Dry-Type Distribution Transformers

Contents

Standards and Certifications

Eaton dry-type distribution transformers are approved, listed, recognized or may comply with the following standards.

Engineering Standards

Catalog Product Name	UL Standard ①	UL/cUL File Number	UL Listed Control Number	cUL Energy Efficiency File Number	CSA File Number	Insulation System Temp/°C	kVA Single-Phase	kVA Three-Phase	Applicable IEC Standard
Industrial Control Transformer									
MTE	5085	E46323	702X	—	LR27533	105	0.025–1.5	N/A	61558
MTK	5085	E46323	702X	—	LR27533	180	0.05–5	N/A	61558
Encapsulated Transformer									
AP	5085	E10156	591H	—	—	180	3–10	N/A	61558
AP	1561	E78389	591H	—	—	180	15	N/A	61558
EP	5085	E10156	591H	—	LR60545	180	0.05–10	N/A	61558
EP	1561	E78389	591H	EV157 ②	LR60545 ③	180	15–50	N/A	61558 ④ / 726 ⑤
EPT	5085	E10156	591H	—	LR60545	180	N/A	3–9	61558 ⑥ / 726 ⑦
EPT	1561	E78389	591H	EV157 ⑧	LR60545 ⑨	180	N/A	15–75	726
MPC	1062	E53449	591H	—	LR60546	180	3–25	15–30	—
Ventilated Transformer									
DS-3	1561	E78389	591H	—	—	220	15–167	N/A	60726
DT-3	1561	E78389	591H	—	—	220	N/A	15–750	60726
KT	1561	E78389	591H	—	—	220	N/A	9–500	N/A

Notes

① UL 5085 replaces UL 506.
② Applies to 25–50 kVA.
③ Applies to 25 kVA.
④ Applies to 15–25 kVA.
⑤ Applies to 37.5 kVA.
⑥ Applies to 3 kVA.
⑦ Applies to 5–9 kVA.
⑧ Applies to 30–75 kVA.
⑨ Applies to 30 kVA.

In addition to the above standards, Eaton dry-type distribution transformers are also manufactured in compliance with the applicable standards listed below.

Not all of the following standards apply to every transformer.

NEC: National Electrical Code

NEMA ST-1: Specialty Transformers (C89.1) (control transformers).

NEMA ST-20: General-Purpose Transformers.

NEMA TP-1: Guide for Determining Energy Efficiency for Distribution Transformers.

NEMA 250: Enclosures for Electrical Equipment (1000 volts maximum).

IEEE C57.12.01: General Requirements for Dry-Type Distribution and Power Transformers (including those with solid-cast and/or resin-encapsulated windings).

ANSI C57.12.70: Terminal Markings and Connections for Distribution and Power Transformers.

ANSI C57.12.91: Standard Test Code for Dry-Type Distribution and Power Transformers.

CSA C22 No. 47-M90: Air-Cooled Transformers (Dry-Type).

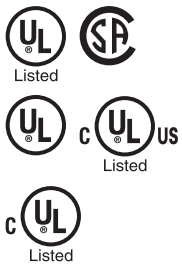
CSA C9-M1981: Dry-Type Transformers.

CSA C22.2 No. 66: Specialty Transformers.

CSA 802-94: Maximum Losses for Distribution, Power and Dry-Type Transformers.

NEMA TP-2: Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.

NEMA TP-3



Catalog Number Selection

General-Purpose, Energy-Efficient, Mini–Power Center, Shielded Isolation, Nonlinear, Buck-Boost, Marine Duty Transformers—Example: S20N11S05A

T S 20 N 11 S 05 A

Prefix Options

C	= CSA labeled ventilated transformer
Marine Duty	
QS	= EPM marine (1-Ph encapsulated)
LY	= EPTM Marine (3-Ph encapsulated)
RT	= DS-3M marine (1-Ph ventilated)
MV	= DT-3M marine (3-Ph ventilated)

Type

S	= EP (single-phase encapsulated)
Y	= EPT (three-phase encapsulated)
T	= DS-3 (single-phase ventilated)
V	= DT-3 (three-phase ventilated)
P	= Mini–power center
Z	= Class 1 Division 2 Groups C and D
X	= Harmonic mitigating (three-phase ventilated)
Nonlinear	
H	= KT-4 (three-phase ventilated)
B	= KT-9 (three-phase ventilated)
N	= KT-13 (three-phase ventilated)
G	= KT-20 (three-phase ventilated)
J	= KT-30 (three-phase ventilated)
A	= KT-40 (three-phase ventilated)
K	= KT-50 (three-phase ventilated)
HT	= KT-4 (single-phase ventilated)
NT	= KT-13 (single-phase ventilated)
GT	= KT-20 (single-phase ventilated)

Primary Voltage

13	= 110 x 220
12	= 120
10	= 120 x 240
29	= 208
72	= 200
25	= 220
23	= 230
24	= 240
20	= 240 x 480
27	= 277
38	= 380
39	= 400
43	= 416
44	= 440
45	= 450
48	= 480
57	= 575
60	= 600
42	= 2400
46	= 4160
49	= 4800
40	= Export model
54	= 120/208/240/277

Taps

D	= 2 at +2.5%, 2 at –2.5%
E	= 1 at +5%, 1 at –5%
F	= 1 at –10%
G	= 2 at –5%
J	= 4 at –2.5%
K	= 1 at –10% x 2 at –5%
L	= 2 at –5% x 4 at –2.5%
M	= 2 at +2.5%, 4 at –2.5%
N	= None
R	= 1 at +5%, 2 at –5%
P	= 1 at +5%, 2 at –5% x 2 at +2.5%, 4 at –2.5%
T	= 1 at +4.2%, 1 at –4.2%
U	= 1 at +2.5%, 3 at –2.5%
W	= 1 at +3.5%, 1 at –3.5%
X	= 2 at +3.1%, 2 at –3.1%

kVA

81 = 0.05	**03** = 3	**37** = 37.5	**52** = 250
85 = 0.075	**05** = 5	**45** = 45	**33** = 300
82 = 0.10	**06** = 6	**50** = 50	**54** = 333
83 = 0.15	**07** = 7.5	**75** = 75	**55** = 500
26 = 0.25	**09** = 9	**99** = 100	**60** = 600
51 = 0.50	**10** = 10	**12** = 112.5	**77** = 750
76 = 0.75	**15** = 15	**49** = 150	**11** = 1000
01 = 1	**21** = 22.5	**67** = 167	**14** = 1500
16 = 1.5	**25** = 25	**22** = 225	
02 = 2	**30** = 30		

Phase

A = Buck and boost	**E** = Electrostatic shield
B = 80°C rise	**S** = Single
F = 15°C rise	**T** = Three
P = 115°C rise epoxy	

Secondary Voltage

04 = 12/24	**20** = 240 x 480
06 = 16/32	**21** = 240/480
08 = 24/48	**27** = 277
14 = 110/220	**38** = 380 delta
12 = 120	**37** = 380Y/220
10 = 120 x 240	**34** = 400Y/231
11 = 120/240	**51** = 416Y/240
54 = 127/254	**35** = 440Y/254
19 = 190Y/110	**62** = 460Y/266
28 = 208Y/120	**47** = 480Y/277
29 = 208	**48** = 480 delta
25 = 220 delta	**60** = 600 delta
31 = 220Y/127	**61** = 600Y/346
26 = 220 delta/110 midtap	**42** = 2400
22 = 240 delta/120 midtap	**41** = 4160Y/2400
64 = 240Y/139	**46** = 4160
24 = 240 delta	**49** = 4800

Suffix Options

A...Y	= ①
CU	= ②
SS	= ③
ZZ	= ④
NV	= ⑤
X	= ⑥
LS_ _	= ⑦
AF	= ⑧
TR	= ⑨
SR	= ⑩
CE	= ⑪
T	= ⑫
EE	= ⑬
NON	= ⑭
POS	= ⑮
NEG	= ⑯
THR	= ⑰
E3	= ⑱
SS4X	= ⑲
Z	= ⑳
S6	= ㉑
I2	= ㉒
I3	= ㉓
I4	= ㉔
N3	= ㉕

Notes

① Model number is not used on newly designed/redesigned transformers.
② Copper windings.
③ Grade 304 stainless steel enclosure (does not imply a NEMA 4X rating).
④ Open type core and coil assembly.
⑤ Totally enclosed non-ventilated DS-3 or DT-3.
⑥ 50/60 Hz.
⑦ Low sound design. LS47 indicates low sound equal to 47 dB; LS42 indicates 42 dB.
⑧ Fungus proof.
⑨ Certified test report of standard production tests for the specific serial number to be shipped.
⑩ Certified sound level report.
⑪ CE Marked.
⑫ Thermal indicator embedded in center coil. Suffix "TT" indicates two thermal indicators of different temperature ratings, are installed.
⑬ NEMA TP-1 efficient.
⑭ 0° phase-shift (used with HMTs).
⑮ +15° phase-shift (used with HMTs).
⑯ –15° phase-shift (used with HMTs).
⑰ –30° phase-shift (used with HMTs).
⑱ CSL3 DOE 2007 energy-efficient.
⑲ NEMA 4X Grade 304 stainless steel enclosure.
⑳ Easy install base.
㉑ Grade 316 stainless steel enclosure (does not imply NEMA 4X rating).
㉒ Integral 2-inch infrared viewing window.
㉓ Integral 3-inch infrared viewing window.
㉔ Integral 4-inch infrared viewing window.
㉕ NEMA premium efficiency.

For Eaton's industrial control transformers catalog number selection, see **Page 316.**

Contact your local Eaton sales office for voltage combinations not shown. Use table for catalog number breakdown only. Do not use to create catalog numbers because all combinations may not be valid.

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Motor Drive Isolation Transformers—Example: MD145E89B

MD 145 E 89 B

Type	
MD	= DT-3
HD	= KT-4
ND	= KT-13

kVA			
075	= 7.5	**175**	= 175
11	= 11	**220**	= 220
14	= 14	**275**	= 275
20	= 20	**330**	= 330
27	= 27	**440**	= 440
34	= 34	**550**	= 550
40	= 40	**660**	= 660
51	= 51	**770**	= 770
63	= 63	**880**	= 880
75	= 75	**1000**	= 1000
93	= 93	**1250**	= 1250
118	= 118	**1500**	= 1500
145	= 145		

Taps ①
D = 2 at +2.5%, 2 at –2.5%
E = 1 at +5%, 1 at –5%

Voltage			
		Primary	Secondary
82	=	230 delta	208Y/120
83	=	208 delta	208Y/120
84	=	240 delta	480 delta
85	=	208 delta	230Y/133
86	=	208 delta	460Y/266
87	=	208 delta	480 delta
88	=	230 delta	230Y/133
89	=	230 delta	460Y/266
90	=	230 delta	575Y/332
91	=	460 delta	230Y/133
92	=	460 delta	460Y/266
93	=	460 delta	575Y/332
94	=	575 delta	230Y/133
95	=	575 delta	460Y/266
96	=	575 delta	575Y/332
97	=	575 delta	480 delta
98	=	600 delta	480 delta

Suffix Options	
Y	= Encapsulated (Type EPT) design
ES	= Electrostatic shield
CU	= Copper windings
F	= 115°C rise
B	= 80°C rise
X	= 50/60 Hz

Notes

① For other tap combinations, contact your local Eaton sales office.

Contact your local Eaton sales office for voltage combinations not shown. Use table for catalog number breakdown only. Do not use to create catalog numbers because all combinations may not be valid.

Product Selection

Single-Phase Transformers

How to Select Single-Phase Units

1. Determine the primary (source) voltage—the voltage presently available.
2. Determine the secondary (load) voltage—the voltage needed at the load.
3. Determine the kVA load:
   - If the load is defined in kVA, a transformer can be selected from the tabulated data
   - If the load rating is given in amperes, determine the load kVA from the chart (below right). To determine kVA when volts and amperes are known, use the formula:

$$kVA = \frac{Volts \times Amperes}{1000}$$

   - If the load is an AC motor, determine the minimum transformer kVA from the chart at the right
   - Select a transformer rating equal to or greater than the load kVA.
4. Define tap arrangements needed.
5. Define temperature rise.

Using the above procedure, select the transformer from the listings in this catalog.

Single-Phase AC Motors

	Full Load Amperes				Minimum Transformer kVA ①
Horsepower	115 Volts	208 Volts	220 Volts	230 Volts	
1/6	4.4	2.4	2.3	2.2	0.53
1/4	5.8	3.2	3.0	2.9	0.70
1/3	7.2	4.0	3.8	3.6	0.87
1/2	9.8	5.4	5.1	4.9	1.18
3/4	13.8	7.6	7.2	6.9	1.66
1	16	8.8	8.4	8	1.92
1-1/2	20	11.0	10.4	10	2.40
2	24	13.2	12.5	12	2.88
3	34	18.7	17.8	17	4.10
5	56	30.8	29.3	28	6.72
7-1/2	80	44	42	40	9.6
10	100	55	52	50	12.0

Full Load Current in Amperes—Single-Phase Circuits

	Voltage								
kVA	120	208	220	240	277	480	600	2400	4160
0.25	2.0	1.2	1.1	1.0	0.9	0.5	0.4	0.10	0.06
0.50	4.2	2.4	2.3	2.1	1.8	1.0	0.8	0.21	0.12
0.75	6.3	3.6	3.4	3.1	2.7	1.6	1.3	0.31	0.18
1	8.3	4.8	4.5	4.2	3.6	2.1	1.7	0.42	0.24
1.5	12.5	7.2	6.8	6.2	5.4	3.1	2.5	0.63	0.36
2	16.7	9.6	9.1	8.3	7.2	4.2	3.3	0.83	0.48
3	25	14.4	13.6	12.5	10.8	6.2	5.0	1.2	0.72
5	41	24.0	22.7	20.8	18.0	10.4	8.3	2.1	1.2
7.5	62	36	34	31	27	15.6	12.5	3.1	1.8
10	83	48	45	41	36	20.8	16.7	4.2	2.4
15	125	72	68	62	54	31	25	6.2	3.6
25	208	120	114	104	90	52	41	10.4	6.0
37.5	312	180	170	156	135	78	62	15.6	9.0
50	416	240	227	208	180	104	83	20.8	12.0
75	625	360	341	312	270	156	125	31.3	18.0
100	833	480	455	416	361	208	166	41.7	24.0
167	1391	802	759	695	602	347	278	69.6	40.1

Notes

① If motors are started more than once per hour, increase minimum transformer kVA by 20%.

When motor service factor is greater than 1, increase full load amperes proportionally. Example: If service factor is 1.15, increase above ampere values by 15%.

Three-Phase Transformers

How to Select Three-Phase Units

1. Determine the primary (source) voltage—the voltage presently available.
2. Determine the secondary (load) voltage—the voltage needed at the load.
3. Determine the kVA load:
   - If the load is defined in kVA, a transformer can be selected from the tabulated data
   - If the load rating is given in amperes, determine the load kVA from the chart (below right). To determine kVA when volts and amperes are known, use the formula:

$$kVA = \frac{Volts \times Amperes \times 1.732}{1000}$$

   - If the load is an AC motor, determine the minimum transformer kVA from the chart at the right
   - Select a transformer rating equal to or greater than the load kVA
4. Define tap arrangements needed.
5. Define temperature rise.

Using the above procedure, select the transformer from the listings in this catalog.

Three-Phase AC Motors

Horsepower	Full Load Amperes 208 Volts	230 Volts	380 Volts	460 Volts	575 Volts	Minimum Transformer kVA ①
0.5	2.2	2.0	1.2	1.0	0.8	0.9
3/4	3.1	2.8	1.7	1.4	1.1	1.2
1	4.0	3.6	2.2	1.8	1.4	1.5
1.5	5.7	5.2	3.1	2.6	2.1	2.1
2	7.5	6.8	4.1	3.4	2.7	2.7
3	10.7	9.6	5.8	4.8	3.9	3.8
5	16.7	15.2	9.2	7.6	6.1	6.3
7.5	24	22	14	11	9	9.2
10	31	28	17	14	11	11.2
15	46	42	26	21	17	16.6
20	59	54	33	27	22	21.6
25	75	68	41	34	27	26.6
30	88	80	48	40	32	32.4
40	114	104	63	52	41	43.2
50	143	130	79	65	52	52
60	170	154	93	77	62	64
75	211	192	116	96	77	80
100	273	248	150	124	99	103
125	342	312	189	156	125	130
150	396	360	218	180	144	150
200	528	480	291	240	192	200

Full Load Current in Amperes—Three-Phase Circuits

kVA	Voltage 208	240	380	480	600	2400	4160
3	8.3	7.2	4.6	3.6	2.9	0.72	0.42
6	16.6	14.4	9.1	7.2	5.8	1.4	0.83
9	25	21.6	13.7	10.8	8.6	2.2	1.2
15	41.7	36.1	22.8	18.0	14.4	3.6	2.1
22.5	62.4	54.1	34.2	27.1	21.6	5.4	3.1
30	83.4	72.3	45.6	36.1	28.9	7.2	4.2
37.5	104	90.3	57.0	45.2	36.1	9.0	5.2
45	124	108	68.4	54.2	43.4	10.8	6.3
50	139	120	76	60.1	48.1	12.0	6.9
75	208	180	114	90	72	18.0	10.4
112.5	312	270	171	135	108	27.1	15.6
150	416	360	228	180	144	36.1	20.8
225	624	541	342	270	216	54.2	31.3
300	832	721	456	360	288	72.2	41.6
500	1387	1202	760	601	481	120	69.4
750	2084	1806	1140	903	723	180	104
1000	2779	2408	1519	1204	963	241	139

Notes

① If motors are started more than once per hour, increase minimum transformer kVA by 20%.

When motor service factor is greater than 1, increase full load amperes proportionally. Example: If service factor is 1.15, increase above ampere values by 15%.

Options and Accessories

(Order separately)

Weathershield Kit

A weathershield kit consisting of a front and rear cover shield must be installed on all ventilated dry-type distribution transformers when the unit is located outdoors. The shields protect the transformer top ventilation openings against rain but allow for proper ventilation. Field installation hardware is not required. Refer to specific transformer listing for selection of weathershield kit. Proper installation provides a NEMA 3R rating.

Note: For 304 stainless steel, add the suffix 'S' to the catalog number.

Weathershield Kit

Weathershield Kit

Fits Frame Size(s) ①	Catalog Number ②
809, 810, 811, 816, 817, 818	**WS11**
814, 814E	**WS13**
815	**WS15**
819, 820	**WS16**
808, 908, 909, 910, 911, 912, 910A, 911A, 912A	**WS31**
912B, 912Z	**WS38**
812, 813, 913A, 913B, 914A, 915A, 916, 914B, 915B	**WS33**
914D, 915D, 914Z, 915Z	**WS39**
916A, 916B, 912Z	**WS19**
917, 918, 918A	**WS34**
919, 920, 919E, 919EX, 920E, 920EX	**WS35**
922	**WS36**
923	**WS37**

Terminal Extension Kit

A terminal extension kit is used to allow front access to the rear terminals on most 500 and 750 kVA transformers (transformers on frames 919 and 920) when insufficient space is available at the rear of the transformer. Eaton recommends a minimum 6-inch clearance from the wall to maintain proper ventilation.

Terminal Extension Kit

Fits Frame Size(s) ①	Bus Material	Catalog Number ②
919	Aluminum	**EXT55AL**
919	Copper	**EXT55CU**
920	Aluminum	**EXT77AL**
920	Copper	**EXT77CU**

Wall-Mounting Bracket

Wall-mounting brackets are used to wall-mount most 15 through 75 kVA ventilated Type DS-3 and DT-3 transformers. See availability guide. This bracket allows for a 6-inch clearance from the wall as recommended by Eaton.

Wall-mounting brackets are compatible with the following frames.

Wall-Mounting Bracket

Availability Guide Wall-Mounting Bracket WMB01

Frame Sizes ①	Catalog Number ②
Type DS-3 (Single-Phase Compatible)	
809, 810, 811, 812, 813, 815, 816, 817, 818, 819, 820, 835, 836, 837, 814A	**WMB01**
Type DT-3, K-Factor, Drive Isolation (Three-Phase Compatible)	
908, 909, 910, 911, 912, 910A, 911A, 912A, 913A, 913B, 914A, 914B, 915A, 915B, 921B, 914D, 915D, 912Z, 914Z, 915Z	**WMB01**

Notes

① Effective June 1, 2001, frame numbers will have a prefix of FR, e.g., **FR819**. Dimensions, accessories and so on are still applicable as if the FR did not exist.

② For Grade 304 stainless steel weathershields, add the suffix "S" to a catalog number, e.g., **WS31S**.

Terminal Lug Kits for Type DT-3 Transformers

Typical Sizing	Terminal Lugs Cable Range	Quantity	Hardware Bolt Size	Quantity	Catalog Number
15–37.5 kVA single-phase 15–45 kVA three-phase	#14–#2 #6–250 kcmil	8 4	1/4-20 x 3/4	8	**LKS1**
50–75 kVA single-phase 75–112.5 kVA three-phase	#6–250 kcmil	12	1/4-20 x 3/4 1/4-20 x 1-3/4	8 8	**LKS2**
100–167 kVA single-phase 150–300 kVA three-phase	#6–250 kcmil #2–600 kcmil	3 22	1/4-20 x 3/4 3/8-16 x 2	3 16	**LKS3**
500 kVA three-phase	#2–600 kcmil	29	3/8-16 x 2	18	**LKS4**

Rodent Screens

Description	Frame Size(s) ①	Catalog Number
Rodent screens are used to discourage entry by birds or rodents.	908, 909	**RS01**
	910A, 911, 912	**RS02**
	913B, 914B, 915B	**RS03**
	916	**RS04**
	917, 918, 918A	**RS05**
	919, 920, 919E, 919EX, 920E, 920EX	**RS06**
	916A, 916B	**RS07**
	922	**RS08**
	923	**RS09**
	814, 821, 814E	**RS11**
	815	**RS12**
	816	**RS13**
	817, 818	**RS14**
	819, 820	**RS15**
	912B, 912Z	**RS16**
	914D, 915D, 914Z, 915Z	**RS17**
	916Z	**RS07**

Replacement Parts for Mini–Power Centers

Frame	Deadfront Cover (Breaker Cover)	Front Cover
283	47-37503	7074C98H04
284	47-37503-2	7074C98H01
285	47-37503-3	7074C98H02
286	47-37503-4	7074C98H02
287	47-37503-5	7074C98H03
289	47-37459	7074C44H01
290	47-37459-2	7074C44H02
291	47-37459-3	7074C44H03
289A	47-42072-1	7074C44H01
290A	47-42072-2	7074C44H02
291A	47-42072-3	7074C44H03

Notes

① Effective June 1, 2001, frame numbers will have a prefix of FR, e.g., **FR819**. Dimensions, accessories and so on are still applicable as if the FR did not exist.

Lugs are rated Al/Cu and are suitable for use with either aluminum or copper conductors.

Case Parts for Ventilated Units

Frame(s) ①	Front Panel (Upper)	Front Panel (Lower)	Back Panel (Upper)	Back Panel (Lower)	Front or Back Panel (Cutout Cover Plate)	Top Cover	Side Panel (Two Required per Transformer)	Bottom
Single-Phase								
809	7073C16P03	—	7073C16P03	—	—	7073C17P01	7073C18P04	7073C14P03
810	7073C16P01	—	7073C16P01	—	—	7073C17P01	7073C18P01	7073C14P01
811	7073C16P01	—	7073C16P01	—	—	7073C17P01	7073C18P01	7073C14P01
812	7073C16P02	—	7073C16P02	—	—	7073C17P02	7073C18P02	7073C14P02
813	7073C16P02	—	7073C16P02	—	—	7073C17P02	7073C18P02	7073C14P02
814, 814E	7073C54P01	—	7073C54P01	—	—	7073C17P03	7073C18P05	7073C14P04
815	47-39433	—	47-39433	—	—	47-39431	47-39430	47-39429
816	47-40452	—	47-40452	—	—	47-40453	47-40451	47-40449
817	47-40457	—	47-40457	—	—	47-40458	47-40456	47-40454
818	47-40457	—	47-40457	—	—	47-40458	47-40456	47-40454
819	47-40574	—	47-40574	—	—	47-40575	47-40573	47-40459
820	47-40574	—	47-40574	—	—	47-40575	47-40573	47-40459
Three-Phase								
908	7073C37P01	—	7073C37P01	—	—	1714C45P01	1714C44P03	7073C20P05
909	7073C37P01	—	7073C37P01	—	—	1714C45P01	1714C44P03	7073C20P05
910	1714C46P01	—	1714C46P01	—	—	1714C45P01	1714C44P01	7073C20P01
911	1714C46P01	—	1714C46P01	—	—	1714C45P01	1714C44P01	7073C20P01
912	1714C46P01	—	1714C46P01	—	—	1714C45P01	1714C44P01	7073C20P01
916	1714C60P01	—	1714C60P01	—	—	1714C58P01	1714C56P01	7073C20P03
917	47-44973-1	—	47-44973-1	—	—	1714C67P01	1714C64P01	7073C20P04
918	47-44973-1	—	47-44973-1	—	—	1714C67P01	1714C64P01	7073C20P04
919, 919E, 919EX	2D46331P03	2D46331P04	2D46331P03	2D46331P04	2D46331P01	2D46331P02	2D46332P01	2D46331P04
920, 920E, 920EX	2D46331P03	2D46331P04	2D46331P03	2D46331P04	2D46331P01	2D46331P02	2D46332P01	2D46331P04
922	2D46391H06	2D46391H08	2D46391H03	2D46391H08		2D46391H02	2D46392H01	—
923	47-45927-1	—	47-45927-1	—	—	47-45926-1	47-45925-1	47-45759-1
910A	47-40592	—	47-40592	—	—	1714C45P01	47-40591	47-40589
911A	47-40592	—	47-40592	—	—	1714C45P01	47-40591	47-40589
912A	47-40592	—	47-40592	—	—	1714C45P01	47-40591	47-40589
912B	47-49323-1	—	47-49323-1	—	—	47-49322-1	47-49321-1	47-49320-1
913A	1714C47P03	—	1714C47P03	—	—	1714C45P02	1714C44P07	7073C30P02
913B	47-40580	—	47-40580	—	—	1714C45P02	47-40578	47-41792
914A	1714C47P03	—	1714C47P03	—	—	1714C45P02	1714C44P07	7073C30P02
914B	47-40580	—	47-40580	—	—	1714C45P02	47-40578	47-41792
914D	47-49317-1	—	47-49317-1	—	—	47-49316-1	47-49315-1	47-49314-1
915A	1714C47P03	—	1714C47P03	—	—	1714C45P02	1714C44P07	7073C30P02
915B	47-40580	—	47-40580	—	—	1714C45P02	47-40578	47-41792
915D	47-49317-1	—	47-49317-1	—	—	47-49316-1	47-49315-1	47-49314-1
916A	47-41790	—	47-41790	—	—	47-41791	47-41789	47-41788
918A	47-41801	—	47-41801	—	—	47-41802	47-41800	47-41802
912Z	47-49323-1	—	47-49323-1	—	—	47-49322-1	47-49991-1	47-49989-1
915Z	47-49317-1	—	47-49317-1	—	—	47-49316-1	47-49994-1	47-49995-1
916Z	47-49992-1	—	47-49992-1	—	—	47-41791	47-49988-1	47-49987-1

Notes

① Effective June 1, 2001, frame numbers will have a prefix of FR, e.g., **FR819**. Dimensions, accessories and so on are still applicable as if the FR did not exist.

Parts listed are for standard catalog listed transformers. Units with modifications may require different parts. (Frame number from transformer nameplate required.) Transformer nameplate and UL label are not field replaceable.

Technical Data and Specifications

Customer-Furnished Connecting Cables

Eaton recommends that external cables be rated 90°C (sized at 75°C ampacity) for encapsulated designs and 75°C for ventilated designs. **Primary and secondary terminal lugs are not included. Lug kits are available separately.**

Overload Capability

Short-term overload capacity is designed into transformers as required by ANSI. Dry-type distribution transformers will deliver 200% nameplate load for one-half hour, 150% load for one hour and 125% load for four hours without being damaged, provided that a constant 50% load precedes and follows the overload. See ANSI C57.96-01.250 for additional limitations.

Continuous overload capacity is not deliberately designed into a transformer because the design objective is to be within the allowed winding temperature rise with nameplate loading.

Seismically Qualified

Eaton manufactured dry-type distribution transformers are seismically qualified, and exceed requirements of the Uniform Building Code (UBC) and California Code Title 24.

Taps

Primary taps are available in most ratings to allow compensation for source voltage variations.

Series-Multiple Windings

Series-multiple windings consist of two similar coils in each winding that can be connected in series or parallel (multiple). Transformers with series-multiple windings are designated with a "x" or "/" between the voltage ratings, such as voltages of "120/240" or "240 x 480." If the series-multiple winding is designated by an "x," the winding can be connected only for a series or parallel. With the "/" designation, a midpoint also becomes available in addition to the series or parallel connection. As an example, a 120 x 240 winding can be connected for either 120 (parallel) or 240 (series), but a 120/240 winding can be connected for 120 (parallel), 240 (series) or 240 with a 120 midpoint.

Enclosures

Eaton's ventilated transformers—Types DS-3, DT-3, MD and KT—use a NEMA 2 rated (drip-proof) enclosure as standard, and are rated NEMA 3R with the addition of weathershields. Eaton encapsulated—Types EP, EPT, EPZ and EPTZ—and totally enclosed, non-ventilated (Types DS-3E and DT-3E) transformers use a NEMA 3R rated enclosure.

Buck-Boost Transformers

An autotransformer has only one winding, and is therefore smaller and more economical than the conventional two-winding transformer. In an autotransformer, the primary and secondary are electrically and mechanically connected. The required secondary voltage is obtained by "tapping-off" from the single winding.

Buck-boost autotransformers are insulated units with 120 x 240 or 240 x 480 volt primaries and 12/24, 16/32 or 24/48 volt secondaries, and provide a very economical method for minor voltage adjustments where circuit isolation is not needed.

Autotransformers can be used only where local electrical codes permit, and isolation of the two circuits is not required.

Nonlinear Ratings

The transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of 4 or 13, as described in the following table, without exceeding specified temperature rise.

Nonlinear Ratings

Harmonic	K-4	K-13
Fundamental	100.0%	100.0%
3rd	34.0%	70.0%
5th	22.0%	42.0%
7th	3.0%	5.0%
9th	1.0%	3.0%
11th	0.7%	3.0%
13th	0.5%	1.0%
15th	0.3%	0.7%
17th	0.3%	0.6%

Sound Levels

All Eaton 600 volt class general-purpose dry-type distribution transformers are designed to meet NEMA ST-20 sound levels listed here. These are the sound levels measured in a soundproof environment. Actual sound levels measured at an installation will likely be higher (up to 15 dB greater) due to electrical connections and environmental conditions. Lower sound levels are available and should be specified when the transformer is going to be installed in an area where sound may be a concern.

All Eaton general-purpose dry-type distribution transformers are designed with sound levels lower than NEMA ST-20 maximum levels. However, consideration should be given to the specific location of the transformers and their installation to minimize the potential for sound transmission to surrounding structures and sound reflection. It is suggested that the following installation methods be included:

1. If possible, mount the transformer away from corners of walls or ceilings. For installation that must be near a corner, use sound-absorbing materials on the walls and ceilings if necessary to eliminate reflection.
2. Provide a solid foundation for mounting the transformer and then use vibration dampening mounts if not already provided in the transformer. (Eaton encapsulated EP/EPT designs use a special encapsulation system and ventilated DS/DT-3 designs contain a built-in vibration dampening system to minimize and isolate sound transmission.)
3. Provide flexible conduit to make the connections to the transformer.
4. Locate the transformer as far as possible from areas where high sound levels are undesirable.

Average Sound Levels ①

NEMA ST-20 Average Sound Level in dB

kVA	Up to 1.2 kV Ventilated	Up to 1.2 kV Encapsulated	Above 1.2 kV Ventilated
0–9	40	45	45
10–50	45	50	50
51–150	50	55	55
151–300	55	57	58
301–500	60	59	60
501–700	62	61	62
701–1000	64	63	64
1001–1500	65	64	65

Note

① Currently being reviewed and revised by NEMA.

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Aluminum Wound ①

Type EP 115°C Rise

	Weight Lbs		Losses in Watts		Efficiency				% Regulation		% Impedance ②		
kVA	Al	Cu	No Load	Total	1/4 Load	1/2 Load	3/4 Load	Full Load	100% P.F.	80% P.F.	Min.	Max.	Sound Level dB
0.05	—	7	6	9	65.3	79.6	84.3	85.6	5.9	6.4	5.5	9.5	45
0.075	—	7	7	14	66.0	79.0	82.5	82.8	9.4	9.2	7.5	11.0	45
0.10	—	7	5	15	82.4	86.9	87.7	86.5	10.3	10.6	8.0	12.0	45
0.15	—	8	7	20	83.4	88.2	88.9	87.8	9.0	9.6	8.0	12.0	45
0.25	—	12	14	29	79.0	87.2	89.5	89.6	5.9	7.5	7.5	9.5	45
0.5	—	13	20	47	85.1	90.3	91.4	91.4	5.5	7.0	5.0	7.0	45
0.75	—	20	29	57	86.0	91.3	92.7	92.9	3.9	5.0	4.0	6.0	45
1	—	30	24	60	90.8	93.9	94.5	94.4	3.8	4.9	3.8	5.8	45
1.5	65	40	30	90	92.5	94.7	95.0	94.6	4.1	5.2	2.5	4.5	45
2	113	40	30	100	94.2	95.7	95.8	95.4	3.6	4.7	3.3	5.3	45
3	—	69	61	135	92.0	95.0	95.7	95.7	2.5	3.5	2.5	4.1	45
5	—	120	104	215	91.8	95.0	95.8	95.9	2.3	3.3	2.0	4.6	45
7.5	123	133	129	250	93.2	96.0	96.7	95.9	1.5	2.4	2.4	3.4	45
10	193	208	153	295	93.9	96.3	97.0	97.2	1.5	2.5	2.0	3.3	50
15	216	235	209	435	94.4	96.6	97.1	97.2	1.6	2.8	1.6	3.6	50
25	385	414	191	440	96.8	98.0	98.3	98.4	1.1	2.5	1.6	4.2	50
37.5	735	856	225	370	97.4	98.3	98.5	98.4	1.2	2.6	2.8	4.0	50

Type EPT 115°C Rise ③

	Weight Lbs		Losses in Watts		Efficiency				% Regulation		% Impedance ②		
kVA	Al	Cu	No Load	Total	1/4 Load	1/2 Load	3/4 Load	Full Load	100% P.F.	80% P.F.	Min.	Max.	Sound Level dB
3	116	123	110	165	87.3	92.6	94.3	94.9	2.1	6.1	2.4	8.0	45
6	143	153	145	275	90.9	94.5	95.5	95.7	2.2	3.1	2.9	4.9	45
9	166	178	195	375	91.6	95.0	95.9	96.1	2.0	2.8	2.0	3.6	45
15	275	300	265	545	93.0	95.7	96.5	96.6	1.9	3.1	1.9	3.9	50
30	422	504	250	665	96.5	97.7	98.0	97.9	1.5	2.5	1.8	3.8	50
45	660	745	300	740	97.2	98.2	98.4	98.5	1.0	2.1	1.8	4.0	50
75	1275	1450	400	945	97.7	98.6	98.8	98.8	0.8	1.6	1.7	3.4	55

Notes

① Typical values for aluminum windings. Contact Eaton for values of copper windings. Up-to-date design data is available at www.eaton.com.

② Actual impedance may be ± 7.5%.

③ Type EPT transformers 3–15 kVA are T-T connected.

Performance data is based upon 480 volt Delta primary and a 208Y/120 volt secondary for three-phase transformers; 240 x 480 volt primary and a 120/240 volt secondary for single-phase transformers. All data is subject to future revision. Refer to Eaton for 5 kV class information. All data is subject to future revision.

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Aluminum Wound

Type DS-3 150°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	246	80	549	97.6	97.6	97.2	96.6	2.0	2.9	4.3	3.0	3.1	45	97.70	737	245
25	359	300	848	97.7	98.1	97.9	97.5	1.4	2.7	3.5	2.8	2.2	45	98.00	1139	379
37.5	374	125	1314	98.1	97.8	97.2	96.6	2.2	4.6	5.8	4.8	3.2	45	98.20	1066	355
50	555	300	1668	98.2	98.1	97.6	97.0	1.9	4.0	5.1	4.3	2.7	45	98.30	1585	528
75	740	170	2266	98.4	98.2	97.6	97.0	2.3	5.3	6.9	6.3	2.8	50	98.50	2105	701
100	841	260	2543	98.5	98.4	98.0	97.6	1.9	4.7	6.1	5.6	2.3	50	98.60	2834	944
167	1610	900	3987	68.7	98.7	98.4	98.0	1.4	6.8	9.7	9.5	1.8	55	98.70	1250	416

Type DS-3 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	246	80	519	97.8	97.8	97.3	96.8	2.1	3.1	3.9	2.6	2.9	45	97.70	773	244
25	373	300	766	97.7	98.1	98.0	97.7	1.4	2.8	3.3	2.8	1.9	45	98.00	1102	367
37.5	380	125	1182	98.2	98.4	98.1	97.8	2.0	3.1	4.1	2.9	2.8	45	98.20	616	205
50	590	300	417	98.4	98.3	97.9	97.4	1.8	4.1	5.2	5.2	0.2	45	98.30	1553	511
75	689	170	2356	98.5	98.2	97.6	97.0	2.7	5.6	6.9	6.3	2.9	50	98.50	1717	572

Type DS-3 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	360	115	269	97.4	98.3	98.4	98.4	0.8	1.7	2.0	1.8	1.0	45	97.70	1381	460
25	370	120	580	97.8	98.2	98.0	97.8	1.5	3.2	3.9	3.4	1.8	45	98.00	1046	348
37.5	565	150	834	98.1	98.4	98.1	97.8	1.5	3.3	4.1	3.6	1.8	45	98.20	1471	490
50	680	175	1014	98.4	98.5	98.4	98.1	1.5	3.4	4.2	3.9	1.7	45	98.30	1733	577
75	900	260	1387	98.3	98.6	98.5	98.2	1.4	3.5	4.3	4.0	1.5	50	98.50	2423	807

Type DT-3 150°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	204	95	778	96.6	96.7	96.0	95.1	4.8	4.0	4.8	1.4	4.6	45	97.00	382	127
30	291	165	1207	97.2	97.3	96.9	96.2	3.7	5.6	4.6	3.0	3.5	45	97.50	479	159
37.5	381	210	1428	97.5	97.5	97.0	96.4	3.5	5.5	4.5	3.1	3.2	45	97.70	484	161
45	351	210	1911	97.5	97.4	96.7	96.0	3.8	6.3	5.1	3.4	3.8	45	97.70	564	188
50	531	270	1316	97.7	98.1	97.9	97.5	2.2	4.0	3.2	2.4	2.1	45	98.00	999	333
75	553	300	2917	97.9	97.7	97.0	96.3	3.6	6.6	5.3	4.0	3.5	50	98.00	561	187
112.5	793	400	3693	98.0	98.0	97.5	96.9	3.2	7.5	6.0	5.2	2.9	50	98.20	1049	350
150	913	490	4923	98.2	98.0	97.5	96.9	3.2	6.5	5.3	4.4	3.0	50	98.30	1518	506
225	1343	650	6476	98.4	98.2	97.8	97.2	2.8	6.3	5.1	4.4	2.6	55	98.50	2204	734
300	1597	750	8239	98.5	98.3	97.9	97.3	2.9	8.9	7.6	7.2	2.5	55	98.60	2097	699
500	2590	1400	9782	98.6	98.7	98.5	98.1	1.9	8.2	7.2	7.0	1.7	60	98.70	3769	1256
750	3340	1800	12,692	98.8	98.9	98.7	98.4	1.8	8.9	8.0	7.9	1.5	64	98.80	4521	1507

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Aluminum Wound

Type DT-3 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	202	100	743	96.7	96.8	96.2	95.4	4.4	3.9	4.4	1.2	4.3	45	97.00	383	127
30	311	165	1492	97.3	97.1	96.3	95.5	4.5	4.8	4.8	1.8	4.4	45	97.50	411	137
45	418	220	1458	97.8	97.9	97.5	97.0	2.8	5.4	4.6	3.7	2.8	45	97.70	550	183
50	556	270	1211	97.6	98.1	98.0	97.7	1.9	3.7	3.2	2.6	1.9	45	98.00	892	297
75	581	300	2415	97.9	97.9	97.5	96.9	3.0	6.7	5.9	5.1	2.8	50	98.00	758	252
112.5	829	440	3209	98.0	98.1	97.8	97.3	2.6	3.6	3.1	1.9	2.5	50	98.20	1301	433
150	996	530	3781	98.1	98.3	97.9	97.5	2.4	5.8	5.2	4.7	2.2	50	98.30	1534	511
225	1569	720	5205	98.4	98.4	98.1	97.8	2.2	6.8	6.2	5.8	2.0	55	98.50	1875	631
300	1908	830	6926	98.5	98.5	98.2	97.8	2.3	6.0	5.4	4.9	2.0	55	98.60	2678	872
500	3117	1650	6968	98.5	98.9	98.8	98.7	1.2	6.6	6.6	6.5	1.1	60	98.70	3930	1310
750	4884	2000	9335	98.9	99.1	99.0	98.8	1.3	8.7	9.0	8.9	1.0	64	98.80	4458	1486

Type DT-3 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	276	165	551	96.7	97.4	97.2	96.8	3.4	3.9	3.5	2.3	2.6	45	97.00	358	119
30	350	180	904	97.3	97.8	97.6	97.2	2.5	3.9	3.4	2.5	2.4	45	97.50	337	112
45	540	290	1027	97.7	98.2	98.2	97.9	1.7	3.5	3.3	2.9	1.6	45	97.70	953	317
75	810	360	1782	97.8	98.2	98.0	97.7	0.3	3.5	4.3	3.9	1.9	50	98.00	1006	355
112.5	944	470	2521	98.2	98.4	98.2	97.9	1.9	4.4	4.1	3.7	1.8	50	98.20	1554	518
150	1438	650	2760	98.2	98.6	98.5	98.3	1.5	4.8	4.7	4.5	1.4	50	98.30	1665	555
225	1746	830	4047	98.3	98.6	98.5	98.3	1.6	5.5	5.6	5.4	1.4	55	98.50	2003	667
300	2400	1100	5338	98.6	99.0	99.0	98.9	1.6	5.9	6.1	5.9	1.4	55	98.60	2655	885
500	3418	1800	5858	98.6	99.0	99.0	98.9	0.9	4.9	5.4	5.3	0.8	60	98.70	4462	1487

Type KT-4 150°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	206	100	883	96.7	96.5	95.6	94.6	5.5	5.2	5.5	1.8	5.2	45	97.00	375	125
30	311	165	1263	97.2	97.3	96.7	96.0	3.9	7.4	6.0	4.8	3.7	45	97.50	453	151
45	400	220	1554	97.7	97.7	97.3	96.7	3.2	5.9	4.8	3.8	3.0	45	97.70	710	236
75	547	300	2622	97.9	97.8	97.2	96.6	3.3	6.7	5.3	4.4	3.1	50	98.00	995	331
112.5	800	440	3525	98.0	98.0	97.6	97.0	3.0	7.4	6.0	5.3	2.7	50	98.20	1082	360
150	1010	530	4055	98.1	98.2	97.8	97.4	2.6	6.6	5.4	4.8	2.3	50	98.30	1574	524
225	1680	700	5879	98.3	98.3	97.9	97.5	2.6	7.6	6.3	5.9	2.3	55	98.50	1943	647
300	2122	1100	5895	98.4	98.6	98.4	98.1	1.9	6.8	5.9	5.7	1.6	55	98.60	2863	954
500	3201	1800	7054	98.5	98.9	98.8	98.7	1.3	5.9	5.4	5.2	1.1	60	98.70	4588	1529

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Aluminum Wound

Type KT-4 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	307	135	394	96.3	97.5	97.6	97.5	1.8	2.7	2.2	1.4	1.7	45	97.00	491	163
30	313	165	1344	97.4	97.3	96.6	95.9	4.1	5.1	4.6	2.4	3.9	45	97.50	584	194
45	400	220	1463	97.8	97.9	97.5	97.0	3.0	6.1	5.2	4.4	2.8	45	97.70	591	197
75	587	285	2355	97.9	97.9	97.5	97.0	2.9	6.7	5.9	5.2	2.8	50	98.00	823	274
112.5	947	470	2910	97.9	98.1	97.9	97.5	2.4	5.0	4.3	3.7	2.2	50	98.20	1447	482
150	1243	560	4119	98.1	98.2	97.8	97.4	2.5	6.6	5.7	5.2	2.4	50	98.30	1468	489
225	1680	700	5413	98.3	98.3	98.1	97.7	2.3	7.5	7.0	6.7	2.1	55	98.50	1719	573
300	2480	1100	5735	98.4	98.7	98.5	98.2	1.8	6.7	6.3	6.1	1.5	55	98.60	2547	849

Type KT-4 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	378	165	416	96.4	97.6	97.7	97.6	1.7	2.9	2.5	1.9	1.7	45	97.00	482	160
30	365	188	877	97.2	97.7	97.6	97.2	2.4	3.9	3.5	2.6	2.3	45	97.50	583	194
45	550	285	1055	97.4	98.1	98.0	97.8	1.8	3.7	3.4	2.9	1.7	45	97.70	708	236
75	774	360	1784	97.8	98.2	98.0	97.7	2.0	4.7	4.5	4.0	1.9	50	98.00	986	328
112.5	1380	550	1872	97.9	98.5	98.5	98.4	1.3	4.2	4.2	4.1	1.2	50	98.20	1577	525
150	1604	700	2728	98.0	98.5	98.5	98.3	1.4	4.4	4.5	4.3	1.4	50	98.30	1880	626
225	2336	850	3728	98.4	98.7	98.6	98.4	1.4	5.0	5.2	5.1	1.3	55	98.50	2647	882
300	2689	1100	4589	98.4	98.8	98.7	98.5	1.4	5.5	5.8	5.6	1.2	55	98.60	2610	870

Type KT-13 150°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	271	165	604	96.7	97.3	97.0	96.5	3.1	4.2	3.6	2.1	2.9	45	97.00	379	126
30	365	198	977	97.1	97.6	97.3	96.9	2.7	4.3	3.5	2.4	2.6	45	97.50	565	188
45	545	280	1215	97.5	98.0	97.8	97.4	2.2	4.2	3.3	2.6	2.1	45	97.70	890	277
75	812	360	2139	97.7	98.0	97.8	97.4	2.6	5.9	4.9	4.3	2.4	50	98.00	907	302
112.5	920	490	3059	98.0	98.2	97.8	97.4	2.4	5.0	4.1	3.4	2.3	50	98.20	1513	504
150	1221	530	4297	98.1	98.1	97.7	97.2	2.7	6.5	5.3	4.6	2.5	50	98.30	1790	597
225	1960	830	4461	98.3	98.6	98.3	98.0	1.9	6.6	6.1	5.9	1.6	55	98.50	1771	590
300	2358	1100	5931	98.4	98.6	98.4	98.2	1.9	7.2	6.3	6.0	1.6	55	98.60	2543	847

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Aluminum Wound

Type KT-13 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	332	165	432	96.6	97.6	97.6	97.4	1.9	3.2	2.8	2.2	1.8	45	97.00	409	136
30	390	200	903	97.3	97.8	97.6	97.2	2.5	4.4	3.6	2.8	2.3	45	97.50	420	120
45	548	280	1187	97.5	98.1	98.0	97.7	2.2	—	3.0	2.3	2.0	45	97.70	836	278
75	808	360	1850	97.8	98.1	97.8	97.5	2.4	5.6	4.8	4.3	2.2	50	98.00	805	268
112.5	990	540	2373	97.9	98.3	98.2	98.0	1.8	4.5	4.0	3.6	1.6	50	98.20	1303	434
150	1600	650	2372	98.1	98.5	98.4	98.1	1.3	3.4	3.0	2.8	1.1	50	98.30	1932	644
225	2306	850	4001	98.3	98.7	98.6	98.3	1.6	4.9	5.1	4.9	1.4	55	98.50	2508	836
300	3291	1100	4583	98.4	98.8	98.7	98.5	1.3	6.2	6.3	6.2	1.2	55	98.60	2851	950

Type KT-13 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation		% Imp.	X	R			Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	Trise +20	Trise +20	Trise +20	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	315	165	536	96.4	97.3	97.2	96.9	2.5	3.9	3.6	2.5	2.5	45	97.00	375	125
30	408	188	854	97.4	97.9	97.7	97.3	2.3	4.0	3.6	2.8	2.2	45	97.50	497	166
45	555	280	982	97.6	98.2	98.2	98.0	1.6	3.2	3.0	2.5	1.6	45	97.70	656	218
75	838	400	1289	97.8	98.4	98.5	98.4	1.3	3.0	2.9	2.6	1.2	50	98.00	1624	541
112.5	1367	550	1905	97.9	98.5	98.5	98.4	1.3	4.2	4.4	4.2	1.2	50	98.20	1171	390
150	1607	668	2474	98.2	98.6	98.6	98.4	1.4	4.6	4.7	4.5	1.2	50	98.30	1562	520
225	2582	850	3471	98.3	98.7	98.7	98.5	1.3	5.1	6.3	6.2	1.2	55	98.50	2159	719
300	3228	1100	3978	98.3	98.8	98.8	98.7	1.1	4.2	4.5	4.3	1.0	55	98.60	3255	1085

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Copper Wound

Type DS-3 150°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	270	80	605	97.6	97.5	96.9	96.3	3.5	4.2	4.2	2.3	3.5	45	97.70	551	183
25	406	115	732	97.9	98.1	97.7	97.3	—	—	3.5	2.5	2.5	45	98.00	1379	459
37.5	453	125	1154	98.2	98.1	97.6	97.0	2.7	3.7	4.8	4.0	2.7	45	98.20	1321	440
50	657	160	1159	98.3	98.4	98.1	97.7	2.0	3.3	3.8	3.8	2.0	45	98.30	1321	440
75	803	175	2259	98.5	98.3	97.7	97.1	2.8	4.8	6.5	5.8	2.8	50	98.50	2133	711
100	960	250	2504	98.6	98.4	98.0	97.5	2.3	4.3	5.5	5.0	2.3	50	98.60	2779	926
167	1665	570	3094	98.7	98.8	98.6	98.3	1.5	6.3	9.0	8.8	1.5	50	98.70	2865	955

Type DS-3 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	264	80	437	97.8	98.1	97.8	97.3	2.4	2.2	3.3	2.2	2.4	45	97.70	718	239
25	420	110	603	97.9	98.2	98.0	97.7	2.0	2.9	3.2	2.6	2.0	45	98.00	862	287
37.5	450	125	1217	98.2	98.0	97.5	96.9	2.9	4.5	5.9	5.1	2.9	45	98.20	1300	433
50	703	300	1409	98.4	98.4	98.0	97.6	2.2	3.8	4.7	4.1	2.2	—	98.30	1498	499
75	793	175	2178	98.5	98.3	97.8	97.2	2.7	4.7	6.2	5.6	2.7	50	98.50	2107	702

Type DS-3 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	407	115	293	97.3	98.2	98.3	98.2	1.2	1.7	1.8	1.4	1.2	45	97.70	375	125
25	430	300	679	97.9	98.4	98.3	98.1	1.5	2.6	3.0	2.6	1.5	45	98.00	494	164
37.5	685	300	729	98.1	98.6	98.6	98.5	1.1	2.2	2.6	2.3	1.1	45	98.20	617	205
50	799	180	1013	98.3	98.6	98.4	98.1	1.7	2.9	3.4	2.9	1.7	45	98.30	989	329
75	1042	250	1447	98.3	98.6	98.4	98.1	1.6	3.4	3.8	3.5	1.6	50	98.50	1015	338

Type DT-3 150°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	250	150	755	98.9	97.0	96.4	95.7	4.2	5.3	4.8	2.6	4.0	45	97.00	321	107
30	350	165	1100	97.3	97.5	97.0	96.5	3.2	4.5	5.2	4.1	3.1	45	97.50	614	204
37.5	415	210	1382	97.5	97.6	97.1	96.5	3.2	4.8	4.0	2.5	3.1	45	97.70	639	213
45	416	215	1786	97.4	97.4	96.9	96.2	3.6	5.5	4.6	3.0	3.5	45	97.70	637	212
50	647	270	1220	97.7	98.2	98.0	97.7	2.0	3.5	2.8	2.0	1.9	45	98.00	1072	357
75	643	320	2903	97.9	97.5	97.1	96.4	3.6	7.4	4.3	2.5	3.4	50	98.00	1015	338
112.5	876	420	3699	97.9	97.9	97.4	96.8	3.0	6.7	5.1	4.2	2.9	50	98.20	1185	395
150	1064	530	4269	98.1	98.2	97.8	97.3	2.7	5.3	4.3	3.5	2.5	50	98.30	1752	584
225	1569	560	7124	98.4	98.1	97.5	97.0	3.2	8.7	7.4	6.8	2.9	55	98.50	2498	832
300	2050	730	7959	98.4	98.3	97.9	97.4	2.6	6.7	5.5	4.9	2.4	55	98.60	2872	964
500	3681	1400	8292	98.8	98.9	98.7	98.4	1.6	7.4	6.8	6.7	1.4	60	98.70	3839	1279

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Copper Wound

Type DT-3 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	256	95	669	97.7	97.8	97.3	96.7	4.0	5.4	4.8	2.9	3.8	45	97.00	229	76
30	337	180	1077	97.7	97.8	97.3	96.8	3.0	6.2	4.6	3.5	3.0	45	97.50	433	144
45	446	215	1625	97.7	97.7	97.2	96.6	3.2	5.2	4.4	3.1	3.1	45	97.70	658	219
50	630	270	1213	97.8	98.2	98.0	97.7	2.0	3.5	3.0	2.3	1.9	45	98.00	960	320
75	662	320	2346	97.9	98.0	97.6	97.0	2.8	5.4	4.7	3.9	2.7	50	98.00	842	280
112.5	914	400	2953	98.1	98.2	97.9	97.4	2.5	5.7	5.0	4.5	2.3	50	98.20	1036	345
150	1132	530	3364	98.3	98.5	98.2	97.8	2.0	4.8	4.4	4.0	1.9	50	98.30	1605	535
225	2036	650	6445	98.4	98.3	97.8	97.3	2.9	8.8	8.1	7.7	2.6	55	98.50	1572	524
300	2325	830	6038	98.6	98.7	98.4	98.1	2.0	5.7	5.2	4.9	1.7	55	98.60	1860	620
500	3681	1400	7841	98.8	98.9	98.7	98.5	1.4	6.8	6.8	6.6	1.3	60	98.70	4033	1344

Type DT-3 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	349	135	390	96.6	97.7	97.7	97.6	1.8	2.4	2.1	1.3	1.7	45	97.00	449	150
30	410	210	823	97.3	97.9	97.7	97.4	2.1	3.4	3.0	2.1	2.0	45	97.50	493	164
45	504	200	1308	97.9	98.0	97.7	97.2	2.5	4.5	3.9	3.1	2.5	45	97.70	473	158
75	818	370	1837	97.9	98.2	98.0	97.7	2.0	9.3	4.3	3.8	2.0	50	98.00	937	312
112.5	1065	440	2409	98.1	98.3	98.0	97.6	1.8	3.8	3.3	2.8	1.8	50	98.20	1754	584
150	1410	650	3349	98.3	98.5	98.3	97.9	1.9	3.9	3.7	3.2	1.8	50	98.30	1593	531
225	2030	830	4096	98.4	98.7	98.5	98.3	1.6	5.4	5.4	5.2	1.5	55	98.50	2568	856
300	3041	1100	4646	98.5	98.8	98.7	98.5	1.4	5.6	6.1	6.0	1.2	55	98.60	3753	1251

Type KT-4 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	251	100	635	96.8	97.1	96.6	96.0	3.7	5.0	4.2	2.1	3.6	45	97.00	265	88
30	326	165	1134	97.4	97.5	97.1	96.5	3.5	5.3	4.3	2.9	3.2	45	97.50	504	168
45	479	220	1505	97.6	97.8	97.3	96.8	3.0	5.6	5.0	4.1	2.9	45	97.70	670	223
75	463	300	2883	97.9	97.7	97.1	96.4	3.6	7.1	5.9	4.7	3.4	50	98.00	975	325
112.5	977	440	2952	98.1	98.2	97.9	97.5	2.6	6.6	5.6	5.1	2.2	50	98.20	1031	344
150	1212	540	3716	98.3	98.4	98.0	97.6	2.4	6.0	5.1	4.6	2.1	50	98.30	1574	524
225	1815	650	5420	98.4	98.5	98.1	97.7	2.4	7.6	6.5	6.2	2.1	55	98.50	1694	565
300	2400	830	6259	98.6	98.6	98.4	98.0	2.2	6.3	5.2	4.9	1.8	55	98.60	2594	864

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Copper Wound

Type KT-4 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	256	95	702	96.7	96.9	96.3	95.6	4.2	5.7	5.0	2.9	4.0	45	97.00	279	93
30	341	165	1007	97.4	97.6	97.3	96.8	3.0	4.8	4.2	3.1	2.8	45	97.50	466	155
45	526	220	1200	97.9	98.1	97.9	97.5	2.3	5.0	4.1	3.5	2.2	50	97.70	633	211
75	759	300	1715	98.1	98.3	98.1	97.8	1.9	5.0	4.5	4.1	1.9	50	98.00	929	309
112.5	1030	470	2735	98.0	98.3	98.0	97.7	2.2	4.4	3.8	3.2	2.0	50	98.20	1171	390
150	1631	650	3076	98.2	98.5	98.3	98.1	1.7	4.9	4.5	4.2	1.6	50	98.30	1250	416
225	1965	690	4434	98.5	98.6	98.4	98.1	1.9	5.6	5.3	5.0	1.7	55	98.50	1979	659
300	2337	830	6127	98.6	98.7	98.4	98.0	2.0	5.2	4.7	4.3	1.8	55	98.60	2187	729

Type KT-4 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	365	165	371	97.0	98.0	98.1	98.0	1.5	2.3	2.1	1.5	1.4	45	97.00	499	166
30	424	210	787	97.3	97.9	97.8	97.6	2.0	3.2	2.9	2.2	1.9	45	97.50	659	219
45	653	290	977	97.4	98.1	98.1	98.0	1.6	3.1	3.0	2.5	1.5	45	97.70	925	308
75	640	350	1951	97.8	98.1	97.8	97.5	2.2	5.2	4.9	4.4	2.1	50	98.00	854	284
112.5	1264	560	2009	98.2	98.7	98.6	98.4	1.4	4.3	4.2	4.0	1.3	50	98.20	1449	483
150	1825	650	2873	98.5	98.7	98.5	98.2	1.6	6.1	6.4	6.3	1.5	50	98.30	1288	429
225	2096	890	4449	98.3	98.6	98.4	98.1	1.8	6.5	6.6	6.4	1.6	55	98.50	2292	764

Type KT-13 150°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	346	165	461	96.2	97.4	97.5	97.3	2.1	3.0	2.5	1.6	2.0	45	97.00	527	176
30	390	190	908	97.2	97.7	97.5	97.1	2.6	4.0	3.3	2.3	2.4	45	97.50	579	193
45	623	235	1328	97.6	97.9	97.6	97.2	2.5	3.2	2.8	1.4	2.4	45	97.70	854	285
75	848	370	2402	97.7	97.9	97.5	97.0	2.8	5.7	4.5	3.6	2.7	50	98.00	1046	348
112.5	1080	455	2991	98.0	98.2	97.9	97.4	2.4	4.3	3.5	2.7	2.3	50	98.20	1180	393
150	1431	600	3686	98.2	98.3	98.1	97.7	2.3	5.1	4.2	3.7	2.1	50	98.30	1250	416
225	2129	830	4250	98.4	98.6	98.4	98.2	2.0	6.3	5.4	5.1	1.5	55	98.50	2771	923

Type KT-13 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	341	165	378	96.6	97.8	97.9	97.9	1.5	2.4	2.1	1.6	1.4	45	97.00	472	157
30	444	188	824	97.1	97.8	97.6	97.3	2.2	3.6	3.1	2.2	2.1	45	97.50	620	206
45	598	250	1476	97.4	97.7	97.4	96.9	2.8	4.6	4.0	2.9	2.7	45	97.70	939	313
75	894	350	2128	97.9	98.1	97.9	97.5	1.9	5.1	4.6	4.0	2.4	50	98.00	847	282
112.5	1054	460	2612	98.1	98.3	98.1	97.8	2.0	4.3	3.3	2.6	1.9	50	98.20	1375	458
150	1399	600	3185	98.2	98.5	98.3	98.0	2.0	5.9	5.4	5.1	1.7	50	98.30	1379	460
225	2088	890	4382	98.3	98.6	98.4	98.2	1.8	6.1	5.7	5.5	1.6	55	98.50	2490	830

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Copper Wound

Type KT-13 80°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	370	165	382	96.7	97.8	97.9	97.8	1.5	2.4	2.2	1.6	1.4	45	97.00	472	157
30	490	188	595	97.4	98.2	98.2	98.1	1.4	3.0	2.8	2.5	1.4	45	97.50	592	197
45	635	290	1189	97.4	97.9	97.8	97.5	2.1	3.9	3.5	2.8	2.0	45	97.70	736	245
75	987	410	1351	97.7	98.9	98.4	98.3	1.4	2.8	2.6	2.3	1.3	50	98.00	1590	530
112.5	854	560	2039	98.1	98.6	98.5	98.3	1.4	4.2	4.3	4.1	1.3	50	98.20	1374	458
150	1807	650	3053	98.0	98.4	98.3	98.0	1.7	4.3	4.0	3.7	1.6	50	98.30	1472	490
225	4091	1200	2364	98.2	98.9	99.1	99.1	0.6	2.7	2.9	2.8	0.5	55	98.50	4321	1440

Type KT-13 115°C Rise E3 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	3.25	78	359	97.6	98.1	98.0	97.7	2.0	3.7	3.2	2.6	1.9	45	98.00	307	102
30	370	125	636	98.1	98.4	98.3	98.0	1.7	2.7	2.3	1.6	1.7	45	98.30	779	260
45	635	135	1076	98.5	98.5	98.1	97.7	2.2	4.1	3.5	2.8	2.1	45	98.50	617	206
75	870	225	1529	98.5	98.6	98.4	98.0	1.9	4.9	4.4	4.1	1.7	50	98.60	993	331
112.5	1526	350	1768	98.6	98.8	98.7	98.5	1.3	3.5	3.1	2.8	1.3	50	98.80	2447	816
150	1665	350	2419	97.8	98.9	98.7	98.4	1.5	4.5	4.2	3.9	1.4	50	98.90	1976	659
225	2094	650	3650	98.9	98.9	98.8	98.5	1.5	5.4	5.2	5.1	1.3	55	99.00	2686	895
300	3900	750	3731	98.9	99.1	99.0	98.8	1.3	5.2	5.2	5.1	1.0	55	99.04	2990	997

Type KT-9 115°C Rise E3 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	335	78	353	97.4	98.0	98.0	97.7	2.0	3.7	3.2	2.6	1.8	45	98.00	287	96
30	406	125	670	98.0	98.3	98.1	97.8	1.9	2.7	2.4	1.5	1.8	45	98.30	780	260
45	635	135	1075	98.6	98.5	98.2	97.7	2.3	4.1	3.5	2.8	2.1	45	98.50	603	201
75	870	210	1551	98.5	98.6	98.3	98.0	1.9	4.0	3.6	3.1	1.8	50	98.60	958	319
112.5	1526	350	1583	98.6	98.9	98.8	98.6	1.2	3.0	2.7	2.5	1.1	50	98.80	2480	827
150	1665	350	2463	98.8	98.9	98.7	98.4	1.6	4.5	4.2	4.0	1.4	50	98.90	1930	643
225	2094	650	3766	98.8	98.9	98.7	98.4	1.7	5.5	5.2	5.0	1.4	55	99.00	2778	926

Typical Data for 600-Volt Class General-Purpose Dry-Type Transformers, Copper Wound

Type NON HMT 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	362	80	527	97.6	97.7	97.3	96.7	3.2	5.9	5.1	4.2	3.0	45	97.00	—	—
30	430	100	1040	98.3	98.0	97.4	96.7	3.2	6.2	5.4	4.4	3.1	45	97.50	—	—
45	627	170	1368	98.3	98.2	97.7	97.2	2.8	6.0	5.2	4.4	2.7	45	97.70	—	—
75	926	250	2096	98.4	98.3	97.9	97.4	2.6	7.0	6.2	5.7	2.5	50	98.00	—	—
112.5	1628	400	2515	98.4	98.5	98.3	97.9	2.0	5.5	4.9	4.5	1.9	50	98.20	—	—
150	2001	500	2688	98.5	98.7	98.6	98.3	1.6	5.6	5.2	5.0	1.5	50	98.30	—	—
225	3596	590	3310	98.8	98.9	98.8	98.6	1.5	6.2	6.0	5.9	1.2	55	98.50	—	—
300	3891	800	4854	98.7	98.9	98.7	98.4	1.7	7.1	7.0	6.8	1.4	55	98.60	—	—

Type THR HMT 115°C Rise NEMA TP-1 Efficient

		Losses in Watts		Efficiency (Trise +20°)				% Regulation							Inrush	
kVA	Weight	No Load	Total at Rise +20	25%	50%	75%	Full Load	100% PF	80% PF	% Imp.	X	R	Sound Level dB	TP1 Efficiency	Absolute Max.	Practical Max.
15	—	80	708	97.1	97.0	96.4	95.5	4.3	7.4	6.3	4.7	4.2	45	97.00	—	—
30	450	100	1409	98.0	97.4	96.5	95.6	4.7	8.0	6.8	5.2	4.4	45	97.50	—	—
45	610	170	1374	98.2	98.1	97.7	97.1	2.8	4.8	4.2	3.2	2.7	45	97.70	—	—
75	868	250	2341	98.2	98.1	97.6	97.0	2.9	6.6	5.8	5.0	2.8	50	98.00	—	—
112.5	1643	400	2685	98.3	98.4	98.1	97.7	2.2	5.5	5.0	4.6	2.0	50	98.20	—	—
150	—	500	3304	98.5	98.6	98.3	97.9	2.0	6.7	6.3	6.0	1.9	50	98.30	—	—
225	3370	590	3712	98.7	98.8	98.7	98.4	1.7	6.6	6.4	6.2	1.4	55	98.50	—	—
300	3894	800	4688	98.9	99.0	98.8	98.5	1.7	7.4	7.2	7.1	1.3	55	98.60	—	—

Typical Specifications—General-Purpose (1000 kVA and Below)

General

Furnish and install, single-phase and three-phase general-purpose individually mounted dry-type transformers of the two-winding type, self-cooled, with ratings and voltages as indicated on the drawings. Transformers shall be manufactured by Eaton.

Transformers shall be designed, manufactured and tested in accordance with all the latest applicable ANSI, NEMA and IEEE Standards. All 600-volt class transformers through 1000 kVA shall be UL listed and bear the UL label.

Transformers shall be designed for continuous operation at rated kVA, for operation 24 hours a day, 365 days a year, with normal life expectancy as defined in ANSI C57.96.

Insulation Systems

Transformers shall be insulated as follows:

- **Type EP or EPT:** 0.050 through 75 kVA: 180°C insulation system
- **Type DS-3 or DT-3:** 15 kVA and above: 220°C insulation system

Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, with a 30°C average over 24 hours.

All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

Core and Coil Assemblies

Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical-grade [aluminum] [copper] and continuous wound construction. BIL (basic impulse level) for all 600-volt class windings shall be 10 kV.

On encapsulated units rated [75 kVA and below] [15 kVA and below] [9 kVA and below], the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin or epoxy and aggregate to provide a moisture-proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.

On ventilated units rated [15 kVA and above] [30 kVA and above] [112.5 kVA and above], the core and coil assembly shall be installed on vibration-absorbing pads.

Enclosures

The enclosure shall be made of heavy-gauge steel and shall be finished using a continuous process of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of a thermosetting polyester powder coating and subsequent baking. The coating color shall be ANSI 61 and shall be UL recognized for outdoor use. The maximum temperature on top of the enclosure shall not exceed 90°C.

On units rated [75 kVA and below] [15 kVA and below] [9 kVA and below] encapsulated, the enclosure construction shall be totally enclosed, non-ventilated, NEMA 3R, with lifting provisions.

On units rated [15 kVA and above] [30 kVA and above] [112.5 kVA and above], the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. On outdoor units, provide suitable weathershields over ventilation openings. **To ensure proper ventilation, locate the unit at least 6 inches (152.4 mm) from the adjacent wall or structure**.

Tests

The following tests shall be performed as standard on all transformers:

1. Ratio tests at the rated voltage connection and at all tap connections.
2. Polarity and phase relation tests on the rated voltage connection.
3. Applied potential tests.
4. Induced potential test.
5. No-load and excitation current at rated voltage on the rated voltage connection.

Sound Levels

Transformer average sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings measured in accordance with NEMA ST-20.

Average Sound Levels ①

NEMA ST-20 Average Sound Level in dB

kVA	Up to 1.2 kV Ventilated	Encapsulated	Above 1.2 kV Ventilated
0–9	40	45	45
10–50	45	50	50
51–150	50	55	55
151–300	55	57	58
301–500	60	59	60
501–700	62	61	62
701–1000	64	63	64
1001–1500	65	64	65

Note

① Currently being reviewed and revised by NEMA.

Typical Specifications—Dry-Type Transformers for Nonlinear Loads

General

Furnish and install, individually mounted dry-type transformers of the two-winding type, self-cooled, with ratings and voltages as indicated on the drawings.

Transformers shall be manufactured by Eaton.

Transformers shall be designed, manufactured and tested in accordance with all the latest applicable ANSI, NEMA and IEEE Standards. All 600-volt class transformers through 500 kVA shall be UL listed as suitable for non-sinusoidal current loads with K factor not to exceed [4] [13] [20].

Insulation Systems

Transformers shall be insulated with a UL recognized 220°C insulation system. Winding temperature rise shall be [80°C] [115°C] [150°C].

Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, with a 30°C average.

All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

Core and Coil Assemblies

Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed.

Transformer coils shall be wound of electrical-grade [aluminum] [copper] conductor with continuous wound construction. An electrostatic shield consisting of a single turn of aluminum shall be placed between the primary and secondary winding and grounded to the transformer core. BIL (basic impulse level) for all 600-volt class windings shall be 10 kV.

The core and coil assembly shall be installed on vibration-absorbing pads.

The neutral conductor shall be rated to carry 200% of normal phase current.

Enclosures

The enclosure shall be made of heavy gauge steel and shall be finished utilizing a continuous process of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of a polymer polyester powder coating and baking. The coating color shall be ANSI 61 and shall be UL recognized for outdoor use. The maximum temperature on top of the enclosure shall not exceed 90°C.

The enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. On outdoor units, provide suitable weathershields over ventilation openings. **To ensure proper ventilation, locate the unit at least 6 inches (152.4 mm) from the adjacent wall or structure.**

Nonlinear Ratings

The transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of 4 or 13 as described below without exceeding [80°C] [115°C] [150°C] temperature rise.

Nonlinear Ratings

Harmonic	K-4	K-13
Fundamental	100.0%	100.0%
3rd	34.0%	70.0%
5th	22.0%	42.0%
7th	3.0%	5.0%
9th	1.0%	3.0%
11th	0.7%	3.0%
13th	0.5%	1.0%
15th	0.3%	0.7%
17th	0.3%	0.6%

Tests

The following tests shall be performed as standard on all transformers:

1. Ratio tests at the rated voltage connection and at all tap connections.
2. Polarity and phase relation tests on the rated voltage connection.
3. Applied potential tests.
4. Induced potential test.
5. No-load and excitation current at rated voltage on the rated voltage connection.

Sound Levels

Transformer average sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings measured in accordance with NEMA ST-20.

Average Sound Levels ①

NEMA ST-20 Average Sound Level in dB

kVA	Up to 1.2 kV Ventilated	Encapsulated	Above 1.2 kV Ventilated
0–9	40	45	45
10–50	45	50	50
51–150	50	55	55
151–300	55	57	58
301–500	60	59	60
501–700	62	61	62
701–1000	64	63	64
1001–1500	65	64	65

Note

① Currently being reviewed and revised by NEMA.

Typical Specification—AC Adjustable Frequency Drive Isolation Transformers

General

Furnish and install, single-phase and three-phase general-purpose individually mounted dry-type transformers of the two-winding type, self-cooled, with ratings and voltages for input application as indicated on the drawings. Transformers shall be manufactured by Eaton.

Transformers shall be designed, manufactured and tested in accordance with all the latest applicable ANSI, NEMA and IEEE Standards. All 600-volt class transformers through 550 kVA shall be UL listed and bear the UL label.

Transformers shall be designed for continuous operation at rated kVA, for operation 24 hours a day, 365 days a year, with normal life expectancy as defined in ANSI C57.96.

Insulation Systems

Transformers shall be insulated with a UL recognized 220°C insulation system.

Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, with a 30°C average over 24 hours.

All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

Core and Coil Assemblies

Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical-grade [aluminum] [copper] and continuous wound construction. BIL (basic impulse level) for all 600-volt class windings shall be 10 kV.

A temperature sensing device shall be imbedded in the center coil.

The core and coil assembly shall be installed on vibration-absorbing pads.

Enclosures

The enclosure shall be made of heavy-gauge steel and shall be finished using a continuous process of degreasing, cleaning, and phosphatizing, followed by electrostatic deposition of a thermosetting polyester powder coating and subsequent baking. The coating color shall be ANSI 61 and shall be UL recognized for outdoor use. The maximum temperature on top of the enclosure shall not exceed 90°C.

The enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. **To ensure proper ventilation, locate the unit at least 6 inches (152.4 mm) from the adjacent wall or structure. On outdoor units, provide suitable weathershields over ventilation openings.**

Sound Levels

Transformer average sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings measured in accordance with NEMA ST-20.

The following table lists the recommended kVA size of the drive isolation transformer for a specific horsepower requirement.

Three-Phase

Horsepower AC Motor	kVA Minimum
5	7.5
7.5	11
10	14
15	20
20	27
25	34
30	40
40	51
50	63
60	75
75	93
100	118
125	145
150	175
200	220
250	275
300	330
400	440
500	550
600	660
700	770

Average Sound Levels ①

NEMA ST-20 Average Sound Level in dB

kVA	Up to 1.2 kV Ventilated	Encapsulated	Above 1.2 kV Ventilated
0–9	40	45	45
10–50	45	50	50
51–150	50	55	55
151–300	55	57	58
301–500	60	59	60
501–700	62	61	62
701–1000	64	63	64
1001–1500	65	64	65

Note

① Currently being reviewed and revised by NEMA.

Typical Specifications—Mini–Power Centers (3–30 kVA)

General

Furnish and install, single-phase and three-phase general-purpose individually mounted mini–power centers of the two-winding type, self-cooled, with ratings and voltages as indicated on the drawings. Mini–power centers shall be manufactured by Eaton.

Units shall be designed, manufactured and tested in accordance with all the latest applicable ANSI, NEMA, IEEE, CSA and UL standards, and shall be UL listed and CSA certified and bear the UL and CSA labels.

Units shall be designed for continuous operation at rated kVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in ANSI C57.96.

Each mini–power center shall include a main primary breaker with an interrupting rating of 14 kA at 277/480 volts; an encapsulated dry-type transformer and a secondary panelboard with main breaker rated 10 kA interrupting rating at 120/240 volts.

1. All interconnecting wiring between the primary breaker and transformer, secondary main breaker and transformer, and distribution section shall be factory installed. Main primary, secondary and feeder breakers shall be enclosed with a padlockable hinged door.
2. The secondary distribution section shall accommodate one-inch, plug-in breakers with 10 kA interrupting capacity.
3. On the all-copper, bolt-on designs, the secondary distribution section shall accommodate bolt-on breakers with 10 kA interrupting capacity.

Insulation System

Transformers shall be insulated with a 180°C insulation system.

Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, with a 30°C average over 24 hours.

All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

Core and Coil Assemblies

Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point.

The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical-grade aluminum (copper) with continuous wound construction. BIL (basic impulse level) for all 600-volt class windings shall be 10 kV.

The core and coil assembly shall be completely encapsulated in a proportioned mixture of resin or expoxy and aggregate to provide a moisture-proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.

Enclosures

The enclosure shall be made of heavy-gauge steel and shall be finished using a continuous process of degreasing, cleaning, and phosphatizing, followed by electrostatic deposition of a thermosetting polymer polyester powder coating and subsequent baking. The coating color shall be ANSI 61 and shall be UL recognized for outdoor use. Mini–power centers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature on top of the enclosure shall not exceed 90°C. The core of the transformer shall be grounded to the enclosure. The enclosure shall be totally enclosed, non-ventilated, NEMA 3R, with lifting eyes.

Tests

The following tests shall be performed as standard on all transformers:

1. Ratio tests at the rated voltage connection and at all tap connections.
2. Polarity and phase relation tests on the rated voltage connection.
3. Applied potential tests.
4. Induced potential test.
5. No-load and excitation current at rated voltage on the rated voltage connection.

Sound Levels

Transformer average sound levels shall not exceed the following ANSI/NEMA levels for self-cooled ratings measured in accordance with NEMA ST-20.

Average Sound Levels ①

kVA	NEMA Average Sound Level in dB
0–9	45
10–30	50

Note

① Currently being reviewed and revised by NEMA.

Typical Specification—NEMA TP-1-2002 Compliant Energy-Efficient Transformers

General

Furnish and install, three-phase energy-efficient dry-type transformers that comply with NEMA Standard TP-1-2002 and U.S. DOE 10 CFR Parts 430 and 431. Transformers shall be of the two-winding type, self-cooled, with ratings (kVA) as indicated on the drawings. Transformer's losses shall conform to NEMA TP-1 requirements. Transformers shall be manufactured by Eaton.

Transformers shall be designed, manufactured and tested in accordance with all the latest applicable ANSI, NEMA and IEEE Standards, and shall be listed by Underwriters Laboratories and bear the UL label.

Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year, with normal life expectancy as defined in ANSI C57.96.

Insulation System and Temperature Rise

Transformers shall be insulated with a 220°C insulation system. Transformers shall be 150°C rise and shall be capable of carrying a 15% continuous overload without exceeding a 150°C rise. Required performance shall be obtained without exceeding the above rise in a 40°C maximum, 30°C average ambient temperature.

All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

Core and Coil Assemblies

Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point.

The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade [aluminum] [copper] and continuous wound construction. BIL (basic impulse level) for all 600-volt class windings shall be 10 kV.

The core and coil assembly shall be installed on vibration-absorbing pads.

Enclosures

The enclosure shall be made of heavy gauge steel and shall be finished utilizing a continuous process of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of a thermosetting polyester powder coating and subsequent baking. The coating color shall be ANSI 61 and shall be UL recognized for outdoor use.

The enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. **To ensure proper ventilation, locate the unit at least 6 inches (152.4 mm) from the adjacent wall or structure.**

All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature on top of the enclosure shall not exceed 90°C.

Tests

The following tests shall be performed as standard on all transformers:

1. Ratio tests at the rated voltage connection and at all tap connections.
2. Polarity and phase relation tests on the rated voltage connection.
3. Applied potential tests.
4. Induced potential test.
5. No-load and excitation current at rated voltage on the rated voltage connection.

Efficiency

Transformers shall be energy-efficient with minimum efficiencies as set forth per NEMA TP-1-2002 and U.S. DOE 10 CFR Parts 430 and 431 when operated at 35% of full load capacity.

NEMA TP-1-2002 Efficiency Levels

Tables of Energy Efficiency
NEMA Class 1 Efficiency Levels
Dry-Type Distribution Transformers—Low Voltage (600 V and below)

Single-Phase		Three-Phase	
kVA	Efficiency	kVA	Efficiency
15	97.7	15	97.0
25	98.0	30	97.5
37.5	98.2	45	97.7
50	98.3	75	98.0
75	98.5	112.5	98.2
100	98.6	150	98.3
167	98.7	225	98.5
250	98.8	300	98.6
333	98.9	500	98.7
—	—	750	98.8
—	—	1000	98.9

Sound Levels

Transformer average sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings.

Average Sound Levels ①

NEMA ST-20 Average Sound Level in dB

	Up to 1.2 kV		Above 1.2 kV
kVA	Ventilated	Encapsulated	Ventilated
0–9	40	45	45
10–50	45	50	50
51–150	50	55	55
151–300	55	57	58
301–500	60	59	60
501–700	62	61	62
701–1000	64	63	64
1001–1500	65	64	65

Note

① Currently being reviewed and revised by NEMA.

Glossary of Transformer Terms

Air cooled: A transformer that is cooled by the natural circulation of air around, or through, the core and coils.

Ambient noise level: The existing or inherent sound level of the area surrounding the transformer, prior to energizing the transformer. Measured in decibels.

Ambient temperature: The temperature of the air surrounding the transformer into which the heat of the transformer is dissipated.

Ampacity: The current-carrying capacity of an electrical conductor under stated thermal conditions. Expressed in amperes.

Ampere: The practical unit of electric current.

Attenuation: A decrease in signal power or voltage. Unit of measure is dB.

Autotransformer: A transformer in which part of the winding is common to both the primary and the secondary circuits.

Banked: Two or more single-phase transformers wired together to supply a three-phase load. Three single-phase transformers can be "banked" together to support a three-phase load. For example, three 10 kVA single-phase transformers "banked" together will have a 30 kVA three-phase capacity.

BIL: Basic impulse level. The ability of a transformer's insulation system to withstand high voltage surges. All Eaton 600V-class transformers have a 10 kV BIL rating.

BTU: British thermal unit. In North America, the term "BTU" is used to describe the heat value (energy content) of fuels, and also to describe the power of heating and cooling systems, such as furnaces, stoves, barbecue grills and air conditioners. When used as a unit of power, BTU "per hour" (BTU/h) is understood, though this is often abbreviated to just "BTU."

Buck-boost: The name of a standard, single-phase, two-winding transformer application with the low voltage secondary windings connected as an autotransformer for boosting (increasing) or bucking (decreasing) voltages in small amounts. Applications can either be single-phase or three-phase.

CE: Mark to indicate third-party approved or self-certification to specific requirements of the European community.

Celsius (centigrade): Metric temperature measure.

°F = (1.8 x °C) + 32

°C = (°F-32) / 1.8

Center tap: A tap at the mid-point of a winding. The center tap on three-phase delta-delta transformers is called a lighting tap. It provides 5% of the transformer's kVA for single-phase loads.

Certified tests: Actual values taken during production tests and certified as applying to a given unit shipped on a specific order. Certified tests are serial number–specific.

Common mode: Electrical noise or voltage fluctuation that occurs between all of the line leads and the common ground, or between ground and line or neutral.

Compensated transformer: A transformer with a turns ratio that provides a higher than nameplate output (secondary) voltage at no load, and nameplate output (secondary) voltage at rated load. It is common for small transformers (2 kVA and less) to be compensated.

Conductor losses: Losses (expressed in watts) in a transformer that are incidental to carrying a load: coil resistance, stray loss due to stray fluxes in the windings, core clamps, and the like, as well as circulating currents (if any) in parallel windings. Also called load losses.

Continuous rating: The load that a transformer can handle indefinitely without exceeding its specified temperature rise.

Core losses: Losses (expressed in watts) caused by magnetization of the core and its resistance to magnetic flux. Also called no-load losses or excitation losses. Core losses are always present when the transformer is energized.

CSA: Canadian Standards Association. The Canadian equivalent of Underwriters Laboratories (UL).

CSL3: Candidate Standard Level 3 (CSL3) design criteria developed by the U.S. Department of Energy. This term is used when considering the maximum, practical efficiency of a transformer.

cUL: Mark to indicate UL Certification to specific CSA Standards.

Decibel (dB): Unit of measure used to express the magnitude of a change in signal or sound level.

Delta connection: A standard three-phase connection with the ends of each phase winding connected in series to form a closed loop with each phase 120 degrees from the other. Sometimes referred to as three-wire.

Dielectric tests: Tests that consist of the application of a voltage higher than the rated voltage for a specified time for the purpose of determining the adequacy against breakdowns of insulating materials and spacings under normal conditions.

Dry-type transformer: A transformer in which the core and coils are in a gaseous or dry compound insulating medium. A transformer that is cooled by a medium other than a liquid, normally by the circulation of air.

E3: Eaton's version of a CSL3 transformer.

Eddy currents: The currents that are induced in the body of a conducting mass by the time variation of magnetic flux or varying magnetic field.

Efficiency: The ratio of the power output from a transformer to the total power input. Typically expressed as a %.

Electrostatic shield: Copper or other conducting sheet placed between primary and secondary windings, and grounded to reduce electrical interference and to provide additional protection from line-to-line or line-to-ground noise. Commonly referred to as "Faraday shield."

Encapsulated transformer: A transformer with its coils either dipped or cast in an epoxy resin or other encapsulating substance.

Enclosure: A surrounding case or housing used to protect the contained equipment against external conditions and prevent personnel from accidentally contacting live parts.

Environmentally preferable product: A product that has a lesser or reduced negative effect on human health and the environment when compared to competing products that serve the same purpose. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance and disposal of the product. This term includes recyclable products, recycled products and reusable products.

EPACT: The Energy Policy Act of 1992 (EPAct) is an important piece of legislation for efficiency because it established minimum efficiency levels for dry-type distribution transformers manufactured or imported after December 2006. EPAct, which was based on NEMA standards, defined a number of terms, including what constitutes an energy-efficient transformer. The DOE issued a rule that defines these transformers and how manufacturers must comply. DOE EPAct rule (PDF): Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures, Labeling, and the Certification Requirements for Electric Motors. Final Rule. 10-CFR Part 431.

Excitation current: No load current. The current that flows in any winding used to excite the transformer when all other windings are open-circuited. It is usually expressed in percent of the rated current of a winding in which it is measured. Also called magnetizing current.

FCAN: "Full Capacity Above Nominal" taps. Designates the transformer will deliver its rated kVA when connected to a voltage source which is higher than the rated primary voltage.

FCBN: "Full Capacity Below Nominal" taps. Designates the transformer will deliver its rated kVA when connected to a voltage source which is lower than the rated primary voltage.

Frequency: On AC circuits, designates the number of times that polarity alternates from positive to negative and back again per second, such as 60 cycles per second. Typically measured in Hertz (Hz).

Ground: Connecting one side of a circuit to the earth through low resistance or low impedance paths to help prevent transmitting electrical shock to personnel.

Harmonic: A sinusoidal waveform with a frequency that is an integral multiple of the fundamental frequency (60 Hz).

60 H_3 fundamental
120 H_3 2nd harmonic
180 H_3 3rd harmonic
240 H_3 4th harmonic

Harmonic distortion: Nonlinear distortion of a system characterized by the appearance of harmonic (non-sinusoidal) currents in the output, when the input is sinusoidal.

Harmonic distortion, total (THD): The square root of the sum of the squares of all harmonic currents present in a load, excluding the fundamental 60 Hz current. Usually expressed as a percent of the fundamental.

High voltage windings: In a two-winding transformer, the winding intended to have the greater voltage. Usually marked with "H" designations.

HMT: Harmonic Mitigating Transformer (HMT) is better able to handle the harmonic currents present in today's electrical power system. thereby increasing system capacity, reducing distortion throughout a facility, help to minimize downtime and "mysterious" maintenance on equipment, and return the longevity of equipment life through reduced operational energy losses, thereby running cooler.

Hp: Horsepower. The energy required to raise 33,000 pounds a distance of one foot in one minute. 1 hp is equal to 746 watts, or 0.746 kW.

Hi pot: A standard test on dry-type transformers consisting of extra-high potentials (voltages) connected to the windings. Used to check the integrity of insulation materials and clearances.

Hottest-spot temperature: The highest temperature inside the transformer winding. Is greater than the measured average temperature of the coil conductors, when using the resistance change method.

Hysteresis: The tendency of a magnetic substance to persist in any state of magnetization.

Impedance: The retarding forces of current in an AC circuit; the current-limiting characteristics of a transformer. Symbol = Z

Inductance: In electrical circuits, the opposition to a change in the flow of electrical current. Symbol = L

Inducted potential test: A standard dielectric test of transformer insulation. Verifies the integrity of insulating materials and electrical clearances.

Inrush current: The initial high peak of current that occurs in the first few cycles of energization, which can be 30 to 40 times the rated current.

Insulating transformer: Another term for an isolating transformer.

Insulation: Material with a high electrical resistance.

Insulation materials: Those materials used to insulate the transformer's electrical windings from each other and ground.

Integral TVSS or SPD: Major Standard Change for Surge Protective Devices (formerly known as Transient Voltage Surge Suppressors). The primary safety standard for transient voltage surge suppressors (TVSS) has undergone major revisions in the past three years with mandatory compliance by manufacturers required by September 29, 2009. Even the name of the standard has changed from UL Standard for Safety for Transient Voltage Surge Suppressors, UL 1449 to UL Standard for Safety for Surge Protective Devices, UL 1449. This means that TVSS listed to the UL 1449 2nd Edition standard will no longer be able to be manufactured after September 29, 2009. All Surge Protective Devices must be designed, tested, manufactured and listed to the UL 1449 3rd Edition standard after this date.

Isolating transformer: A transformer where the input (primary) windings are not connected to the output (secondary) windings (i.e., electrically isolated).

K-factor: A common industry term for the amount of harmonics produced by a given load. The larger the K-factor, the more harmonics that are present. Also used to define a transformer's ability to withstand the additional heating generated by harmonic currents.

kVA: Kilovolt-ampere. Designates the output that a transformer can deliver for a specified time at a rated secondary voltage and rated frequency without exceeding the specified temperature rise. When multiplied by the power factor, will give kilowatts or kW.

1000 VA = 1 kVA

Lamination: Thin sheets of electrical steel used to construct the core of a transformer.

Limiting temperature: The maximum temperature at which a component or material may be operated continuously with no sacrifice in normal life expectancy.

Linear load: A load where the current waveform conforms to that of the applied voltage, or a load where a change in current is directly proportional to a change in applied voltage.

Live part: Any component consisting of an electrically conductive material that can be energized under conditions of normal use.

Load losses: I^2R losses in windings. Also see conductor losses.

Low voltage winding: In a two-winding transformer, the winding intended to have the lesser voltage. Usually marked with "X" designations.

Mid-tap: See center tap.

Noise level: The relative intensity of sound, measured in decibels (dB). NEMA Standard ST-20 outlines the maximum allowable noise level for dry-type transformers.

Nonlinear load: A load where the current waveform does not conform to that of the applied voltage, or where a change in current is not proportional to a change in applied voltage.

Non-ventilated transformer: A transformer where the core and coil assembly is mounted inside an enclosure with no openings for ventilation. Also referred to as totally enclosed non-ventilated (TENV).

No load losses: Losses in a transformer that is excited at rated voltage and frequency but that is not supplying a load. No load losses include core losses, dielectric losses and conductor losses in the winding due to the exciting current. Also referred to as excitation losses.

Overload capability: Short-term overload capacity is designed into transformers as required by ANSI. Continuous overload capacity is not deliberately designed into a transformer because the design objective is to be within the allowed winding temperature rise with nameplate loading.

Percent IR (% resistance): Voltage drop due to resistance at rated current in percent of rated voltage.

Percent IX (% reactance): Voltage drop due to reactance at rated current in percent of rated voltage.

Percent IZ (% impedance): Voltage drop due to impedance at rated current in percent of rated voltage.

Phase: Type of AC electrical circuit; usually single-phase two- or three-wire, or three-phase three- or four-wire.

Polarity test: A standard test on transformers to determine instantaneous direction of the voltages in the primary compared to the secondary.

Primary taps: Taps added to the primary (input) winding. See Tap.

Primary voltage: The input circuit voltage.

Power factor: The cosine of the phase angle between a voltage and a current.

Ratio test: A standard test of transformers to determine the ratio of the input (primary) voltage to the output (secondary) voltage.

Reactance: The effect of inductive and capacitive components of a circuit producing other than unity power factor.

Reactor: A single winding device with an air or iron core that produces a specific amount of inductive reactance into a circuit. Normally used to reduce of control current.

Regulation: Usually expressed as the percent change in output voltage when the load goes from full load to no load.

Scott T connection: Connection for three-phase transformers. Instead of using three sets of coils for a three-phase load, the transformer uses only two sets of coils.

Series/multiple winding: A winding consisting of two or more sections that can be connected for series operation or multiple (parallel) operation. Also called series-parallel winding.

Short circuit: A low resistance connection, usually accidental, across part of a circuit, resulting in excessive current flow.

Sound levels: All transformers make some sound mainly due to the vibration generated in its core by alternating flux. All Eaton general-purpose dry-type distribution transformers are designed with sound levels lower than NEMA ST-20 maximum levels.

Star connection: Same as a wye connection.

Step-down transformer: A transformer where the input voltage is greater than the output voltage.

Step-up transformer: A transformer where the input voltage is less than the output voltage.

T-T connection: See Scott T connection.

Tap: A connection brought out of a winding at some point between its extremities, usually to permit changing the voltage or current ratio. Taps are typically used to compensate for above or below rated input voltage, in order to provide the rated output voltage. See FCAN and FCBN.

Temperature class: The maximum temperature that the insulation system of a transformer can continuously withstand. The common insulation classes are 105, 150, 180 (also 185) and 220.

Temperature rise: The increase over ambient temperature of the windings due to energizing and loading the transformer.

Total losses: The sum of the no-load losses and load losses.

Totally enclosed non-ventilated enclosure: The core and coil assembly is installed inside an enclosure that has no ventilation to cool the transformer. The transformer relies on heat to radiate from the enclosure for cooling.

Transformer tests: Per NEMA ST-20, routine transformer production tests are performed on each transformer prior to shipment. These tests are: *Ratio tests* on the rated voltage connection; *Polarity and Phase Relation tests* on the rated connection; *No-Load and Excitation Current tests* at rated voltage on the rated voltage connection and *Applied Potential and Induced Potential tests*. Special tests include sound level testing.

Transverse mode: Electrical noise or voltage disturbance that occurs between phase and neutral, or from spurious signals across metallic hot line and the neutral conductor.

Turns ratio: The ratio of the number of turns in the high voltage winding to that in the low voltage winding.

Typical test data: Tests that were performed on similar units that were previously manufactured and tested.

UL (Underwriters Laboratories): An independent safety testing organization.

Universal taps: A combination of six primary voltage taps consisting of 2 at +2-1/2% FCAN and 4 at -2-1/2% FCBN.

Watt: A unit of electrical power when the current in a circuit is one ampere and the voltage is one volt.

Wye connection: A standard three-wire transformer connection with similar ends of single-phase coils connected together. The common point forms the electrical neutral point and may be grounded. Also referred to as three-phase four-wire. To obtain the line-to-neutral voltage, divide the line voltage by $\sqrt{3}(1.732)$.

Frequently Asked Questions About Transformers

Can 60 Hz transformers be used at other frequencies?

Transformers rated for 60 Hz can be applied to circuits with a higher frequency, as long as the nameplate voltages are not exceeded. The higher the frequency that you apply to a 60 Hz transformer, the less voltage regulation you will have. 60 Hz transformers may be used at lower frequencies but only at reduced voltages corresponding to the reduction in frequency. For example, a 480 to 120 volt 60 Hz transformer can carry rated kVA at 50 Hz but ONLY when applied as a 400 to 100 volt transformer (50/60 x 480 = 400).

Can single-phase transformers be used on a three-phase source?

Yes. Any single-phase transformer can be used on a three-phase source by connecting the primary terminals of the single-phase transformer to any two wires of a three-phase system. It does not matter whether the three-phase source is three-phase three-wire or three-phase four-wire. The output of the transformer will be single-phase.

Can transformers be used to create three-phase power from a single-phase system?

No. Single-phase transformers alone cannot be used to create the phase-shifts required for a three-phase system. Phase shifting devices (reactors or capacitors) or phase converters in conjunction with transformers are required to change single-phase power to three-phase.

What considerations need to be taken into account when operating transformers at high altitudes?

At altitudes greater than 3300 feet (1000 meters), the density of the air is less than at lower elevations. This reduces the ability of the air surrounding a transformer to cool it, so the temperature rise of the transformer is increased. Therefore, when a transformer is being installed at altitudes greater than 3300 feet above sea level, it is necessary to derate the nameplate kVA by 0.3% for each 330 feet (100 meters) in excess of 3300 feet (1000 meters).

What considerations need to be taken into account when operating transformers where the ambient temperature is high?

Eaton's dry-type transformers are designed in accordance with ANSI standards to operate in areas where the average maximum ambient temperature is 40°C. For operation in ambient temperatures above 40°C, there are two options:

1. Order a custom designed transformer made for the specific application.
2. Derate the nameplate kVA of a standard transformer by 8% for each 10°C of ambient above 40°C.

What is the normal life expectancy of a transformer?

When a transformer is operated under ANSI/IEEE basic loading conditions ANSI C57.96), its normal life expectancy is 20 years. The ANSI/IEEE basic loading conditions are:

A. The transformer is continuously loaded at rated kVA and rated voltages.

B. The average temperature of the ambient air during any 24-hour period is equal to 30°C and at no time exceeds 40°C.

C. The altitude where the transformer is installed does not exceed 3300 feet (1000 meters).

What are insulation classes?

Insulation classes were originally used to distinguish insulating materials operating at different temperatures. In the past, letters were used for the different designations. Recently, insulation system temperatures (°C) have replaced the letters' designations.

Insulation Classes

Previous Designation	Insulation System Rating (°C)
Class A	105
Class B	150
Class F	180
Class H	220
Class R	220

How do you know if the enclosure temperature is too hot?

UL and CSA standards strictly regulate the highest temperature that an enclosure can reach. For ventilated transformers, the temperature of the enclosure should not increase by more than 50°C in a 40°C ambient at full rated current. For encapsulated transformers, the temperature of the enclosure should not increase by more than 65°C in a 25°C ambient at full rated current. This means that it is permissible for the temperature of the enclosure to reach 90°C (194°F). Although this temperature is very warm to the touch, it is within the allowed standards. A thermometer should be used to measure enclosure temperatures, not your hand.

Can transformers be reverse-connected (reverse-fed)?

Yes, with limitations. Eaton single-phase transformers rated 3 kVA and larger can be reverse-connected without any loss of kVA capacity or any adverse effects. Transformers rated 2 kVA and below, because there is a turns ratio compensation on the low voltage winding that adjusts voltage between no load and full load conditions, should not be reverse-fed.

Three-phase transformers with either delta-delta or delta-wye configurations can also be reverse-connected for step-up operation. When reverse-feeding a delta-wye connected transformer, there are two important considerations to take into account: (1) The neutral is not connected, only the three-phase wires of the wye system are connected, and (2) the ground strap between X0 and the enclosure must be removed. Due to high inrush currents that may be created in these applications, it is recommended that you do not reverse-feed transformers rated more than 75 kVA. The preferred solution is to purchase an Eaton step-up transformer designed specifically for your application.

Can transformers be connected in parallel?

Yes, with certain restrictions. For single-phase transformers being connected in parallel, the voltages and impedances of the transformers must be equal (impedances must be within 7.5% of each other). For three-phase transformers, the same restrictions apply as for single-phase transformers, plus the phase shift of the transformers must be the same. For example, a delta-wye–connected transformer (30° phase shift) must be connected in parallel with another delta-wye–connected transformer, not a delta-delta connected–transformer (0° phase shift).

Why is the impedance of a transformer important?

The impedance of a transformer is important because it is used to determine the interrupting rating and trip rating of the circuit protection devices on the load or line side of the transformer. To calculate the maximum short circuit current on the load side of a transformer, use the following formula:

$$\text{Maximum Short Circuit Load Current (Amps)} = \frac{\text{Full Load Current (Amps)}}{\text{Transformer Impedance}}$$

Full load current for single-phase circuits is:

$$\frac{\text{Nameplate Volt-Amps}}{\text{Load (output) Voltage}}$$

and for three-phase circuits, the full load current is:

$$\frac{\text{Nameplate Volts-Amps}}{\text{Load (output) Volts} \times \sqrt{3}}$$

Example: For a standard three-phase, 75 kVA transformer, rated 480 volt delta primary and 208Y/120 volt secondary (catalog number V48M28T75J) and impedance equal to 5.1%, the full load current is:

$$\frac{75{,}000\ \text{VA}}{208\text{V} \times 1.732} = 208.2\text{A}$$

The maximum short circuit load current is:

$$\frac{208.2\text{A}}{0.051} = 4{,}082.4\text{A}$$

The circuit breaker or fuse on the secondary side of this transformer would have to have a minimum interrupting capacity of 4083 amperes at 208 volts. NEMA ST-20 (1992).

A similar transformer with lower impedance would require a primary circuit breaker or fuse with a higher interrupting capacity.

What clearances are required around transformers when they are installed?

All dry-type transformers depend upon the circulation of air for cooling; therefore, it is important that the flow of air around a transformer not be impeded. UL 1561 requires that there be no less than 6 inches (152.4 mm) clearance between any side transformer with ventilation openings and any wall or obstruction. In compliance with NEC 450-9, Eaton's ventilated transformers have a note on their nameplates requiring a minimum of 6 inches (152.4 mm) clearance from the ventilation openings and walls or other obstructions. This clearance only addresses the ventilation needs of the transformer. There may be additional local codes and standards that affect installation clearances.

Transformers should not be mounted in such a manner that one unit will contribute to the additional heating of another unit, beyond allowable temperature limits, for example, where two units are mounted on a wall one above the other.

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