MIL-STD-704
6 OCTOBER 1959

SUPERSEDING
MIL-E-7894A(ASG)
17 MAY 1955

MILITARY STANDARD

ELECTRIC POWER, AIRCRAFT, CHARACTERISTICS AND UTILIZATION OF

DEPARTMENT OF DEFENSE
ARMED FORCES SUPPLY SUPPORT CENTER
WASHINGTON 25, D. C.

Standardization Division
ELECTRIC POWER, AIRCRAFT, CHARACTERISTICS
AND UTILIZATION OF
MIL-STD-704 6 October 1959

1. This standard has been approved by the Department of Defense and is mandatory for use by the Army, the Navy, and the Air Force, effective 6 October 1959.

2. In accordance with established procedure, the Transportation Corps, Bureau of Aeronautics, and Air Force have been designated, respectively, as Army-Navy-Air Force custodians of this standard.

3. Recommended corrections, additions, or deletions should be addressed to the Standardization Division, Armed Forces Supply Support Center, Washington 25, D. C.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

FIGURES

TABLES

MILITARY STANDARD
ELECTRIC POWER, AIRCRAFT, CHARACTERISTICS AND UTILIZATION OF

1. GENERAL

1.1 **Scope.** This standard delineates the characteristics of electric power to be supplied to airborne equipment at the equipment terminals and the requirements for the utilization of such electric power by the airborne equipment.

1.2 **Purpose.** The purpose of this standard is to foster compatibility between aircraft electric systems and airborne utilization equipment to the extent of confining the aircraft electric power characteristics within definitive limits and restricting the requirements imposed on the electric power by the airborne utilization equipment.

2. APPLICABLE DOCUMENTS

2.1 **Not applicable.**

3. DEFINITIONS

3.1 **Average value.** The average value of phase quantities is the arithmetical sum of the phase values divided by the number of phases.

3.2 **Ground.** The primary aircraft structure is the referenced ground for the negative of the dc and the neutral of the ac in the power generation and power utilization systems.

3.3 **Transients.** A transient is the changing condition of a characteristic which goes beyond the steady-state limits and returns to the steady-state limits within a specified time period.

3.4 **Total harmonic content.** The total harmonic content of a complex wave is the total rms voltage remaining when the fundamental component is removed.

3.5 **Frequency modulation.** Frequency modulation is the cyclic or random dynamic variation, or both, of instantaneous frequency about a mean frequency during steady-state electric-system operation. The frequency modulation is normally within narrow frequency limits and occurs as a result of speed variations in a generator rotor owing to the dynamic operation of the rotor coupling and drive speed regulation.

3.6 **Frequency modulation rate.** The frequency modulation rate is the rate of change of frequency owing to frequency modulation when plotted against time.

3.7 **Frequency drift.** Frequency drift is the extremely slow and random variation in frequency within the steady-state limits occurring as a result of environmental effects and wear on the electric power-drive system.

3.8 **Frequency drift rate.** The frequency drift rate is the rate of change of frequency owing to frequency drift when plotted against time.

3.9 **A-c voltage.** The a-c voltage values stated herein shall be for any phase of those supplied utilization equipment, a phase being considered a line to neutral. All a-c voltage values are root mean square (rms) values.

3.10 **Voltage modulation.** Voltage modulation is the cyclic variation or random dynamic variations, or both, about an average of the a-c peak voltage during steady-state electric-system operation such as caused by voltage regulation and speed variations. The modulation envelope is formed by a continuous curve connecting each sine wave peak to the successive sine wave peak.

3.11 **Voltage modulation frequency characteristics.** The frequency characteristic of voltage modulation is defined as the component frequencies which make up the modulation envelope wave form.

3.12 **Ripple.** Ripple is the a-c variation of voltage about a fixed d-c voltage during steady-state d-c electric-system operation.

3.13 **Unsafe condition.** An unsafe condition is any condition within aircraft that jeopardizes the safety of the aircraft and the personnel aboard.

3.14 **Aircraft operational period.** The operational period of an aircraft is defined as the time interval between the start of preparation for flight and the post flight engine shutdown with consequent deactivation of the aircraft electric system.

3.15 **Utilization equipment.** Utilization equipment will be considered as comprising either an individual unit, set, or a complete system to which the electrical power is applied or disconnected, or both, as a whole.

3.16 **Category "A" utilization equipment.** Category "A" equipment are those utilization equipments whose installation in aircraft will be controlled so that line drops will be limited to 2-volts a-c line drop or ½-volt dc, or both. The line drop is the voltage difference between the point of voltage regulation and the power input terminals of the equipment. Use of this category should be held to a minimum, and its use will be subject to approval by the procuring activity.

3.17 **Category "B" utilization equipment.** Category "B" equipment are those utilization equipments destined for aircraft for which the line drops will be less than 4 volts ac or 1 volt dc, or both. When a detail equipment specification does not designate a category, the equipment will be considered a category "B" equipment.

3.18 **Category "C" utilization equipment.** Category "C" equipment are those equipments which are intermittently operated. During operation, voltage limits include allowance for 8 volts a-c line drop or 2 volts d-c line drop, or both.

4. GENERAL REQUIREMENTS

4.1 **Power systems.** Characteristics of aircraft power at the input terminals of utilization equipment shall be within the limits stated in section 5 under the conditions of power utilization prescribed by section 6.

4.1.1 *A-c power.* The a-c power system shall be a 3-phase, 4-wire "Y" system, having a nominal voltage of 115/200 and a nominal frequency of 400 cps. The neutral point of the source of power is connected to ground (see 3.2), and the ground is considered the fourth conductor.

4.1.2 *D-c power.* The d-c power system shall be a 2-wire, grounded system having a nominal voltage of 28 volts. The negative of the power source is connected to ground and the ground is considered the second wire.

4.2 **Utilization equipment.** Utilization equipment shall maintain specified performance, using the power with characteristics which are listed in section 5. When use of power is required having other characteristics or narrower tolerances than specified herein, the conversion to other characteristics or closer tolerances shall be accomplished as a part of the utilization equipment. Utilization equipment designed for a specific aircraft application may deviate from these requirements only upon approval of the procuring activity.

5. DETAIL REQUIREMENTS

5.1 A-c power system characteristics.

5.1.1 *Line-to-neutral.* Characteristics of line-to-neutral power shall be within the limits specified herein.

5.1.2 *Line-to-line.* Characteristics of line-to-line power shall be as a result of line-to-neutral characteristics being as specified.

TABLE I. *Steady-state a-c voltage limits*

Mode of operation	Single-phase limits		Average of 3 phases limits	
	Normal	Emergency	Normal	Emergency
Category "A"	109.5 to 119.5	107 to 122	110.5 to 117.5	108 to 120
Category "B"	107.5 to 119.5	105 to 122	108.5 to 117.5	106 to 120
Category "C"	103.5 to 119.5	101 to 122	104.5 to 117.5	102 to 120

5.1.3 *Steady-state voltage.* The steady-state phase voltage shall be within the limits of table I. These limits are applicable during 380- to 420-cps operation. Modes of electric-system operation shown in table I and subsequent are explained in section 7. Utilization equipment categories shown in table I and subsequent are defined in section 3.

5.1.3.1 *Single phase.* The steady-state voltage for a single phase shall be within the limits of table I.

5.1.3.2 *Three phase.* The steady-state voltage average for the three phases shall be within the limits of table I.

5.1.3.3 *Phase displacements.* The displacement between adjacent phases shall be within the limits of 120° ± 1.5°.

5.1.3.4 *Unbalance.* Maximum spread in phase voltages shall be less than 3 volts between the phase with the highest voltage and the phase with the lowest voltage for all aircraft operations.

5.1.3.5 *Wave form.* The voltage wave form shall be within the following limits:

(a) Crest factor: 1.41 ± 0.1.

(b) Total harmonic content: 4 percent of the fundamental (rms) with linear loads, or 5 percent of the fundamental (rms) with nonlinear loads, when measured with a distortion meter as distortion of the fundamental frequency.

(c) Individual harmonic content: 3 percent of the fundamental (rms) with linear loads, or 4 percent of the fundamental (rms) with nonlinear loads, when measured with a harmonic analyzer.

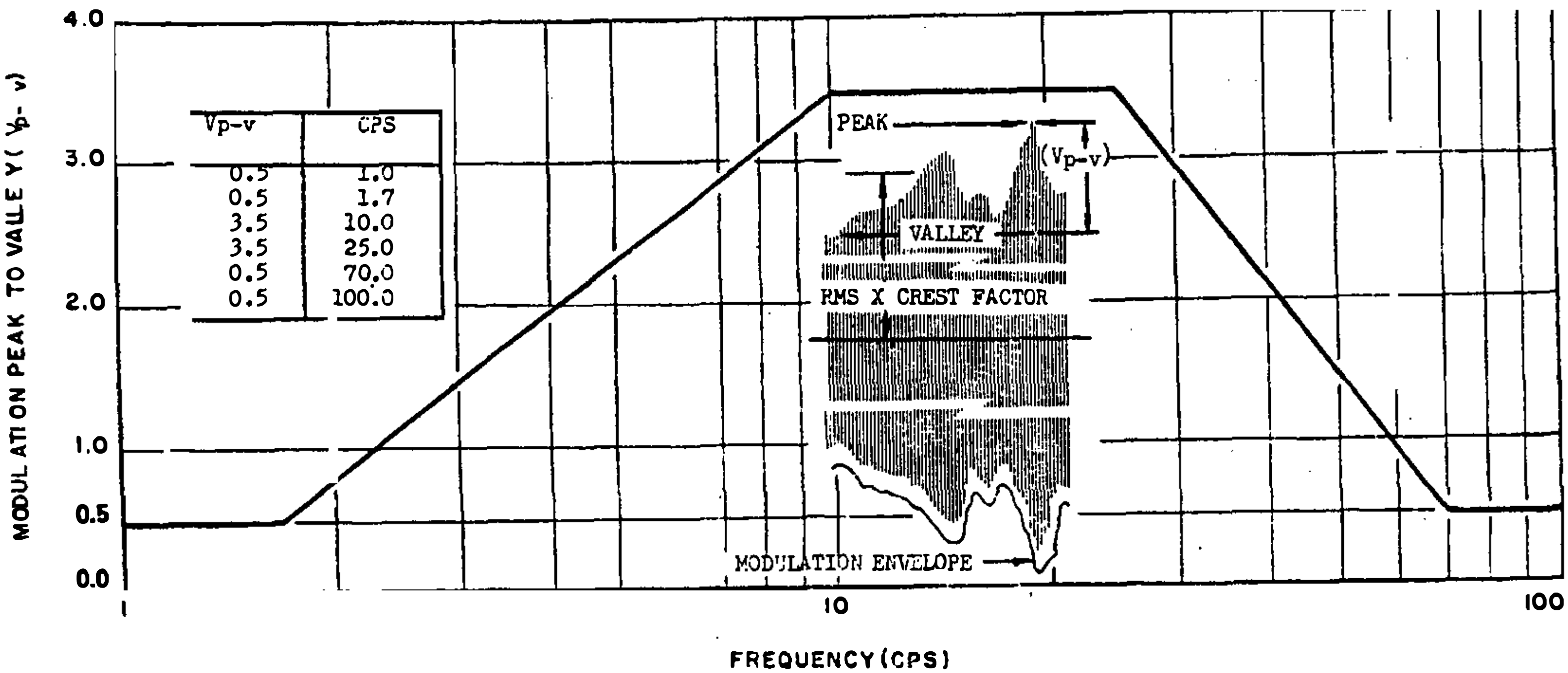
5.1.3.6 *Modulation.*

5.1.3.6.1 *Amplitude.* The modulation of voltage (see 3.10) shall not exceed an amplitude of 3.5 volts when measured as the peak-to-valley difference between the minimum voltage reached and the maximum voltage reached on the modulation envelope over a period of at least 1 second. A sketch of voltage modulation is shown in figure 1.

5.1.3.6.2 *Frequency characteristics.* The frequency components of the voltage modulation envelope wave form (see 3.11) shall be within the limits specified in figure 1.

5.1.4 *Transient voltage.* Voltage transients, when converted to their evaluated step function loci (see 7.6), shall be within the limits of figure 2 for all operations of the aircraft electric system. The most severe phase transient shall be used in determining conformance to figure 2.

5.1.4.1 *Normal electric-system operation.* The evaluated step function loci of the a-c voltage transients for all normal electric-system operations shall be within the limits 2 and 3 of figure 2.



V_{p-v}	CPS
0.5	1.0
0.5	1.7
3.5	10.0
3.5	25.0
0.5	70.0
0.5	100.0

FIGURE 1. *Frequency characteristics of a-c voltage modulation envelope*

LIMIT 1		LIMIT 2		LIMIT 3		LIMIT 4	
SEC	V	SEC	V	SEC	V	SEC	V
5.0	137	5.0	126	5.0	104	5.0	103
3.0	139	2.0	128	2.0	103	5.0	90
1.0	155	1.0	130	1.0	100	3.0	90
0.4	174	0.30	142	0.30	87	3.0	0
0.2	184	0.10	164	0.10	62		
0.1	190	0.03	173	0.05	56		
0.0	190	0.0	173	0.02	54		
				0.02	0		

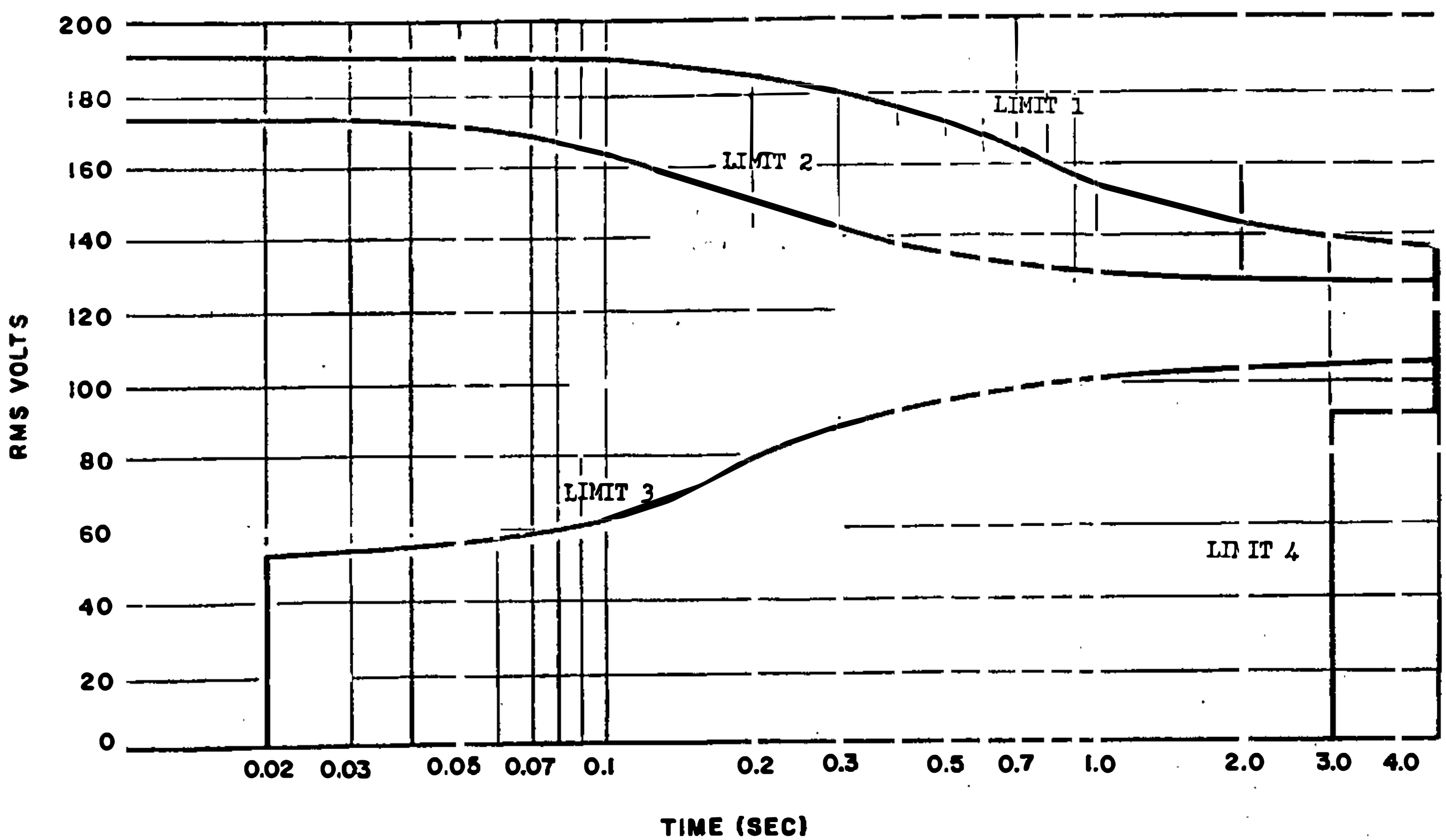


FIGURE 2. *Transient a-c voltage step function loci limits*

LIMIT 1		LIMIT 2		LIMIT 3		LIMIT 4	
SEC	FREQ	SEC	FREQ	SEC	FREQ	SEC	FREQ
0.000	0	0.000	0	0.000	0	0.000	0
0.015	+10	0.015	+10	0.015	-10	0.015	-10
0.080	+40	0.080	+28	0.080	-28	0.080	-40
0.250	+60	0.200	+30	0.200	-30	0.250	-60
1.00	+60	1.00	+13	1.00	-13	1.00	-60
5.00	+60	3.00	+5	3.00	-5	5.00	-60

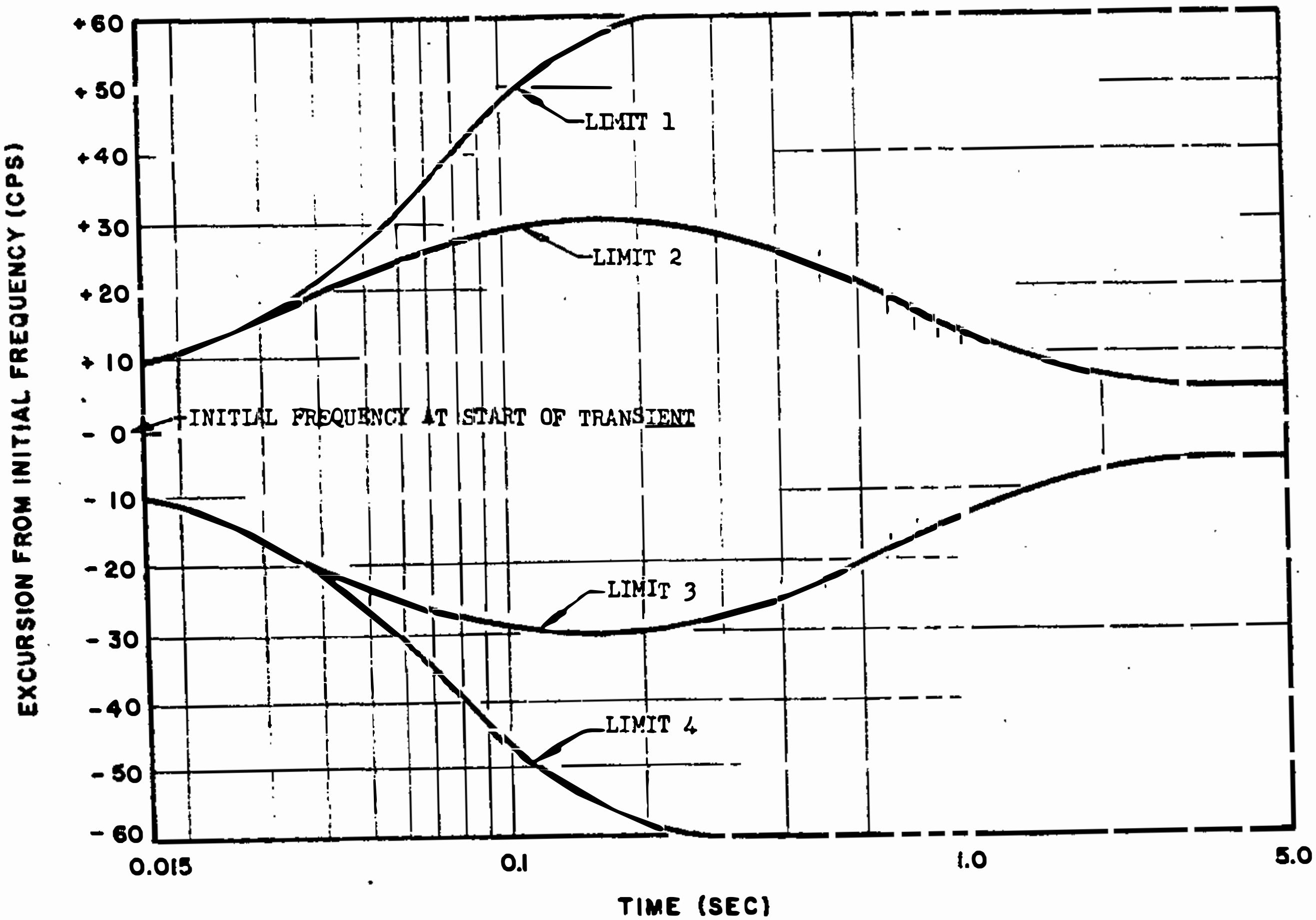


FIGURE 8. *Transient frequency limits*

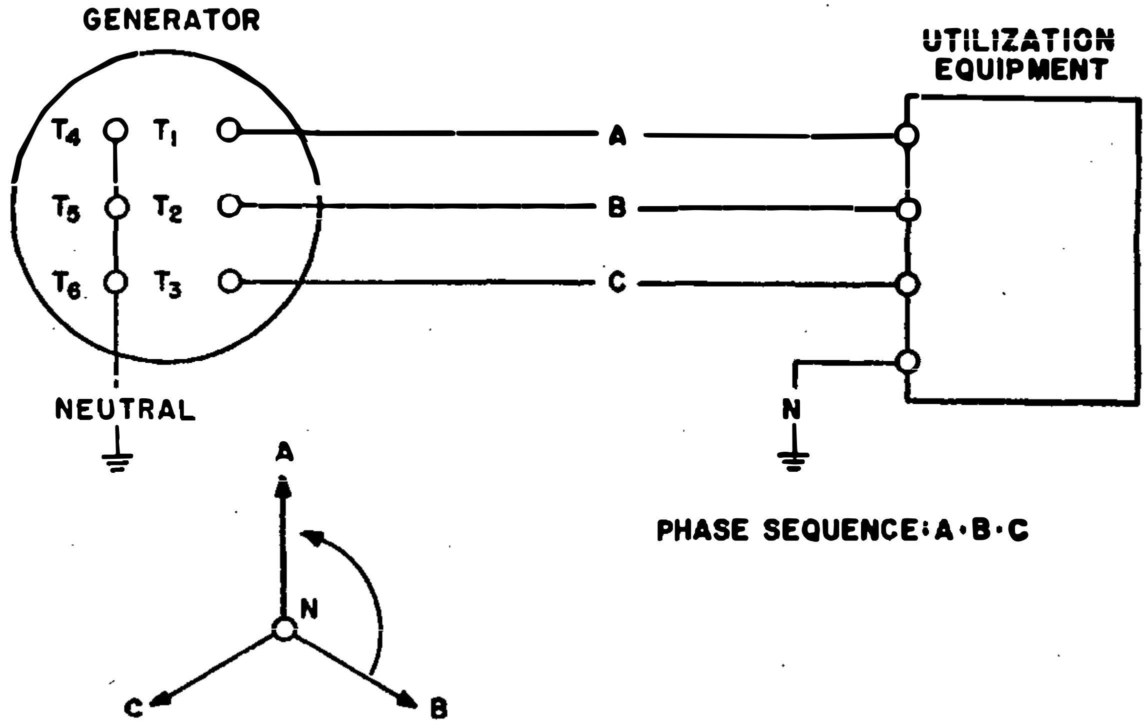


FIGURE 4. *Diagram of phase sequence and line designations*

5.1.4.2 *Abnormal electric-system operation.* The evaluated step function loci of the a-c voltage transients which result from abnormal electric-system operation shall be less than the limits 1 and 4 of figure 2.

5.1.5 *Steady-state frequency.* The a-c power systems frequency shall be maintained at 400 ± 20 cps for steady-state operation.

5.1.5.1 *Drift.* Variation within steady-state frequency limits owing to drift (see 3.7) shall be not more than ± 5 cps for any period of steady-state electric-system operation. Frequency variation owing to drift shall not occur at a rate (see 3.8) greater than 15 cps per minute.

5.1.5.2 *Modulation amplitude.* Variations of frequency owing to frequency modulation (see 3.5) during any 1-minute period shall be within a band of ± 2 cps about a mean frequency. The mean frequency may drift within the limits defined by 5.1.5.1.

5.1.5.3 *Modulation rate.* Rates of frequency change (see 3.6) owing to frequency modulation shall be not greater than 13 cps per second.

5.1.6 *Transient frequency.* Frequency transients shall be contained within the limits of figure 3 for all aircraft operations. Rates of frequency change during a transient shall not exceed 500 cps per second for any period longer than 15 milliseconds.

5.1.6.1 *Normal electric-system operation.* Frequency transients as a result of normal system operations (see 7.1) shall be within the limits of 2 and 3 of figure 3.

5.1.6.2 *Abnormal electric-system operation.* Frequency transients as a result of abnormal electric-system operations (see 7.2) shall be within the limits 1 and 4 of figure 3.

5.1.7 *Phase sequence.* The electric distribution and utilization systems shall have a phase

TABLE II. *Steady-state d-c voltage limits*

Category	Start warmup[1] 5 min max[2]	Takeoff climb cruise-combat[1]	Landing[1] 5 min max[3]	Emergency
"A"	21.5 to 29	25.5 to 28.5	21.5 to 28.5	17.5 to 29
"B"	21 to 29	25 to 28.5	21 to 28.5	17 to 29
"C"	20 to 29	24 to 28.5	20 to 28.5	16 to 29

[1] These listed conditions of aircraft operation are within the normal mode of electric-system operation.
[2] After 5 minutes of start and warmup aircraft operation, the steady-state voltage limits shall be within the limits specified for takeoff operation.
[3] When aircraft landing operations have durations exceeding 5 minutes, the wider voltage limits allowed for landing shall not remain beyond the limits allowed for cruise for more than 5 minutes.

sequence of A, B, C corresponding to $T_1 — T_2 — T_3$ of the power source. Figure 4 diagrams this relationship.

5.2 D-c power system characteristics.

5.2.1 *Steady-state voltage.* Steady-state voltage shall be within the limits specified in table II.

5.2.2 *Ripple.* The a-c peak of ripple voltage to average d-c voltage (see 3.12) shall be less than 1.5 volts, when measured with a peak reading vacuum tube voltmeter in series with a 4.0 microfarad capacitor. The higher of the two values measured when the voltmeter is successively connected for each of two polarities shall be considered the ripple voltage.

5.2.2.1 *Frequency characteristics.* The frequency components of the ripple shall be within the limits of figure 5 when measured as conducted interference.

5.2.3 *Transient voltage.* Voltage transients, when converted to their evaluated step function loci, shall be within the limits of figure 6 for all operations of the aircraft electric system.

5.2.3.1 *Normal electric-system operation.* The evaluated step function loci of the d-c voltage transients for all normal electric-system operations shall be within the limits 2 and 3 of figure 6.

5.2.3.2 *Abnormal electric-system operation.* The evaluated step function loci of the d-c voltage transients which result from abnormal electric-system operation shall be less than the limits 1 and 4 of figure 6.

6. UTILIZATION OF AIRCRAFT ELECTRIC POWER

6.1 Power types. The utilization equipment specification shall specify as shown in 6.13.1 which of the types of power listed herein is required. The equipment may require one or both of these types of power. No other types of input power shall be used without written permission from the procuring activity. It is preferred that equipment be required to use, where practicable, only the a-c type of power listed herein.

6.2 Conversion. Equipment which requires conversion of input power to power with other characteristics shall accept the power as defined herein for modification and use. Modification and use shall be integral with the utilization systems or utilization equipment.

6.2.1 *Ac to 28 volts dc.* Utilization equipment of a size to require a-c input power above 500 va may include integral static converters to obtain up to 5 amperes of 28-volt d-c power in lieu of requiring the 28-volt d-c power specified herein.

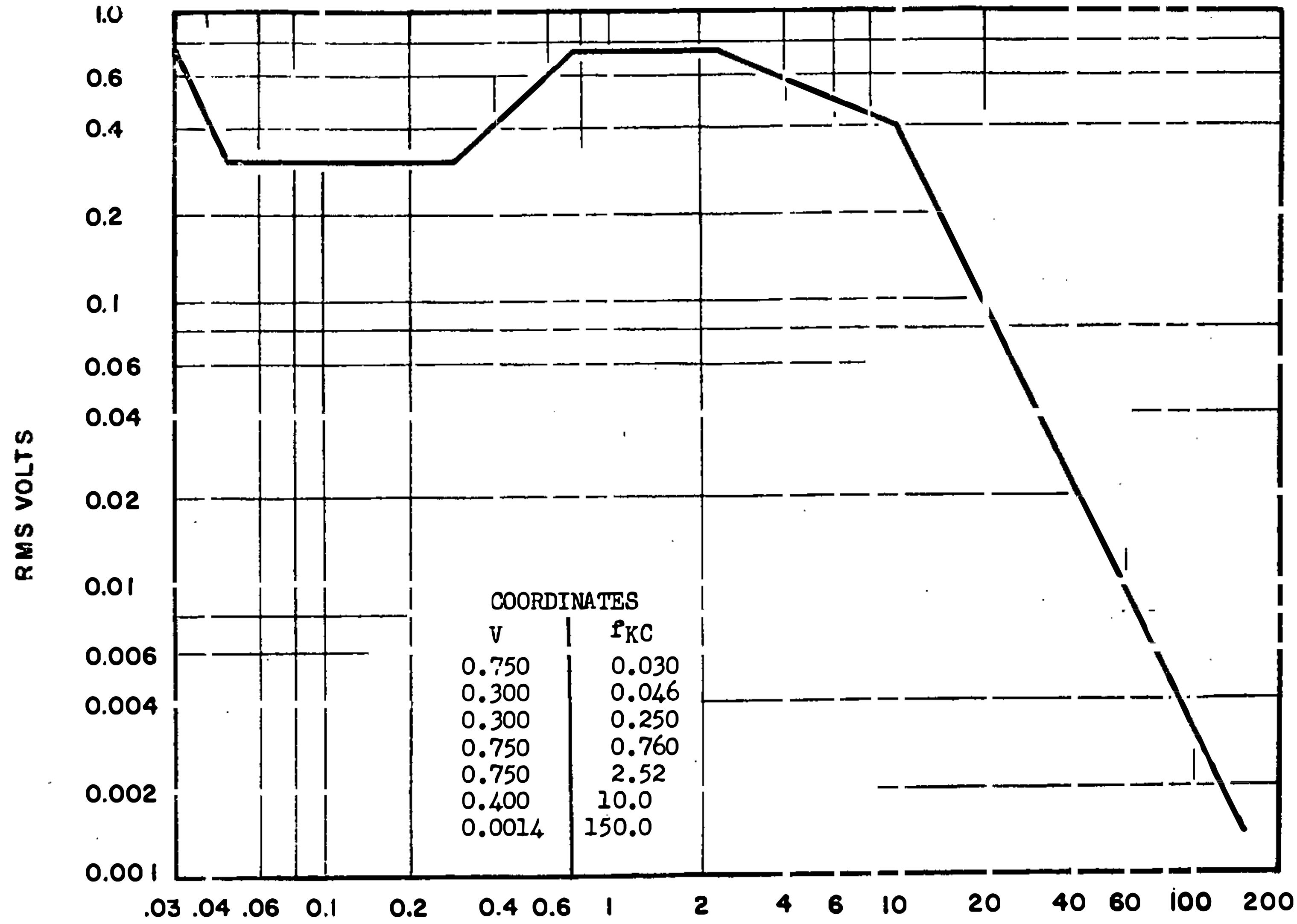
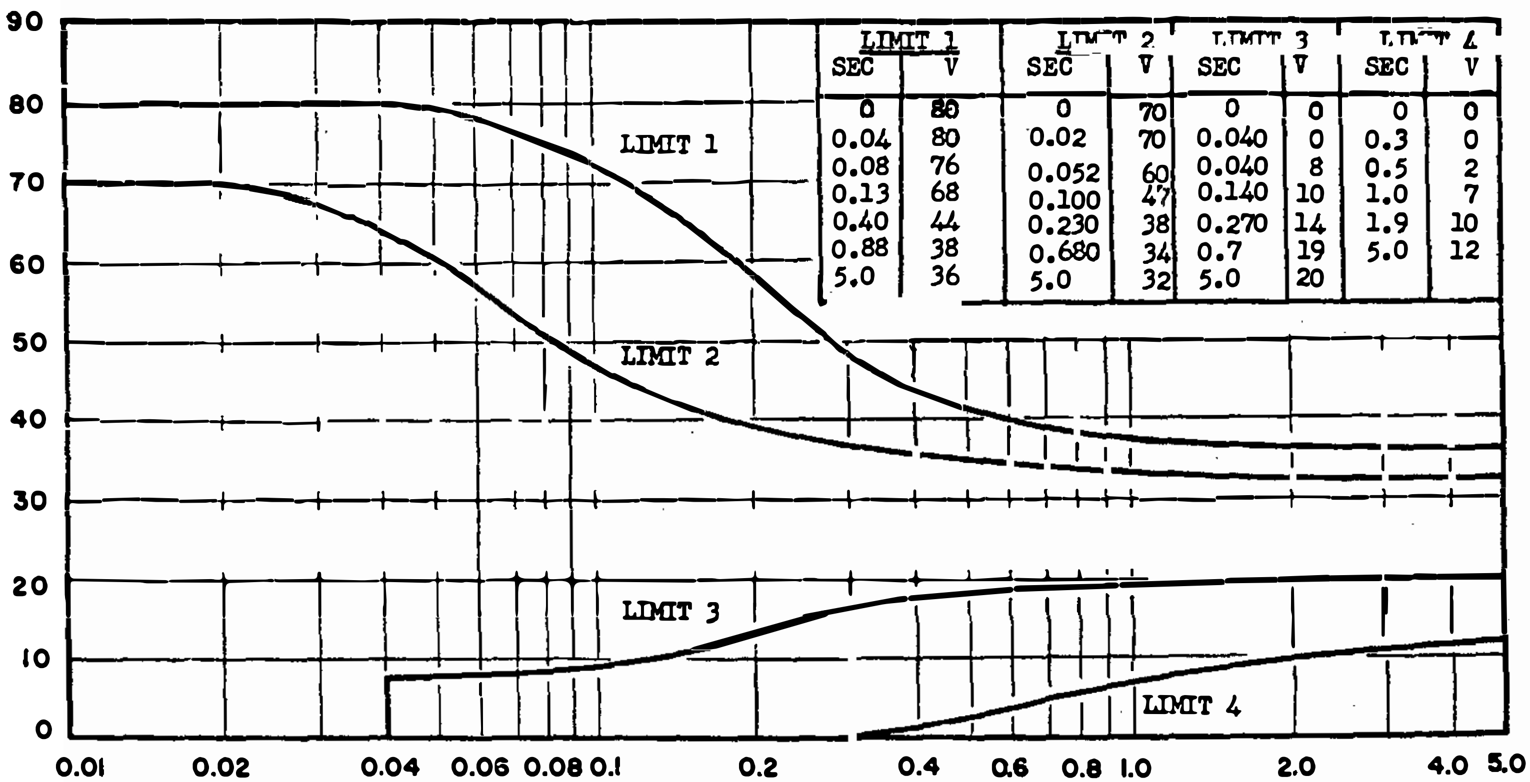


FIGURE 5. *Frequency characteristics of ripple in 28-volt d-c electric systems*



LIMIT 1		LIMIT 2		LIMIT 3		LIMIT 4	
SEC	V	SEC	V	SEC	V	SEC	V
0	80	0	70	0	0	0	0
0.04	80	0.02	70	0.040	0	0.3	0
0.08	76	0.052	60	0.040	8	0.5	2
0.13	68	0.100	47	0.140	10	1.0	7
0.40	44	0.230	38	0.270	14	1.9	10
0.88	38	0.680	34	0.7	19	5.0	12
5.0	36	5.0	32	5.0	20		

FIGURE 6. *Transient d-c voltage step function loci limits*

6.3 Normal electric-system operation. During normal operation of the electric system (see 5.1.3, 5.1.4.1, 5.1.5, 5.1.6.1, 5.2.1, and 5.2.3.1), utilization equipment shall:

(a) Provide 100-percent performance, except when the detail specification for a given utilization equipment defines specific regions of the electric system characteristics with corresponding degrees of performance degradation (see 7.8).

(b) Remain safe.

(c) When degraded performance has been permitted for given regions of given characteristics, after operation in such regions with return to other regions of normal electric-system operation, the utilization equipment shall:

(1) Automatically recover to 100-percent performance.

(2) Remain unaffected in reliability.

6.4 Abnormal electric-system operation. During abnormal operation of the electric-system (see 5.1.4.2, 5.1.6.2, and 5.2.3.2) utilization equipment:

(a) Shall have no performance requirements, unless the detail specification for a given utilization equipment requires specific degrees of performance to be maintained within specific regions of the electric-system characteristics (see 7.8).

(b) Shall remain safe.

(c) May have momentary loss of function; however, this momentary loss shall not affect later equipment performance.

(d) After abnormal operation of the electric system and with return of the electric system to normal operation, utilization equipment shall:

(1) Recover automatically to specified performance, unless the detail specification for a given utilization equipment permits manual reset of equipment after the abnormal electric-system operation.

(2) Have negligible effect on reliability owing to the abnormal electric-system operation.

6.5 Other electric-system operation. While the electric system operates in regions of characteristics other than specified in section 5, utilization equipment shall:

(a) Not be required to perform.

(b) Not be required to perform after return of the electric system into the regions of characteristics specified in section 5.

6.6 Voltage transients. For the purpose of testing performance of utilization equipment during conditions of input voltage transients, voltage transients shall be considered as any voltage at its corresponding time on the limits of figures 2 and 6.

6.7 Warmup. Time required for equipment to warmup prior to obtaining specified performance shall be kept to a minimum. Time to return to specified performance, after a power interruption, shall not exceed the actual thermal or mechanical requirements, or both. Warmup shall be less than 5 minutes unless approved in writing by the procuring activity.

6.8 Influence on electric system. There shall be no influence by utilization equipment on the characteristics of power at the input to its terminals which would cause these characteristics to go beyond the limits specified in section 5.

6.8.1 *Self-modulation.* The modulation induced by varying loads within utilization equipment shall not, at the terminals of the utilization equipment, cause voltage modulation or ripple to go beyond the limits of 5.1.3.6 and 5.2.2. This self-modulation is caused by variations in the current required by the equipment, in turn causing a varying voltage drop in the wiring of the power circuit to the equipment.

6.9 A-c power.

6.9.1 *Three phase.* For loads less than 500 va, 3-phase power shall be used when practicable. For a-c input demands exceeding 500 va, 3-phase power shall be required. The average of three phases steady-state voltage limits in table I are applicable only when a phase of the three phases is not utilized as a single-phase load.

6.9.2 *Single phase.* For a-c input demands not exceeding 500 va, it is allowable for the equipment to require single-phase power. Equipment which is inherently single phase in power consumption shall present, if practicable, a three-phase demand by being internally segregated into three single-phase loads. Single-phase power shall be used only on a line-to-neutral basis.

6.9.3 *Phase balance.* Equipment requiring three-phase power shall require equal phase volt-amperes and power factor insofar as practicable. The phase volt-ampere difference between the highest and lowest phase values, assuming balanced voltages, shall be less than the limits specified in figure 7.

6.9.4 *Power factor.* Equipment utilizing a-c power shall be designed to present as near a unity power factor as practicable for all modes of equipment operation. The fully loaded equipment shall present a power factor on the worst phase not less than the limits specified in figure 8.

6.9.5 *Phase failure.* One phase of three-phase power can fail. Failure of one phase shall not result in an unsafe condition. During failure of the one phase, no equipment performance is required unless specified in the equipment detail specification.

6.10 Power failure. For those equipments which require both a-c and d-c power, one of these power sources may fail. Failure of one power source shall not result in an unsafe condition. During the loss of the one power source, no equipment performance is required.

6.11 Standby power. For those modes of equipment operation in which performance is not required but power is required to maintain equipment standby readiness, the standby power requirement should be kept to a minimum.

6.12 Power tolerance. Input power requirements shall not vary by more than + 10 percent and − 10 percent of an established limit between production units of a given utilization equipment. The specified tolerance limits do not include changes in equipment power demands as a result of engineering changes made during production.

6.13 Power requirements data (required for Navy equipment only). Power requirement data shall be submitted to the procuring activity. The data shall be successively submitted as soon as available based on:

(a) Specification requirements.

(b) Preliminary design data for the equipment.

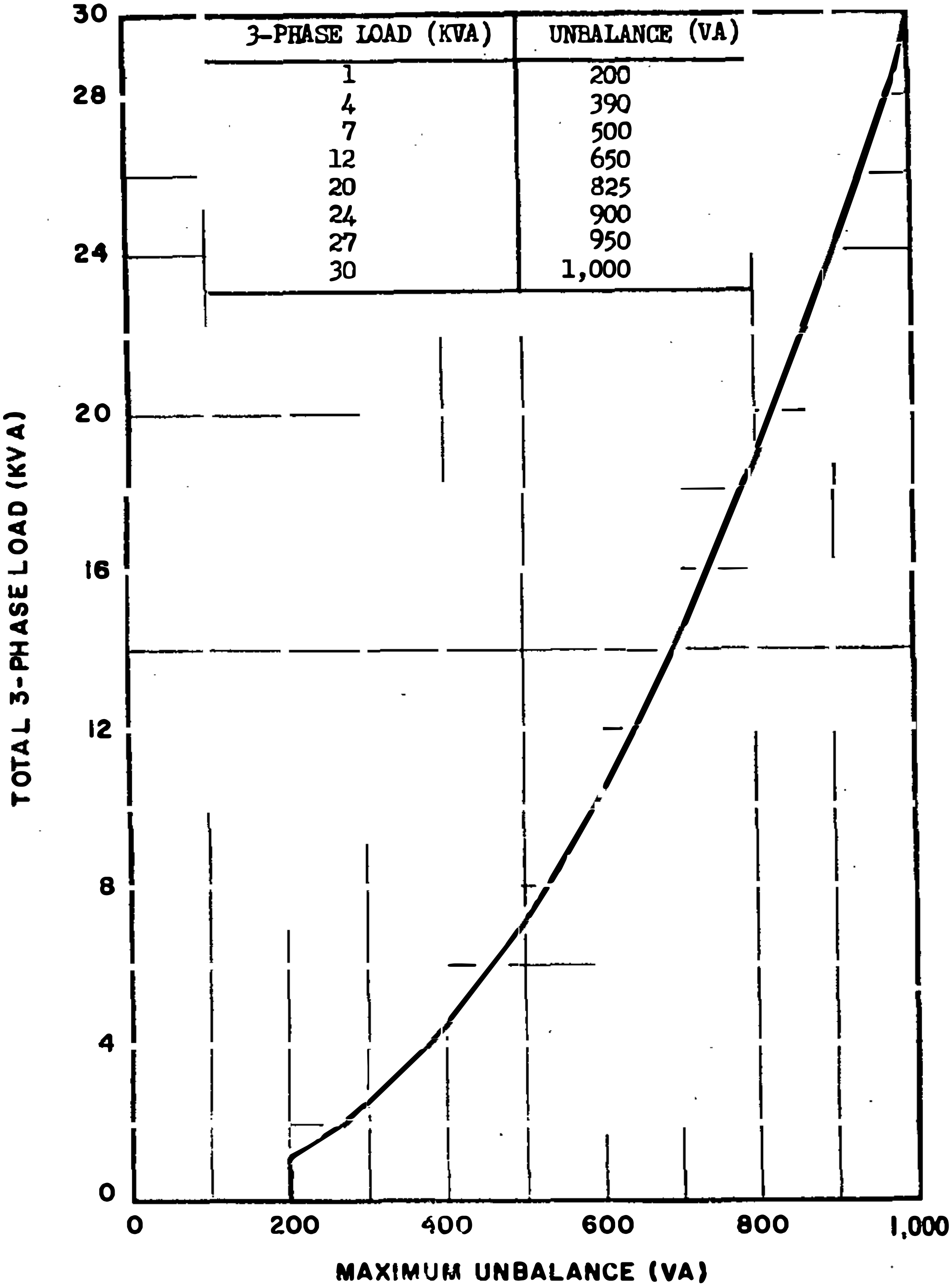
(c) Measurements made on the first models.

(d) Measurements made on representative production units.

(e) Power requirements revisions caused by proposed equipment changes.

NOTE: When the Air Force is the procuring activity, a copy of the power requirements data shall be submitted to the Wright Air Development Center, Wright-Patterson Air Force Base, Ohio; Attention: WCLES.

6.13.1 *Sample form.* The sample form for submittal of the power requirements data shall be as shown on figure 9. It shall be submitted



3-PHASE LOAD (KVA)	UNBALANCE (VA)
1	200
4	390
7	500
12	650
20	825
24	900
27	950
30	1,000

FIGURE 7. *Unbalance limits for 3-phase utilization equipment*

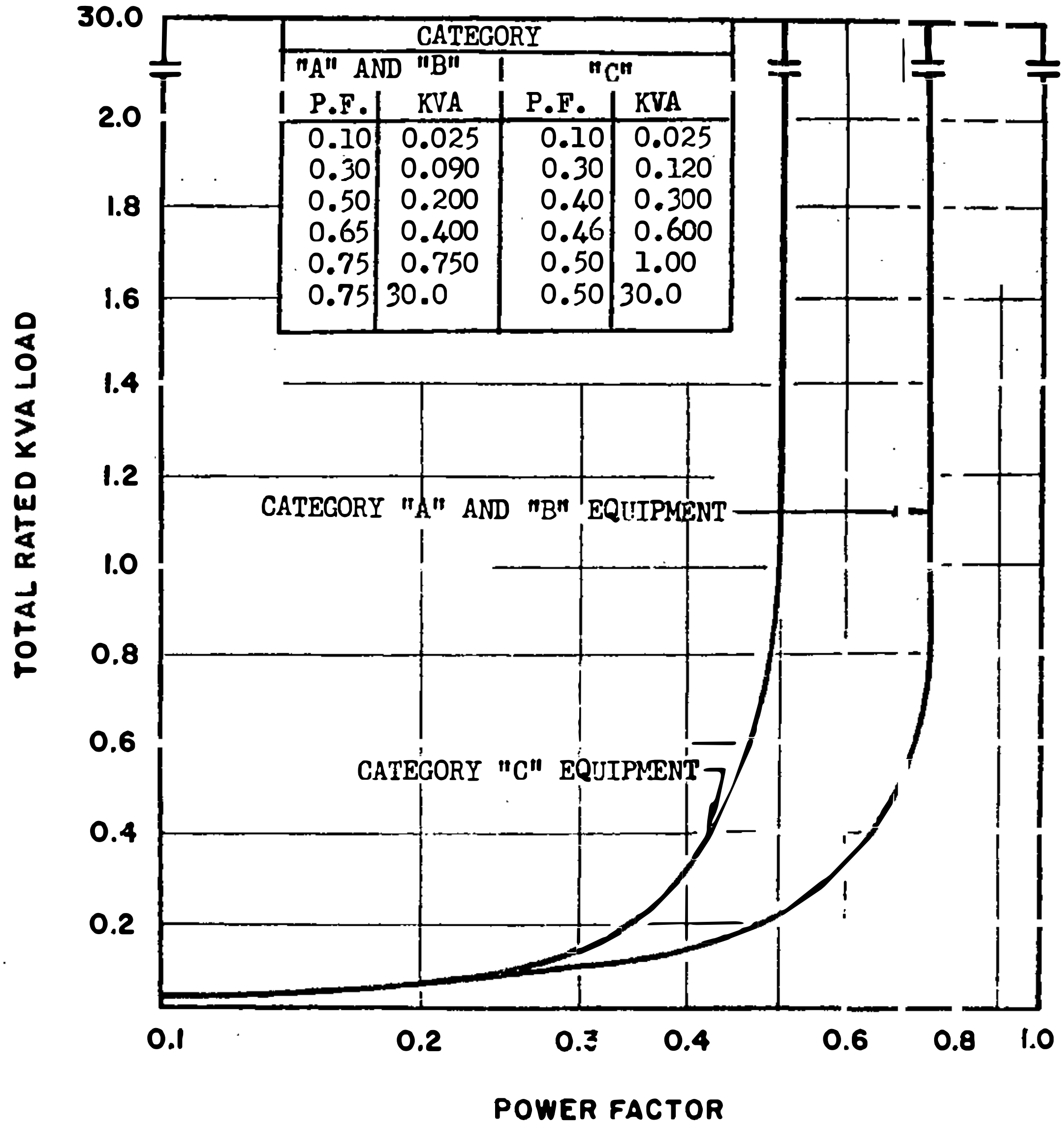


FIGURE 8. *Lagging power factor limits for utilization equipment*

on 8 by 10½ sheets. Instructions for completing the form shall be as follows:

(a) Cross out category of equipment not applicable.

(b) Fill in brackets to indicate mode or modes of equipment operation such as Warmup, Standby, Operate, Low Power, Power Duty Cycle, Start, etc. Prepare separate load requirements data for each mode of operation.

(c) Enter brackets at the top of the power requirements columns "M" for measured, "C" for calculated, or "R" for referenced, to indicate the source of information. Reference "R" can be detailed in the line "Source of Information" or under "REMARKS" as applicable.

(d) Under "Operating Time" enter operating time for the corresponding mode. Strike out "(min)" or "(sec)" as applicable. Under "Specified" write the specified time for the mode of operation being reported.

(e) If the operation is cyclic, describe the cycle under "Note."

(f) The power requirements shall be measured in a line-to-neutral basis with the reference voltage and frequency applied to the terminals of the equipment and entered in the appropriate spaces. A-c measurements shall be effective values (rms), with an accuracy of at least 1 percent. D-c measurements should be accurate to 3/4 of 1 percent. The angle entered under $\angle\phi$ shall be the angle between the corresponding line current and the line A to neutral voltage.

(g) When the current lags, the voltage, vars and PF shall be entered without sign; when the current is leading, these items shall be boxed as indicated in the following example: $\boxed{25}$

(h) All power requirements entries shall be the steady-state demand for the mode of operation reported. If unusual changes in power demand occur during a given mode of operation, description of the conditions and demands shall be made under "REMARKS."

(i) Power requirements for utilization equipment whose application will determine the input power shall be based on full-load (nameplate) rating. Conditions of loading versus power demand shall be explained under "REMARKS." Power requirements for intermittent duty equipment shall have the rated duty cycle described under "REMARKS."

(j) If the equipment has transient power requirements, an oscillographic record of current versus time characteristics shall be presented as supplementary data. These data are not a requirement for loads rated less than 500 va or 20 amperes dc.

(k) Description of any internal electrical protective devices shall be listed under "REMARKS."

(l) Information may be included under "REMARKS" regarding substantial improvement of utilization equipment performance, reliability, weight, and size beyond specification requirements by maintaining characteristics different than specified herein under section 5. If possible, the degrees of improvement corresponding to changes of the given characteristics should be listed. Note under "REMARKS" any unusual or unique power conditions, data, or limits which will assist the applications engineer in determining the proper application of the equipment. Information, when known, should be included to indicate maximum or minimum (or both) power source impedance limitations for satisfactory equipment operation.

7. NOTES

7.1 Normal electric-system operation. Normal operation of the electric system are all functional electric-system operations required for aircraft operation, aircraft mission and electric-system controlled continuity. These operations occur at any given instant and any number of times during flight preparation, takeoff, airborne conditions, landing, and anchoring. Examples of such operations are switching of utilization equipment loads, engine speed changes, bus switching and synchronization, and paralleling of electric power sources.

SECURITY CLASSIFICATION

ELECTRIC POWER REQUIREMENTS FOR AIRCRAFT EQUIPMENT: ____________

____________ SHEET ______ OF ______

EQUIPMENT CATEGORY ("A") ("B") ("C")

5 SECOND MAX POWER REQUIREMENTS FOR ( ) MODE(S) OF OPERATION

Operating Time (min) (sec)	Line	( ) V (L-N)	( ) A (L)	( ) /φ	( ) P.F.	( ) VA	( ) Watts	( ) Vars
Specified ____	A							
	B							
Note:	C							
	Totals	XXXXXXX	XXXXXX	XXXXXXX				
	1φ							
	D-C			XXXXXXX	XXXXXX	XXXXX	XXXXX	XXXX

REMARKS: Inrush transient shown on supplementary data sheet No. ____________

1 MINUTE MAX POWER REQUIREMENTS FOR ( ) MODE(S) OF OPERATION

Operating Time (min) (sec)	Line	( ) V (L-N)	( ) A (L)	( ) /φ	( ) P.F.	( ) VA	( ) Watts	( ) Vars
Specified ____	A							
	B							
Note:	C							
	Totals	XXXXXXX	XXXXXX	XXXXXXX				
	1φ							
	D-C			XXXXXXX	XXXXXX	XXXXX	XXXXX	XXXX

REMARKS: Inrush transient shown on supplementary data sheet No. ____________

15 MINUTE POWER REQUIREMENTS FOR ( ) MODE(S) OF OPERATION

Operating Time (min) (sec)	Line	( ) V (L-N)	( ) A (L)	( ) /φ	( ) P.F.	( ) VA	( ) Watts	( ) Vars
Specified ____	A							
	B							
Note:	C							
	Totals	XXXXXXX	XXXXXX	XXXXXXX				
	1φ							
	D-C			XXXXXXX	XXXXXX	XXXXX	XXXXX	XXXX

REMARKS: Inrush transient shown on supplementary data sheet No. ____________

MANUFACTURED UNDER SPECS: ____________

Deviations Affecting Power Data	Authorized by	Reference
1.		
2.		
3.		

SOURCE OF INFORMATION ____________

Unless otherwise stated herein, this equipment conforms to the requirements of MIL-STD-704.

SIGNED: ____________

DATE:

COMPANY:

(Army) (BuAer) (Air Force)

APPROVED: ____________ DATE: ______

FIGURE 9. *Sample form for submittal of power requirements data*

7.2 Abnormal electric - system operation. Abnormal operation of the electric system is the unexpected but momentary loss of control of the electric system. The initiating action of the abnormal operation is uncontrolled and the exact moment of its occurrence is not anticipated. However, recovery from this operation is a controlled action. This operation occurs perhaps once during a flight or as a result of battle damage or it may never occur during the life of an aircraft. An example of an abnormal operation is the faulting of electric power to the structure of an aircraft and its subsequent clearing by fault protective devices.

7.3 Emergency electric - system operation. Emergency operation is defined as that condition of the electric system during flight when the primary electric system becomes unable to supply sufficient or proper electric power, thus requiring the use of a limited independent alternate source of power.

7.4 Reference voltage. For the measurement of input power and calibration of utilization equipment the following reference voltages shall be used:

(a) 115 volts line-to-neutral for the 115/200-volt a-c system.

(b) 28 volts line-to-ground for the 28-volt d-c system.

7.5 Reference frequency. For the measurement of input power and calibration of utilization equipment. the reference frequency of 400 cps shall be used.

7.6 Conversion of a transient to its evaluated step function loci. On a basis of converting a complex voltage transient (V_a) into a function of its reasonable equivalent rms on a continuous basis (f V_a (rms) $= V_e$), the basic formulas used for the conversion are:

$$V_e = \sqrt{\frac{1}{t_n} \sum_{0}^{t_n} V_a^2 \Delta t},$$

$$V_a^2 = \frac{V_1^2 \pm V_2^2}{2}.$$

$$\text{and } T_e = \frac{1}{V_e^2} \sum_{0}^{t_n} V_a^2 \Delta t$$

where: V_a = Variable transient voltage as a function of time,

t_n = Total time being considered on a continuous basis,

V_e = Voltage at t_n which provides an equivalent step function of the transient from zero to t_n,

T_e = Time at a value of V_a being considered which provides an equivalent step function of the previous part of the transient.

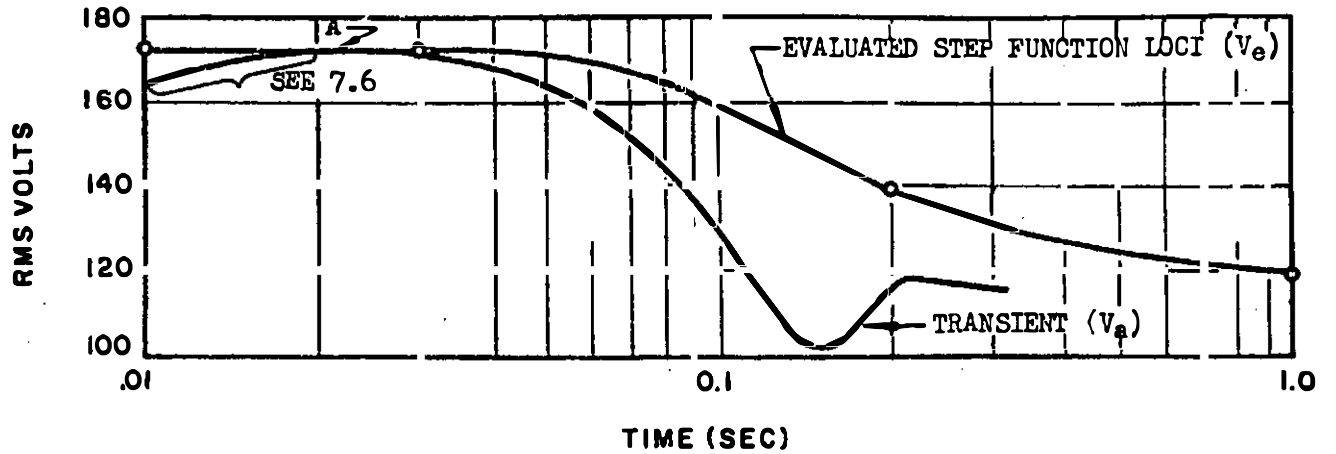
ΔT = Arbitrary time increments used to convert the transient to a step function loci,

V_1 = Voltage at the start of the Δ t increment.

V_2 = Voltage at the end of the Δ t increment.

Zero time is the start of the transient and is considered to be the point in time when V_a initially changes from one per unit. For all transients occurring in the normal mode of electric-system operation, the peak voltage or minimum voltage is reached very rapidly. Evaluation of these transients should reflect the minimum or maximum reached by considering the transient starting at the maximum or minimum voltage from time zero (start of transient) until its coincidence of the actual transient. The coincidence is shown as point A in figure 10. Figure 10 is a sample conversion of an overvoltage transient to its evaluated step function loci.

7.6.1 Fault transients. The conversion of a fault transient to its step function loci should be made on a continuous basis from time zero (initial time at start of the transient). Conformance to the requirement shall be indicated by the step function loci of the fault transient remaining within the limits for abnormal mode of electric-system operation of figures 2 and 6. Additionally, conform-



	T_1	T_2	Δt	PU V_1	PU V_2	PU V_a^2	$V_a^2\Delta t$	$\Sigma V_a^2\Delta t$	$\frac{\Sigma V_a^2\Delta t}{t_n}$	PU = 115 PU V_e	V_e
1	0	0.022	0.022	1.50	1.50	2.25	0.0495	0.0495	2.25	1.500	172.5
2	0.022	0.030	0.008	1.50	1.48	2.22	0.0178	0.0673	2.24	1.496	172.0
3	0.030	0.040	0.010	1.48	1.46	2.16	0.0217	0.0889	2.22	1.490	171.5
4	0.040	0.060	0.020	1.46	1.39	2.03	0.0407	0.130	2.16	1.470	169.0
5	0.060	0.080	0.020	1.39	1.27	1.77	0.0354	0.165	2.07	1.435	165.0
6	0.080	0.100	0.020	1.27	1.15	1.467	0.0293	0.194	1.94	1.390	160.0
7	0.100	0.120	0.020	1.15	1.01	1.17	0.0234	0.218	1.81	1.340	155.0
8	0.120	0.130	0.010	1.01	0.950	0.980	0.0098	0.278	1.75	1.320	152.0
9	0.130	0.140	0.010	0.950	0.900	0.925	0.0090	0.237	1.69	1.300	149.5
10	0.140	0.150	0.010	0.900	0.885	0.892	0.0089	0.245	1.64	1.278	147.0
11	0.150	0.160	0.010	0.885	0.895	0.890	0.0089	0.254	1.59	1.260	145.0
12	0.160	0.190	0.030	0.895	0.975	0.935	0.0280	0.282	1.48	1.220	140.5
13	0.190	0.220	0.030	0.975	1.03	1.00	0.0300	0.312	1.42	1.190	137.0
14	0.220	0.320	0.100	1.035	1.00	1.015	0.102	0.414	1.29	1.140	130.5
15	0.320	0.500	0.180	1.00	1.00	1.00	0.180	0.594	1.19	1.090	125.0
16	0.500	1.00	0.500	1.00	1.00	1.00	0.500	1.094	1.09	1.043	120.0
17	1.00	2.00	1.00	1.00	1.00	1.00	1.00	2.094	1.05	1.020	117.5
18	2.00	4.00	2.00	1.00	1.00	1.00	2.00	4.094	1.023	1.010	116.0
19	4.00	5.00	1.00	1.00	1.00	1.00	1.00	5.094	1.019	1.008	116.0

FIGURE 10. *Sample conversion of an overvoltage transient to its evaluated step function loci*

ITEM	No	Yes	Note
1. MIL-STD-704 POWER REQUIRED (AC)			
2. MIL-STD-704 POWER REQUIRED (DC)			
3. OTHER TYPE POWER REQUIRED			
4. CATEGORY "A" EQUIPMENT			
5. CATEGORY "B" EQUIPMENT			
6. CATEGORY "C" EQUIPMENT			
7. DURING NORMAL OPERATION, REGIONS AND DEGREES OF DEGRADED PERFORMANCE ARE PERMITTED			
8. DURING ABNORMAL OPERATION, REGIONS AND DEGREES OF PERFORMANCE ARE REQUIRED			
9. MANUAL RESET IS PERMITTED AFTER ABNORMAL OPERATION			
10. FULL EQUIPMENT PERFORMANCE IS REQUIRED FOR THE FOLLOWING AIRCRAFT OPERATING CONDITIONS:			
START AND WARMUP			
TAKEOFF AND CLIMB			
CRUISE AND CRUISE-COMBAT			
LANDING			
EMERGENCY			
11. EQUIPMENT PERFORMANCE IS REQUIRED WITH LOSS OF POWER FROM ONE PHASE			
12.			

NOTES:

FIGURE 11. *Standard MIL-STD-704 power utilization checklist*

ance should be obtained in that the actual fault voltage should not exceed the minimum or maximum step function voltages specified in figures 2 and 6.

7.7 **Line drop compensation.** Upon specific approval from the procuring activity, the categories "A" and "B" utilization equipment may incorporate means to compensate for line drop. It is preferred that the means consist of taps brought out to the input power connection for selection at time of installation.

7.8 **Equipment detail specification.** The equipment detail specification may use the checkoff list illustrated in figure 11 to specify considerations applicable to this standard. The notes detail the qualifying aspects for each item.

7.9 **Assumptions.**

7.9.1 *Smallest primary electric system.* The smallest primary electric system is 1,500 va ac, 50 amps dc.

7.9.2 *Electric-system balance.* Balance in the electric system is within 15 percent, i.e., no lines are loaded so that the maximum va differential between lines is more than 15 percent of ⅓ the 3-phase va capacity.

7.9.3 *Generating-system characteristics.* No generating-system characteristic is considered unless it is usual and normal for the generating system to be tied to the bus at the time the characteristic becomes evident.

7.9.4 *Electric-system characteristics.* Characteristics covered in this standard are based on the electric-system power source being:

Hydraulic (constant speed drive)
Air turbine (constant speed drive)
Mechanical (constant speed drive)
Turboprop
Inverters
Transformer-rectifiers
Batteries supported by generators

7.9.5 *Normal loading.* Normal loading of an electric system is between 15 percent and 85 percent of the power-system capacity and will be 30 to 85 percent for cruise-combat conditions.

7.9.6 *Initial warmup.* Initial warmup (first 5 minutes) is not inclusive with takeoff, climb, cruise-combat, and landing aircraft operations.

7.9.7 *System power factor.* System power factor during cruise, and cruise-combat aircraft operations will be more than 85 percent.

7.9.8 *Power-system rating.* Power systems will be rated from discreet capacities such as 1.5, 2.5, 10, 20, 30, 40, 60, 90, and 120 kva ac and 50, 100, 200, 300, and 400 amps dc.

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.

Copies of this standard for military use may be obtained as indicated in the foreword to the Index of Military Specifications and Standards.

Copies of this standard may be obtained for other than official use by individuals, firms, and contractors from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Preparing activity:
Navy—Bureau of Aeronautics

Other custodians:
Army—Transportation Corps
Air Force

GPO 815986—2