

METRIC

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SUPERSEDING  
MIL-STD-867C  
25 November 2008

# DEPARTMENT OF DEFENSE STANDARD PRACTICE

## TEMPER ETCH INSPECTION



This standard is approved for use by all Departments and Agencies of the Department of Defense.

AMSC: N/A

AREA: NDTI

## MIL-STD-867D

### FORWARD

1. This military standard is approved for use by AF70 Hill AF Base, OO-ALC/EN Engineering Program Office, Department of the Air Force, and is available for use by all departments and agencies of the Department of Defense.
2. This standard describes the requirements for the etch inspection of steel components to detect evidence of overheating or flaws in carburization. Etch inspection is typically used for bare low alloy steels heat treated to 180,000 pound per square inch (180 ksi/1241 Megapascal [MPa])) and higher or carburized parts, however usage is not limited to these applications. This standard may be used where applicable for repair, acquisition, and manufacture of parts and/or spare parts on military components.
3. Beneficial comments, recommendations, additions, deletions, and any pertinent data, which may be of use in improving this document, should be addressed to OO-ALC/EN Engineering Program Office, Bldg. 849, Hill AFB, UT 84056, email [OOALC.EN.Workflow@us.af.mil](mailto:OOALC.EN.Workflow@us.af.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database <https://assist.dla.mil>.

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**SUMMARY OF CHANGES**

<u>PAGE</u>	<u>MODIFICATIONS</u>
Page I – Title	Changed
Page ii – Forward	Changed
Page iii – Summary of changes	Added
Page iv – vi Table of contents	Changed
<u>PARAGRAPH/SECTION</u>	<u>MODIFICATIONS</u>
1.1 – 1.2 a.	Changed
1.3	Changed
1.3.1 – 1.3.2	Deleted
2.1	Changed
2.2.1 – 2.2.2	Changed
2.3	Changed
4.1	Changed
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4.1.2, a., b., c., and d.	Changed
4.1.2, e., and f	Added
4.1.3 – 4.1.3.1	Deleted
4.2 – 4.4	Changed
4.4.1 – 4.4.4	Added
4.5 – 4.5.4	Deleted
5.1 – 5.3	Changed
TABLE I – TABLE V	Changed
5.4 – 5.4.2	Deleted
5.5 – 5.5.1	Changed
5.5.1.1 – 5.5.1.2	Added
5.6 – 5.6.4	Changed
5.7	Changed
5.7.1 – 5.7.4	Added
5.8 – 5.10	Changed
5.11 – 5.13	Deleted
6.3	Changed
Concluding Material	Changed

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1. SCOPE

1.1 Scope. This standard establishes requirements for performing temper etch inspection of low alloy steels, carburized steels, and tool steels which are heat treated above 180 ksi (1241 MPa).

1.2 Groups. Temper-etch inspection is typically performed on steels from the following groups:

a. Group A: Low alloy steels:

SAE 52100	SAE 4140	SAE 4330
SAE 4340	300 M	D6AC
440C	Aermet 100	

## Carburizing Steels:

SAE 4620	9310	AMS 6260
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b. Group B: Tool Steels:

H-11	M-50	M-2
H-13		

NOTE: The alloys listed are examples. This process is applicable to any alloy that would be considered part of each group.

1.2.1 Case hardened steels. The standard is not applicable to surface hardened steels produced by nitriding or carbonitriding.

1.3 Purpose. This standard provides the step by step process and procedures to temper etch components to verify they have not been damaged by excess heat during use, repair, or manufacturing. This may be used on all high strength low alloy steels including landing gear and other military components. The process and procedures described here may also be used to detect problems or inconsistencies in carburization.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4 and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections three (3), four (4), and five (5) of this standard, whether or not they are listed here.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

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### DEPARTMENT OF DEFENSE SPECIFICATIONS AND STANDARDS

MIL-PRF-16173	Corrosion Preventive Compound, Solvent Cutback, Cold Application
MIL-PRF-32033	Lubrication Oil, General Purpose, Preservative (Water-displacing, Low Temperature)
MIL-PRF-680	Degreasing Solvents
MIL-STD-1504	Abrasive Blasting

(Copies of these documents are available online at <https://assist.dla.mil>.)

### COMMERICAL ITEM DESCRIPTIONS

A-A-59105	Nitric Acid, Technical
A-A-59281	Cleaning Compound, Solvent Mixtures

(Copies of these documents are available online at <https://assist.dla.mil>.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

### CODE OF FEDERAL REGULATIONS (CFR)

Title 27 CFR § 21.35	Formula 3-A
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(A copy of this document is available online at <https://www.access.gpo.gov/nara/cfr>.)

2.3 Non-Government standards and publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

### SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-H-6875	Heat Treatment of Steel, Raw Materials
SAE AMS2750	Pyrometry
SAE ARP1923	Qualification and Certification of Etch Inspectors
SAE AMS3002	Alcohol, Denatured Ethyl

(Copies of these documents are available online at <https://www.sae.org>.)

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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D329	Acetone
ASTM E1146	Acid, Muriatic (Technical Grade Hydrochloric Acid)
ASTM E1444	Particle Testing, Magnetic
ASTM D770	Isopropyl Alcohol
ASTM D1152	Methanol (Methyl Alcohol)

(Copies of these documents are available at <https://www.astm.org>.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. DEFINITIONS (Not applicable)

### 4. GENERAL REQUIREMENTS

#### 4.1 Materials.

##### 4.1.1 Materials. Materials required are as follows:

- a. Ethyl Alcohol (AMS3002), Isopropyl Alcohol (ASTM D770), or Methyl Alcohol (ASTM D1152)
- b. Hydrochloric Acid (HCL), (ASTM E1146) (Muriatic Acid)
- c. Nitric Acid (HNO<sub>3</sub>), (A-A-59105)
- d. Sodium Hydroxide (NaOH)
- e. In lieu of (d) above, any common alkali solution, including alkaline cleaners with a pH greater than or equal to 10 may be used provided it does not embrittle high strength steel.
- f. Ammonium Peroxydisulfate (Ammonium Persulfate) (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub> commercial.
- g. Acetone (ASTM D329)
- h. Anti-smut additive (JAR-3N, preferred)
- i. Vapor degreasing solvent (use in accordance with current laws and regulations).

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4.1.2 Local processing instructions. The processor shall create and maintain processing instructions, which provide detailed information and procedures to ensure the process meets or exceeds this standard. The instructions shall define the following:

- a. Tanks used in each step.
- b. Process step number and operation name.
- c. Processing time for each step.
- d. Processing temperature for each step.
- e. Materials used in each processing tank.
- f. Inspection criteria.

4.2 Manufacturing process cycle. The temper etch process shall be used after final base metal grinding or machining operations but prior to any processing which may interfere with this inspection, such as plating or shot peening. Shot peening surfaces may be temper etched during repair or overhaul.

NOTE: The etch process will remove approximately 0.0013 millimeters (0.00005 inch) of material from the surface of the part using the process in [TABLE I](#) or [TABLE V](#).

NOTE: Material removal using the process in [TABLE II](#) could be 0.0051 millimeters (0.0002 inches) or more.

4.3 Documentation. A process control document (shop traveler, work control document, etc.) that identifies the specific part-by-part number and serial number and includes the processing steps shall be produced by the processor. This document shall identify the individual inspector accomplishing the temper etch inspection along with the date and time the inspection was performed. This document shall be made available to the customer upon request.

4.4 Qualification and certification. Before performing temper etch inspection on production parts inspection personnel shall be qualified and certified in accordance with SAE ARP1923.

4.4.1 Initial qualification. All qualification inspection personnel shall pass the physical, written, and practical tests described in SAE ARP1923

4.4.2 Re-certification. Personnel performing temper etch inspection shall be re-qualified and re-certified per SAE ARP1923 at intervals not to exceed five (5) years. Physical tests are required yearly.

4.4.3 Re-examine for qualification. Personnel who do not meet qualification standards shall wait 30-days, and then provide current evidence of having performed suitable corrective actions, completed additional applicable training, or self-study before re-examination.

4.4.4 Certification. All records for qualified personnel shall be recorded and maintained. They shall include:

- 1- Date of qualification
- 2- Results of physical test

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- 3- Results of written test
- 4- Results of practical test
- 5- Documented experience as a temper etch inspector

## 5. DETAILED REQUIREMENTS

5.1 Process. Temper etch inspection shall be accomplished utilizing a process procedure as listed in Tables I, II, III, IV, or V. The entire surface of the feature in question shall be etched and inspected. The procedures in TABLE I and V may be used interchangeably. The procedure in TABLE IV is not as sensitive for detecting grinding burns and shall be used only when authorized by the cognizant engineering authority.

NOTE: "Alcohol" used herein refers to either ASTM D1152 methyl alcohol, ASTM D770 isopropyl alcohol, or AMS3002 denatured ethyl alcohol.

NOTE: "Ambient" used herein refers to a temperature range of approximately 55 to 80°F; acid temperatures above 80°F should be avoided due to increased etch rates and material removal.

NOTE: Alkaline solutions used for neutralizing must be non-embrittling and compatible with low alloy high strength steels and carburized steels.

5.2 Cleaning. Parts shall be cleaned to a water break free condition just prior to temper etch inspection. Cleaning methods may include vapor degreasing, alkaline solution cleaning, grit blasting per MIL-STD-1504, or wiping with or dipping parts in alcohol, MIL-PRF-680 solvent, or acetone. Cleaned parts shall not be touched with bare hands prior to inspection. If grit blasting is used, the grit size shall be 100 grit or finer. Where the minimum standoff distance cannot be maintained due to component geometry, the blast stream shall be continually kept in motion to avoid excess erosion and overheating of the surface. When grit blast is used to clean components the resulting cleaned surface shall be a uniform grey appearance.

5.3 Solution concentrations. The acid solution concentrations listed in the tables that follow are a volume percent of the concentrated solution used in the makeup. For example: Solution one (1) in TABLE I is three (3) to five (5) percent of the concentrated nitric acid solution used. That is, three (3) to five (5) gallons of concentrated nitric acid diluted to 100-gallons with water. Rinse tanks shall be maintained at a level of cleanliness that does not adversely affect the process or components.

5.4 Anti-smut additives. The anti-smut additive shall be a solution of chemicals that when mixed with the etchant, precludes the formation of smut on the surface of etched steel parts. These additives allow the processor to omit the embrittling hydrochloric acid de-smut step

NOTE: Anti-smut (JAR 3N) is the preferred anti-smut additive.

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TABLE I.  
Etch low alloy or carburized steels (Group A).

STEP	PROCESS	SOLUTION	TIME	TEMP	REMARKS
***1.	Nitric Acid Etch	Nitric Acid 3% to 5% (by volume) in alcohol	15 to 60 Seconds	Ambient	Exact time may vary to produce a uniform gray Surface.
		Nitric Acid 3% to 5% (by volume) in water	5 to 60 seconds		
2.	Rinse	Circulating water	Rinse only	Ambient	To remove acid. Total immersion required.
3.	Hydrochloric Acid Dip	Hydrochloric Acid 4% to 6% (by volume) in alcohol or water	30 to 60 seconds	Ambient	To remove smut and provide a uniform gray surface
4.	Rinse	Circulating water	Rinse only	Ambient	Agitate parts when immersed.
5.	Neutralize	Alkaline solution with pH of 10 minimum or Sodium Hydroxide 2% to 6% (by weight) in water	15 seconds minimum	16 to 82°C (60 to 180°F)	Agitate parts when immersed.
6.	Rinse	Circulating water	Rinse only	Ambient	To remove caustic.
*7.	Rinse	Alcohol	Rinse only	Ambient	To remove water.
8.	Inspect and evaluate in accordance with appropriate criteria.				
**9.	Oil	Rust preventative oil MIL-PRF-16173 or MIL-PRF-32033	Swab, dip, or spray	Ambient	To prevent corrosion
* Operational procedure: Hot water rinse (54°C minimum { 130°F}), followed by a dry air blast may be used in lieu of Steps 6 and 7.					
Pre-cleaning, water rinse and Steps 1 thru 8 shall be one continuous operation.					
** Apply the oil after the required embrittlement relief bake. This step may be omitted if the facility can show evidence that corrosion during the queue between process steps is not an issue. This could be the case in a low humidity environment.					
*** Etch time beyond 60-seconds may be required for Aermet 100 and similar metals.					

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TABLE II.  
Acid etch tool steels (Group B).

STEP	PROCESS	SOLUTION	TIME	TEMP	REMARKS
1.	Hydrochloric Acid Dip	Hydrochloric Acid 4% to 6% (by volume) in alcohol or water	1½ to 3½ minutes	Ambient	To de-oxidize part.
2.	Rinse	Circulating water	Rinse only	Ambient	To remove acid. Total immersion required.
3.	Nitric Acid	Nitric acid 2.5% to 4% (by volume) in alcohol or water	1½ to 2½ minutes	Ambient	Agitate parts during entire immersion time. Exact time may vary to produce desired black oxide film.
4.	Rinse	Circulating water	Rinse only	Ambient	To remove acid. Total immersion required.
5.	Hydrochloric Acid de-smut	Hydrochloric acid 4% to 6% (by volume) in alcohol or water	1½ to 3½ minutes	Ambient	To remove smut and produce a uniform gray surface.
6.	Rinse	Circulating water	Rinse only	Ambient	
7.	Neutralize	Alkaline solution with pH of 10 minimum or Sodium Hydroxide 2% to 6% (by weight) in water	15-second minimum	Ambient	
8	Rinse	Circulating water	Rinse only	Ambient	To remove caustic
*9	Rinse	Alcohol	Rinse only	Ambient	To remove water
10	Inspect and evaluate in accordance with appropriate criteria.				
**11	Oil	Rust preventative MIL-PRF-16173 or MIL-PRF-32033	Swab, dip, or spray	Ambient	To prevent corrosion
* Optional procedure: Hot water rinse (54°C minimum { 130°F}), followed by a dry air blast may be used in lieu of steps 8 and 9.					
Pre-cleaning, water rinse and Steps 1 thru 10 shall be one continuous operation.					
** Apply the rust preventative after the required embrittlement relief bake. This step may be omitted if the facility can show evidence that corrosion during the queue between process steps is not an issue. This could be the case in a low humidity environment or short queue time after etch.					

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TABLE III.  
Limited access or swab etch technique.

STEP	PROCESS	SOLUTION	TIME	TEMP	REMARKS
1.	Solvent clean	Cleaner A-A-59281 or Acetone (ASTM D329)	As necessary	Ambient	Wipe surface with commercial cheesecloth saturated with solvent. Wipe dry with cheesecloth.
2.	Nitric acid etch	Nitric acid (A-A-59105) 4% to 10% (by volume) in alcohol (Title 27 CFR § 21.35, Formula 3-A)	Until a black smutty etch is produced.	Ambient	Swab the surface with commercial grade cheesecloth saturated with Nitric solution. A more concentrated solution reduces time.
3.	Rinse	Acetone (ASTM D329)	To remove nitric acid	Ambient	Rinse immediately
4.	Acid clean	Hydrochloric acid (ASTM E1146) 6% to 10% (by volume) in water	To remove black smut.	Ambient	Swab with commercial cheesecloth saturated with HCL solution.
5.	Rinse	Clean water	To remove HCL	Ambient	Swab with commercial cheesecloth saturated with water.
6.	Neutralize	Alkaline solution with pH of 10 minimum or Sodium Hydroxide 2% to 6% (by weight) In water	To neutralize HCL	Ambient	Swab with commercial cheesecloth saturated with alkaline solution.
7.	Rinse	Clean water	To remove caustic	Ambient	Swab with commercial cheesecloth saturated with water.
8	Rinse	Alcohol or Acetone	To remove water	Ambient	Swab with commercial cheesecloth saturated with alcohol or acetone and wipe dry.
9	Inspect and evaluate in accordance with appropriate criteria.				
*10	Oil	Rust preventative MIL-PRF-16173 or MIL-PRF-32033	Swab only	Ambient	To prevent corrosion.
Steps 1 thru 9 shall be completed without interruption.					
* Apply the rust preventative after the required embrittlement relief bake. This step may be omitted if the facility can show evidence that corrosion during the queue between process steps is not an issue. This could be the case in a low humidity environment or a short queue time after etch.					

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\*TABLE IV.

Ammonium Peroxydisulfate (Ammonium Persulfate) swab etch technique.

STEP	PROCESS	SOLUTION	TIME	TEMP	REMARKS
1.	Solvent clean	Acetone (ASTM D329) or cleaner (A-A-59281)	As necessary	Ambient	Wipe surface with commercial cheesecloth saturated with solvent. Wipe dry with cheesecloth.
2.	Etch	Ammonium Peroxydisulfate 10% $\pm$ 1% (by weight) in water.	15 to 60 seconds	Ambient	Make solution just before use. Swab with commercial cheesecloth saturated with solution.
3.	Rinse	Clear water	As required to remove etch solution	Ambient	Swab area with commercial cheesecloth saturated with water.
4.	Neutralize	Alkaline solution with a pH of 10 minimum or Sodium Hydroxide 2% to 6% (by weight)	As required to neutralize etchant	Ambient	Swab area with commercial cheesecloth saturated with alkali solution.
5.	Rinse	Clear water	As required to remove alkaline solution	Ambient	Swab with commercial cheesecloth saturated with water.
**6.	Rinse	Alcohol or acetone	To remove water	Ambient	Swab with commercial cheesecloth saturated with alcohol. Wipe dry.
7.	Inspect and evaluate in accordance with appropriate criteria.				
***8.	Oil	Rust preventative MIL-PRF-16173 or MIL-PRF-32033	Swab only	Ambient	To prevent corrosion.
* This process may also be used as an immersion technique, provided pre-cleaning is in accordance with <a href="#">paragraph 5.2</a> . However, see the <a href="#">NOTE 2</a> below.					
Steps 1 thru 7 shall be completed without interruption.					
NOTE 1: No bake required after etching using this process.					
NOTE 2: Make solution up just before use as it becomes inactive after 72-hours.					
** Hot water rinse (54 °C minimum {130 °F}) by immersion, followed by a dry air blast may be used in lieu of steps 5 and 6.					
*** This step may be omitted if the facility can show evidence that corrosion during the queue between process steps is not an issue. This could be the case in a low humidity environment or a short queue time after etch.					

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\*TABLE V.  
Etch low alloy steels (Group A).

STEP	PROCESS	SOLUTION	TIME	TEMP	REMARKS
*1.	Nitric Acid Etch w/ Anti-Smut Additive	Nitric Acid 3% - 5% and 3% - 5% Anti-Smut Additive (JAR 3N is preferred) (by volume) in alcohol  Nitric Acid 3% - 5% and 3% - 5% Anti-Smut Additive (JAR 3N is preferred) (by volume) in water	15 to 120 seconds	Ambient	Exact time may vary to produce a uniform gray surface.
**2.	Rinse thoroughly	Circulating water	60-seconds minimum	Ambient to 180° F	To remove acid. Total immersion required.
3.	Inspect and evaluate in accordance with appropriate criteria.				
***4.	Oil	Rust preventative MIL-PRF-16173 or MIL-PRF-32033	Swab, dip, or spray	Ambient	To prevent corrosion.
* It is not possible to measure the concentration of anti-smut additive once dissolved in solution. Exact measurement of anti-smut concentration is not critical; small additions shall be made if smutting occurs during normal etching conditions. Etch time beyond 120-seconds may be required for Aermet 100 and similar steels.					
** Step 2 (rinsing) shall immediately follow step 1.					
*** This step may be omitted if the facility can show evidence that corrosion during the queue between process steps is not an issue. This could be the case in a low humidity environment or a short queue time after etch.					

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5.5 Inspection Criteria.5.5.1 Inspection of etched surfaces.

5.5.1.1 Shall be performed under light with a minimum of 2153 Lux (200 foot candles) at part surface.

5.5.1.2 The surface shall be visually inspected for indications of heat damage.

- a. A surface that has not been heat damaged shall have a uniform grey appearance.
- b. Un-tempered (re-hardened) martensite is indicated by light gray to white areas surrounded by a light brown to black border. Indications of un-tempered martensite shall be cause for rejection. Rejected parts shall be re-inspected in accordance with [paragraph 5.8](#).
- c. Over-tempered martensite is indicated by light brown to black indications darker than surrounding areas. Indications of over-tempered martensite shall be cause for rejection. Rejected parts shall be re-inspected in accordance with [paragraph 5.8](#) to verify indications.

5.5.2 Inspection of carburization.

- a. Indications of carburization where carburization is not allowed shall be cause for rejection. Rejected parts shall be re-inspected in accordance with [paragraph 5.8](#).
- b. Lack of carburization indications where carburization is required shall be cause for rejection. Rejected parts shall be re-inspected in accordance with [paragraph 5.8](#).

5.6 Baking.

5.6.1 Baking after the final etch. All parts processed by etch methods in TABLES [I](#), [II](#) and [III](#) shall be:

- a. Baked at  $191 \pm 14^{\circ}\text{C}$  ( $375 \pm 25^{\circ}\text{F}$ ) except as noted in [paragraph 5.6.1.b](#).
- b. Carburized parts, ultra-high strength steel (HRC 60 and higher), case-hardened steels, and any other steels that would have their physical properties negatively affected by baking at  $375^{\circ}$  shall be baked at  $135 \pm 14^{\circ}\text{C}$  ( $275 \pm 25^{\circ}\text{F}$ ).
- c. Soak time shall be a minimum of eight (8) hours for parts baked at  $135 \pm 14^{\circ}\text{C}$  ( $275 \pm 25^{\circ}\text{F}$ ).
- d. Soak time shall be a minimum of four (4) hours for parts baked at  $191 \pm 14^{\circ}\text{C}$  ( $375 \pm 25^{\circ}\text{F}$ ).
- e. All baking shall be initiated within eight (8) hours of start of the initial etch inspection process and before any plating operations.
- f. Bake furnace pyrometry shall conform to SAE AMS-H-6875 or SAE AMS2750.
- g. Parts processed by etch methods in [TABLE IV](#) and [TABLE V](#) do not require an embrittlement relief bake.

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### 5.7 Processing and quality requirements.

5.7.1 Solution concentrations. Process solutions shall be analyzed at a frequency determined to assure the solutions are maintained in accordance with the limits of this standard.

5.7.2 Etch process sensitivity. A standard test piece, which contains known unacceptable conditions, shall be processed at the start of each day the temper etch process is operated to verify the etch inspection process is acceptable. If the solutions and techniques do not adequately detect known defects, components shall not be processed and all process deficiencies shall be corrected and adequacy of inspection process shall be verified prior to etch inspecting components.

#### 5.7.2.1 Etch test specimen configuration.

- a. The test piece shall exhibit areas of un-tempered martensite and over-tempered martensite.
- b. The test piece may also have known flaws in carburization.
- c. The test piece shall be either 300M steel heat treated 275 to 305 ksi ultimate tensile strength or 4340 steel heat treated 260 to 300 ksi ultimate tensile strength or as specified by the cognizant engineering authority.

5.7.3 Magnetic Particle Inspection. All parts shall be magnetic particle inspected in accordance with ASTM E1444 after the final temper etch and prior to other processing which might hinder detection of a discontinuity. If baking is required, magnetic particle inspection shall be performed after the bake is complete.

5.7.4 Records. Historical records shall be maintained on all chemical tests and on additions made to the solution.

5.8 Re-etching. Parts with areas indicating under-tempering, over-tempering, absent, or unauthorized carburization shall be cleaned in accordance with [paragraph 5.2](#) and re-etched in accordance with the appropriate procedure in TABLES [I](#), [II](#), [III](#), [IV](#), or [V](#). A part may be etched two (2) or more times if dimensions and surface finish allow, in order to distinguish burn indications from irrelevant indications. If baking is required, it shall be performed in accordance with [paragraph 5.6](#) within eight (8)-hours of the initial etch inspection. Hand abrading with sandpaper or abrasive pads may be used to prepare the surface for re-etching.

5.9 Seeking competent advice. A metallurgist or engineer shall be consulted in instances where the results of the etching appear inconclusive and where further interpretation is required.

5.10 Acid etch removal. Discoloration from the acid etch inspection process shall be acceptable unless otherwise specified by the drawing or customer requirements. The discoloration may be removed by polishing, honing, vapor grit blasting, or alkaline cleaning methods providing dimensional changes do not exceed drawing requirements.

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### 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This standard provides the step-by-step process and procedures for temper etch to be used during repair process and acquisition of spares for all military components fabricated from high strength steel.

#### 6.2 Subject term (key word) listing.

Equipment  
Materials  
Process

6.3 Changes from previous issue. The margins of this standard have not been marked with vertical lines to indicate modifications generated by this change. A Summary of Changes page has been added at the beginning of this document to identify the changes. Bidders and contractors are cautioned to thoroughly evaluate the requirements of this document based on the entire content.

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CONCLUDING MATERIAL

Custodians:

Army – AV

Navy – AS

DLA – GS

Air Force – 70

Preparing Activity

Air Force – 70

Project NDTI-2016-002

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.