The documentation and process conversion measures necessary to comply with this revision shall be completed by 1 November 1999

INCH-POUND

MIL-PRF-19500/302C
1 August 1999
SUPERSEDING
MIL-S-19500/302B
20 January 1995

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN,
SILICON, LOW-POWER,
TYPE 2N2708, JAN

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

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN, silicon, VHF-UHF amplifier transistor. One level of product assurance is provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (similar to T0-72).

1.3 Maximum ratings.

P_T 1/ T_A = +25°C	P_T 2/ T_C = +25°C	I_C	V_{CBO}	V_{CEO}	V_{EBO}	T_J and T_{STG}
mW	mW	mA dc	V dc	V dc	V dc	°C
300	200	50	35	20	3	-65 to +200

1/ Derate linearly 1.71 mW/°C for T_C > +25°C.

2/ Derate linearly 1.14 mW/°C for T_A > +25°C

1.4 Primary electrical characteristics at T_A = +25°C.

	h_{FE} I_C = 2 mA dc V_{CE} = 2 V dc	$\|h_{fe}\|$ I_C = 1.0 mA dc V_{CE} = 15 V dc f = 100 MHz	$r_b'C_c$ I_C = 2 mA dc V_{CB} = 2 V dc f = 31.8 MHz	C_{cb} V_{CB} = 15 V dc I_E = 0 100 kHz ≤ f ≤ 1 MHz	NF V_{CE} = 15 V dc I_C = 2 mA dc f = 200 MHz	G_{pe} V_{CE} = 15 V dc I_C = 2 mA dc f = 200 MHz
			psec	pF	db	db
Min	30	7	9			15
Max	180	12	33	1.0	7.5	22

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad St., Columbus, OH 43216-5000, by using the addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5961

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification 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 documents cited in section 3 and 4 of this specification, whether or not they are listed.

2.1.1 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

MILITARY

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automated Printing Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.3 Interface requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1 (similar to T0-72).

3.3.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500. Where a choice of lead finish is desired, it shall be specified in the contract or purchase order (see 6.2).

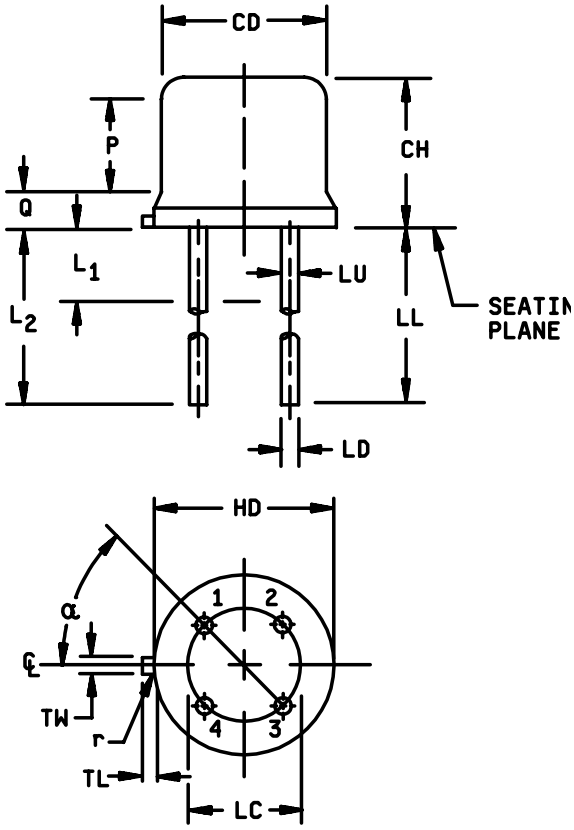
3.4 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.5 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.6 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I herein.

3.7 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified manufacturer's list before contract award (see 4.2 and 6.3).

LTR	Inches		Millimeters		Note
	Min	Max	Min	Max	
CD	0.178	0.195	4.52	4.95	
CH	0.170	0.210	4.32	5.33	
HD	0.209	0.230	5.31	5.84	
LC	0.100 TP		2.54		6
LD	0.016	0.021	0.41	0.53	7
LL	0.500	0.750	12.70	19.05	7
LU	0.016	0.019	0.41	0.48	7
L_1		0.050		1.27	7
L_2	0.250		6.35		7
TL	0.028	0.048	0.71	1.22	3
TW	0.036	0.046	0.91	1.17	10
P	0.100		2.54		
Q		0.040		1.02	4
r		0.007		0.18	11
α	450 TP				6



NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Details of outline in this zone are optional.
5. Symbol CD shall not vary more than 0.010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane 0.054 inch (1.37 mm) +0.001 inch (0.03 mm) -0.000 inch (0.00 mm) below seating plane shall be within 0.007 inch (0.18 mm) radius of TP relative to tab. Device may be measured by direct methods or by gauge.
7. Symbol LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Lead diameter shall not exceed 0.042 inch (1.07 mm) within L_1 and beyond LL minimum.
8. Lead designation, depending on device type, shall be as follows: 1 - emitter, 2 - base, 3 - collector, 4 - case.
9. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions (similar to TO-72).

4.VERIFICATION

4.1 Classification of Inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

4.3 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

4.3.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein.

4.3.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in VIb (JAN) of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

Subgroup	Method	Condition
B3	1026	$V_{CB} \geq 10$ V dc; adjust P_T to achieve $T_J = +150°C$ minimum; $T_A \leq +35°C$.
B5		Not applicable.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500. Electrical measurements (end points) shall be in accordance with table I, subgroup 2 herein.

Subgroup	Method	Condition
C2	2036	Test condition E.
C6	1026	$V_{CB} \geq 10$ V dc; adjust P_T to achieve $T_J = +150°C$ minimum; $T_A \leq +35°C$.

4.4 Method of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.4.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.4.2 Collector-base feedback capacitance. This test shall be conducted in accordance with method 3236 of MIL-STD-750, except that the case and emitter leads shall be connected to the guard terminal of the measuring equipment.

4.4.3 Noise figure test. Noise figure shall be measured using a HP 342A voltmeter and 343A noise source in conjunction with the small signal power gain test circuit or equivalent.

4.4.4 Disposition of "CASE" lead. Except for the following tests, the "CASE" lead shall be "floating" during all electrical tests and measurements: noise figure; small-signal power gain; collector-base time constant; and magnitude of $|h_{fe}|$. These tests shall be conducted with the "CASE" lead connected to a common rf chassis ground.

TABLE I. Group A inspection

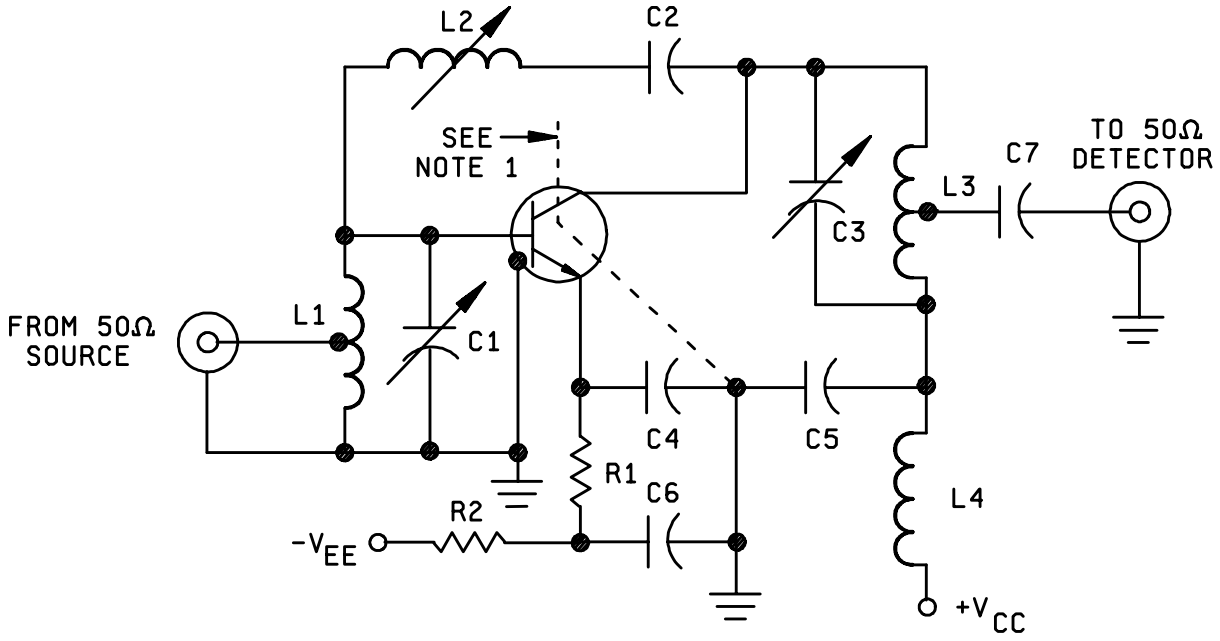
Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Breakdown voltage, collector to base	3001	Bias condition D; I_C = 1.0 μA dc	$V_{(BR)CBO}$	35		V dc
Breakdown voltage, emitter to base	3026	Bias condition D; I_E = 10 μA dc	$V_{(BR)EBO}$	3		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 10 mA dc; pulsed (see 4.4.1)	$V_{(BR)CEO}$	20		V dc
Collector to base cutoff Current	3036	Bias condition D; V_{CB} = 15 V dc	I_{CBO}		10	nA dc
Forward-current transfer ratio	3076	V_{CE} = 2 V dc; I_C = 2 mA dc	h_{FE}	30	180	
Collector-emitter saturation voltage	3071	I_C = 10 mA dc; I_B = 1 mA dc	$V_{CE(sat)}$		0.4	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 10 mA dc; I_B = 1 mA dc	$V_{BE(sat)}$		1.0	V dc
Subgroup 3						
High temperature operation		T_A = +150°C				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 15 V dc	I_{CBO}		1.0	μA dc
Low temperature operation		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc; I_C = 2.0 mA dc	h_{FE}	15		
Subgroup 4						
Small-signal short-circuit forward current transfer ratio	3206	V_{CE} = 15 V dc; I_C = 2 mA dc	h_{fe}	30	180	
Magnitude of small-signal short- circuit forward current transfer ratio	3306	V_{CE} = 15 V dc; I_C = 2 mA dc; f = 100 MHz	$\|h_{fe}\|$	7	12	

See footnotes at end of table.

TABLE I. Group A inspection - continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 4 – Continued						
Collector-base feedback capacitance (see 4.4.2)	3236	V_{CB} = 15 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{cb}		1	pF
Subgroup 5						
Small-signal power gain circuited)		V_{CE} = 15 V dc; I_C = 2 mA dc, f = 200 MHz (see 4.4.4 and figure 2)	G_{pe}	15	22	dB
Collector-base time constant		V_{CB} = 15 V dc, I_C = 2 mA dc, f = 31.8 MHz (see 4.4.4 and figure 3)	$r_b'C_c$	9	33	ps
Noise figure	3246	V_{CE} = 15 V dc, I_C = 2 mA dc, f = 200 MHz R_g = 50 Ω (see 4.4.3 and 4.4.4)	NF		7.5	dB
Subgroups 6 and 7						
Not required						

1/ For sampling plan see MIL-PRF-19500.



NOTE 1: External interlead shield to isolate the collector from the emitter and base leads.

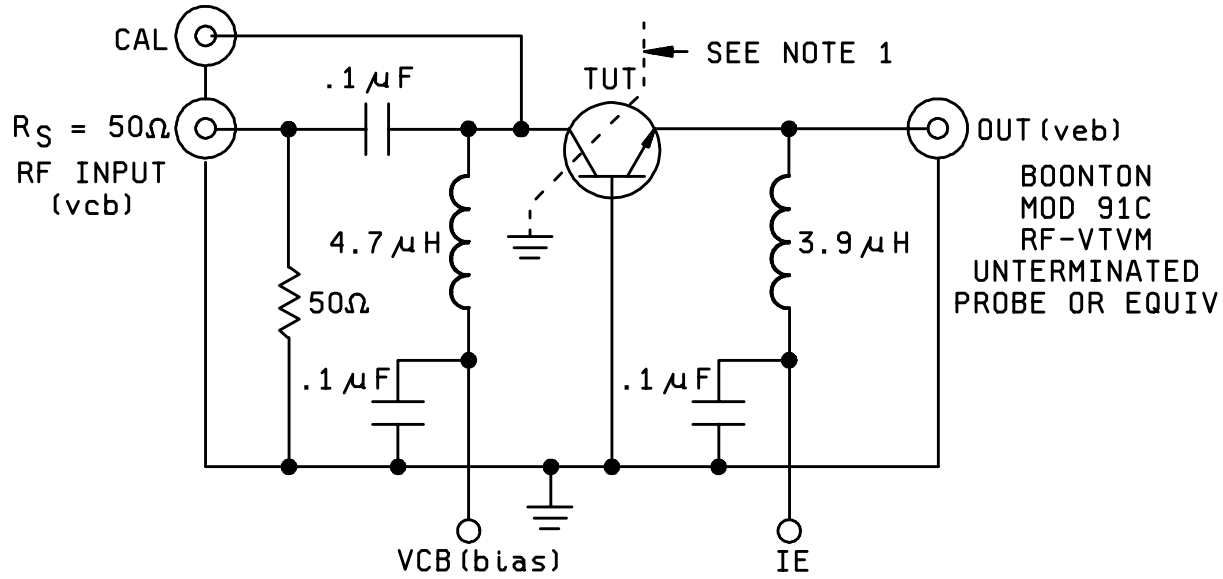
NEUTRALIZATION PROCEDURE:

1. Connect a 200 MHz signal generator (with a 50 ohm output impedance) to the input terminals of the amplifier, and connect a 50 ohm rf voltmeter to the output terminals of the amplifier.
2. Apply V_{EE} and V_{CC} to obtain the specified conditions.
3. Adjust the output of the signal generator to approximately 10 millivolts and tune C_1 and C_3 for maximum output.
4. Interchange the connections to the signal generator and rf voltmeter and with sufficient signal applied at the output terminals, tune L_2 for a minimum indication on the rf voltmeter.
5. Repeat this sequence until optimum settings are obtained for all variables.

Circuit-component information:

C_1	3 - 12 pF.
C_2 and C_7	1000 pF.
C_3	1.5 - 7.5 pF.
C_4 and C_5	0.01 μF.
C_6	0.05 μF.
L_1	3.5 T No. 16 AWG 0.312 inch ID, 0.438 inch length, Turns ratio ≈ 2 to 1.
L_2	0.4 - 0.65 μH, Miller No. 4303 or equal.
L_3	8 T No. 16 AWG, 0.125 inch ID, 0.875 inch length, Turns ratio ≈ 8 to 1.
L_4	200 MHz RFC.
R_1	100 Ω.
R_2	1 kΩ.

FIGURE 2. Small-signal power gain.



NOTE 1: External interlead shield to isolate the collector from the emitter and base leads.

PROCEDURE:

1. Connect 31.8 MHz source to input connect on test jig.
2. Connect RF voltmeter to "CAL" connector on test jig.
3. Adjust 31.8 MHz signal level so that 0.5 volts is read on RF voltmeter.
4. Remove the RF voltmeter from "CAL" connector and connect to "OUT" connector.
5. Insert TUT into socket and adjust bias.
6. Read output on RF voltmeter and compute $r_b'C_c$ from the following relationship:

$r_b'C_c$:(psec) = 10 x V_{eb} (millivolts)

Derivation of $r_b'C_c$ readout:

h_{rb} set-up:

Set input (V_{cb}) at 1.0 Volt; then $h_{rb} = \frac{V_{eb}}{V_{cb}} = \frac{V_{eb}}{1}$ = meter reading.

$r_b'C_c = \frac{h_{rb}}{2\pi f}$; therefore, $h_{rb} = (2Xf)(r_b'C_c)$, also $h_{rb} = \frac{V_{eb}}{V_{cb}}$.

Sample: at 31.8 MHz

Make $h_{rb} = .2$; $h_{rb} = \frac{V_{eb}}{V_{cb}} = \frac{.1}{.5} = .2$ then

$r_b'C_c = \frac{h_{rb}}{2Xf} = \frac{.2}{200x10^6} = 1\,x\,10^{-9}\ x\,1{,}000\ p\text{sec}.$

(Other frequencies are treated in the same manner).

FIGURE 3. Collector-base time constant test circuit (an equivalent circuit may be used).

For information purposes

Input levels (V_{cb}):

4.0 MHz = 400 mV	46.0 MHz = 346 mV
10.7 MHz = 471 mV	50.0 MHz = 318.4 mV
31.8 MHz = 500 mV	63.6 MHz = 250 mV
40.0 MHz = 400 mV	79.8 MHz = 200 mV

INTERPRETATION OF READINGS:

Meter range full scale	$r_b'C_c$ range (psec)		
	31.8, 40.0, 46.0, 50.0 63.6, 79.8 MHz	4.0 MHz	10.7 MHz
0.001 volt	10 psec	100 psec	31.6
0.003 volt	30 psec	300 psec	100.0
0.01 volt	100 psec	1000 psec	316.0
0.03 volt	300 psec		1000.0
0.1 volt	1000 psec		

FIGURE 3. Collector-base time constant test circuit (an equivalent circuit may be used). - Continued.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements should be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Notes. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Issue of DODISS to be cited in the solicitation (see 2.1.1).

b. The lead finish as specified (see 3.3.1).

c. Type designation and quality assurance level.

d. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List QML-19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Review activities:
Air Force - 19, 99

Preparing activity:
DLA – CC

(Project 5961-2134)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/302C	2. DOCUMENT DATE 990801

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, LOW-POWER, TYPES 2N2708, JAN

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial: 614-692-0510 DSN: 850-0510 FAX: 614-692-6939 EMAIL: alan_barone@dscc.dla.mil
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad Street, Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888