MILITARY SPECIFICATION

SENSING AND SIGNALING DEVICE, CURRENT-TIME (CTS)

(NAVAL SHIPBOARD USE)

This specification is approved for use by the Naval Sea Systems Command and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a current-time sensing and signaling device (CTS) and a test set for such device for use on Naval ships.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-B-117 - Bags, Sleeves and Tubing - Interior Packaging.
MIL-S-901 - Shock Tests, H. I. (High-Impact), Shipboard Machinery Equipment and Systems, Requirements for.
MIL-E-917 - Electric Power Equipment, Basic Requirements For (Naval Shipboard Use).
MIL-E-2036 - Enclosures For Electric and Electronic Equipment, Naval Shipboar
MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.
MIL-P-15024/5 - Plates, Identification.
MIL-C-17361 - Circuit Breakers, Air Electric, Insulated Enclosure (Shipboard Use).
MIL-I-17384 - Insulating Compound, Electrical, Quick-Drying.
MIL-E-17555 - Electronic and Electrical Equipment, Accessories, and Repair Parts: Packaging and Packing of.

STANDARDS

MILITARY

MIL-STD-130 - Identification Marking of U.S. Military Property.
MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
MIL-STD-471 - Maintainability Demonstration.
MIL-STD-721 - Definitions of Effectiveness Terms For Reliability, Maintainability, Human Factors, and Safety.
MIL-STD-882 - System Safety Program For Systems and Associated Subsystems and Equipment: Requirements For.
MIL-STD-965 - Parts Control Program.
MIL-STD-1399 - Interface Standard for Shipboard Systems.
MIL-STD-1399, Section 103 - Interface Standard for Shipboard Systems, Electric Power, Alternating Current.
MS90363 - Box, Fiberboard, With Cushioning Insert, Limited Re-Use (For Items 10 Pounds or Less).
MS90407 - Box, Fiberboard, With Cushioning Insert, Limited Re-Use (For Items Over 10 Pounds to 100 Pounds Inclusive).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Ship Engineering Center, SEC 6124, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General requirements. The CTS device and test set shall be in accordance with the requirements of MIL-E-917 except for the following:

(a) Radio interference.
(b) Noise reduction.
(c) Piping systems.
(d) Equipment cooled by forced air.
(e) Equipment cooled by water fuses.

In the event a requirement of MIL-E-917 and a requirement of this specification conflict, the requirement of this specification shall govern.

3.1.1 Materials. Reclaimed materials shall be used to the maximum extent possible.

3.2 Sample for first article inspection. Prior to beginning production a sample shall be examined and tested as specified in 4.3 (see 6.4).

3.3 Safety criteria. The equipment design and operational procedures shall comply with the following:

(a) Avoid or eliminate identified hazards by design selection or material selection.
(b) Control and minimize hazards to personnel, equipment, and material which cannot be avoided or eliminated.
(c) Isolate hazardous substances, parts, and operations from other activities, areas, personnel, and incompatible materials.
(d) Incorporate "fail-safe" principles where failures would cause a casualty through injury to personnel or damage to equipment.
(e) Locate equipment parts so that access to them by personnel during operation, maintenance, repair, or adjustment shall not require exposure to hazards such as chemical burns, electrical shock, cutting edges, sharp points, or toxic atmospheres.
(f) Provide warning and caution notes in operations, assembly, maintenance, and repair instructions; and distinctive warnings of hazards on the equipment.

3.3.1 System hazard analysis. The contractor shall conduct a system hazard analysis in accordance with the requirements of MIL-STD-882.

3.3.2 Operating hazard analyses. The contractor shall conduct operating hazard analyses in accordance with the requirements of MIL-STD-882.

3.3.3 Data use. Engineering data, procedures and instructions developed from the engineering design and the failure mode effects and criticality analysis (FMEA&CA) shall be used in support of the effort in 3.3.1 and 3.3.2.

3.3.4 System safety precedence. Safety hazards shall be resolved in accordance with the precedence established by MIL-STD-882.

3.3.5 Hazard analyses report. The contractor shall prepare a hazard analyses report in accordance with the data ordering document included in the contract or order (see 6.2.2).

3.4 CTS function. The CTS shall monitor current in 400 Hz 3-phase lines, and shall deliver a 60 Hz shunt trip signal to the associated circuit breaker, after a time delay, whenever the ratio of the current in the lines to the current setting of the CTS exceeds a prescribed value. The amount of time delay shall vary as a function of the current, up to a particular value of current, and shall be constant for all higher values of current. The amount of the constant time delay shall be selectable from among 3 optional delay times (see 3.5).

3.5 CTS current time response relationships. The relationship between 400 Hz current values, in terms of per unit current (see 6.3.2), and time delay (see 6.3.5) shall be as indicated in figure 1. The relationship shall be continuous between 1.25 per unit and 3.0 per unit. For currents above 3.0 per unit the value of time delay shall be 0.3 seconds ± 5 percent, 0.5 seconds ± 5 percent or 0.7 seconds ± 5 percent. Provision shall be made for selection among the 3 values.

submitted for initial production tests, and contractor

3.5.1 Reset. After a time delay has been initiated but not completed, if the value of 400 Hz current drops below 1 per unit, timing shall be discontinued and the CTS shall revert to the condition of availability for pickup.

3.5.2 Cycling. The CTS shall be capable of cycling (at fast repetition rates) in accordance with 4.6.3.

3.6 Description. The current time signaling device shall consist of a current transformer module and a control module. The current transformer module shall consist of three current transformers assembled into a single module, so arranged that each transformer of the module shall enclose one line of the 3-phase distribution circuit being monitored. The control module shall consist of the current value selection, processing and output signal circuitry, in an enclosure suitable for mounting in a control panel or switchboard. The current transformer module shall be in two ratings, selectable for use with the control module according to the current ratings to be monitored.

3.6.1 Current rating. The current rating (see 6.3.1) of the CTS shall be determined by the rating of the current transformer module selected and by the current value selected for the input circuit of the control module (see 3.6.1.2).

3.6.1.1 Current transformer ratings. Current transformers shall be designed for two current ratings: 100 amperes and 800 amperes.

3.6.1.2 Control module ratings. The control module shall include, in each phase, at the interface with the current transformer, a set of input resistors of such values that the desired current range of the CTS may be selected by retention or removal of appropriate resistors of the set. The following current ratings shall be selectable:

(a) With the 100 ampere current transformer: 15, 25, 50, 75, 100 amperes.
(b) With the 800 ampere current transformer: 125, 150, 175, 200, 225, 250, 300, 350, 400, 500, 600, 700, 800 amperes.

3.6.2 Constant time band selection. A means shall be provided in the control module for selection of the constant time delay band (see 3.5). The means of selection shall be easily accessible by opening the enclosure. Provision shall be made for marking of the value of the selected time band conspicuously on the outside of the enclosure (see 3.10.2).

3.6.3 Pickup and time-delay values.

3.6.3.1 Pickup value. Pickup (see 6.3.3) shall occur when the value of the 400 Hz current being monitored is 1.25 ± 5 per unit.

3.6.3.2 Time delay at pickup value. At values of current of 1.25 ± 5 per unit, the time delay shall be as indicated on figure 1.

3.6.4 400 Hz current monitored. The CTS device shall be designed to monitor 400 Hz distribution systems in accordance with the type III power requirements of MIL-STD-1399, section 103 except that the steady-state voltage regulation will be plus or minus 5 percent. The CTS shall tolerate, without damage, overload currents up to 5000 amperes root mean square (rms) symmetrical, for 0.7 second.

3.6.4.1 400 Hz circuits and voltages. The circuits and voltages in the 400 Hz systems to be monitored shall be:

(a) Delta, ungrounded, 3-phase, 3-wire - 120 volts.
(b) Wye, grounded, 3-phase, 4-wire, grounded neutral - 120/208 volts.
(c) Delta, ungrounded, 3-phase, 3-wire - 450 volts.

3.6.5 60 Hz energizing power. The energizing power for the CTS control module and for tripping the circuit breaker shall be 60 Hz, 115 volts a.c. in accordance with the type I power requirements of MIL-STD-1399, section 103.

3.6.6 Operation on system with ground fault. The CTS shall continue to perform as specified herein when any one line of either or both the 60 Hz and the 400 Hz circuits is grounded, separately or in any combination.

3.6.7 Ambient temperature. The CTS shall meet all the performance requirements herein when operated at any temperature from 0°C through 65°C, and shall be capable of performing in accordance with figure 1 except with tolerances increased from 5 percent to 6 percent when operated at a temperature of 85°C.

3.6.8 Temperature rise. The temperature rise in °C with the CTS carrying its rated current continuously in an ambient temperature of 65°C shall not exceed the following:

(a) Terminal studs and bolted connections silver-plated: 50°C; non-silver-plated: 35°C (see note 1).
(b) Coils, class B insulation: 55°C (see note 2).
(c) Solid state components - (see note 3).
(d) Ambient air inside control module enclosure near top, (see note 3).

NOTES:
1. Measured by the thermocouple method at predicted hottest spot on line-current-carrying studs and connections.
2. Measured by resistance method.
3. Measured by thermocouple method at predicted hottest spot shall not exceed the design value.

3.6.9 Associated circuit breaker. The circuit breaker which shall operate in conjunction with the CTS shall be type AQB in accordance with MIL-C-17361, with a shunt trip actuated by 115-volt, 60 Hz current, having continuous current rating of 1 ampere.

3.6.9.1 Enclosures.

3.6.9.1.1 Current transformer modules. The current transformer modules shall be of molded construction, with terminal boards for all secondary circuit terminals.

3.6.9.1.2 Control module. The enclosure for the control module shall be of the totally enclosed type in accordance with MIL-E-2036, except the terminal board shall be so mounted as to permit direct, external connections.

3.6.10 Insulation resistance. The insulation resistance of the CTS device shall be not less than 10 megohms at 25°C, as measured between each electrically isolated circuit and all other circuits connected together and to ground.

3.6.11 Vibration. CTS devices shall withstand type I vibration tests specified in MIL-STD-167-1 without mechanical damage or maloperation. Calibration shall remain within the specified limits.

3.6.12 Shock resistance. CTS devices shall withstand grade A, deck mounted class 1, type C HI shock tests specified in MIL-S-901 on the light-weight shock machine without mechanical damage or maloperation. Calibration shall remain within the specified limits. Device shall be tested at full operating load during test.

3.6.13 Dielectric strength. CTS devices shall withstand for a period of 1 minute an alternating 60 Hz voltage of 2200 volts rms between each electrically isolated circuit and all other circuits connected together and to ground.

3.6.14 Creepage and clearance distances. Creepage and clearance distances shall be in accordance with MIL-E-917. Requirements therein for group 1 enclosures and set C spacings shall apply to all external parts, and requirements for group 2 enclosures and set B spacings shall apply to all internal parts. Mounting screws and fittings shall be considered ground.

3.7 Supplementary requirements for parts. All parts shall be in accordance with the requirements of MIL-E-917 except as modified by the requirements herein. Nonstandard parts shall be used only as recommended by the contractor in accordance with the procedures herein and as reviewed by NAVSEC. Initial requests for use of nonstandard parts shall be in accordance with the data ordering documents included in the contract or order (see 6.2.2).

3.7.1 Solid state circuitry. The CTS and test set shall use all solid state circuitry.

3.7.2 Semiconductor devices. Semiconductor devices shall be chosen and applied in accordance with MIL-E-917. All semiconductor devices shall be of the silicon type.

3.7.3 Standardization promotion. When a justifiable need exists for a component not covered by an existing military specification but which can be provided by extension of a series of military devices such extension shall be employed in preference to choice of a component from a new series. The components used shall be of a military approved type and at least two sources of supply shall be available.

3.7.4 Component selection prohibition. Modules shall meet all requirements without the need for component selection (matched pairs) beyond that covered by the applicable component detail specification. Semiconductor components of the same type designation shall be interchangeable for all modules without any restrictions, including source of manufacture.

3.7.5 Reverse polarity prohibition. Non-polar components shall be used wherever feasible. Polarized components may be used only under the conditions applicable to the use of nonstandard parts (see 3.7).

3.7.6 Stress factors and limits. Circuits and components shall not exceed stress limits specified in table I under any condition of operation, standby and during test. The values specified shall be applied as limits - not design factors nor design margins. The contractor shall determine and provide sufficient margin between the applied stresses and the specified limits to insure that the required life and reliability are achieved. Circuits which employ controlled rectifiers or transistors shall operate to supress surge voltages to no more than 3 times the normal rms supply voltage.

TABLE I. Application stress limits and rerating factors.

Stress factor	Stress factor limit in relation to rating factor		Rating factor
	Lower	Upper	
Semiconductor devices:			
(a) General:			
(1) Ambient temperature design			
a. Minimum T_{AL}	T_{AD} - 50°C	T_{AD} - 30°C	T_{AD} = equipment design ambient
b. Maximum T_{AH}	T_{AD} + 15°C	T_{AD} + 35°C	T_{AL} = design ambient temperature lower limit
(2) Ambient temperature measured			
a. Minimum, start-up	T_{AL}	----------	
b. Maximum, operating	----------	T_{AH}	T_{AH} = design ambient temperature higher limit
(b) Rectifiers and controlled rectifiers (SCR's):			
(1) Nominal working peak reverse voltage	----------	0.5	Repetitive peak reverse voltage
(2) Repetitive peak reverse voltage	----------	0.7	Repetitive peak reverse voltage
(3) Non-repetitive peak reverse voltage	----------	1.0	Repetitive peak reverse voltage
(4) D.c. blocking voltage	----------	0.4	Repetitive peak reverse voltage
(5) Nominal working peak forward voltage (SCR's)	----------	0.5	Forward blocking voltage
(6) Repetitive peak forward voltage (SCR's)	----------	0.7	Forward blocking voltage

TABLE I. Application stress limits and rerating factors. - Continued

Stress factor	Stress factor limit in relation to rating factor		Rating factor
	Lower	Upper	
(b) Rectifiers and controlled rectifiers (SCR's) (continued):			
(7) Non-repetitive peak forward voltage (SCR's):			
a. Self-firing unacceptable	----------	0.8	Forward blocking voltage
b. Occasional self-firing acceptable	----------	1.0	Forward blocking voltage
c. Same as b. and di/dt = 0.3 maximum allowable	----------	1.0	Peak forward blocking voltage
(8) Reapplied forward blocking voltage (SCR's)	----------	0.7	Forward blocking voltage at rated dv/dt, junction temperature and turn-off time
(9) Minimum duration of voltage reversal (SCR's)	2.0	----------	Turn-off time
(10) Maximum rate of rise of forward blocking voltage (SCR's)	----------	0.5	Minimum rate of rise, forward blocking voltage (dv/dt)
(11) Average forward current:			
a. Nominal value	----------	0.7	Forward current derated for conduction angle, wave form stud or case temperature T_C plus 15°C (ambient temperature T_A plus 15°C for lead-mounted devices) and duty cycle
b. Maximum value	----------	1.0	
(12) Repetitive peak forward current:			
a. Nominal value	----------	0.7	Repetitive peak forward current at maximum case temperature (maximum ambient temperature for lead-mounted devices)
b. Maximum value	----------	1.0	
(13) Surge current:			
a. Peak, one cycle, non-repetitive	----------	0.7	Surge current peak, half cycle (1/120 sec.) non-repetitive (log = logarithm to base 10, f = pulse frequency in Hz, n = number of pulses, t = time in ms
b. Effective peak and cycles duration	----------	$0.2 + 0.28 \log \frac{f}{n}$	
c. Effective amplitude and duration sub-cycle	----------	$1 - 0.6t$	
(14) Peak current during turn-on (SCR's)	----------	0.7	Peak current during turn-on
(15) Maximum rate of current rise during turn-on (SCR's)	----------	0.5	Maximum rate of current rise during turn-on

TABLE I. Application stress limits and rerating factors. - Continued

Stress factor	Stress factor limit in relation to rating factor		Rating factor
	Lower	Upper	
(b) Rectifiers and controlled rectifiers (SCR's) (continued):			
(16) Peak forward gate current (SCR's):			
a. Maximum (for firing)	----------	0.7	Peak forward gate current
b. Minimum (for firing)	2.0	----------	Forward gate current, minimum to cause firing
c. Maximum (during blocking)	----------	0	Forward gate current, minimum to cause firing
(17) Peak forward gate voltage (SCR's):			
a. Maximum (for firing)	----------	0.7	Peak forward gate voltage
b. Minimum (for firing)	2.0	----------	Minimum firing voltage
c. Maximum (during blocking)	----------	0	Minimum firing voltage
(18) Peak reverse gate voltage maximum (SCR's)	----------	0.7	Peak reverse gate voltage
(19) Maximum gate power dissipation (SCR's):			
a. Average	----------	0.7	Average gate power dissipation
(20) Junction temperature (calculated):			
a. Average	----------	T_j (maximum) - 40°C	T_j (maximum) = maximum junction temperature
b. Peak	----------	T_j (maximum) - 25°C	
(c) Voltage reference diodes:			
(1) Bias current	0.8	1.2	Zener test current (value for rated zener voltage)
(2) Diode reverse current (zener current):			
a. Minimum	0.1	----------	Zener test current (value for rated zener voltage)
b. Maximum	----------	0.5	Maximum zener current
c. Maximum, continuous duty	----------	0.3	Maximum zener current
(3) Junction temperature (calculated)	----------	100°C	
(d) Voltage regulator diodes:			
(1) Diode reverse current (zener current):			
a. Minimum	0.1	----------	Zener test current (value for rated zener voltage)
b. Maximum (steady-state)	----------	0.5	Maximum zener current
c. Maximum, continuous duty	----------	0.3	Maximum zener current
d. Surge	----------	0.5	Surge current

TABLE I. Application stress limits and rerating factors. - Continued

Stress factor	Stress factor limit in relation to rating factor		Rating factor
	Lower	Upper	
(d) Voltage regulator diodes (continued):			
(2) Junction temperature (calculated):			
a. Average (steady-state	----------	T_j (maximum) - 50°C	T_j (maximum) = maximum junction temperature
b. Peak	----------	T_j (maximum) - 25°C	
(e) Transistors:			
(1) Collector to emitter voltage	----------	0.5	Collector to emitter voltage, VCEO
(2) Collector current	----------	0.5	Maximum collector current
(3) Collector power dissipation:			
a. Maximum (steady-state average)	----------	0.5	Collector power dissipation, Pc, derated for $T_C + \Delta T$ (or $T_A + \Delta T$) where ΔT = 50°C for silicon or 15°C for germanium
b. Peak	----------	0.7	
(4) Junction temperature (calculated):			
a. Average (steady-state)	----------	T_j (maximum) - 50°C	T_j (maximum) = maximum junction temperature
b. Peak	----------	T_j (maximum) - 25°C	

3.7.7 Application limitations. The following limitations and design guides shall apply in the application of semiconductor devices:

(a) Device ratings established by dependence on conduction cooling shall be maintained by mounting on metallic heat dissipators. Due regard shall be given to the compatibility of materials and to the finish coatings on parts mounted together in an assembly. Connections and joints in both electrical and thermal circuits shall be effectively maintained for the life of the equipment under adverse shipboard conditions, including shocks, vibration, thermal cycling, high and low humidity, and salt-laden atmosphere. Means shall be included for maintaining positive contact pressure on all bolted or clamped joints, under all service conditions, taking into account the aging (including creep, cold flow, relaxation, fatigue, shrinkage, and so forth) of materials.

(b) Direct mounting of devices to their heat dissipator with electrical insulation of the heat dissipators, as necessary, is preferred to the use of intervening electrical insulating material between the devices and their heat dissipators. This preferred arrangement shall be used except where it is impracticable to insulate the heat dissipators, or where other technical considerations make electrical insulation of the semiconductor device from its mounting surface necessary.

(c) Where parallel operation of devices is necessary to provide current capacity, means shall be provided in the equipment to force current sharing between or among the paralleled devices, except as otherwise specified herein. Device matching shall not be used to provide improved load sharing capabilities. Impedance in series with each parallel path shall be as nearly equal as practicable. Voltage reference diodes and voltage regulator diodes shall not be paralleled to obtain higher current capacity. Semiconductor controlled rectifier (SCR's) rated 110 amperes rms and higher may be operated in parallel without force current sharing under conditions specified in 3.7.7.1.

(d) Insofar as practicable, devices loaded in parallel shall share the same heat dissipator (that is, shall be mounted on a single heat dissipator which is common to all devices loaded in parallel) when required to stabilize the effects of thermal differences on load division.

(e) Gate or control signals shall be provided from a common source with a fast rise time and a pulse width of sufficient duration to assure near simultaneous turn on (or off) of all controllable semiconductor devices which are operated in parallel. Slave or sequential firing or control of devices operating in parallel shall not be used.

(f) Series operation of semiconductor devices (diodes, rectifiers, SCR's and transistors) shall not be used. Transistors shall not be used in series to obtain higher voltage capacity.

(g) Voltage reference diodes and voltage regulator diodes shall not be used in parallel to obtain higher current capacity.

3.7.7.1 Parallel operation of SCR's rated 110 ampere rms and above. Where circuit requirements dictate a.c. operation at higher currents than can be accommodated by one SCR, parallel operation of SCR's without forced current sharing may be employed provided all of the following requirements are complied with:

(a) Only devices of the same type designation (part identification) shall be connected in parallel.

(b) Parallel connected devices shall share a common heat sink and shall be mounted directly thereon.

(c) Paralleled devices shall be triggered from a common source with a gate signal having a rise time of 1 ms or shorter and a duration of no less than 10 ms so that all paralleled devices reach their respective specified latching currents over the device specified operating temperature range before their gating pulse is terminated. The foregoing is the minimal requirement; wherever feasible, the gate signal shall be maintained over the full conducting interval.

(d) The maximum value of total load current for the paralleled combination shall not exceed the amount derived from the following equation:

$$I_{total} = f_{cd} (0.6n + 0.4) I_{cell}$$

where: I_{total} = Total average forward current rating of the paralleled group of devices in the intended application.

f_{cd} = Composite derating factor which for the particular device operating alone - applies to I_{cell} under the applicable environment and service conditions and provide the degree of reliability and design margin appropriate for the application.

n = The number of devices connected in parallel.

I_{cell} = The specified average forward current rating of the device operating singly.

NOTE: Any rerating factory which is applicable to average forward current of the device because of the manner in which it is used (mode, duty, waveform, frequency, etc.) or for any other cause, shall also be included in the composite derating factor.

(e) Parallel connection of devices shall be accomplished with connections and leads of the same size and length arranged to provide balanced impedances between or among, the paralleled devices.

3.7.7.2 Surge voltage suppression. Circuits containing devices which do not have inherent capability to withstanding voltage surges of the level specified in 3.7.6 without exceeding allowable stresses shall be protected by incorporating adequate surge voltage suppression within the circuit. The internal generation of voltage surges shall be minimized with respect to both frequency of occurrence and amplitude. Means shall be provided within the circuit for suppressing any remaining voltage surges generated within the circuit that would otherwise be excessive. Surge voltage suppressors shall be in accordance with MIL-E-917.

3.7.8 Heat dissipators. Heat dissipators for semiconductor devices shall be constructed of metallic material which is either corrosion-resistant, or which is treated or coated to resist corrosion under shipboard environmental conditions. Surfaces which contact the semiconductor device, and surfaces to which electrical contacts are made shall not be painted or anodized, but shall be plated or otherwise coated to form surfaces to which the connections or junctions are made and which will retain their mechanical, thermal and electrical

effectiveness for the life of the equipment. The method of processing and the preparation of the connections and joints shall be as specified on the applicable heat dissipator drawing. Heat dissipators shall be sized to dissipate the heat generated by the semiconductor device of highest losses that may be expected to conform to the applicable semiconductor device specification, and to do so under the highest ambient temperature conditions without exceeding the limiting temperatures specified in table I. Maximum power dissipation may be estimated from calculations taking into account the mode of operation of the device in the circuit, the worst stress levels applied, and the limiting device characteristics as covered by the device specification. Maximum power dissipation may also be estimated by using published data for a particular brand of device, and scaling up the losses using a factor calculated from parameter limits applicable to the particular brand of device and specification limits, taking into account the influence of the parameters considered on the losses under the mode of operation in the circuit and allowing for any difference in form factor involved in the way the values are given. Where maximum power dissipation at rated conditions is specified and controlled by the device specification, this value corrected for the stress levels of the application, shall be used in the design.

3.7.9 Coating. All solid state type components and associated wiring shall be sprayed or dipped in an air drying clear varnish in accordance with MIL-I-17384 to prevent corrosion or oxidation. Contact surfaces of electrical terminals and connectors and of grounding surfaces shall be free of such coating.

3.8 Size and weight. The sizes of the current transformers shall not exceed 4.25 inch by 2.25 inch by 1.00 inch for the 100 amperes, and 9.00 inch by 3.75 inch by 1.5 inch for the 800 amperes. The weights shall not exceed 0.6 pound and 13.1 pounds, respectively. The size of the control module shall not exceed 4.125 inch by 4.75 inch by 3.75 inch and the weight 3.5 pounds.

3.9 Special tools. Special tools shall not be required for installation, maintenance adjustment, or removal of CTS devices. Tools not listed in the Federal Supply Catalog are defined as special tools (copies of this catalog may be consulted in the office of the Defense Contract Administration Service (DCAS)).

3.10 Designation and markings. Identification plates and other designating markings for CTS devices shall be in accordance with MIL-STD-130 and type A, B or C of MIL-P-15024 and MIL-P-15024/5. These plates shall be installed on and furnished as part of such equipment. They shall be attached to the part of the equipment which will not ordinarily be renewed during normal service life, and be located in a readily accessible position where they can be read at all times without danger to personnel. Identification plates shall be installed on both the control module current transformers.

3.10.1 Markings for small components. Markings for small components shall be of a legible size and type.

3.10.2 Identification plate marking. The data marked on identification plates shall include the following:

(a) Manufacturer's name and catalog number.
(b) Year of manufacture.
(c) Nomenclature.
(d) Navy type CTS device designation.
(e) Voltage, frequency.
(f) Ampere rating (current transformers only).
(g) National stock number.

The selected current rating of the CTS control module shall be indicated on a separate plate or label.

3.11 Reliability and maintainability.

3.11.1 Definitions. Definitions of terms for reliability and maintainability shall be in accordance with MIL-STD-721 unless otherwise specified herein. Endurance shall mean the operating life under specified conditions of load and time.

3.11.2 Reliability. The reliability measure shall be Mean Time Between Failure (MTBF). The MTBF of the CTS device shall be not less than 30,000 hours.

3.3.1 Operation. Brakes shall be either the shoe or disc type, and shall be shunt solenoid operated,

3.11.3 Definition of failure. The criteria of a failure for the purpose of determining achievement of reliability characteristics shall be as follows:

(a) The CTS will not perform its functions within the limits specified herein.
(b) There is evidence that heating exceeds temperature limits.
(c) There is evidence of broken parts or wiring.

3.11.4 Maintenance concept. Maintenance shall consist of the removal and replacement of modules at the site of installation and the repair of control modules at intermediate or depot levels.

3.11.4.1 Maintainability. The maintainability measure shall be Equipment Repair Time (ERT) as defined in MIL-STD-471, method 3. The ERT of the CTS shall be twenty minutes. The time for any one repair shall be not more than 60 minutes (see 4.6.9).

3.12 Test set for CTS device.

3.12.1 Characteristics. The test set shall present go-no-go information on the basis of input-output values. The test set shall be usable at both the site of installation and at maintenance facilities. The energizing power for the test set shall be 115 volts a.c., 60 Hz, type I, in accordance with MIL-STD-1399, section 103.

3.12.2 Construction. The test set shall be a compact portable unit in a dripproof enclosure, painted yellow, with leads. The unit shall be able to pass through a 25 inch diameter circular opening, and shall be capable of being handled by one man unassisted. The test set shall meet the drop test requirements of 4.6.12 and the parts requirements of MIL-E-917.

3.12.3 Storage space. Leads, test charts, tables, characteristic curves, and 1 copy each of the technical manuals for the CTS and for the test set shall be furnished with the test set. Provision shall be made for storage of these items within the enclosure.

3.13 Technical data. The contractor shall prepare drawings, certification data, and manuals in accordance with the data ordering documents included in the contract or order (see 6.2.2).

3.13.1 Drawings. The contractor shall prepare drawings in accordance with the data ordering document included in the contract or order (see 6.2.2) and the following unique features are to be included:

(a) Complete elementary and schematic wiring diagrams of the electrical circuits. This includes the current transformers, sensing and processing circuits, and trip signal circuit.
(b) List of electrical and electronic components such as transformers, diodes, resistors, capacitors, silicon rectifiers, reactors and coils. Each item shall have a piece number, type description, electrical rating and applicable Government specification. The electrical rating shall include both the component manufacturer's rating and the specific application rating.
(c) Transformer and coil data:
    (1) Core material and core or lamination form and size (including stack height). If core boxes are used, the material and size of the box should be given.
    (2) Winding data including number of turns, tape, wire size, and specification type designation, insulation, method of impregnation and treatment.
    (3) If potted, the method of potting and potting compound should be identified.
    (4) Identification as to where used.
(d) Various views of CTS device, including all parts to cover in detail the complete CTS device, the associated current carrying parts, the sensing elements, current sensing components and details of the enclosure construction. Data shall be included in regard to outline and mounting dimensions, performance data and characteristic curves, and a list of sensing elements with complete ordering data.
(e) In addition to the requirements specified in 3.10.2 certification data sheets shall include applicable data listed on the identification plate.

3.13.2 Technical manuals. The contractor shall prepare manuals in accordance with the data ordering document included in the contract or order (see 6.2.2) and as specified in 3.13.2.1 and 3.13.2.2.

3.13.2.1 The manual shall be suitable for binding as a separate book or for inclusion as a part of a technical manual for an assembly such as a switchboard. The manuals may be furnished with commercial protective paper covers and shall contain illustrations of the CTS sensing elements and mounting assemblies. The CTS device drawings shall also be included. The CTS manual shall include information on the use of the test set.

3.13.2.2 Test set technical manual. The technical manual for the test set shall include detail instructions, charts, and diagrams for use of the test set in shipboard testing of the CTS devices. A copy of the test set manual and a copy of the CTS manual shall be included in each test set.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection system. The contractor shall provide and maintain an inspection system in accordance with the data ordering documents included in the contract or order (see 6.2.2).

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall be conducted at a laboratory satisfactory to the Naval Ship Engineering Center (NAVSEC) and shall consist of the examination and tests specified in table II for the CTS device and test specified in 4.6.11 for the test set.

TABLE II. First article inspection of the CTS[1/].

Inspection	Requirement paragraph	Inspection paragraph
Examination	---	4.5
Creepage and clearance[2/]	3.6.14	4.6.1
Temperature rise cycling	3.6.8	4.6.2
Insulation resistance	3.6.10	4.6.4
Dielectric strength	3.6.13	4.6.5
Performance	3.6.4 and 3.6.5	4.6.6
Shock[2/]	3.6.12	4.6.7
Vibration[2/]	3.6.11	4.6.8
Maintainability[2/]	3.11.4.1	4.6.9
Self-protection from input voltage spikes[2/]	3.6.4 and 3.6.5	4.6.10
Grounding	3.6.6	4.6.11

[1/] Unless otherwise indicated, all tests shall be run at room ambient temperature and all CTS correctional tests with 115 volts, 60 Hz or 450 volts, 400 Hz inputs are required.

[2/] One specimen only of each size given these tests.

4.3.1 First article inspection shall be 3 CTS devices having 100 ampere current transformers and 3 CTS devices having 800 ampere current transformers. One test set shall constitute the test sample.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examination of 4.5 and the tests specified in 4.7.4, 4.7.5, 4.7.6, and 4.7.11. Each test set shall withstand the test specified in 4.7.12(a) through (c).

4.4.1 Lot. All CTS devices having the same size current transformers and all test sets offered for delivery at one time shall be considered a lot.

4.4.2 Sampling, inspection, and acceptance. Sampling and acceptance for quality conformance inspection of CTS devices shall be performed in accordance with MIL-STD-105 for Acceptance Quality Level (AQL) of 1.0 percent normal level.

4.5 Examination. CTS devices shall be subjected to an examination to ascertain that the material, workmanship and design are in conformance with this specification, the applicable detail drawings and MIL-E-917.

4.6 Tests.

4.6.1 Creepage and clearance. Creepage and clearance distances shall be demonstrated by actual measurement as specified in 3.6.14.

4.6.2 Temperature rise. The CTS device shall be operated at rated current until a steady-state temperature is reached. The test may be conducted at any constant ambient temperature between 25°C and 65°C. The temperature rises shall not exceed the specified values in 3.6.7. In addition to requirements of MIL-E-917, the requirements specified in 4.6.2.1 and 4.6.2.2 shall apply.

4.6.2.1 The ambient temperature shall be determined by a liberal number of thermometers suitably located. The temperature rise shall be determined by a liberal number of thermocouples.

4.6.2.2 Bus bars or cables shall be used for connecting the CTS device. The size of the bus bars and cables shall be selected in accordance with table III. The copper cross section of the cables and bus bars shall remain constant for at least 3 feet from the CTS mounting.

TABLE III. Size of cable and bus bars for temperature rise tests.

Copper rating - amperes	Cable size - approx. cm	Copper bus size - inches
100	50,000	1/2 x 1/8
800	900,000	1-1/2 x 1/4

4.6.3 Cycling. Each of the CTS devices specified in 4.3.1 shall be connected to an AQB circuit breaker as specified in 3.6.9 and tested. Each device shall be operated for the number of hours and number of cycles specified in table IV. A cycle shall consist of one make and one break operation. Performance shall be checked at 1.15, 1.35, and 4.0 per unit, at the start and finish of the cycling tests to determine that performance is in accordance with figure 1. Reset shall also be checked at the start and finish of cycling test to determine conformance with 3.5.1. Acceptance and rejection shall be as indicated in table IV. A failure is defined as no break when specified conditions for break exist, a break when specified conditions for break do not exist, or failure to meet performance requirements.

TABLE IV. Cycling test.

Hours of operation	No. of cycles 1/	No. of failures	
		Accept	Reject
108	500	0	1 or more

1/ 400 cycles of operation shall be performed at a rate of 50 cycles per hour in continuous runs of not less than 2 hours; 100 cycles at 1 cycle per hour.

4.6.4 Insulation resistance. The insulation resistance shall be measured with a 500 volt d.c. testing generator to determine compliance with the requirements of 3.6.10.

4.6.5 Dielectric strength. Tests for dielectric strength shall be made with an alternating potential from a transformer or generator of ample capacity having a sinusoidal wave shape. The test voltage shall be as specified in 3.6.13.

4.6.6 Performance test. Performance tests shall be made to determine that the CTS devices are in accordance with this specification. The tests shall be performed with the sizes of AQB circuit breakers corresponding to the CTS current setting, having shunt trip devices as specified in 3.6.9 at ambient temperatures of 0°C and 65°C. The CTS devices shall be supplied with 60 Hz power, and shall be tested in accordance with table V. The following tests shall be performed:

(a) Demonstrate conformance with the time current characteristics indicated on figure 1 at the following per unit current values: 1.19, 1.31, 1.50, 2.00, 2.85, 3.15, 4.00, 5.00.
(b) Demonstrate reset.
(c) Demonstrate ability to withstand 5000 amperes for 0.7 seconds (see 3.6.4.1) (test condition A only of table V).

The above tests at condition A of table V shall be performed at 85°C to determine conformance with 3.6.9. The contractor shall prepare detailed test procedures in accordance with the data ordering document included in the contract or order (see 6.2.2).

TABLE V. Performance test condition.

Test condition	Nominal 400 Hz current supply		Nominal 60 Hz control power supply	
	Voltage	Frequency	Voltage	Frequency
(Code)	(rms volts)	(Hz)	(rms volts)	(Hz)
A	450	400	115	60
B	450	400	107	61.8
C	450	400	123	58.2
D	450	400	86	63.6
E	450	400	144	50.4
F	120	400	115	60

4.6.7 Shock. CTS devices shall be tested in accordance with grade A, class 1, type C and as specified in MIL-S-901. The mounting for shock testing CTS devices shall be in accordance with the fixture 6E of MIL-S-901. The CTS devices shall be carrying 100 percent rated current and be at an operating temperature not to exceed temperature limits during all shock tests. Monitoring during test shall be as specified in 3.6.4.1. Device shall continuously perform its intended function. After shock tests, the CTS devices shall be subjected to the following examinations and tests:

(a) Examination for evidence of mechanical damage or loosening of parts.
(b) Performance as specified in 4.6.6 for test condition A at 65°C ambient temperature. No change from original specified limits.
(c) Insulation resistance - Shall be not less than 10 megohms (see 3.6.10 and 4.6.4).
(d) Dielectric strength - Shall withstand 60 percent of the specified voltage of 3.6.13.

4.6.7.1 Failure to perform principal functions. The CTS device shall not be damaged and shall be capable of continuously performing its intended functions.

4.6.8 Vibration. CTS devices shall be tested in accordance with type I of MIL-STD-167-1. The CTS devices shall be carrying 100 percent rated current and be at an operating temperature not to exceed temperature limits during the tests. After vibration tests, the CTS devices shall be subjected to the examinations and tests listed in 4.6.7(a) through (d).

4.6.8.1 Failure to perform principal functions. The CTS device shall not be damaged, shall not operate to trip the circuit breaker, and shall be capable of continuously performing its intended functions.

4.6.9 Maintainability demonstration. Maintainability shall be demonstrated in accordance with MIL-STD-471, method 4. The test set shall be used as applicable.

4.6.9.1 Faults for correction. Corrective maintenance tasks for the demonstration shall consist of the correction of simulated faults. No advance information on the faults shall be allowed to the demonstration technicians.

4.6.9.2 Scope of demonstration tasks. The time measured for each corrective maintenance task shall consist of the sum of the times of all the steps sufficient to complete the repair, including preparation, fault location, fault correction, adjustment, calibration, checkout, and the consulting of technical manuals and other allowed aids.

4.6.10 Self-protection from input voltage spikes. A separate test shall be performed for:

(a) Voltage spike to the 60 Hz input.
(b) Voltage spike to the 400 Hz input.

During each test the inputs shall be at rated current, frequency, and voltage. The 60 Hz input shall have a source impedance of 0.4 ohm inductive reactance and 0.07 ohm resistance. For each test, the CTS device shall be disconnected from the input lines and a 2500 (peak) volt spike having a basic impulse level (BIL) wave shape as shown on figure entitled "Spike voltage (short time transient) wave shape" of MIL-STD-1399, section 110 shall be applied to its required input between both line-to-line and line-to-ground. After reconnecting the CTS device back to the input lines, the voltage spike shall be reapplied. Three CTS control modules and 3 of each size current transformer circuitry, rigged in simulated operation with appropriate size of AQB circuit breaker as specified in 3.6.9 and shall be tested at the zero, plus or minus 45 degrees and plus or minus 90 degrees phase relationship with respect to the voltage wave. The CTS device input voltage wave form shall be observed on an oscilloscope and pictures of the voltage wave forms shall be taken. Following the input voltage spike test, each CTS device shall be subjected to the performance tests specified by 4.6.8(a) and 4.6.8(b) for test condition A.

4.6.11 Grounding. The test shall be performed as follows: The CTS shall be sensing 47 amperes current. Each terminal (60 Hz power and 400 Hz sensing signal) shall be connected in turn to ground as follows:

(a) Connect each terminal separately to ground through a 100,000 ohm resistor.
(b) Ground each terminal in turn by shorting one of its 100,000 ohm resistor.
(c) While each terminal is shorted to ground as specified in (b), the CTS device shall be subjected to the portions of the performance test specified in 4.6.8(a) and (b) for the steady-state test condition A and ambient temperature of 65°C. The CTS device shall continue to perform within specifications.

4.6.12 Test set for CTS devices. Tests applicable to the test set shall be as follows:

(a) Shall pass through an opening of 25-inch diameter.
(b) Shall provide for check-out of all 3-phases of a CTS device.
(c) Shall be suitable for use with all the CTS ratings as specified in 3.6.1.2.
(d) Shall operate satisfactorily, be within performance tolerances, show no indication of loose or broken parts and indicate only minor distortion of the enclosure or its internal components when dropped from a table top height of 36 inches above a concrete floor as follows:
(1) Drop the test set so that it strikes the floor in an approximate horizontal plane (flat) with its bottom side down.
(2) Repeat (1) except that the top side of the unit shall strike the floor.
(3) Drop the test set so that it strikes the floor in an approximate vertical position on its edge having the longer dimension.
(4) Repeat (3) except that the test set shall strike the floor on its edge having the shorter dimension.

4.7 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation-packaging, packing, and the marking for shipment shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.2.)

5.1 Preservation-packaging, packing, and marking. CTS devices, test set repair parts, and manuals shall be preserved-packaged level A or C; packed level A, B, or C, as specified (see 6.2) and marked in accordance with MIL-E-17555. Drawings shall be packaged and packed for the level specified (see 6.2.1) and marked for shipment in accordance with the applicable drawing specification.

5.1.1 Technical data requirements. The contractor shall submit packaging technical documentation in accordance with 6.2.2.

5.1.2 Repairables. Items subject for return to a repair facility for restoration and reissue shall be packaged and packed in materials capable of reuse. Unless otherwise specified (see 6.2.1), packaging shall be in accordance with MS90363 and MS90407 as applicable. Repairables requiring reusable containers shall be in accordance with the guidelines of MIL-B-17555. Containers shall be marked - REUSABLE DO NOT DESTROY.

5.1.3 Semi-conductors or solid state devices. Semi-conductors such as diodes, transistors, intergrated circuits as well as circuit boards or chassis in which they are incorporated, shall be individually packaged in a barrier bag conforming to class E, style 1, type I or II, or class F, style 1, type I of MIL-B-117. MIL-B-117 bag material shall employ alurinum foil as a laminate of the bag barrier material. Bag closure shall be effected by heat sealing. Leads and terminals shall be protected from damage by means of the container (carrier) design, die cut inserts, or by the use of noncorrosive cushioning material. Leads and other projecting parts may be used for positioning but shall not be subjected to loads or other stresses such as bending or twisting that can damage the entry seals. For level C preservation-packing, semi-conductors or solid state devices subject to electromagnetic degradation shall be protected with a wrap of aluminum foil or a barrier bag employing aluminum foil as a laminate of the bag material. Leads and terminals shall be protected as specified herein.

5.1.4 Cushioning, dunnage, and wrapping materials.

5.1.4.1 Level A preservation-packaging and levels A and B packing. Use of all types of loose-fill materials for packaging and packing applications such as cushioning, filler or dunnage is prohibited for materials destined for shipboard installation/stowage.

5.1.4.2 Level C preservation-packaging and packing. When loose-fill type materials are used for packaging and packing applications such as cushioning, filler and dunnage, all containers (unit, intermediate and shipping) shall be marked or labelled with the following information.

"CAUTION

Contents cushioned, etc. loose-fill material.
Not to be taken aboard ship.
Remove and discard loose-fill material before shipboard storage.
If required, recushion with cellulosic material bound fiber,
fiberboard or transparent flexible cellular material."

5.1.4.3 Cushioning, filler, dunnage and wrapping materials selected, whenever available, shall exhibit improved performance for resistance to fire.

6. NOTES

6.1 Intended use. The CTS is intended to provide protection against overcurrent by means of selective tripping in 400 Hz, 3-phase distribution system supplied by 60 to 400 Hz frequency chargers and the test set is intended to test the performance of the CTS.

6.2 Ordering data.

6.2.1 Procurement requirements. Procurement requirements should specify the following:

(a) Title, number, and date of this specification.
(b) CTS device rating.
(c) CTS device marked.
(d) Level of preservation-packaging and level of packing required (see 5.1).
(e) When repairable packaging is not required (see 5.1.2).

6.2.2 Data requirements. When this specification is used in a procurement which invokes the provision of the "Requirements for Data" of the Armed Services Procurement Regulations (ASPR), the data identified below, which are required to be developed by the contractor, as specified on an approved Data Item Description (DD Form 1664), and which are required to be delivered to the Government, should be selected and specified on the approved Contract Data Requirement List (DD Form 1423) and incorporated in the contract. When the provisions of the "Requirements for Data" of the ASPR are not invoked in a procurement, the data required to be developed by the contractor and required to be delivered to the Government should be selected from the list below and specified in the contract.

Paragraph	Data requirements	Applicable DID	Option
3.3.5	Report, systems hazards analysis	UDI-R-23391	------
3.7	Program parts selection list (PPSL)	DI-E-7027	------
3.7	Nonstandard parts requests/proposed additions to an approved PPSL	DI-E-7028	------
3.13.1	Drawings, engineering and associated lists level 3 (production)	DI-E-7015	Design activity designation - Procuring activity Drawing number - Procuring activity Associated list - Procuring activity Delivery of hard copy or microfilm - Microfilm
3.13.2	Technical manual (manuscript review)	DI-M-2042	Type I of MIL-M-15071
3.13.2	Technical manual (camera ready copy)	DI-M-2044	Type I of MIL-M-15071
4.1.1	Inspection system	DI-R-4803	------
4.6.6	Procedures, test	UDI-T-23732	------
5.1.1	Drawing, preservation-packaging, packing, and marking	UDI-E-23123	------
5.1.1	Packaging and transportation data	UDI-P-23508	------
5.1.1	Report, preservation-packaging and packing test	UDI-T-23766	------

(Copies of data item descriptions required by the contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.)

6.2.3 The data requirements of 6.2.2 and any task in section 3, 4, or 5 or the specification required to be performed to meet a data requirement may be waived by the procuring/purchasing activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item procured to this specification. This does not apply to specific data which may be required for each procurement regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Definitions.

6.3.1 Current rating. Current rating of a CTS device is the value of the sum of the current ratings in any one phase of those input resistors of the control module which are connected to the circuit.

6.3.2 Per unit current. Per unit current is the ratio between the rms current in the 400 Hz lines being monitored and the current rating of the CTS device.

6.3.3 Pick-up. Pick-up is the initiation of a time-delay interval in the CTS.

6.3.4 Pick-up current value. Pick-up current value is the lowest value of rms current, expressed as per unit current, sufficient to induce pick-up in the CTS.

6.3.5 Time delay. Time delay is the interval of time purposely interposed between pick-up and the initiation of a trip signal at the output of the CTS.

6.4 First article inspection. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection as to those bidders offering a product which has been previously procured or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending procurement.

6.5 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are procured by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

Preparing activity:
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(Project 6110-N211)

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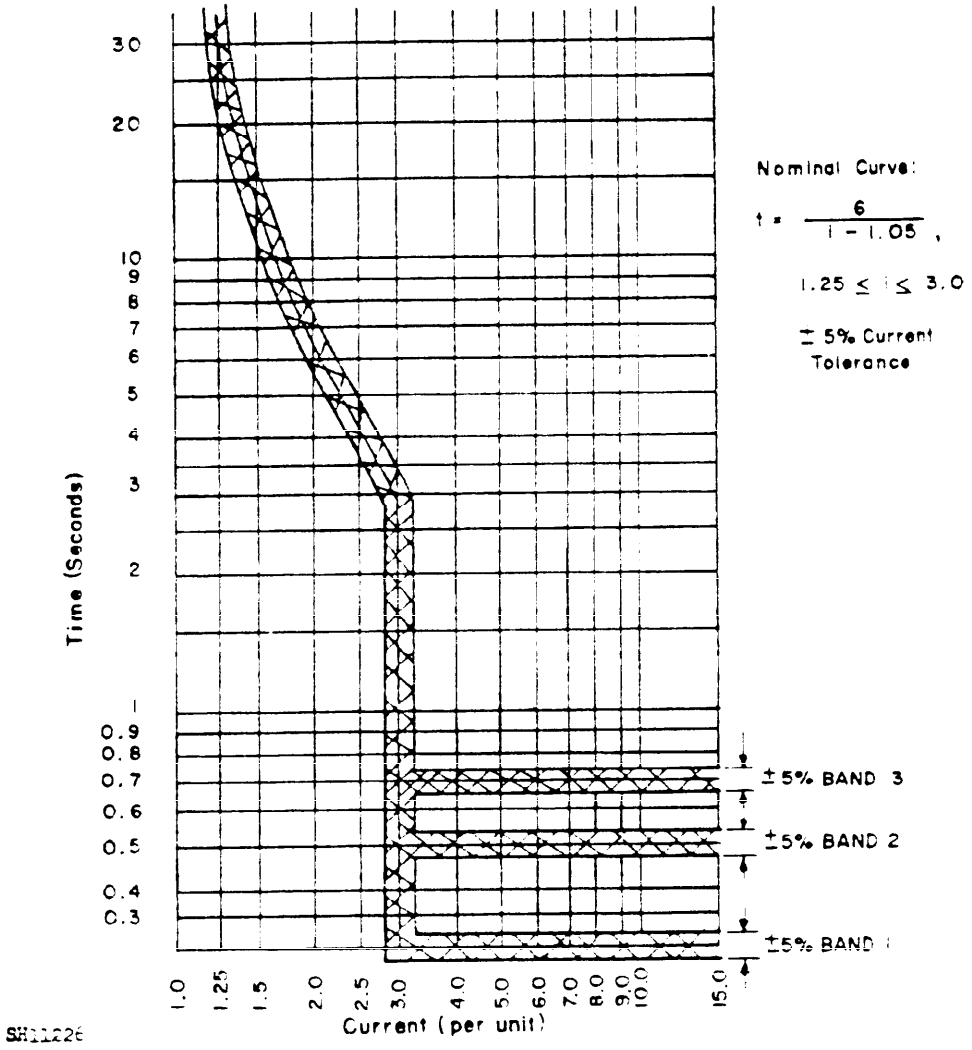

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FIGURE 1 - CTS current-time characteristics

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CONTRACT NUMBER

MATERIAL PROCURED UNDER A

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1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
   A. GIVE PARAGRAPH NUMBER AND WORDING.

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?

   ☐ YES ☐ NO *(If "Yes", in what way?)*

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