths, combination coarse and fine</td>
<td></td>
</tr>
<tr>
<td>Tongs; 24 in.</td>
<td></td>
</tr>
<tr>
<td>Twist drill; set, 1/16 to 1/2 by 16ths</td>
<td></td>
</tr>
<tr>
<td>Wing dividers; 6 in., 8 in.</td>
<td></td>
</tr>
<tr>
<td>Wrench; Allen, set</td>
<td></td>
</tr>
<tr>
<td>Wrench; combination box and open end, 5/16 to 1 1/8</td>
<td></td>
</tr>
<tr>
<td>Wrench; crescent, 6 in., 8 in., 12 in.</td>
<td></td>
</tr>
<tr>
<td>Wrench; pipe, 8 in., 12 in., 18 in.</td>
<td></td>
</tr>
<tr>
<td>Wrench; socket, set, 3/8 to 7/8, 3/8 in. drive with extensions</td>
<td></td>
</tr>
<tr>
<td>Machete; hydraulic</td>
<td></td>
</tr>
</tbody>
</table>

MACHINES

<table>
<thead>
<tr>
<th>Machine</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press; floor mount, tilting</td>
<td></td>
</tr>
<tr>
<td>Slot table with vise, 450 rpm</td>
<td></td>
</tr>
<tr>
<td>Maximum slow speed, w/accessories</td>
<td></td>
</tr>
<tr>
<td>Table drill; 3/8 in. capacity</td>
<td></td>
</tr>
<tr>
<td>Table drill; 1/2 in. capacity</td>
<td></td>
</tr>
<tr>
<td>Grinder; pedestal, 12 in. minimum</td>
<td></td>
</tr>
<tr>
<td>Grinder; portable, 7 in.</td>
<td></td>
</tr>
<tr>
<td>Hacksaw</td>
<td></td>
</tr>
<tr>
<td>Machine; hydraulic</td>
<td></td>
</tr>
<tr>
<td>Saw (optional)</td>
<td></td>
</tr>
</tbody>
</table>

OTHER

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anvil</td>
<td></td>
</tr>
<tr>
<td>Bench; layout</td>
<td></td>
</tr>
<tr>
<td>Blanket; fire</td>
<td></td>
</tr>
<tr>
<td>Booth; welding</td>
<td></td>
</tr>
<tr>
<td>Clamp; bar</td>
<td></td>
</tr>
<tr>
<td>Clamp; C</td>
<td></td>
</tr>
<tr>
<td>Clamp; welding</td>
<td></td>
</tr>
<tr>
<td>Dresser; grinding wheel</td>
<td></td>
</tr>
<tr>
<td>Extinguishers; Type A and Type B/C</td>
<td></td>
</tr>
<tr>
<td>Screws; portable</td>
<td></td>
</tr>
<tr>
<td>Solder kits</td>
<td></td>
</tr>
<tr>
<td>Stones; marking</td>
<td></td>
</tr>
<tr>
<td>Tanks; quenching</td>
<td></td>
</tr>
<tr>
<td>Ventilating system</td>
<td></td>
</tr>
<tr>
<td>Vise; bench, machinists</td>
<td></td>
</tr>
</tbody>
</table>

38A
These excerpts from the Z87.1-1968 USA Standard Practices for Occupational and Educational Eye Protection relate to the use of eye safety devices. This information represents factors for schools to consider in the acquisition and maintenance of eye protective devices. The remainder of the Bulletin is about technical testing and production standards.

Selection Chart

Recommended Eye and Face Protectors for Use in Industry, Schools, and Colleges

1. Goggles, Flexible Fitting, Regular Ventilation
2. Goggles, Flexible Fitting, Hooded Ventilation
3. Goggles, Cushioned Fitting, Rigid Body
4. Spectacles, Metal Frame, with Sideshields
5. Spectacles, Plastic Frame, with Sideshields
6. Spectacles, Metal-Plastic Frame, with Sideshields
7. Welding Goggles, Eyecup Type, Tinted Lenses (Illustrated)
7A. Chipping Goggles, Eyecup Type, Clear Safety Lenses (Not Illustrated)
7B. Welding Goggles, Coverspec Type, Tinted Lenses (Illustrated)
7C. Chipping Goggles, Coverspec Type, Clear Safety Lenses (Not Illustrated)
8. Welding Goggles, Coverspec Type, Tinted Plate Lens
9. Welding Goggles, Coverspec Type, Tinted Plate Lens
10. Face Shield (Available with Plastic or Mesh Window)
11. Welding Helmets

*Non-sideshield spectacles are available for limited hazard use requiring only frontal protection.
**See appendix chart "Selection of Shade Numbers for Welding Filters."
EYE SAFETY

from the 287.1-1968 USA Standard Practices for Occupational and Educational Eye and Face
Schools, to the use of eye safety devices. This information represents factors for school districts to
acquisition and maintenance of eye protective devices. The remainder of the Bulletin is informa-
tional testing and production standards.

Selection Chart

Recommended Eye and Face Protectors for Use in Industry, Schools, and Colleges

1. GOGGLES, Flexible Fitting, Regular Ventilation
2. GOGGLES, Flexible Fitting, Hooded Ventilation
3. GOGGLES, Cushioned Fitting, Rigid Body
4. SPECTACLES, Metal Frame, with Sideshields
5. SPECTACLES, Plastic Frame, with Sideshields
6. SPECTACLES, Metal-Plastic Frame, with Sideshields
7. WELLING GOGGLES, Eyecup Type, Tinted Lenses (Illustrated)
7A. CHIPPING GOGGLES, Eyecup Type, Clear Safety Lenses (Not Illustrated)
8. WELLING GOGGLES, Coverspec Type Tinted Lenses (Illustrated)
8A. CHIPPING GOGGLES, Coverspec Type, Clear Safety Lenses (Not Illustrated)
9. WELLING GOGGLES, Coverspec Type, Tinted Plate Lens
10. FACE SHILD (Available with Plastic or Mesh Window)
11. WELDING HELMETS

*Non-sideshield spectacles are available for limited hazard use requiring only frontal protection.*
**See appendix chart "Selection of Shade Numbers for Welding Filters."
<table>
<thead>
<tr>
<th>Operation</th>
<th>Hazards</th>
<th>Recommended Protectors:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACETYLENE-BURNING</td>
<td>SPARKS, HARMFUL RAYS, MOLTEN METAL, FLYING PARTICLES</td>
<td>7, 8, 9</td>
</tr>
<tr>
<td>ACETYLENE-CUTTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACETYLENE-WELDING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEMICAL HANDLING</td>
<td>SPLASH, ACID BURNS, FUMES</td>
<td>2, 10</td>
</tr>
<tr>
<td>CHIPPING</td>
<td>FLYING PARTICLES</td>
<td>1, 3, 4, 5, 6, 7A, 8A</td>
</tr>
<tr>
<td>ELECTRIC (ARC) WELDING</td>
<td>SPARKS, INTENSE RAYS, MOLTEN METAL</td>
<td>9, 11</td>
</tr>
<tr>
<td>FURNACE OPERATIONS</td>
<td>GLARE, HEAT, MOLTEN METAL</td>
<td>7, 8, 9</td>
</tr>
<tr>
<td>GRINDING-LIGHT</td>
<td>FLYING PARTICLES</td>
<td>1, 3, 4, 5, 6, 10</td>
</tr>
<tr>
<td>GRINDING-HEAVY</td>
<td>FLYING PARTICLES</td>
<td>1, 3, 7A, 8A</td>
</tr>
<tr>
<td>LABORATORY</td>
<td>CHEMICAL SPLASH, GLASS BREAKAGE</td>
<td>2</td>
</tr>
<tr>
<td>MACHINING</td>
<td>FLYING PARTICLES</td>
<td>1, 3, 4, 5, 6, 10</td>
</tr>
<tr>
<td>MOLTEN METALS</td>
<td>HEAT, GLARE, SPARKS, SPLASH</td>
<td>7, 8 (10 in combination with 4, 5, 6)</td>
</tr>
<tr>
<td>SPOT WELDING</td>
<td>FLYING PARTICLES, SPARKS</td>
<td>1, 3, 4, 5, 6, 10</td>
</tr>
<tr>
<td>Hazards</td>
<td>Recommended Protectors:</td>
<td>Bold Type Numbers Signify Preferred Protection</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>SPARKS, HARMFUL RAYS, MOLTEN METAL, FLYING PARTICLES</td>
<td>7,8,9</td>
<td></td>
</tr>
<tr>
<td>SPLASH, ACID BURNS, FUMES</td>
<td>2,10 (For severe exposure add 10 over 2)</td>
<td></td>
</tr>
<tr>
<td>FLYING PARTICLES</td>
<td>1,3,4,5,6,7A,8A</td>
<td></td>
</tr>
<tr>
<td>SPARKS, INTENSE RAYS, MOLTEN METAL</td>
<td>9,11 (11 in combination with 4,5,6, in tinted lenses, advisable)</td>
<td></td>
</tr>
<tr>
<td>GLARE, HEAT, MOLTEN METAL</td>
<td>7,8,9 (For severe exposure add 10)</td>
<td></td>
</tr>
<tr>
<td>FLYING PARTICLES</td>
<td>1,3,4,5,6,10</td>
<td></td>
</tr>
<tr>
<td>FLYING PARTICLES</td>
<td>1,3,7A,8A (For severe exposure add 10)</td>
<td></td>
</tr>
<tr>
<td>CHEMICAL SPLASH, GLASS BREAKAGE</td>
<td>2 (10 when in combination with 4,5,6)</td>
<td></td>
</tr>
<tr>
<td>FLYING PARTICLES</td>
<td>1,3,4,5,6,10</td>
<td></td>
</tr>
<tr>
<td>HEAT, GLARE, SPARKS, SPLASH</td>
<td>7,8 (10 in combination with 4,5,6, in tinted lenses)</td>
<td></td>
</tr>
<tr>
<td>FLYING PARTICLES, SPARKS</td>
<td>1,3,4,5,6,10</td>
<td></td>
</tr>
</tbody>
</table>
Selection of Shade Numbers for Welding Filters

The following is a guide for the selection of the proper shade numbers of filter lenses or pads for welding. Shades more dense than those shown for various operations may be selected to suit individual conditions.

<table>
<thead>
<tr>
<th>Welding Operation</th>
<th>Suggested Shade Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shielded metal-arc welding;</td>
<td>1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes</td>
</tr>
<tr>
<td>1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes</td>
<td></td>
</tr>
<tr>
<td>Gas-shielded arc welding (nonferrous)</td>
<td>1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes</td>
</tr>
<tr>
<td>Gas-shielded arc welding (ferrous)</td>
<td>1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes</td>
</tr>
<tr>
<td>Shielded metal-arc welding</td>
<td>3/16-, 7/32-, 1/4-inch diameter electrodes</td>
</tr>
<tr>
<td>3/16-, 7/32-, 1/4-inch diameter electrodes</td>
<td>5/16-, 3/8-inch diameter electrodes</td>
</tr>
<tr>
<td>Atomic hydrogen welding</td>
<td></td>
</tr>
<tr>
<td>Carbon-arc welding</td>
<td></td>
</tr>
<tr>
<td>Soldering</td>
<td></td>
</tr>
<tr>
<td>Torch brazing</td>
<td></td>
</tr>
<tr>
<td>Light cutting, up to 1 inch</td>
<td></td>
</tr>
<tr>
<td>Medium cutting, 1 inch to 6 inches</td>
<td></td>
</tr>
<tr>
<td>Heavy cutting, over 6 inches</td>
<td></td>
</tr>
<tr>
<td>Gas welding (light), up to 1/8 inch</td>
<td></td>
</tr>
<tr>
<td>Gas welding (medium), 1/8 inch to 1/2 inch</td>
<td></td>
</tr>
<tr>
<td>Gas welding (heavy), over 1/2 inch</td>
<td></td>
</tr>
</tbody>
</table>
Selection of Shade Numbers for Welding Filters

is a guide for the selection of the proper shade numbers of filter lenses or plates used in more dense than those shown for various operations may be selected to suit the individual's needs.

<table>
<thead>
<tr>
<th>Welding Operation</th>
<th>Suggested Shade Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>led metal-arc welding; 3/32-, 1/8-, 5/32-inch diameter electrodes</td>
<td>10</td>
</tr>
<tr>
<td>canned arc welding (nonferrous) 3/32-, 1/8-, 5/32-inch diameter electrodes</td>
<td>11</td>
</tr>
<tr>
<td>canned arc welding (ferrous) 3/32-, 1/8-, 5/32-inch diameter electrodes</td>
<td>12</td>
</tr>
<tr>
<td>canned metal-arc welding 7/32-, 1/4-inch diameter electrodes</td>
<td>12</td>
</tr>
<tr>
<td>canned metal-arc welding 3/8-inch diameter electrodes</td>
<td>14</td>
</tr>
<tr>
<td>hydrogen welding</td>
<td>10-14</td>
</tr>
<tr>
<td>*-arc welding</td>
<td>14</td>
</tr>
<tr>
<td>brazing</td>
<td>2</td>
</tr>
<tr>
<td>cutting, up to 1 inch</td>
<td>3 or 4</td>
</tr>
<tr>
<td>cutting, 1 inch to 6 inches</td>
<td>3 or 4</td>
</tr>
<tr>
<td>cutting, over 6 inches</td>
<td>4 or 5</td>
</tr>
<tr>
<td>ding (light), up to 1/8 inch</td>
<td>4 or 5</td>
</tr>
<tr>
<td>ding (medium), 1/8 inch to 1/2 inch</td>
<td>5 or 6</td>
</tr>
<tr>
<td>ding (heavy), over 1/2 inch</td>
<td>6 or 8</td>
</tr>
</tbody>
</table>
6.4 MAINTENANCE AND DISINFECTION OF EYE PROTECTORS

6.4.1 Maintenance

6.4.1.1 It is essential that the lenses of eye protectors be kept clean. Continuous vision through dirty lenses can cause eye fatigue and become a contributory factor to accidents. Daily cleaning of eye protectors is recommended.

6.4.1.2 Pitted or scratched lenses reduce vision and seriously reduce protection. They shall be replaced immediately.

6.4.1.3 Replace headbands. Slack, wornout, sweat-soaked, knotted, or twisted headbands do not hold the eye protector in proper position. Visual inspection can determine when the elasticity is reduced to a point beyond proper function.

6.4.1.4 To prolong the life of eye protectors, they shall be placed in suitable cases or containers between periods of use.

6.4.2 Issue and Use. Protectors are a personal item and should be for the individual and exclusive use of the person to whom they are issued. If circumstances require reissue, the protectors shall be thoroughly cleaned and disinfected as hereinafter described.

6.4.3 Disinfection

6.4.3.1 General. When a personal protective equipment, it is recommended that this equipment be cleaned and disinfected as herein specified.

6.4.3.2 Procedure. Thoroughly wash all surfaces with soap or suitable detergent. Carefully rinse all surfaces with soap or suitable detergent. Completely immerse the protective equipment for 10 minutes in a solution of hypochlorite, or quaternary ammonium in a strength specified by the manufacturer, at a room temperature of 68°F. Remove from solution and suspend in a warm air drying at room temperature, without rinsing because this reduces the residual effect. Ultraviolet disinfecting equipment, utilized in conjunction with the procedure above, when such equipment has been demonstrated to provide comparable results, should be disassembled to the extent without tools, prior to the wash and disinfection procedure. Replace disassembled protectors showing need for disinfection with new ones.

6.4.3.3 Storage. The dry pair of protectors should be placed in clean, dust-free containers to protect them.
6.4 MAINTENANCE AND DISINFECTION OF EYE PROTECTORS

6.4.3 Disinfection

6.4.3.1 General. When a person is assigned protective equipment, it is recommended that this equipment be cleaned and disinfected regularly, without sharing by another person unless disinfected as herein specified.

6.4.3.2 Procedure. Thoroughly clean all surfaces with soap or suitable detergent, and warm water. Carefully rinse all traces of soap or detergent. Completely immerse the protector for 10 minutes in a solution of modified phenol, hypochlorite, or quaternary ammonium compounds, in a strength specified by the manufacturer at a room temperature of 68°F. Remove protector from solution and suspend in a clean place for air drying at room temperature, or with heated air. Do not rinse because this will remove the residual effect.

Ultraviolet disinfecting equipment may be utilized in conjunction with the washing procedure above, when such equipment can be demonstrated to provide comparable disinfection. Protectors showing need for extensive cleansing should be disassembled to the extent possible without tools, prior to the washing and disinfection procedure. Replace defective parts with new ones.

6.4.3.3 Storage. The dry parts or items should be placed in clean, dust-proof containers to protect them.
FITTING OF GOGGLES AND SPECTACLES

A3.1 Cup Goggles

The first step in fitting cup goggles is to adjust the nose bridge. Both the ball and link- or plastic strap bridges of goggles are adjustable to accommodate the individual wearer. Both types usually have some means for shortening or lengthening. In either case, to shorten or lengthen the instructions of the manufacturer should be followed. Chain, leather, or plastic not needed after should be cut off. The chain should be insulated to protect the nose of the wearer.

The proper procedure for adjusting headbands is to keep the band loose enough to slip two fingers down, without stretching. Headbands should be worn low and flat and approximately at the skull in order to hold goggles in a comfortable position. Most cup goggles are thinner and slant lower nasal sides, which makes for comfort as well as easy identification in getting them right.

A3.2 Spectacles

The first step in fitting spectacles is to determine the proper eye and bridge sizes. This using fitting samples and placing the sample spectacles on the nose to arrive at the proper size. Rocker pads should fit flush against the sides of the nose without allowing the metal bridge of the rest on the nose bridge of the wearer. The small metal arms, to which the pearloid pads are attached, are readily adjusted by round nose pliers which are especially designed for this purpose. To fit comfortably over the ears, hold the spectacle firmly in one hand and shape the bow of the temple gently between thumb and forefinger of the other hand. Temples should be angled down from the frame of the lenses will be perpendicular to the line of vision.

Prescription safety spectacles should be fitted only by qualified optical personnel.
FITTING OF GOGGLES AND SPECTACLES

In fitting cup goggles is to adjust the nose bridge. Both the ball and link-chain and leather bridges of goggles are adjustable to accommodate the individual wearer. Both types of bridges means for shortening or lengthening. In either case, to shorten or lengthen the bridge, the manufacturer should be followed. Chain, leather, or plastic not needed after adjustment. The chain should be insulated to protect the nose of the wearer.

Procedure for adjusting headbands is to keep the band loose enough to slip two fingers under it, without stretching. Headbands should be worn low and flat and approximately at the base of the hold goggles in a comfortable position. Most cup goggles are thinner and slanted away at the, which makes for comfort as well as easy identification in getting them right side up.

In fitting spectacles is to determine the proper eye and bridge sizes. This is done best by ples and placing the sample spectacles on the nose to arrive at the proper size. The adjustable fit flush against the sides of the nose without allowing the metal bridge of the spectacles to bridge of the wearer. The small metal arms, to which the pearloid pads are attached, can be by round nose pliers which are especially designed for this purpose. To fit the temples com-ears, hold the spectacle firmly in the hand and shape the bow of the temple gradually by drawing thumb and forefinger of the other hand. Temples should be angled down from frame to ear so that pendicular to the line of vision.

Safety spectacles should be fitted only by qualified optical personnel.
WELDER CERTIFICATION

Welder certification, and the attendant testing, required for State contract work is administered by the Department of Transportation.

General Procedure:

Contact the supervisor of welder certification at the nearest Department of Transportation regional office to determine the time and location of that region's next certification test and the manner of filing an application.

The welding is done in the presence of the Department's representative, who stamps the samples for identification. Welding samples must be prepared in the field—they are not supplied by the regional office.

The samples are sent to the materials testing laboratory where X-ray photographs are made and evaluated.

If the inspection of the welds is affirmative a qualification card is sent to the regional supervisor, who personally presents it to the welder.

The card specifies the limits of qualification tested. A welder qualifying for unlimited thickness head position is, however, automatically qualified for everything else. The card is valid until the calendar year of issue provided that there is no lapse of 90 consecutive days in employment requirement. Certificate renewal is the responsibility of the welder, who must submit application with documents verifying maintenance of qualifying skills and employment.

Questions regarding this program should be directed to:

Department of Transportation — Structural Unit
Building 5, Sixth Floor
State Campus
Albany, New York 12226
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Albany, New York 12226
DEPARTMENT OF TRANSPORTATION — REGIONAL OFFICES

Region #1:
F. J. Fuller
50 Wolf Road
Albany, N.Y. 12205
Telephone: (518)-457-7130

Region #3:
E. E. Towlson
333 East Washington Street
Syracuse, N.Y. 13201
Telephone: (315)-474-5951

Region #5:
D. H. Ketchum
125 Main Street
Buffalo, N.Y. 14203
Telephone: (716)-842-4432

Region #7:
C. J. Lyman
444 Van Duzee Street
Watertown, N.Y. 13601
Telephone: (315)-782-2100

Region #9:
J. C. Federick
71 Frederick Street
Binghamton, N.Y. 13902
Telephone: (607)-772-1540

Region #2:
B. M. Evans
109 North Genesee Street
Utica, N.Y. 13503
Telephone: (315)-733-23

Region #4:
B. F. Perry
Barge Canal Terminal
Rochester, N.Y. 14601
Telephone: (716)-325-48

Region #6:
L. W. Allenbeck
30 West Main Street
Hornell, N.Y. 14843
Telephone: (607)-324-19

Region #8:
M. N. Sinacori
P.O. Box 1315
Arlington Branch
19 Davis Avenue
Poughkeepsie, N.Y. 1260
Telephone: (914)-454-80

Region #10:
A. H. Emery
325 West Main Street
Babylon, N.Y. 11702
Telephone: (212)-823-5
DEPARTMENT OF TRANSPORTATION — REGIONAL OFFICES

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Ext: 322

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Ext: 209

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Ext: 233

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Ext: 40

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Barge Canal Terminal
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Telephone: (716) 325-4880
Ext: 13

Region #6:
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30 West Main Street
Hornell, N.Y. 14843
Telephone: (607) 324-1900
Ext: 17

Region #8:
M. N. Sinacori
P.O. Box 1315
Arlington Branch
19 Davis Avenue
Poughkeepsie, N.Y. 12603
Telephone: (914) 454-8000
Ext: 231

Region #10:
A. H. Emery
325 West Main Street
Babylon, N.Y. 11702
Telephone: (212) 823-5450
WELDER QUALIFICATION TESTING PROCEDURE

When all applicants are assembled at the testing location and before any welding or preparation begins, the following notes should be read aloud to all participants:

1. The test plates must be prepared to the dimensions detailed in Figures 1, 2, 3 or 4, as the entire weld will be radiographed, however, 1 inch at each edge of the 5-inch plate and 1 1/2 inch at each edge of the 10-inch plate will be disregarded to allow for starting and stopping of the weld.

2. There are no requirements regarding the chemical or physical properties of the plates used. However, it is to the welder's advantage to use good quality plate, manufactured to specification A-56 or A-441, or AISI Grades 1010 to 1020 inclusive.

3. It is suggested that the welder preheat the test plates, but preheats in excess of 300°F are not permitted.

4. It is suggested that the welder adjust his welding machine while practicing on a plate similar in size and thickness, and preheated to the same temperature as the plate to be used in the test. It is the welder's advantage to have to readjust the welding machine during the welding of the test plate.

Welders being tested using Submerged Arc and Gas Metal Arc welding will not be allowed to change machine settings after making the initial pass.

5. It is suggested that care be taken to clean properly between passes, and that this time be used to allow the test plate to cool to the desired preheat and interpass temperature so that machine adjustment will not be necessary.

6. Only 5/32 inch diameter electrodes, manufactured to the AWS-ASTM classification E 7018, are to be used during the Manual Shielded Metal Arc Test.

The wire size and type, and the flux or shielding gas used for Submerged Arc or Gas Metal Arc welding should be those approved for use in the work.

7. It is suggested that all electrodes used in the test be dried for a minimum of 2 hours at or below 100°F. It is not to the welder's advantage to use any electrode which has been allowed to cool more than 2 hours removed from the drying or storage oven. It is not to the welder's advantage to attempt to redry electrodes which have been allowed to absorb moisture.
WELDER QUALIFICATION TESTING PROCEDURE

Applicants are assembled at the testing location and before any welding or preparation for welding
any notes should be read aloud to all participants.

Plates must be prepared to the dimensions detailed in Figures 1, 2, 3 or 4, as applicable. All plates will be radiographed, however, 1 inch at each edge of the 5-inch plate and 1 1/2 inches at each
ch plate will be disregarded to allow for starting and stopping of the weld.

There are no requirements regarding the chemical or physical properties of the plates used in this test.

The welder's advantage to use good quality plate, manufactured to specifications such as ASTM

AISI Grades 1010 to 1020 inclusive.

It is suggested that the welder preheat the test plates, but preheats in excess of 300°F. will not be

It is suggested that the welder adjust his welding machine while practicing on a plate similar in size
and preheated to the same temperature as the plate to be used in the test. It is not generally to
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cool to the desired preheat and interpass temperature so that machine adjustments will be

1 inch diameter electrodes, manufactured to the AWS-ASTM classification E 7018 may be used

for the Shielded Metal Arc Test.

Size and type, and the flux or shielding gas used for Submerged Arc or Gas Metal Arc tests must

s for use in the work.

It is suggested that all electrodes used in the test be dried for a minimum of 2 hours at 500°F. It is

advantage to use any electrode which has been allowed to cool more than 2 hours after being
rying or storage oven. It is not to the welder's advantage to attempt to redry electrodes which
to absorb moisture.
8. The test plate detailed in Figure 3, if welded in the vertical position, will qualify the Manual Metal Arc Welding of fillet and groove welds in all positions except overhead, regardless of thickness. In general, this one plate will be sufficient for all testing because the need for overhead welds is very limited by our designs.

It has been our experience that test plates one inch thick are easier to weld in the vertical position than 3/8 inch thick plates because of the ability of the thicker plate to dissipate the welding heat. We strongly recommend that the one-inch test plate be used and welded as a vertical groove weld.

9. The test plate detailed in Figure 4 is to be welded in the flat position only for the Gas Arc test or the Submerged Arc test. This will qualify the welder for flat groove welding and fillet welding.

10. At the completion of welding, the Engineer shall die stamp the test plate number and identification. This will be from the testing agency, i.e. D.O.T. - District No.; O.G.S. - South Mall or District No., or Testing Agency.

11. Machining may be used to remove excess weld metal but the final surface must be produced within the prescribed limits. Either fiber disk or carborundum wheels will produce acceptable grinding results. No surface defects such as gouges, nicks, etc., may remain.

Test plates reduced in thickness by more than 1/16 inch during the grinding process will be unfit for testing.

12. A welder who has failed a test position and is being retested within 30 days must make each test weld of each position being retested unless evidence is supplied to the Engineer showing that the welder has received additional training. If acceptable evidence is supplied it must be noted on the test application report, only one test weld then being required for each position being retested.

13. Grinding, air arc gouging, pneumatic chipping, or machining of any type will not be permitted for any purpose.

Interpass slag chipping and cleaning must be accomplished by means of a hand-held nonmetallic hammer and/or wire brush only.
plate detailed in Figure 3, if welded in the vertical position, will qualify the welder for welding of fillet and groove welds in all positions except overhead, regardless of material or design. This one plate will be sufficient for all testing because the need for overhead welding is rare.

In our experience that test plates one inch thick are easier to weld in the vertical position than plates because of the ability of the thicker plate to dissipate the welding heat. Therefore, end that the one-inch test plate be used and welded as a vertical groove weld.

The plate detailed in Figure 4 is to be welded in the flat position only for the Gas Shielded Metal or submerged Arc test. This will qualify the welder for flat groove welding and flat and horizontal positions.

Completion of welding, the Engineer shall die stamp the test plate number and identity of the welder. D.O.T. - District No.; O.G.S. - South Mall or District No.; or Testing Agency under contract may be used to remove excess weld metal but the final surface must be produced by grinding. Carborundum wheels will produce acceptable grinding results. No surface depressions (lines, etc.) may remain.

Pieces reduced in thickness by more than 1/16 inch during the grinding process will be rejected as unacceptable.

Who has failed a test position and is being retested within 30 days must make two test welds in each position being retested unless evidence is supplied to the Engineer showing that the welder has received training. If acceptable evidence is supplied it must be noted on the test application form under test weld then being required for each position being retested.

Air arc gouging, pneumatic chipping or machining of any type will not be permitted between welds.

Slag chipping and cleaning must be accomplished by means of a hand-held nonmechanical chipping brush only.
## Position of Test Welds

<table>
<thead>
<tr>
<th>Test Position</th>
<th>Position &amp; Type Weld Qualified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>Groove Weld Test Plate, Unlimited* &amp; Limited** Thickness</td>
</tr>
<tr>
<td>Horizontal</td>
<td>Flat Groove; Flat &amp; Horizontal Fillet</td>
</tr>
<tr>
<td>Vertical</td>
<td>Flat &amp; Horizontal Groove; F &amp; H Fillet</td>
</tr>
<tr>
<td>Overhead</td>
<td>F &amp; OH Groove; F, H &amp; OH Fillet</td>
</tr>
<tr>
<td></td>
<td>Flat Fillet</td>
</tr>
<tr>
<td></td>
<td>Flat &amp; Horizontal Fillet</td>
</tr>
<tr>
<td></td>
<td>F, H &amp; V Fillet</td>
</tr>
<tr>
<td></td>
<td>F, H &amp; OH Fillet</td>
</tr>
</tbody>
</table>

*Qualifies for welding groove and fillet welds on material of unlimited thickness.

**Qualifies for welding groove welds in material not over 3/4" thick and fillet welds material of unlimited thickness.

***Qualifies for welding fillet welds only, on material of unlimited thickness.
POSITION OF TEST WELDS

<table>
<thead>
<tr>
<th>POSITION &amp; TYPE WELD QUALIFIED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GROOVE WELD TEST PLATE</strong></td>
</tr>
<tr>
<td><em><em>UNLIMITED</em> &amp; LIMITED</em>*</td>
</tr>
<tr>
<td><strong>THICKNESS</strong></td>
</tr>
<tr>
<td><strong>FLAT GROOVE; FLAT &amp; HORIZONTAL FILLET</strong></td>
</tr>
<tr>
<td><strong>FLAT &amp; HORIZONTAL GROOVE; F &amp; H FILLET</strong></td>
</tr>
<tr>
<td><strong>F, H &amp; V GROOVE; F, H &amp; V FILLET</strong></td>
</tr>
<tr>
<td><strong>F &amp; OH GROOVE; F, H &amp; OH FILLET</strong></td>
</tr>
</tbody>
</table>

Fies for welding groove and fillet welds on material of unlimited thickness.

Fies for welding groove welds in material not over 3/4" thick and fillet welds on material of unlimited thickness.

Fies for welding fillet welds only, on material of unlimited thickness.
FILLET WELDS ONLY

FIGURE 1

NOTES:

1. Do not remove backing plate.

2. All plate surfaces within the area of the backing plate must be free of mill scale depressions. This includes the top and bottom of the test plate and the backing plate.
FILLET WELDS ONLY

FIGURE 1

15/16" ± 4" ± 4"

WELD REINFORCEMENT TO BE GROUND FLUSH WITH SURFACE OF TEST PLATE

INTIMATE CONTACT

3/8° - 3/8" - 3/8°

Min.

3/8"

3/8" - 3"

5"

must remove backing plate.

Plate surfaces within the area of the backing plate must be free of mill scale and surface projections. This includes the top and bottom of the test plate and the backing plates.
GROOVE WELDS - LIMITED THICKNESS
FILLET WELDS - UNLIMITED, THICKNESS

FIGURE 2

NOTES:

1. Do not remove backing plate.

2. All plate surfaces within the area of the backing plate must be free of mill scale depressions. This includes the top and bottom of the test plates and the backing plate.

WELD REINFORCEMENT GROUND FLUSH WITH SURFACE OF TEST PLATE

INTIMATE CONTACT

3/8" 3"
GROOVE WELDS - LIMITED THICKNESS
FILLET WELDS - UNLIMITED THICKNESS

FIGURE 2

V WELD REINFORCEMENT GROUND FLUSH WITH SURFACE OF TEST PLATE

INTIMATE CONTACT

Plate surfaces within the area of the backing plate must be free of mill scale and surface depressions. This includes the top and bottom of the test plates and the backing plate.
GROOVE WELDS - UNLIMITED THICKNESS
FILLET WELDS - UNLIMITED THICKNESS

FIGURE 3

NOTES:
1. Do not remove backing plate.
2. All plate surfaces within the area of the backing plate must be free of mill scale depressions. This includes the top and bottom of the test plates and the backing.
GROOVE WELDS - UNLIMITED THICKNESS
FILLET WELDS - UNLIMITED THICKNESS

FIGURE 3

---

4" ± 1/4" ± 4"

5" MIN.

\[ 1/4" \]

6°

45°

WELD REINFORCEMENT GROUND FLUSH WITH SURFACE OF TEST PLATE

3/8"

3"

1"

INTIMATE CONTACT

not remove backing plate.

plate surfaces within the area of the backing plate must be free of mill scale and surface 

pressions. This includes the top and bottom of the test plates and the backing plate.
SEMIAUTOMATIC GAS SHIELDED METAL ARC & SEMI-AUTOMATIC SUBMERGED ARC PROCESSES

FILLET and GROOVE WELDS, UNLIMITED THICKNESS

FIG

NOT

1. Do not remove

2. All plate surface area of the plate must be free

This includes the surface and the back

WEI D REINFORCEMENT GROUND FLUSH WITH SURFACE OF PLATE

INTIMATE CONTACT

3/8” 3”

45
IMI-AUTOMATIC GAS-SHIELDED METAL ARC & SEMI-AUTOMATIC SUBMERGED-ARC PROCESSES
FILLET and GROOVE WELDS, UNLIMITED THICKNESS

FIGURE 4

NOTES:

1. Do not remove backing plate.
2. All plate surfaces within the area of the backing plate must be free of mill scale and surface depressions. This includes the top and bottom of the test plates and the backing plate.
POSITIONS of TEST PLATES
for FILLET WELDS

THROAT OF WELD VERTICAL

THROAT VERTICAL: WHEN WELDING THIS SIDE

FLAT POSITION

HORIZONTAL POSITION

OVERHEAD POSITION

SHADED PORTION MAY BE WELDED IN ANY POSITION AFTER COMPLETING A 5/16" FILLET WELD ON EACH SIDE WHILE WELDING IN THE POSITION BEING TESTED.
POSITIONS of TEST PLATES for FILLET WELDS

HORIZONTAL POSITION

OVERHEAD POSITION

FILLET WELD TEST ONLY

SHADDED PORTION MAY BE WELDED IN ANY POSITION AFTER COMPLETING A 5/16" FILLET WELD ON EACH SIDE WHILE WELDING IN THE POSITION BEING TESTED.
POSITIONS of TEST PLATES
for GROOVE WELDS

FLAT POSITION

HORIZONTAL POSITION

VERTICAL POSITION

NOTE:
Test Plates must remain in these positions until welding is complete.

OVERHEAD POSITION
POSITIONS of TEST PLATES

for GROOVE WELDS

NOTE:
Test Plates must remain in these positions until welding is complete.
STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION

WELDER QUALIFICATION TEST

Name of Welder: ___________________________ Social Sec. No. ___________________________
Address: __________________________________
Employer's Name: __________________________

Welding Processes

Semi-Auto. Gas-Metal Arc Welding:
Wire Mfg. __________________ Diam. _______ AWS-ASTM Classification _______.
Shielding Gas __________________ Gas Flow Rate _______ c.f.h.

Semi-Auto Submerged Arc Welding:
Wire Mfg. __________________ Diam. _______ AWS-ASTM Classification _______.
Flux Mfg. __________________ Flux Classification _______.

Machine Used
Ampere Rating: __________________ AC _______ DC _______ Polarity: Neg. _______ Pos. _______
Serial Number: ___________________________ Manufactured By: ___________________________

List the following additional material for semi-automatic welding processes:
1) Ampmeter Reading during Welding _______ 
2) Voltmeter Reading during welding _______ 
3) Rate of Welding- inches per Minute _______

Remarks:

WELD TYPE  POSITION  PLATE THICK.  MARK  SW NO  LABORATORY TEST RESULTS

Tests Conducted By: ___________________________ Title: ___________________________
Identification Mark: ___________________________ Date of Tests: ___________________________

INSTRUCTIONS
WHITE & GREEN - to Materials Bureau
YELLOW - to Bridge Office
PINK - retain

FOR MATERIALS BUREAU USE ONLY

No. of Samples: ___________________________ X-Ray Plate No.: ___________________________
X-Rayed By: ___________________________ Date: ___________________________
Reviewed By: ___________________________ Date: ___________________________
Checked & Reported By: ___________________________ Date: ___________________________

Bridge Engineer
STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION

Social Security No.

has qualified for using the following welding processes to the extent shown on the reverse side hereof:

- Manual Metal Arc Welding
- Submerged Flux Coated Arc Welding (with CO2 shield)
- Semiautomatic Submerged Arc Welding (Wire Dia. ___)

Qualification expires on December 31 following the date below unless otherwise revoked.

Date: __________

Deputy Chief Engineer (Structures)

Signature of Welder

Qualification is granted on the basis of X-Ray test welds interpreted to the N.Y.S. Radiographic Qualification Table.

<table>
<thead>
<tr>
<th>WELDING PROCESS</th>
<th>FILLET WELDS</th>
<th>GROOVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>FHVO</td>
<td>FHVO</td>
</tr>
<tr>
<td>Gas-Shield</td>
<td>FHVO</td>
<td>FHVO</td>
</tr>
<tr>
<td>Sub-Arc</td>
<td>FH</td>
<td>F</td>
</tr>
</tbody>
</table>

NOT VALID WHERE PUNCTURED

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Qualification is granted on the basis of X-Ray examination of test welds interpreted to the N.Y.S. Radiographic Specification.