

1.1 WELDING CODE: AMERICAN WELDING SOCIETY (AWS) D1.3 FOR REFERENCE ONLY.

1.2 WELDING PROCEDURE CLASSIFICATIONS: THE METAL-ARC WELDING PROCEDURES ARE CLASSIFIED AS FOLLOWS:

CLASS 1 CONSTRUCTIONAL STEELS, READILY WELDABLE, FOR LOW AND HIGH STRESSED JOINTS.  
CLASS 2 CONSTRUCTIONAL STEELS, REQUIRING SPECIAL WELDING PROCEDURES, EXCLUDING CORROSION RESISTANT STEELS (SEE 2.5).

NOTE: CLASSIFICATIONS OF WELDMENTS SHALL BE IN ACCORDANCE WITH APPLICABLE DRAWINGS.

2.1 WELDING SYMBOLS: SYMBOLS FOR WELDING SHALL BE AS SPECIFIED IN AWS A2.4.

2.2 READILY WELDABLE STEELS: READILY WELDABLE STEELS ARE THOSE WITH A MAXIMUM CARBON EQUIVALENT OF 0.40 WEIGHT PERCENT FOR PLAIN CARBON STEEL GRADES. THIS VALUE MAY BE INCREASED FOR LOW ALLOY STEELS TO 0.45 WEIGHT PERCENT PROVIDED THE CARBON CONTENT DOES NOT EXCEED 0.22 WEIGHT PERCENT AND PHOSPHORUS AND SULFUR DO NOT EXCEED 0.06 WEIGHT PERCENT EACH AND THICKNESS DOES NOT EXCEED 0.75 INCH (19MM).

2.3 STEELS REQUIRING SPECIAL PROCESS CONTROLS: ALL STEELS WHICH DO NOT FALL WITHIN THE LIMITS DEFINED IN 2.2 AS APPLICABLE.

2.4 CARBON EQUIVALENT: CARBON EQUIVALENT (CE) IS DETERMINED FROM THE FOLLOWING FORMULA:

$$CE = C + Mn/6 + Mo/4 + Cr/5 + (Ni + Cu)/15 + P/3$$

NOTE: ELEMENTS REPRESENT A WEIGHT PERCENT. WHEN PHOSPHORUS DOES NOT EXCEED 0.06 WEIGHT PERCENT, THE VALUE OF "P" MAY BE OMITTED.

2.5 CORROSION RESISTANT STEELS: CORROSION RESISTANT STEELS ARE THOSE CONTAINING MORE THAN 4 PERCENT BY WEIGHT OF CHROMIUM AND LESS THAN 50 PERCENT BY WEIGHT OF NICKEL.

2.6 WELD CRACK: A WELD CRACK IS A LINEAR RUPTURE RESULTING FROM EXCESSIVE LOCALIZED STRESS. THEY MAY OCCUR IN THE WELD METAL, FUSION ZONE OR HEAT AFFECTED ZONE.

2.7 POROSITY: POROSITY IS DEFINED AS ROUNDED CAVITIES, FREE FROM SOLID MATERIAL, WHICH RESULTS FROM GAS ENTRAPMENT DURING SOLIDIFICATION.

2.8 OVERLAP: OVERLAP IS THE PROTRUSION OF WELD METAL BEYOND THE BOND AT THE TOE OF THE WELD.

2.9 SLAG INCLUSION: A SLAG INCLUSION IS A NONMETALLIC SOLID MATERIAL ENTRAPPED IN OR ON THE WELD METAL, OR BETWEEN THE WELD METAL AND BASE METAL.

2.10 UNDERCUT: UNDERCUT IS A GROOVE MELTED INTO THE BASE MATERIAL ADJACENT TO THE TOE OF THE WELD AND LEFT UNFILLED BY WELD METAL.

2.11 WELDING TERMS: AWS A3.0 SHALL BE USED TO DEFINE ALL OTHER WELDING TERMS NOT DEFINED HEREIN.

3.1 WELDING PROCEDURES: THE CONTRACTOR SHALL PREPARE OR HAVE THE MANUFACTURER PREPARE DETAILED WELDING PROCEDURES WHICH DELINEATE ALL PROPOSED PROCEDURES, METHODS AND TECHNIQUES APPLICABLE TO THE WELDING REQUIREMENTS OF THE CONTRACT. THE WELDING PROCEDURES SHALL INCLUDE THE FACTORS IN TABLE I AND THEY SHALL INCLUDE ORTHOGONAL, ISOMETRIC, OR OTHER SUITABLE DRAWING TYPES IN ACCORDANCE WITH DOD-STD-100. THE DRAWINGS SHALL DELINEATE A CROSS SECTION OF EACH JOINT, THE LOCATION OF EACH JOINT, AND OTHER INFORMATION NECESSARY TO IDENTIFY THE JOINT AND WELDING REQUIREMENTS. CHANGES IN ANY OF THE ELEMENTS IN TABLE I SHALL BE INCORPORATED INTO REVISED WELDING PROCEDURES. THE PROPOSED WELDING PROCEDURES AND REVISED WELDING PROCEDURES SHALL BE ACCEPTED BY THE GOVERNMENT (SEE 4.1) OR THE PROCURING ACTIVITY PRIOR TO THE CONTRACTOR COMMENCING WELDING OR REVISING WELDING OPERATIONS.

TABLE I FACTORS AND CHANGES IN JOINT WELDING PROCEDURES (CONT.)

JOINT WELDING PROCEDURE FACTORS	JOINT WELDING PROCEDURE TO BE REVISED AND REVIEWED WHEN FACTOR(S) CHANGE.
12. FILLER METAL:	
A) BRAND. ---	YES; UNLESS THE NEW BRAND IS ACCEPTED FOR THE SAME TYPE, AND CLASS UNDER THE APPLICABLE MIL, OPL, OR AWS FILLER METAL SPECIFICATIONS.
B) TYPE AND CLASS. ---	YES.
C) SIZE. ---	YES; FOR INCREASE OF ELECTRODE SIZE.
13. WELDING ENERGY:	
A) ARC CURRENT. ---	YES; WHEN THE LIMITS ESTABLISHED IN THE RECORDED JOINT WELDING PROCEDURE ARE EXCEEDED.
B) ARC VOLTAGE. ---	YES; WHEN THE LIMITS ESTABLISHED IN THE RECORDED JOINT WELDING PROCEDURE ARE EXCEEDED.
C) SOURCE OF POWER, A.C. OR D.C., AND POLARITY IF D.C. IS USED. ---	YES; EXCEPT WHEN ACCEPTANCE GRANTED FOR A.C.-D.C. ELECTRODE OR SHIELDED METAL-ARC WELDING.
14. WELD METAL DEPOSITION, SEQUENCE AND APPROXIMATE NUMBER OF PASSES. ---	YES; WHEN MAJOR CHANGES ARE MADE.
15. MECHANICAL TREATMENT (SUCH AS STRAIGHTENING, PEENING, BURNISHING, PRESETTING, COLD-DRAWING, SPINNING, ETC.) ---	YES; A CHANGE FROM ACCEPTED MECHANICAL TREATMENT WHICH AFFECTS THE REQUIRED PROPERTIES OF THE WELDMENT.
16. POST-WELD HEAT TREATMENT. ---	YES; ANY CHANGE FROM ACCEPTED HEAT TREATMENT PROCEDURE WHICH AFFECTS THE REQUIRED PROPERTIES OF THE WELDMENT CHANGES SUCH AS: A) EXCEEDING TEMPERATURE LIMITS. B) CHANGE OF TIME AT TEMPERATURE. C) CHANGE OF HEATING OR COOLING RATE. D) CHANGE OF COOLING MEDIUM. E) CHANGE OF HEATING MEDIUM. F) CHANGE OF SEQUENCE OF HEAT TREATMENT OPERATIONS INCLUDING TIME INTERVAL FOR STRESS RELIEF.
17. WELDING PROCESS. ---	YES; WHEN CHANGING FROM ONE PROCESS TO ANOTHER.
18. NONCONSUMABLE ELECTRODE:	
A) SIZE. ---	YES.
B) TYPE OR CLASS. ---	YES.
C) SPECIFICATION NUMBER. ---	YES.

3.1.1 HEAT INPUT CONTROLS: FOR STEELS REQUIRING HEAT-INPUT CONTROLS, THE HEAT INPUT EXPRESSED IN JOULES PER INCH (PER MM), SHALL BE RECORDED AND MADE PART OF THE WELDING PROCEDURE FOR EACH DIFFERENT WELDING CONDITION SEE 3.1. THE FOLLOWING INFORMATION WILL BE COMPILED TO CLEARLY SHOW THE JOINT DESCRIPTION, WELDING SYMBOL, SPECIFIC TYPE OF METAL AND ITS THICKNESS, AMPERAGE, VOLTAGE, TRAVEL SPEED, WELDING PROCESS, PREHEAT TEMPERATURE, INTERPASS TEMPERATURE, FILLER WIRE IDENTIFICATION PLUS DIAMETER AND RESULTING HEAT INPUT. THE MAXIMUM HEAT INPUT RECOMMENDED BY THE MANUFACTURER OF THE MATERIAL FOR EACH DIFFERENT WELDING CONDITION SHALL ALSO BE SHOWN. WHERE UNEQUAL THICKNESSES OR DIFFERENT COMPOSITIONS ARE BROUGHT TOGETHER INTO A WELD JOINT, THE SELECTION OF HEAT INPUT SHALL BE BASED ON THE LOWER MAXIMUM.

3.1.2 REPAIR WELDING PROCEDURES: WHEN REPAIR OF DEFECTIVE WELDMENTS IS NECESSARY AND NOT PROHIBITED BY THE CONTRACT OR ORDER, THE CONTRACTOR SHALL PREPARE REPAIR WELDING PROCEDURES DETAILING THE FACTORS LISTED IN TABLE II IN ADDITION TO THE INFORMATION REQUIRED IN 3.1 AND WHEN APPLICABLE 3.1.1. THE CONTRACTOR SHALL SUBMIT REPAIR WELDING PROCEDURES FOR ACCEPTANCE TO THE GOVERNMENT (SEE 4.1) OR THE PROCURING ACTIVITY PRIOR TO THE CONTRACTOR COMMENCING REPAIR WELDING.

TABLE II FACTORS FOR REPAIR WELDING

A) METHOD TO BE USED (GRINDING OR OTHER) FOR REMOVAL OF DEFECTS.
B) METHOD OF INSPECTION USED TO ENSURE REMOVAL OF DEFECTS.
C) CONTOUR OF CAVITY PRIOR TO WELDING, SUCH AS MINIMUM ROOT DIMENSIONS AND INCLUDED ANGLE.

3.2 EVALUATION OF WORKMANSHIP SPECIMENS: WORKMANSHIP SPECIMENS SHALL BE EVALUATED FOR PROPER WELD PROFILE, SURFACE QUALITY, FREEDOM FROM LACK OF PENETRATION AND FUSION, AND MINIMUM EFFECTIVE THROAT (SEE 4.3 AND 4.4.2), ACCORDING TO DRAWINGS OR STANDARDS AGREED UPON IN THE CONTRACT. NONDESTRUCTIVE TESTING IS ALSO APPLICABLE TO THE EXTENT SPECIFIED IN THE CONTRACT.

3.3 WELDING PROCEDURE QUALIFICATIONS FOR WELDMENTS: UNLESS OTHERWISE SPECIFIED, THE MANUFACTURER OR CONTRACTOR SHALL MAINTAIN A RECORD AS ILLUSTRATED IN AWS D1.1 OF ALL WELDMENT QUALIFICATIONS TESTS, USING THE MANUFACTURERS OR CONTRACTORS RECORDED WELDING PROCEDURE IN ACCORDANCE WITH 3.1, WHICH SHALL BE MADE AVAILABLE UPON THE GOVERNMENT'S REQUEST FOR REVIEW FOR CONFORMANCE TO ALL REQUIREMENTS SPECIFIED. THE WELDING PROCEDURES SHALL BE QUALIFIED PER EVALUATION ON THE WORKMANSHIP SPECIMENS IN ACCORDANCE WITH 3.2.

4.1 WELDING PROCEDURES: JOINT WELDING PROCEDURES SHALL BE PREPARED IN ACCORDANCE WITH 3.1 AND WHEN APPLICABLE 3.1.1. PRIOR TO PRODUCTION, THE GOVERNMENT RESERVES THE RIGHT TO REVIEW FOR ACCEPTANCE THE PROCEDURES TOGETHER WITH DRAWINGS PREPARED IN ACCORDANCE WITH DOD-STD-100. SUBSEQUENT TO INITIAL PRODUCTION, THE GOVERNMENT SHALL BE NOTIFIED OF ANY CHANGES TO THE FACTORS LISTED IN TABLE I FOR ACCEPTANCE.

4.2 SOUNDNESS: WHEN REQUIRED, THE DETERMINATION OF SOUNDNESS OF WELDMENTS SHALL BE MADE BY MAGNETIC PARTICLE, DYE PENETRANT, RADIOGRAPHIC OR ULTRASONIC INSPECTION METHODS. PERSONNEL SHALL BE QUALIFIED IN ACCORDANCE WITH MIL-STD-410.

4.2.1 MAGNETIC PARTICLE INSPECTION: WHEN MAGNETIC PARTICLE INSPECTION IS SPECIFIED IN THE CONTRACT OR ORDER, DRAWING, OR DETAILED SPECIFICATION, WELD JOINTS SHALL BE SUBJECT TO MAGNETIC PARTICLE INSPECTION IN ACCORDANCE WITH ASTM E1444.

4.2.1.1 MAGNETIC PARTICLE INSPECTION CRITERIA: UNLESS OTHERWISE SPECIFIED, ACCEPTANCE SHALL BE IN ACCORDANCE WITH MIL-STD-1907.

4.2.2 RADIOGRAPHIC INSPECTION: WHEN RADIOGRAPHIC INSPECTION IS SPECIFIED IN THE CONTRACT OR ORDER, DRAWING OR DETAILED SPECIFICATION, WELD JOINTS SHALL BE SUBJECT TO RADIOGRAPHIC INSPECTION IN ACCORDANCE WITH MIL-STD-1284, MIL-STD-1285 AND MIL-STD-453. THE CONTRACTOR SHALL PREPARE AND SUBMIT TO THE PROCURING ACTIVITY FOR REVIEW AND APPROVAL, PRIOR TO PRODUCTION, A POSITION DRAWING OR DRAWINGS FOR EACH WELDMENT IN ACCORDANCE WITH DOD-STD-100. DRAWINGS SHALL CONSIST OF SYMBOLS IN ACCORDANCE WITH AWS A2.4, AS REQUIRED TO INDICATE WELD JOINTS TO BE RADIOGRAPHED AND INCLUDE IN DETAIL, THE FACTORS IN TABLE III.

TABLE III FACTORS FOR RADIOGRAPHIC INSPECTION

A) THICKNESS OF PLATE THROUGH WHICH RADIOGRAPHS ARE TAKEN.
B) LOCATION OF FILM.
C) POSITION OF FILM.
D) DIRECTION OF RADIATION (SEE NOTE).
E) FREQUENCY OF EXAMINATION FOR JOINTS AND WELDMENTS.
F) SOUNDNESS OF EACH JOINT, IN ACCORDANCE WITH MIL-STD-1284.

NOTE: FILM SIZE AND DIRECTION OF RADIATION MAY BE VARIED PROVIDED THE NECESSARY COVERAGE IS OBTAINED.

4.2.3 DYE PENETRANT INSPECTION: WHEN DYE PENETRANT INSPECTION IS SPECIFIED IN THE CONTRACT OR ORDER, DRAWING, OR DETAILED SPECIFICATIONS, WELD JOINTS SHALL BE SUBJECT TO DYE PENETRANT INSPECTION IN ACCORDANCE WITH MIL-STD-8866.

4.3 WORKMANSHIP: UNLESS OTHERWISE SPECIFIED, THE CONTRACTOR OR MANUFACTURER, PRIOR TO PRODUCTION, SHALL PREPARE WORKMANSHIP SPECIMENS USING THE ESTABLISHED WELDING PROCEDURES (SEE 3.1 THROUGH 3.1.1). THE SPECIMENS MAY BE ACTUAL PARTS OR SAMPLES SIMULATING ALL WELDING CONDITIONS AND SHALL REPRESENT NO LESS THAN THE MINIMUM ACCEPTABLE WELD QUALITY LEVEL AND CLEANING USED IN PRODUCTION. IF THE PRODUCTION WELDMENT IS TO BE WELDED UNDER RIGID RESTRAINT, THE WORKMANSHIP SPECIMEN SHALL BE EQUALLY RESTRAINED. SPECIMENS SHALL BE IDENTIFIED BY PART NUMBER, JOINT CONFIGURATION AND ASSEMBLY LOCATION. WORKMANSHIP SPECIMENS PREPARED TO REPRESENT MULTI-PASS WELDS SHALL BE PREPARED IN SUCH A MANNER AS TO HAVE EXPOSED AT LEAST 1-1/2 INCH (3.8 CM) OF EACH PASS. ALL WORKMANSHIP SPECIMENS SHALL BE CROSS SECTIONED AND ETCHED AND SHALL BE ATTACHED TO THE WORKMANSHIP SAMPLE. THE WORKMANSHIP SPECIMENS SHALL BE APPROVED BY THE GOVERNMENT, AND APPROVED PRIOR TO START OF PRODUCTION. WORKMANSHIP SPECIMENS SHALL BE PROTECTED FROM DAMAGE AND ENVIRONMENTAL DETERIORATION AND MAINTAINED IN THE IMMEDIATE FABRICATION AREA.

4.4 EXAMINATION: WORKMANSHIP SPECIMENS AND PRODUCT WELDMENTS SHALL BE VISUALLY EXAMINED IN ACCORDANCE TO 4.4.1 AND EXAMINED DIMENSIONALLY IN ACCORDANCE TO 4.4.2.

4.4.1 VISUAL: VISUAL EXAMINATION OF WELDMENTS FOR DISCONTINUITIES AND THEIR PERMISSIBLE ACCEPTANCE LIMITS SHALL BE IN ACCORDANCE WITH TABLE IV.

4.4.2 DIMENSIONAL: FILLET AND GROOVE WELD ACCEPTABLE DIMENSIONS SHALL BE IN ACCORDANCE WITH TABLE V. FILLET WELDS SHALL BE MEASURED USING FILLET WELD GAUGES.

TABLE IV VISUAL INSPECTION

DISCONTINUITY	CONDITION	ACCEPTANCE CRITERIA
A) WELD CRACKS		NONE ALLOWED
B) SLAG INCLUSIONS		NONE ALLOWED
C) POROSITY		1. MAXIMUM PORE SIZE SHALL BE 1/16 INCH (1.6 MM) IN DIAMETER. 2. THERE SHALL BE NO MORE THAN SIX PORES FOR ANY TWELVE INCH (30.5 CM) LENGTH OF WELD. FOR SMALL WELDMENTS WITH CONTINUOUS WELDS LESS THAN TWELVE INCHES (30.5 CM) IN LENGTH, THERE SHALL BE PROPORTIONALLY LESS PORES ALLOWED (EXAMPLE: A MAXIMUM OF THREE PORES FOR SIX INCHES (15.25 CM) OF WELD).
D) OVERLAP		THE OVERLAP CONDITION SHALL NOT EXCEED 10% OF THE TOTAL WELD LENGTH.
E) UNDERCUT	1. BASE MATERIAL 0.25 INCH (6.35 MM) AND LESS IN THICKNESS.	1. THE MAXIMUM DEPTH OF UNDERCUT SHALL BE NO GREATER THAN 10% OF THE MATERIAL THICKNESS WHICH HAS THE UNDERCUT. THE EXTENT OF THE UNDERCUT SHALL NOT EXCEED 10% OF THE WELD LENGTH PROVIDED THE WELD SEAM MEETS MINIMUM SIZE. 2. UNDERCUT MUST HAVE A WIDTH NO LESS THAN TWICE THE DEPTH. 3. MELTING OF BASE METAL ON EDGES OF MATERIAL IS NOT CONSIDERED TO BE UNDERCUT. IT IS ACCEPTABLE PROVIDED: (1) WELD SEAM MEETS THE MINIMUM SIZE. (2) MELTING DOES NOT EXCEED 10% THICKNESS FOR 10% OF WELD LENGTH. (3) MELTING OF CORNERS IS NOT CONSIDERED TO BE UNDERCUT. MELTING SHALL NOT EXCEED 25% OF MATERIAL THICKNESS.

REVISION

LTR	DESCRIPTION	DATE	APPROVED
-	PRODUCT BASELINE ERR R7S2021	97-06-05	97-06-23 <i>Shelley</i>

TABLE IV VISUAL INSPECTION (CONT.)

DISCONTINUITY	CONDITION	ACCEPTANCE CRITERIA
	2. BASE MATERIAL GREATER THAN 0.25 INCH (6.35 MM) IN THICKNESS.	1. MAXIMUM DEPTH OF UNDERCUT SHALL BE 1/32 INCH (0.8 MM). 2. UNDERCUT MUST HAVE A WIDTH NO LESS THAN TWICE THE DEPTH, I.E., THE UNDERCUT CONDITION SHALL NOT CREATE A NOTCH IN THE UNDERCUT MEMBER. 3. THE LENGTH OF UNDERCUT SHALL NOT EXCEED TWO INCHES (5 CM) CUMULATIVE IN ANY CONTINUOUS 24 INCH (61 CM) LENGTH OF WELD. FOR CONTINUOUS WELDS LESS THAN 24 INCHES IN LENGTH, THE MAXIMUM CUMULATIVE LENGTH SHALL BE IN DIRECT PROPORTION TO THIS LIMIT OR ONE INCH (2.54 CM), WHICHEVER IS GREATER. EXAMPLE: FOR AN EIGHT INCH (20.3 CM) CONTINUOUS LENGTH OF WELD, MAXIMUM CUMULATIVE ALLOWABLE UNDERCUT LENGTH IS ONE INCH (2.54 CM). 4. MELTING OF BASE METAL ON EDGES OF MATERIAL IS NOT CONSIDERED TO BE UNDERCUT. IT IS ACCEPTABLE PROVIDED: (1) WELD SEAM MEETS THE MINIMUM SIZE. (2) MELTING DOES NOT EXCEED 10% THICKNESS FOR 10% OF WELD LENGTH. (3) MELTING OF CORNERS IS NOT CONSIDERED TO BE UNDERCUT. MELTING SHALL NOT EXCEED 25% OF MATERIAL THICKNESS.

TABLE V WELD DIMENSIONS

TYPE OF WELD	WELD DIMENSIONS	ACCEPTANCE CRITERIA
FILLET	LESS THAN 0.25 INCH (6.35 MM)	THE WELD DIMENSION IS THE MINIMUM AS SPECIFIED ON THE DRAWING SYMBOL.
FILLET	0.25 INCH AND GREATER	THE WELD MAY BE UNDERSIZE BY 1/16 INCH (1.6 MM) FOR A MAXIMUM LENGTH OF 10% OF THE CONTINUOUS WELD LENGTH.
GROOVE	ANY LENGTH	NO UNDERFILL IS ALLOWED.

PART NO ACV00515

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES. BREAK SHARP CORNERS AND EDGES.	DATE 97-06-05	DESIGN ACTIVITY U.S. ARMY INDUSTRIAL OPERATIONS COMMAND DEFENSE AMMUNITION CENTER SAVANNA, ILLINOIS 61074-9639
TOLERANCES ON FRACTIONS _____ DECIMALS _____	DFTSWN BJK	CHECKER SMS
	PROJ ENGR KHANNA	
	SIQAC-DEV <i>William J. Ernst</i>	CHIEF, SUPPLY ENGINEERING DIV
	SUBMITTED <i>William J. Ernst</i>	CHIEF, LOGISTICS ENGINEERING OFFICE
	APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY AMMUNITION CENTER <i>Arthur J. Kozminski</i>	
NEXT ASSY _____ USED ON _____	SIZE D	CAGE CODE 28620
APPLICATION _____	SCALE NONE	UNIT WT UNIT WT
		SHEET 1 OF 1

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