INSTRUCTIONS

ACCURACY STANDARDS FOR CURRENT TRANSFORMERS

ACCURACY CLASSES FOR METERING SERVICE

The accuracy classification of current transformers for metering service includes a correlation between ratio correction factor and phase angle so as to show the overall effect on watthour meter registration. The classification is based on the requirement that the transformer correction factor (the correction for overall error due to both ratio error and phase angle) be within the limits specified in Table 3. For any particular accuracy class the ratio correction factor and phase angle must fall within the parallelograms of Fig. 2 for 100% and 10% current respectively to keep the transformer correction factor within the limits specified in Table 3.

Table 1
METERING ACCURACY CLASSIFICATION

The line numbers are ASA standard accuracy classes for metering (60 cycles).

LINE NUMBER	ACCURACY AT BURDEN			
	B-0.1	B-0.2	B-0.5	B-2.0*
1	0.3	0.3	0.3	0.3
2	0.3	0.3	0.3	0.6
3	0.3	0.3	0.3	1.2
4	0.3	0.3	0.3	...
5	0.3	0.3	0.6	0.6
6	0.3	0.3	0.6	1.2
7	0.3	0.3	0.6	...
8	0.3	0.3	1.2	1.2
9	0.3	0.3	1.2	...
10	0.3	0.3	...	...
11	0.3	0.6	0.6	0.6
12	0.3	0.6	0.6	1.2
13	0.3	0.6	0.6	...
14	0.3	0.6	1.2	1.2
15	0.3	0.6	1.2	...
16	0.3	0.6	...	...
17	0.3	1.2	1.2	1.2
18	0.3	1.2	1.2	...
19	0.3	1.2	...	...
20	0.3	...	...	...
21	0.6	0.6	0.6	0.6
22	0.6	0.6	0.6	1.2
23	0.6	0.6	0.6	...
24	0.6	0.6	1.2	1.2
25	0.6	0.6	1.2	...
26	0.6	0.6	...	...
27	0.6	1.2	1.2	1.2
28	0.6	1.2	1.2	...
29	0.6	1.2	...	...
30	0.6	...	...	...
31	1.2	1.2	1.2	1.2
32	1.2	1.2	1.2	...
33	1.2	1.2	...	...
34	1.2	...	...	...
35	0.5	0.5	...	...

* Not ASA standard metering burden.
NOTE: A single line in the table defines the accuracy classes at four burdens.

For example, the overall correction will never exceed .3% at 100% rated current for a transformer in the 0.3 accuracy class. If the ratio correction factor is 1.003 the maximum allowable phase angle, from Fig. 2, is + 15.6 minutes. The transformer correction factor is:

$$TCF = RCF - \frac{\beta}{2600}$$

$$= 1.003 - \frac{15.6}{2600}$$

$$= .997$$

The corresponding ratio correction factor and phase angle for any point inside the 0.3 class parallelogram for 100% rated current will always give a transformer correciton factor between .997 and 1.003.

ACCURACY CLASSES FOR RELAYING SERVICE

Two classes of error are permissible, 2.5% or 10%, as the operator chooses. The accuracy may then be designated, for instance, as 2.5 H 100. The 2.5 means 2.5% maximum error; the 100 means that the transformer can supply at least 100 volts to the burden without exceeding the error. The 100 volts can be the product of a high burden and a high current. Examples are:

A high burden, 4 ohms at 25 amperes (5 times normal) gives 100 volts; a low burden, 1 ohm at 100 amperes (20 times normal) gives 100 volts, or any intermediate burden and current, 2 ohms at 50 amperes which also gives 100 volts.

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ACCURACY STANDARDS FOR CURRENT TRANSFORMERS

The application engineer uses the standard in perature rise and a 30 C ambient temperature

ACCURACY STANDARDS FOR CURRENT TRANSFORMERS

Table 4

STANDARD BURDENS FOR STANDARD 5-AMPERE SECONDARY CURRENT TRANSFORMERS

ACCURACY STANDARDS FOR POTENTIAL TRANSFORMERS

OPERATION IN WYE AT UNDERVOLTAGE

Transformers of line-to-line voltage rating (Group 2 Table 13.016 ASA C57.13) are commonly connected in wye and operate continuously at $1/\sqrt{3}$ times their rated primary voltage. The accuracy volt-ampere rating based on this lower voltage rating will be only ⅓ of normal value.

If one line becomes grounded the transformer will be operating at full voltage. The transformer can be operated at full voltage without excessive heating if the nameplate thermal burden rating is not exceeded. This means that the volt-ampere burden at the reduced voltage must be kept to ⅓ the original thermal rating, if the nameplate rating is not to be exceeded under line fault conditions. The insulation is, however, stressed $\sqrt{3}$ times normal, and operation under line fault conditions must be on an emergency basis. (See Technical Data 44-060, Page 35.)

NAMEPLATE MARKING

According to ASA Standard C57.13, Par. 13.075 the manufacturer shall specify on the nameplate a reference to a data sheet or instruction book which will give such information as accuracy classification, application data or any other information of general use in the application of potential transformers. Therefore, on the transformer nameplate a line number from Table 1 specifies the accuracy classes at five burdens.

Example: Designation on nameplate
Rating Leaflet No. I.L. 44-060-2-1.

Table 2

STANDARD BURDENS

BURDEN DESIGNATION	SECONDARY VOLT-AMPERES+	BURDEN POWER FACTOR
W	12.5	0.10
X	25	0.70
Y	75	0.85
Z	200	0.85
ZZ	400	0.85

+At 120 volts for secondary winding or 69.3 volts for tertiary winding.

Table 3

LIMITS OF TRANSFORMER CORRECTION FACTOR (TCF)

ACCURACY CLASS	MINIMUM	MAXIMUM	LIMITS OF POWER FACTOR OF METERED LOAD—LAGGING	
			MINIMUM	MAXIMUM
1.2	0.988	1.012	0.6	1.0
0.6	0.994	1.006	0.6	1.0
0.3	0.997	1.003	0.6	1.0

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LINE NUMBER	ACCURACY AT BURDEN			
	B-0.1	B-0.2	B-0.5	B-2.0*
1	0.3	0.3	0.3	0.3
2	0.3	0.3	0.3	0.6
3	0.3	0.3	0.3	1.2
4	0.3	0.3	0.3	...
5	0.3	0.3	0.6	0.6
6	0.3	0.3	0.6	1.2
7	0.3	0.3	0.6	...
8	0.3	0.3	1.2	1.2
9	0.3	0.3	1.2	...
10	0.3	0.3	...	...
11	0.3	0.6	0.6	0.6
12	0.3	0.6	0.6	1.2
13	0.3	0.6	0.6	...
14	0.3	0.6	1.2	1.2
15	0.3	0.6	1.2	...
16	0.3	0.6	...	...
17	0.3	1.2	1.2	1.2
18	0.3	1.2	1.2	...
19	0.3	1.2	...	...
20	0.3	...	...	...
21	0.6	0.6	0.6	0.6
22	0.6	0.6	0.6	1.2
23	0.6	0.6	0.6	...
24	0.6	0.6	1.2	1.2
25	0.6	0.6	1.2	...
26	0.6	0.6	...	...
27	0.6	1.2	1.2	1.2
28	0.6	1.2	1.2	...
29	0.6	1.2	...	...
30	0.6	...	...	...
31	1.2	1.2	1.2	1.2
32	1.2	1.2	1.2	...
33	1.2	1.2	...	...
34	1.2	...	...	...
35	0.5	0.5	...	...

* Not ASA standard metering burden.
NOTE: A single line in the table defines the accuracy classes at four burdens.

For example, the overall correction will never exceed .3% at 100% rated current for a transformer in the 0.3 accuracy class. If the ratio correction factor is 1.003 the maximum allowable phase angle, from Fig. 2, is + 15.6 minutes. The transformer correction factor is:

$$TCF = RCF - \frac{\beta}{2600}$$

$$= 1.003 - \frac{15.6}{2600}$$

$$= .997$$

The corresponding ratio correction factor and phase angle for any point inside the 0.3 class parallelogram for 100% rated current will always give a transformer correciton factor between .997 and 1.003.

ACCURACY CLASSES FOR RELAYING SERVICE

Two classes of error are permissible, 2.5% or 10%, as the operator chooses. The accuracy may then be designated, for instance, as 2.5 H 100. The 2.5 means 2.5% maximum error; the 100 means that the transformer can supply at least 100 volts to the burden without exceeding the error. The 100 volts can be the product of a high burden and a high current. Examples are:

A high burden, 4 ohms at 25 amperes (5 times normal) gives 100 volts; a low burden, 1 ohm at 100 amperes (20 times normal) gives 100 volts, or any intermediate burden and current, 2 ohms at 50 amperes which also gives 100 volts.

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The application engineer uses the standard in this way:

If the actual burden is 3 ohms, and he must have accuracy up to 60 amperes (12 times normal), the necessary voltage is 3 x 60 = 180. Therefore, a 200 class transformer is required.

Table 2

RELAYING ACCURACY CLASSIFICATION

LINE NUMBER	% ERROR CLASS 10H	% ERROR CLASS 2.5H	LINE NUMBER	% ERROR CLASS 10H	% ERROR CLASS 2.5H
A	10	..	J	100	100
B	10	10	K	200	50
C	20	..	L	200	100
D	20	10	M	200	200
E	20	20	N	400	100
F	50	..	O	400	200
G	50	50	P	400	400
H	100	..	Q	800	200
I	100	50	R	800	400
			S	800	800

NOTE: The numbers in the table are the ASA standard (60-cycle) H volts classification.

He can choose either 2.5% or 10% as required for the application; he would specify either 2.5 H 200 or 10 H 200 class accuracy.

This standard does not apply below 5 times nor above 20 times normal secondary current.

THERMAL SHORT TIME CURRENT RATING

The thermal short-time current rating is the RMS symmetrical primary current that may be carried for 1 second. The thermal rating for any time up to 5 seconds may be determined from the 1 second rating by dividing by the square root of the specified number of seconds.

MECHANICAL SHORT TIME CURRENT RATING

The mechanical short-time current rating is the RMS value of the a-c component of a completely displaced primary current wave which the transformer is capable of withstanding with the secondary short circuited.

CONTINUOUS THERMAL-CURRENT RATING FACTOR FOR CURRENT TRANSFORMERS

This is the factor by which the rated primary current is multiplied to obtain the maximum allowable continuous primary current based on temperature rise and a 30 C ambient temperature application. Curves of Fig. 1 may be used to determine the percentage of rated primary current that can be carried at any ambient.

All Westinghouse transformers that are suitable for operation at full rated current in a 55 C ambient are so marked. A sample nameplate marking is as follows:

Standard Ambient
55 C
RF 30 C = 1.33

This information shows at a glance that the transformer can be operated at full rated current in a 55 C ambient. In addition the rating factor shows that the transformer can be operated at 1.33 times rated current in a 30 C ambient.

The rating factor on the nameplate applies only for 30 C ambient. To find the multiplier at any ambient, refer to the curves of Fig. 1. For example, if a transformer with a rating factor of 2.0 is to be applied in a 50 C ambient (from the curve for 2.0 rating factor), the transformer can carry 1.6 times rated primary current continuously in this ambient.

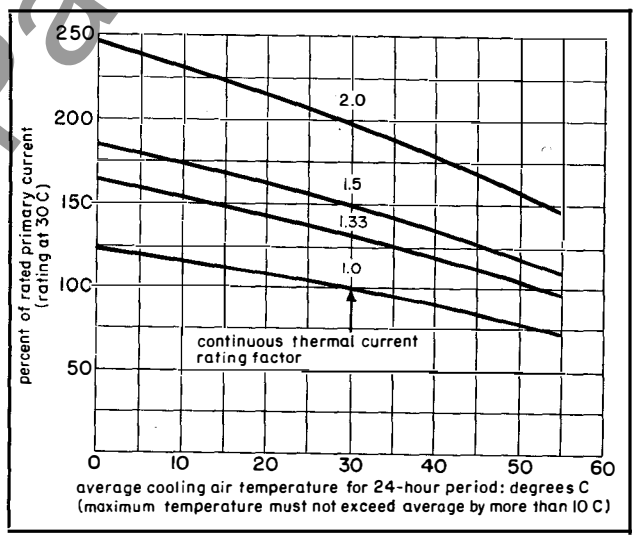

FIG. 1. Basic Loading Characteristics

NAMEPLATE MARKING

According to ASA Standard C57.13, Par. 13.075 the manufacturer shall specify on the nameplate a reference to a data sheet or instruction book which will give such information as thermal short-time and mechanical short-time current ratings, accuracy classifications, application data, or any other information of general use in the application of current transformers. Therefore, on the trans-

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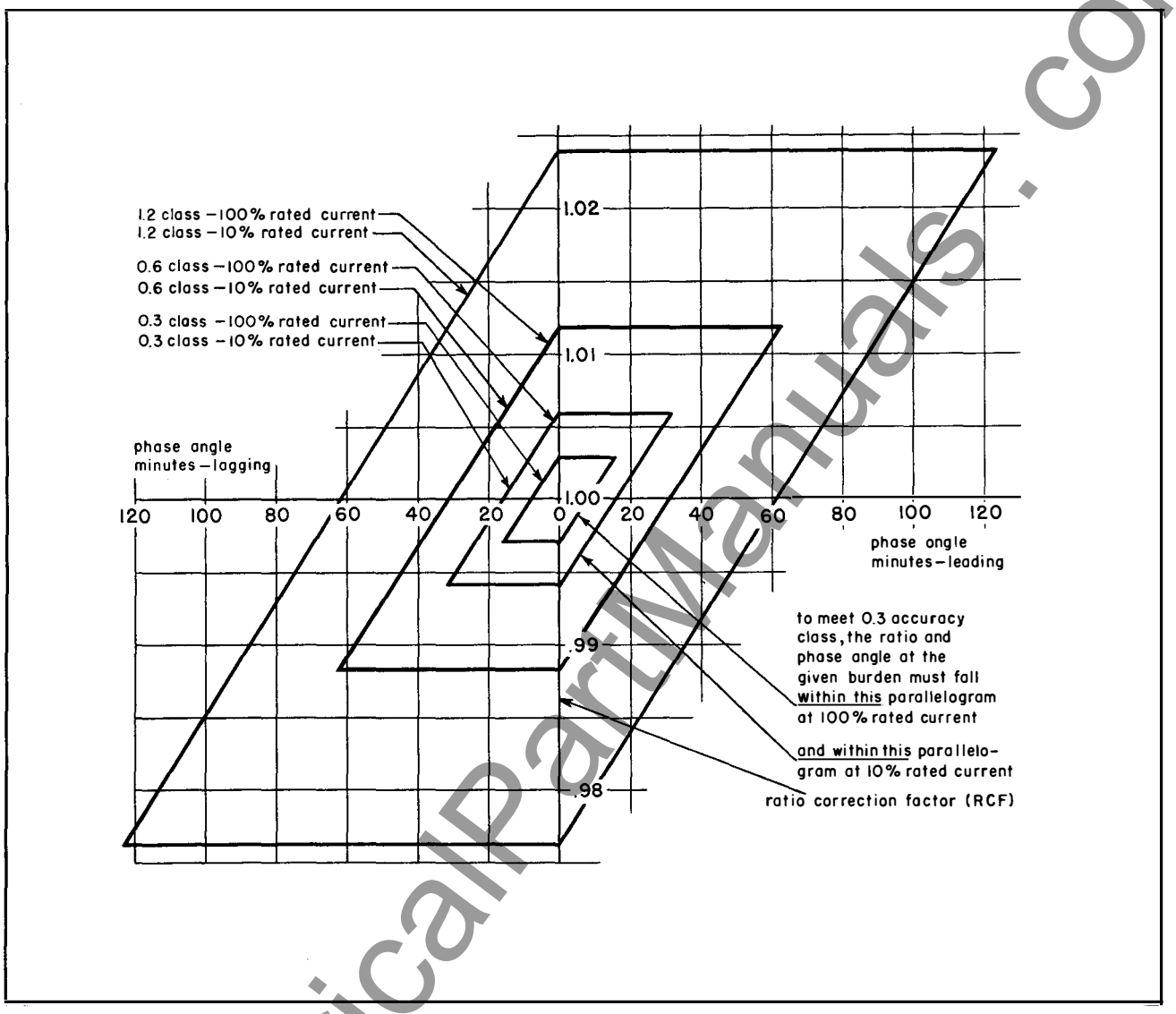

FIG. 2. Equivalent Parallelogram

Table 3

LIMITS OF TRANSFORMER CORRECTION FACTOR (TCF)

ACCURACY CLASS	100% RATED CURRENT		10% RATED CURRENT		LIMITS OF POWER FACTOR OF METERED LOAD (LAGGING)	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
1.2	.988	1.012	.976	1.024	0.6	1.0
0.6	.994	1.006	.988	1.012	0.6	1.0
0.3	.997	1.003	.994	1.006	0.6	1.0
0.5	.995‖	1.005‖	.995	1.005	0.6	1.0

‖ These values also apply to 150 percent rated current.

former nameplate a line number from Table 1 specifies metering accuracy; a line number from Table 2 specifies relaying accuracy; and two numbers followed by M and T designate respectively the mechanical and thermal limits in number of times rated current. An example designation is:

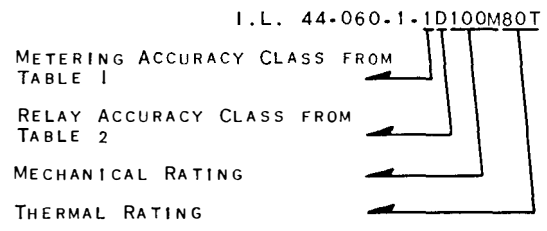

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Table 4

STANDARD BURDENS FOR STANDARD 5-AMPERE SECONDARY CURRENT TRANSFORMERS

STANDARD BURDEN CHARACTERISTICS			IMPEDANCE, POWER FACTOR AND VOLT-AMPERE STANDARD SECONDARY BURDENS					
			FOR 60-CYCLE AND 5-AMPERE SECONDARY CURRENT			FOR 25-CYCLE AND 5-AMPERE SECONDARY CURRENT		
BURDEN DESIGNATION	RESISTANCE: OHMS	INDUCTANCE: MILLIHENRYS	IMPEDANCE: OHMS	VOLT-AMPERES■	POWER FACTOR	IMPEDANCE: OHMS	VOLT-AMPERES■	POWER FACTOR
B-0.1	0.09	0.116	0.1	2.5	0.9	0.0918	2.3	0.98
B-0.2	0.18	0.232	0.2	5.0	0.9	0.1836	4.6	0.98
B-0.5	0.45	0.580	0.5	12.5	0.9	0.4590	11.5	0.98
B-1	0.5	2.3	1.0	25	0.5	0.617	15.4	0.81
B-2	1.0	4.6	2.0	50	0.5	1.234	30.8	0.81
B-4	2.0	9.2	4.0	100	0.5	2.468	61.6	0.81
B-8	4.0	18.4	8.0	200	0.5	4.936	123.2	0.81

■ The burden may also be designated by means of the volt-ampere characteristic: 25 volt-amperes at 5 amperes or 50 volt-amperes at 5 amperes.

NOTE: Burdens for other frequencies shall have the same values of resistance and inductance as those given in this table.
Standard burdens for metering applications are B-0.1, B-0.2 and B-0.5.
Standard burdens for relaying applications are B-1, B-2, B-4 and B-8.

NOTE: For current transformers having nonstandard secondary current, corresponding nonstandard burdens where needed may be derived from the standard burdens in proportion to the square of the ratio of the 5-ampere current to the nonstandard current.

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Instructions for Accuracy Standards for Current Transformers

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The accuracy classification of current transformers for metering service includes a correlation between ratio correction factor and phase angle so as to show the overall effect on watthour meter registration. The classification is based on the requirement that the transformer correction factor (the correction for overall error due to both ratio error and phase angle) be within the limits specified in Table 3. For any particular accuracy class the ratio correction factor and phase angle must fall within the parallelograms of Fig. 2 for 100% and 10% current respectively to keep the transformer correction factor within the limits specified in Table 3.

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LINE NUMBER	ACCURACY AT BURDEN			
	B-0.1	B-0.2	B-0.5	B-2.0*
1	0.3	0.3	0.3	0.3
2	0.3	0.3	0.3	0.6
3	0.3	0.3	0.3	1.2
4	0.3	0.3	0.3	...
5	0.3	0.3	0.6	0.6
6	0.3	0.3	0.6	1.2
7	0.3	0.3	0.6	...
8	0.3	0.3	1.2	1.2
9	0.3	0.3	1.2	...
10	0.3	0.3	...	...
11	0.3	0.6	0.6	0.6
12	0.3	0.6	0.6	1.2
13	0.3	0.6	0.6	...
14	0.3	0.6	1.2	1.2
15	0.3	0.6	1.2	...
16	0.3	0.6	...	...
17	0.3	1.2	1.2	1.2
18	0.3	1.2	1.2	...
19	0.3	1.2	...	...
20	0.3	...	...	...
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22	0.6	0.6	0.6	1.2
23	0.6	0.6	0.6	...
24	0.6	0.6	1.2	1.2
25	0.6	0.6	1.2	...
26	0.6	0.6	...	...
27	0.6	1.2	1.2	1.2
28	0.6	1.2	1.2	...
29	0.6	1.2	...	...
30	0.6	...	...	...
31	1.2	1.2	1.2	1.2
32	1.2	1.2	1.2	...
33	1.2	1.2	...	...
34	1.2	...	...	...
35	0.5	0.5	...	...

* Not ASA standard metering burden.
NOTE: A single line in the table defines the accuracy classes at four burdens.

For example, the overall correction will never exceed .3% at 100% rated current for a transformer in the 0.3 accuracy class. If the ratio correction factor is 1.003 the maximum allowable phase angle, from Fig. 2, is + 15.6 minutes. The transformer correction factor is:

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Effective January, 1963 Supersedes I.L. 44-060-1, March, 1955

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D	20	10	M	200	200
E	20	20	N	400	100
F	50	..	O	400	200
G	50	50	P	400	400
H	100	..	Q	800	200
I	100	50	R	800	400
			S	800	800

NOTE: The numbers in the table are the ASA standard (60-cycle) H volts classification.

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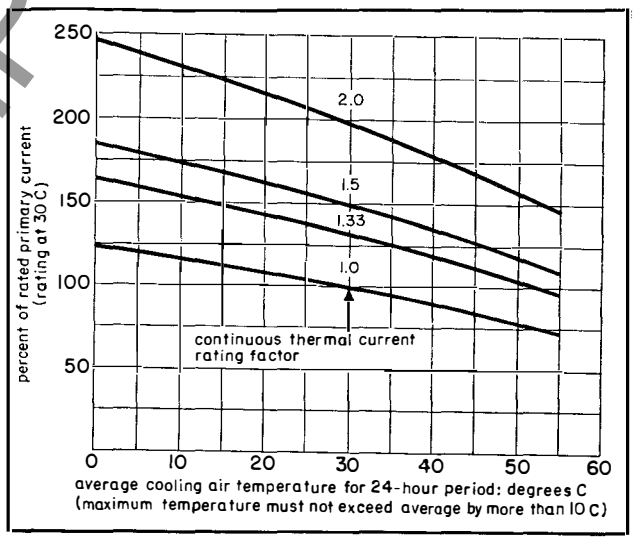

FIG. 1. Basic Loading Characteristics

NAMEPLATE MARKING

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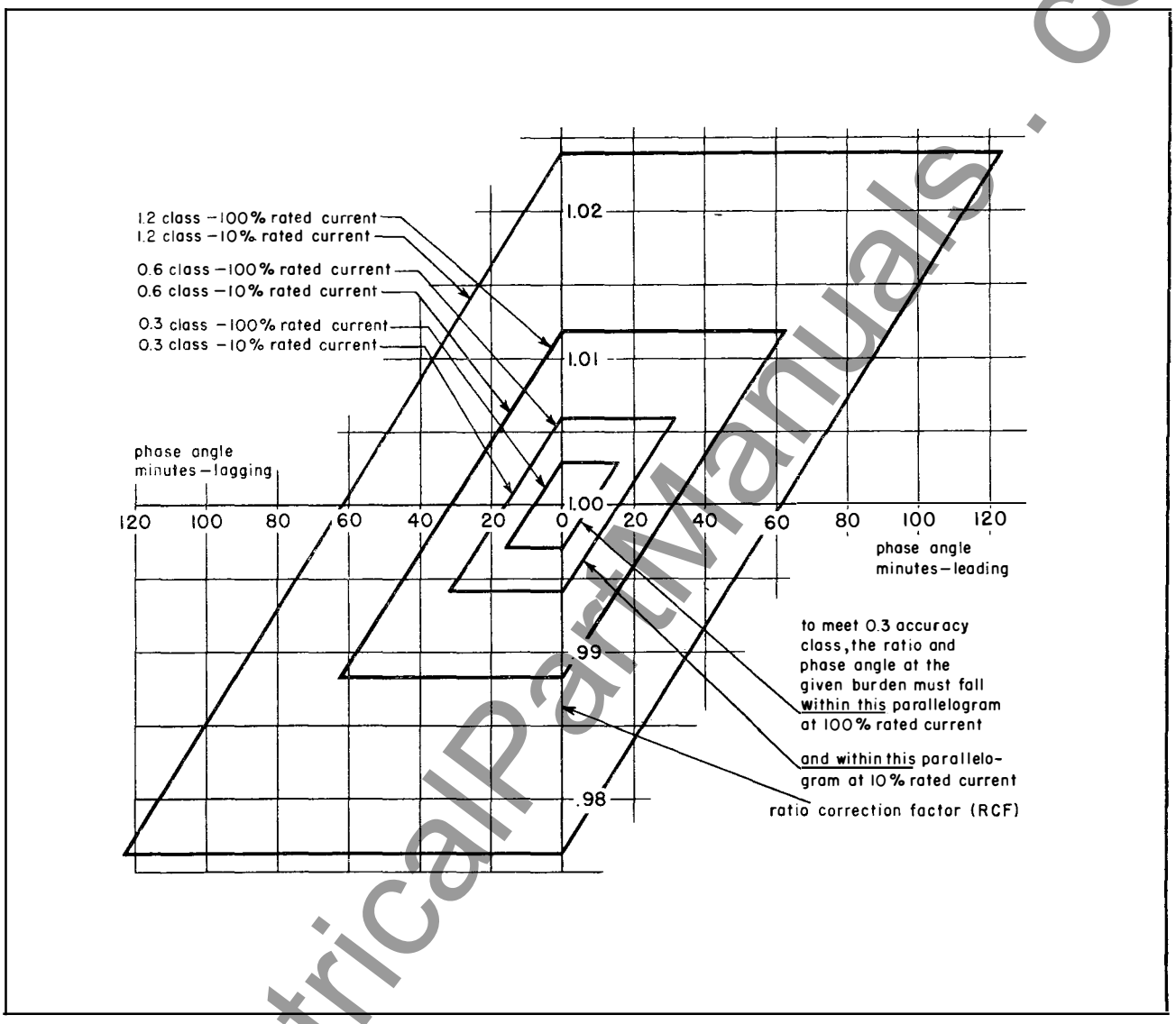

FIG. 2. Equivalent Parallelogram

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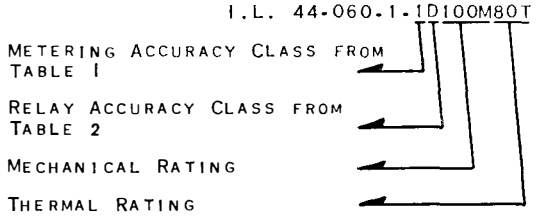
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
1.2	.988	1.012	.976	1.024	0.6	1.0
0.6	.994	1.006	.988	1.012	0.6	1.0
0.3	.997	1.003	.994	1.006	0.6	1.0
0.5	.995‖	1.005‖	.995	1.005	0.6	1.0

‖ These values also apply to 150 percent rated current.

former nameplate a line number from Table 1 specifies metering accuracy; a line number from Table 2 specifies relaying accuracy; and two numbers followed by M and T designate respectively the mechanical and thermal limits in number of times rated current. An example designation is:



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STANDARD BURDEN CHARACTERISTICS			IMPEDANCE, POWER FACTOR AND VOLT-AMPERE STANDARD SECONDARY BURDENS					
			FOR 60-CYCLE AND 5-AMPERE SECONDARY CURRENT			FOR 25-CYCLE AND 5-AMPERE SECONDARY CURRENT		
BURDEN DESIGNATION	RESISTANCE: OHMS	INDUCTANCE: MILLIHENRYS	IMPEDANCE: OHMS	VOLT-AMPERES▪	POWER FACTOR	IMPEDANCE: OHMS	VOLT-AMPERES▪	POWER FACTOR
B-0.1	0.09	0.116	0.1	2.5	0.9	0.0918	2.3	0.98
B-0.2	0.18	0.232	0.2	5.0	0.9	0.1836	4.6	0.98
B-0.5	0.45	0.580	0.5	12.5	0.9	0.4590	11.5	0.98
B-1	0.5	2.3	1.0	25	0.5	0.617	15.4	0.81
B-2	1.0	4.6	2.0	50	0.5	1.234	30.8	0.81
B-4	2.0	9.2	4.0	100	0.5	2.468	61.6	0.81
B-8	4.0	18.4	8.0	200	0.5	4.936	123.2	0.81

▪ The burden may also be designated by means of the volt-ampere characteristic: 25 volt-amperes at 5 amperes or 50 volt-amperes at 5 amperes.

NOTE: Burdens for other frequencies shall have the same values of resistance and inductance as those given in this table.
Standard burdens for metering applications are B-0.1, B-0.2 and B-0.5.
Standard burdens for relaying applications are B-1, B-2, B-4 and B-8.

NOTE: For current transformers having nonstandard secondary current, corresponding nonstandard burdens where needed may be derived from the standard burdens in proportion to the square of the ratio of the 5-ampere current to the nonstandard current.

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