

# Primary Unit Substations Secondary 1000 V & Above

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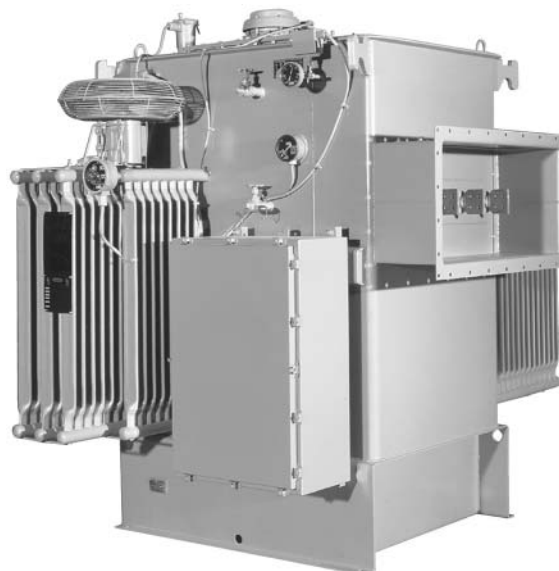
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#### Specifications

See Eaton's Cutler-Hammer Product Specification Guide on enclosed CD-ROM:

CSI Format: .....	1995	2004
	<b>Section 16312</b>	<b>Section 26 11 13</b>



*Primary Unit Substation Transformer — Liquid Filled*

## General Description — Liquid-Type

## General Description

## Definition

A primary unit substation is a close-coupled assembly consisting of enclosed primary high voltage equipment, 3-phase power transformer, and enclosed secondary medium voltage equipment. The following electrical ratings are typical:

- Primary voltage: 6.9 – 69 kV.
- Transformer kVA: 500 – 20,000 kVA.
- Secondary voltage: 2.4 kV – 34.5 kV.

A primary unit substation is defined in the following standards:

- NEMA® Standard No. 201-1982.
- IEEE Standard No. 100-1977.

Primary unit substations are used to step down utility distribution voltages to in-plant distribution voltages.

Primary unit substation transformers are designed, manufactured and tested in accordance with applicable IEEE standards.

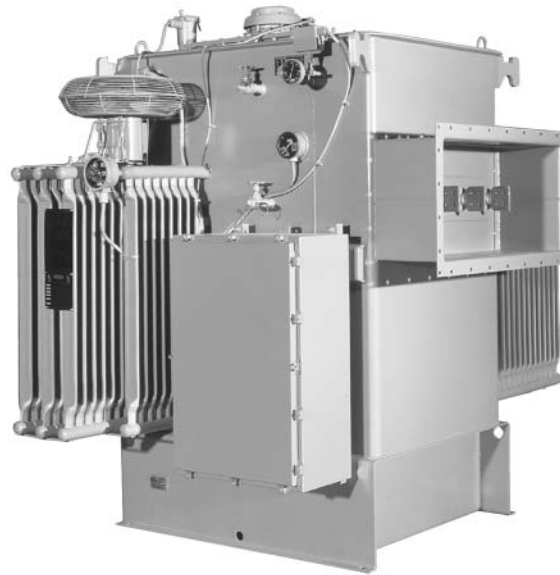
## Advantages

As a result of locating power transformers and their close-coupled equipment as close as possible to the areas of load concentration, the secondary distribution cables or busways are kept to minimum lengths. This concept has obvious advantages such as:

- Reduced power losses.
- Improved voltage regulation.
- Improved service continuity.
- Reduced exposure to faults.
- Increased flexibility.
- Minimum installation cost.
- Efficient space utilization.

Additional advantages of Eaton's Cutler-Hammer® unit substations in this unified approach are:

- Single-source responsibility.
- Complete electrical and mechanical control over coordination of the three close-coupled sections.
- Availability of all switchgear types as secondaries gives broad application flexibility.
- Modern design.
- Composite assembly retains proven safety and integrity of each of its three major parts.



Primary Unit Substation Transformer — Liquid Filled

## Easier to Specify

Standardization through IEEE standards results in proven designs with complete accessory equipment and features.

## Highest Short Circuit Strength

Highly researched and thoroughly tested designs provide the short circuit strength necessary to withstand the repeated large short circuit currents that are available in modern systems.

## Easier Handling and Reduced Maintenance

Compact designs reduce the cost of rigging and hauling and require smaller installation space. Straight-forward design and simplified accessories reduce maintenance costs.

## Ratings Available

## kVA — Three-Phase:

- 6.9 – 69 kV (350 kV BIL and below).
- 500 – 20,000 kVA.

## Frequency:

- 60 Hz or 50 Hz.

## Transformer Fluids:

- Mineral oil.
- Silicone fluid.
- Environmentally friendly fluid.

**Note:** For additional information about insulating fluids, see Sections 14.0-3 - 14.0-8.

## Primary and Secondary Equipment:

- Air terminal chamber (ATC).
- Load interrupter switchgear, Type MVS.
- Metal-enclosed circuit breaker switchgear, Types MEB, MEF and MSB.
- Metal-clad circuit breaker switchgear, Type VacClad-W.
- MV motor control assemblies, Type AMPGARD.
- Cover mounted bushings (liquid transformer only).
- Medium voltage busway.

**Note:** For additional information about transformer applications and types of insulating fluids, see **Section 14**.

## General Description — Liquid-Type

**Standard Features —  
Liquid-Filled Transformer**

① Cover — welded to tank.

② Cooling tubes (Radiators).

**Note:** Radiator position and number of radiators will vary based upon design.

③ Bolted handhole on cover.

④ Automatic resealing mechanical pressure relief device.

⑤ HV bushing, three total, located in ANSI Segment 2.

⑥ LV bushing, four total (wye connected), located in ANSI Segment 4.

**Note:** HV and LV bushings may be cover mounted or left/right orientation may be reversed.

⑦ Z-Bar flange.

⑧ Lifting loops — two for lifting cover only.

⑨ Lifting hooks — four for lifting complete unit.

⑩ Jacking provisions on tank or base.

⑪ Ground pad — two total.

⑫ Drain valve — for combination lower filter press connection and complete drain with sampler.

⑬ Base (may be flat or formed).

⑭ Control cabinet for alarm lead termination.

⑮ Diagram instruction nameplate with warning nameplate.

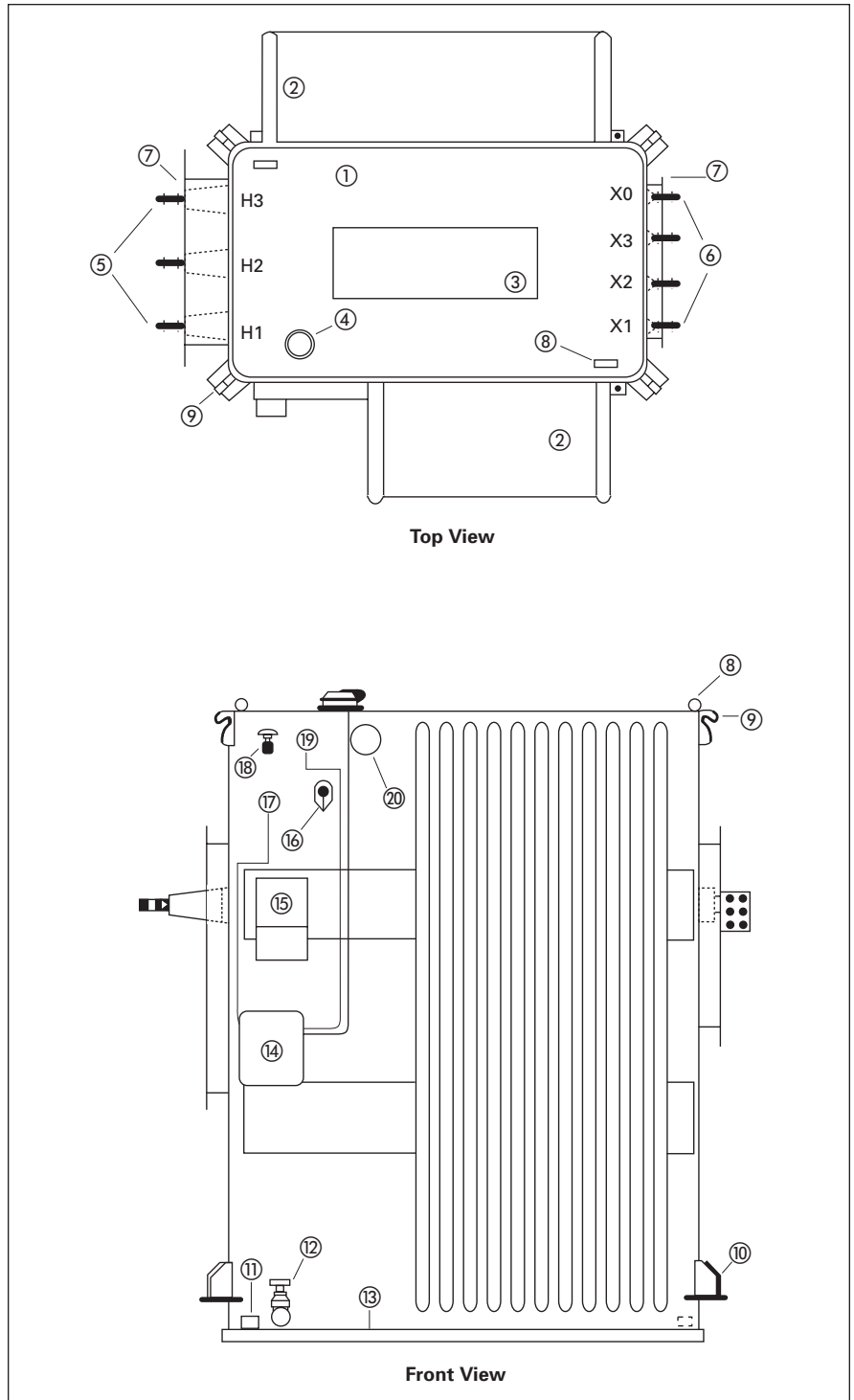
⑯ De-energized tap changer with padlock provisions.

⑰ Liquid temperature indicator with maximum indicating hand.

⑱ Upper valve for upper filter press connection.

⑲ Magnetic liquid level gauge.

⑳ Vacuum pressure gauge with air test and Sealedaire® valve.



**Figure 13.0-1. Liquid-Filled Primary Unit Substation Transformer with Wall-Mounted HV and LV Bushings**

Layout Dimensions — Liquid-Type

Layout Dimensions

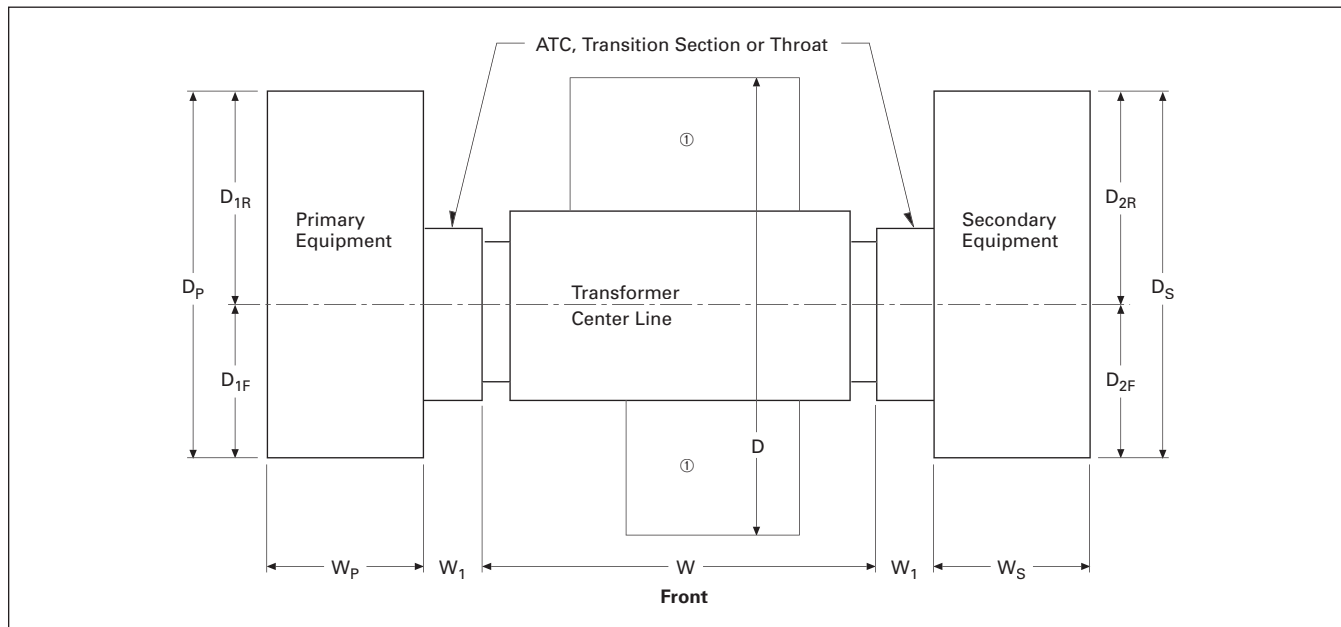


Figure 13.0-2. Outdoor Liquid-Filled Primary Unit Substations — Plan View

① Radiator position and number of radiators will vary based on design.

Table 13.0-1. Outdoor Dimension References

Equipment	Dimensions	Reference
Transformer	W, D	Pages 13.0-5 through 13.0-7
MVC	Ws, Ds	Pages 10.0-25 through 10.0-37
MVS	Wp, Dp, Ws, Ds	Pages 8.0-15 through 8.0-23
ME	Wp, Dp, Ws, Ds	Pages 7.1-4 through 7.1-5
MC	Wp, Dp, Ws, Ds	Pages 5.5-1 through 5.5-6

Legend:

- ATC = Air Terminal Chamber
- MVC = Medium Voltage Motor Control, Type AMPGARD
- MVS = Medium Voltage Metal-Enclosed Switches, Type MVS
- ME = Medium Voltage Metal-Enclosed Breakers, Type MEB, MEF, MSB
- MC = Medium Voltage Metal-Clad Breaker Assemblies, Type VacClad-W

Air Terminal Chamber (ATC), Transition Section or Throat and other Reference Dimensions

Primary or Secondary Equipment	3-Phase, 3-Wire or 4-Wire ②				
	D1F	D1R	W1	D2F	D2R
5 kV MVC ②	—	—	12	—	21
5 kV ATC	—	—	22	—	—
or 15 kV MVS	25.25 ③	—	20	25.25 ③	—
ME	25.25 ③	—	20	25.25 ③	—
MC	—	16.5 ④	16	—	16.5 ④
27 kV ATC	—	—	25	—	—
MVS	⑤	—	35	⑤	—
ME	⑤	—	35	⑤	—
MC ⑥	—	—	—	—	—
38 kV ATC	—	—	35	—	—
MVS	⑤	—	35	⑤	—
ME ⑥	—	—	—	—	—
MC ⑤	—	—	—	—	—

② 4-wire connections are not available with MVC equipment.

③ For 3-phase, 4-wire, D1F and D2F are 30.25.

④ For 3-phase, 4-wire, D1R and D2R are 14.5.

⑤ Contact Eaton.

⑥ This product is not available for this voltage and configuration.

Layout Dimensions — Liquid-Type

For special 55°C rise units, bus duct throats, and air terminal chambers, see **Notes 2 through 6** at bottom of page for dimensions which should be added to the table dimensions.

**Table 13.0-2. 65°C Rise, Oil-Filled  
HV 6900D, 75 BIL  
LV 2400Y, 45 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
500	4520 (2052)	120 (454)	92 (2336.8)	56 (1422.4)	74 (1879.6)
750	4720 (2143)	150 (568)	92 (2336.8)	56 (1422.4)	74 (1879.6)
1000	5590 (2538)	170 (643)	92 (2336.8)	59 (1498.6)	84 (2133.6)
1500	7380 (3351)	210 (795)	92 (2336.8)	67 (1701.8)	95 (2413.0)
2000	8890 (4036)	240 (908)	92 (2336.8)	70 (1778.0)	105 (2667.0)
2500	10,060 (4567)	260 (984)	92 (2336.8)	70 (1778.0)	118 (2997.2)
3000	11,110 (5044)	290 (1098)	95 (2413.0)	70 (1778.0)	127 (3225.8)
3750	13,200 (5993)	340 (1287)	95 (2413.0)	73 (1854.2)	127 (3225.8)
5000	18,020 (8181)	620 (2345)	113 (2870.2)	74 (1879.6)	129 (3276.6)

**Table 13.0-3. 65°C Rise, Oil-Filled  
HV 13800D, 95 BIL  
LV 2400Y, 45 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	4840 (2197)	160 (606)	92 (2336.8)	56 (1422.4)	79 (2006.6)
1000	5720 (2597)	180 (681)	92 (2336.8)	59 (1498.6)	78 (1981.2)
1500	7370 (3346)	210 (795)	92 (2336.8)	65 (1651.0)	92 (2336.8)
2000	8760 (3977)	230 (871)	92 (2336.8)	68 (1727.2)	114 (2895.6)
2500	9940 (4513)	260 (984)	92 (2336.8)	68 (1727.2)	125 (3175.0)
3000	11,650 (5289)	350 (1325)	95 (2413.0)	70 (1778.0)	127 (3225.8)
3750	13,330 (6052)	390 (1476)	95 (2413.0)	72 (1828.8)	127 (3225.8)
5000	16,640 (7555)	480 (1817)	95 (2413.0)	75 (1905.0)	131 (3327.4)
7500	30,300 (13,756)	1220 (4615)	114 (2895.6)	113 (2870.2)	138 (3505.2)
10,000	34,830 (15,813)	1230 (4653)	114 (2895.6)	118 (2997.2)	139 (3530.6)

**Table 13.0-4. 65°C Rise, Oil-Filled  
HV 13800D, 95 BIL  
LV 4160Y, 60 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	5120 (2324)	170 (643)	92 (2336.8)	57 (1447.8)	79 (2006.6)
1000	5980 (2715)	180 (681)	92 (2336.8)	62 (1574.8)	81 (2057.4)
1500	7280 (3305)	210 (795)	92 (2336.8)	63 (1600.2)	100 (2540.0)
2000	8700 (3950)	230 (871)	92 (2336.8)	65 (1651.0)	108 (2743.2)
2500	10,290 (4672)	270 (1022)	92 (2336.8)	70 (1778.0)	114 (2895.6)
3000	11,860 (5384)	320 (1211)	95 (2413.0)	73 (1854.2)	127 (3225.8)
3750	13,410 (6088)	360 (1363)	95 (2413.0)	73 (1854.2)	129 (3276.6)
5000	17,030 (7732)	520 (1968)	99 (2514.6)	75 (1905.0)	131 (3327.4)
7500	29,720 (13,493)	1140 (4313)	109 (2768.6)	113 (2870.2)	140 (3556.0)
10,000	35,790 (16,249)	1310 (4956)	116 (2946.4)	117 (2971.8)	143 (3632.2)

- Notes:**
1. Dimensions are APPROXIMATE. NOT FOR CONSTRUCTION.
  2. For 55°C units, add 5 inches (127.0 mm) to "W" dimension and 10 inches (254.0 mm) to "D" dimension.
  3. Add 9 inches (228.6 mm) to "W" dimension for each bus duct throat.
  4. Add 22 inches (558.8 mm) to "W" dimension for each 15 kV air terminal chamber.
  5. Add 25 inches (635.0 mm) to "W" dimension for each 27 kV air terminal chamber.
  6. Add 35 inches (889.0 mm) to "W" dimension for each 34.5 kV air terminal chamber.

**Table 13.0-5. 65°C Rise, Oil-Filled  
HV 22900D, 150 BIL  
LV 2400Y, 45 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	5650 (2565)	220 (833)	92 (2336.8)	59 (1498.6)	81 (2057.4)
1000	6400 (2906)	220 (833)	92 (2336.8)	61 (1549.4)	87 (2209.8)
1500	8020 (3641)	250 (946)	92 (2336.8)	64 (1625.6)	101 (2565.4)
2000	9500 (4313)	280 (1060)	92 (2336.8)	68 (1727.2)	101 (2565.4)
2500	10,550 (4790)	300 (1136)	92 (2336.8)	70 (1778.0)	107 (2717.8)
3000	12,000 (5448)	330 (1249)	95 (2413.0)	73 (1854.2)	127 (3225.8)
3750	14,350 (6515)	450 (1703)	95 (2413.0)	73 (1854.2)	128 (3251.2)
5000	19,110 (8676)	700 (2648)	117 (2971.8)	74 (1879.6)	129 (3276.6)
7500	30,880 (14,020)	1210 (4577)	117 (2971.8)	102 (2590.8)	140 (3556.0)
10,000	39,080 (17,742)	1600 (6053)	124 (3149.6)	106 (2692.4)	145 (3683.0)

**Table 13.0-6. 65°C Rise, Oil-Filled  
HV 22900D, 150 BIL  
LV 4160Y, 60 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	5660 (2570)	210 (795)	92 (2336.8)	58 (1473.2)	83 (2108.2)
1000	6640 (3015)	230 (871)	92 (2336.8)	62 (1574.8)	87 (2209.8)
1500	8000 (3632)	250 (946)	92 (2336.8)	64 (1625.6)	107 (2717.8)
2000	9350 (4245)	290 (1098)	92 (2336.8)	66 (1676.4)	107 (2717.8)
2500	10,860 (4930)	310 (1173)	92 (2336.8)	71 (1803.4)	107 (2717.8)
3000	12,400 (5630)	340 (1287)	95 (2413.0)	73 (1854.2)	130 (3302.0)
3750	14,500 (6583)	430 (1628)	95 (2413.0)	74 (1879.6)	130 (3302.0)
5000	19,510 (8858)	720 (2725)	118 (2997.2)	74 (1879.6)	132 (3352.8)
7500	30,270 (13,743)	1120 (4239)	118 (2997.2)	101 (2565.4)	143 (3632.2)
10,000	38,140 (17,316)	1500 (5675)	124 (3149.6)	105 (2667.0)	146 (3708.4)

**Table 13.0-7. 65°C Rise, Oil-Filled  
HV 22900D, 150 BIL  
LV 12470Y, 95 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	6630 (3010)	250 (946)	92 (2336.8)	65 (1657.0)	64 (1625.6)
1000	7510 (3410)	280 (1060)	92 (2336.8)	66 (1676.4)	78 (1981.2)
1500	9040 (4104)	290 (1098)	92 (2336.8)	69 (1752.6)	88 (2235.2)
2000	10,110 (4590)	290 (1098)	92 (2336.8)	70 (1778.0)	96 (2438.4)
2500	11,670 (5298)	330 (1249)	92 (2336.8)	73 (1854.2)	106 (2692.4)
3000	12,760 (5793)	350 (1325)	95 (2413.0)	74 (1879.6)	130 (3302.0)
3750	15,280 (6937)	440 (1665)	95 (2413.0)	75 (1905.0)	133 (3378.2)
5000	19,370 (8794)	650 (2460)	107 (2717.8)	76 (1930.4)	136 (3454.4)
7500	30,850 (14,006)	1180 (4464)	114 (2895.6)	100 (2540.0)	139 (3530.6)
10,000	38,320 (17,397)	1450 (5485)	122 (3098.8)	104 (2641.6)	143 (3632.2)

Layout Dimensions — Liquid-Type

For special 55°C rise units, bus duct throats, and air terminal chambers, see **Notes 2 through 6** at bottom of page for dimensions which should be added to the table dimensions.

**Table 13.0-8. 65°C Rise, Oil-Filled  
HV 34400D, 200 BIL  
LV 2400Y, 45 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	7000 (3178)	330 (1249)	115 (2921.0)	67 (1701.8)	66 (1676.4)
1000	7720 (3505)	350 (1325)	115 (2921.0)	67 (1701.8)	79 (2006.6)
1500	9880 (4486)	380 (1438)	115 (2921.0)	69 (1752.6)	98 (2489.2)
2000	11,300 (5130)	410 (1552)	115 (2921.0)	71 (1803.4)	112 (2844.8)
2500	12,880 (5848)	450 (1703)	115 (2921.0)	71 (1803.4)	122 (3098.8)
3000	13,760 (6247)	460 (1741)	115 (2921.0)	72 (1828.8)	130 (3302.0)
3750	16,030 (7278)	520 (1968)	115 (2921.0)	85 (2159.0)	136 (3454.4)
5000	19,780 (8980)	660 (2498)	117 (2971.8)	100 (2540.0)	138 (3505.2)
7500	30,270 (13,743)	1070 (4048)	129 (3276.6)	124 (3149.6)	138 (3505.2)
10,000	39,290 (17,838)	1480 (5600)	136 (3454.4)	127 (3225.8)	140 (3556.0)

**Table 13.0-9. 65°C Rise, Oil-Filled  
HV 34400D, 200 BIL  
LV 4160Y, 60 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	7230 (3282)	340 (1287)	115 (2921.0)	68 (1727.2)	67 (1701.8)
1000	8040 (3650)	360 (1363)	115 (2921.0)	68 (1727.2)	80 (2032.0)
1500	9920 (4504)	390 (1476)	115 (2921.0)	69 (1752.6)	94 (2387.6)
2000	11,700 (5312)	430 (1628)	115 (2921.0)	71 (1803.4)	116 (2946.4)
2500	13,120 (5956)	460 (1741)	115 (2921.0)	73 (1854.2)	124 (3149.6)
3000	14,400 (6538)	500 (1892)	115 (2921.0)	76 (1930.4)	128 (3251.2)
3750	16,210 (7359)	540 (2044)	115 (2921.0)	77 (1955.8)	136 (3454.4)
5000	20,490 (9302)	740 (2800)	124 (3149.6)	95 (2413.0)	139 (3530.6)
7500	31,470 (14,287)	1190 (4502)	133 (3378.2)	122 (3098.8)	140 (3556.0)
10,000	36,390 (16,521)	1190 (4502)	132 (3352.8)	125 (3175.0)	145 (3683.0)

**Table 13.0-10. 65°C Rise, Oil-Filled  
HV 34400D, 200 BIL  
LV 13800Y, 95 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	9110 (4136)	410 (1552)	115 (2921.0)	72 (1828.8)	63 (1600.2)
1000	9370 (4254)	390 (1476)	115 (2921.0)	72 (1828.8)	70 (1778.0)
1500	10,760 (4885)	410 (1552)	115 (2921.0)	72 (1828.8)	93 (2362.2)
2000	12,210 (5543)	450 (1703)	115 (2921.0)	72 (1828.8)	108 (2743.2)
2500	13,600 (6174)	470 (1779)	115 (2921.0)	74 (1879.6)	109 (2768.6)
3000	14,990 (6805)	510 (1930)	115 (2921.0)	77 (1955.8)	125 (3175.0)
3750	16,590 (7532)	540 (2044)	115 (2921.0)	77 (1955.8)	137 (3479.8)
5000	20,480 (9298)	710 (2687)	122 (3098.8)	94 (2387.6)	138 (3505.2)
7500	32,220 (14,628)	1050 (3972)	125 (3175.0)	123 (3124.2)	139 (3530.6)
10,000	38,460 (17,461)	1350 (5107)	135 (3429.0)	124 (3149.6)	148 (3759.2)

- Notes:**
1. Dimensions are APPROXIMATE. NOT FOR CONSTRUCTION.
  2. For 55°C units, add 5 inches (127.0 mm) to "W" dimension and 10 inches (254.0 mm) to "D" dimension.
  3. Add 9 inches (228.6 mm) to "W" dimension for each bus duct throat.
  4. Add 22 inches (558.8 mm) to "W" dimension for each 15 kV air terminal chamber.
  5. Add 25 inches (635.0 mm) to "W" dimension for each 27 kV air terminal chamber.
  6. Add 35 inches (889.0 mm) to "W" dimension for each 34.5 kV air terminal chamber.

**Table 13.0-11. 65°C Rise,  
Silicone/Environmentally Friendly Fluid  
HV 6900D, 75 BIL  
LV 2400Y, 45 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	4930 (2238)	160 (606)	87 (2209.8)	48 (1219.2)	76 (1930.4)
1000	5940 (2697)	180 (681)	87 (2209.8)	52 (1320.8)	92 (2336.8)
1500	7690 (3491)	220 (833)	87 (2209.8)	59 (1498.6)	95 (2413.0)
2000	9270 (4209)	250 (946)	87 (2209.8)	62 (1574.8)	107 (2717.8)
2500	10,630 (4826)	280 (1060)	87 (2209.8)	62 (1574.8)	112 (2844.8)
3000	12,280 (5575)	340 (1287)	87 (2209.8)	63 (1600.2)	121 (3073.4)
3750	14,540 (6601)	380 (1438)	87 (2209.8)	67 (1701.8)	122 (3098.8)
5000	18,620 (8453)	580 (2195)	98 (2489.2)	68 (1727.2)	123 (3124.2)

**Table 13.0-12. 65°C Rise,  
Silicone/Environmentally Friendly Fluid  
HV 13800D, 95 BIL  
LV 2400Y, 45 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	5010 (2275)	160 (606)	87 (2209.8)	48 (1219.2)	79 (2006.6)
1000	6090 (2765)	180 (681)	87 (2209.8)	53 (1346.2)	82 (2082.8)
1500	7730 (3509)	220 (833)	87 (2209.8)	55 (1397.0)	116 (2946.4)
2000	9270 (4209)	250 (946)	87 (2209.8)	59 (1498.6)	118 (2997.2)
2500	10,510 (4772)	270 (1022)	87 (2209.8)	61 (1549.4)	119 (3022.6)
3000	12,100 (5493)	310 (1173)	87 (2209.8)	65 (1651.0)	119 (3022.6)
3750	14,380 (6529)	390 (1476)	87 (2209.8)	65 (1651.0)	121 (3073.4)
5000	18,490 (8394)	560 (2118)	97 (2463.8)	68 (1727.2)	122 (3098.8)
7500	32,180 (14,610)	1020 (3861)	1020 (3861)	112 (2844.8)	131 (3327.4)
10,000	46,580 (21,147)	1760 (6658)	119 (3022.6)	120 (3048.0)	131 (3327.4)

**Table 13.0-13. 65°C Rise,  
Silicone/Environmentally Friendly Fluid  
HV 13800D, 95 BIL  
LV 4160Y, 60 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	5340 (2424)	180 (681)	87 (2209.8)	49 (1244.6)	79 (2006.6)
1000	6120 (2778)	190 (719)	87 (2209.8)	51 (1295.4)	82 (2082.8)
1500	7660 (3478)	220 (833)	87 (2209.8)	56 (1422.4)	116 (2946.4)
2000	9080 (4122)	250 (946)	87 (2209.8)	59 (1498.6)	118 (2997.2)
2500	11,180 (5076)	290 (1098)	87 (2209.8)	64 (1625.6)	119 (3022.6)
3000	12,470 (5661)	310 (1173)	87 (2209.8)	66 (1676.4)	115 (2921.0)
3750	14,590 (6624)	360 (1363)	87 (2209.8)	68 (1727.2)	121 (3073.4)
5000	18,330 (8322)	540 (2044)	93 (2362.2)	68 (1727.2)	122 (3098.8)
7500	31,330 (14,224)	970 (3671)	98 (2489.2)	111 (2819.4)	131 (3327.4)
10,000	39,050 (17,729)	1230 (4653)	101 (2565.4)	114 (2895.6)	131 (3327.4)

Layout Dimensions — Liquid-Type

For special 55°C rise units, bus duct throats, and air terminal chambers, see **Notes 2 through 6** at bottom of page for dimensions which should be added to the table dimensions.

**Table 13.0-14. 65°C Rise, Silicone/Environmentally Friendly Fluid HV 22900D, 150 BIL LV 2400Y, 45 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	5970 (2710)	230 (870)	87 (2209.8)	52 (1320.8)	73 (1854.2)
1000	6820 (3096)	240 (908)	87 (2209.8)	54 (1371.6)	91 (2311.4)
1500	8710 (3954)	280 (1060)	87 (2209.8)	57 (1447.8)	95 (2413.0)
2000	10,140 (4604)	310 (1173)	87 (2209.8)	58 (1473.2)	110 (2794.0)
2500	11,890 (5398)	338 (1279)	87 (2209.8)	62 (1574.8)	121 (3073.4)
3000	13,480 (6120)	380 (1438)	87 (2209.8)	66 (1676.4)	124 (3149.6)
3750	15,820 (7182)	440 (1665)	87 (2209.8)	68 (1727.2)	125 (3175.0)
5000	19,250 (8740)	540 (2043)	87 (2209.8)	70 (1778.0)	129 (3276.6)
7500	32,700 (14,846)	1090 (4123)	100 (2540.0)	99 (2514.6)	133 (3378.2)
10,000	50,160 (22,773)	2200 (8323)	120 (3048.0)	118 (2997.2)	133 (3378.2)

**Table 13.0-15. 65°C Rise, Silicone/Environmentally Friendly Fluid HV 22900D, 150 BIL LV 4160Y, 60 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	6090 (2765)	230 (870)	87 (2209.8)	52 (1320.8)	75 (1905.0)
1000	7110 (3228)	250 (946)	87 (2209.8)	55 (1397.0)	91 (2311.4)
1500	8630 (3918)	280 (1060)	87 (2209.8)	56 (1422.4)	102 (2590.8)
2000	10,050 (4563)	310 (1173)	87 (2209.8)	58 (1473.2)	107 (2717.8)
2500	12,170 (5525)	350 (1325)	87 (2209.8)	63 (1600.2)	114 (2895.6)
3000	13,600 (6174)	380 (1438)	87 (2209.8)	66 (1676.4)	116 (2946.4)
3750	15,300 (6946)	420 (1590)	87 (2209.8)	68 (1727.2)	126 (3200.4)
5000	19,350 (8785)	580 (2195)	89 (2260.6)	70 (1778.0)	129 (3276.6)
7500	32,590 (14,796)	1040 (3934)	94 (2387.6)	98 (2489.2)	134 (3403.6)
10,000	40,250 (18,274)	1370 (5183)	109 (2768.6)	102 (2590.8)	137 (3479.8)

**Table 13.0-16. 65°C Rise, Silicone/Environmentally Friendly Fluid HV 22900D, 150 BIL LV 12470Y, 95 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	6930 (3146)	260 (984)	87 (2209.8)	56 (1422.4)	66 (1676.4)
1000	7920 (3596)	300 (1136)	87 (2209.8)	58 (1473.2)	72 (1828.8)
1500	9370 (4254)	310 (1173)	87 (2209.8)	59 (1498.6)	90 (2286.0)
2000	11,240 (5103)	330 (1249)	87 (2209.8)	62 (1574.8)	104 (2641.6)
2500	12,760 (5793)	370 (1400)	87 (2209.8)	66 (1676.4)	110 (2794.0)
3000	14,260 (6474)	390 (1476)	87 (2209.8)	69 (1752.6)	111 (2819.4)
3750	15,910 (7223)	420 (1590)	87 (2209.8)	69 (1752.6)	122 (3098.8)
5000	19,830 (9003)	530 (2006)	89 (2209.8)	71 (1803.4)	130 (3302.0)
7500	33,990 (15,431)	1100 (4164)	94 (2387.6)	97 (2463.8)	139 (3530.6)
10,000	39,610 (17,983)	1280 (4845)	109 (2768.6)	99 (2514.6)	139 (3530.6)

- Notes:**
1. Dimensions are APPROXIMATE. NOT FOR CONSTRUCTION.
  2. For 55°C units, add 5 inches (127.0 mm) to "W" dimension and 10 inches (254.0 mm) to "D" dimension.
  3. Add 9 inches (228.6 mm) to "W" dimension for each bus duct throat.
  4. Add 22 inches (558.8 mm) to "W" dimension for each 15 kV air terminal chamber.
  5. Add 25 inches (635.0 mm) to "W" dimension for each 27 kV air terminal chamber.
  6. Add 35 inches (889.0 mm) to "W" dimension for each 34.5 kV air terminal chamber.

**Table 13.0-17. 65°C Rise, Silicone/Environmentally Friendly Fluid HV 34400D, 200 BIL LV 2400Y, 45 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	7600 (3450)	370 (1400)	107 (2717.8)	60 (1524.0)	68 (1727.2)
1000	8460 (3841)	390 (1476)	107 (2717.8)	60 (1524.0)	84 (2133.6)
1500	10,720 (4867)	420 (1590)	107 (2717.8)	62 (1574.8)	107 (2717.8)
2000	12,260 (5566)	460 (1741)	107 (2717.8)	64 (1625.6)	115 (2921.0)
2500	13,760 (6247)	490 (1855)	107 (2717.8)	64 (1625.6)	121 (3073.4)
3000	15,020 (6819)	520 (1968)	107 (2717.8)	66 (1676.4)	121 (3073.4)
3750	16,920 (7695)	570 (2157)	107 (2717.8)	78 (1981.2)	129 (3276.6)
5000	20,270 (9203)	650 (2460)	109 (2768.6)	92 (2336.8)	132 (3352.8)
7500	33,980 (15,427)	1200 (4542)	120 (3048.0)	117 (2971.8)	136 (3454.4)
10,000	42,340 (19,222)	1440 (5448)	129 (3276.6)	150 (3810.0)	136 (3454.4)

**Table 13.0-18. 65°C Rise, Silicone/Environmentally Friendly Fluid HV 34400D, 200 BIL LV 4160Y, 60 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	7930 (3600)	380 (1438)	107 (2717.8)	61 (1549.4)	68 (1727.2)
1000	8840 (4013)	400 (1514)	107 (2717.8)	61 (1549.4)	81 (2057.4)
1500	10,710 (4862)	440 (1665)	107 (2717.8)	62 (1574.8)	95 (2413.0)
2000	12,530 (5689)	470 (1779)	107 (2717.8)	64 (1625.6)	117 (2971.8)
2500	13,920 (6320)	500 (1892)	107 (2717.8)	66 (1676.4)	117 (2971.8)
3000	15,620 (7091)	560 (2118)	107 (2717.8)	69 (1752.6)	127 (3225.8)
3750	17,580 (7981)	610 (2309)	107 (2717.8)	71 (1803.4)	127 (3225.8)
5000	20,980 (9525)	680 (2572)	108 (2743.2)	84 (2133.6)	132 (3352.8)
7500	32,460 (14,737)	1080 (4086)	119 (3022.6)	116 (2946.4)	135 (3429.0)
10,000	40,320 (18,305)	1360 (5145)	129 (3276.6)	119 (3022.6)	135 (3429.0)

**Table 13.0-19. 65°C Rise, Silicone/Environmentally Friendly Fluid HV 34400D, 200 BIL LV 13800Y, 95 BIL**

kVA Rating	Weight Lbs. (kg)	Gallons (Liters) Liquid	Dimensions in Inches (mm)		
			Height	Width	Depth
750	9270 (4209)	400 (1514)	107 (2717.8)	65 (1651.0)	55 (1397.0)
1000	9900 (4495)	420 (1590)	107 (2717.8)	65 (1651.0)	67 (1701.8)
1500	11,620 (5275)	460 (1741)	107 (2717.8)	65 (1651.0)	96 (2438.4)
2000	13,160 (5975)	500 (1892)	107 (2717.8)	65 (1651.0)	117 (2971.8)
2500	14,580 (6619)	530 (2006)	107 (2717.8)	67 (1701.8)	117 (2971.8)
3000	16,090 (7305)	560 (2118)	107 (2717.8)	69 (1752.6)	123 (3124.2)
3750	17,930 (8140)	600 (2271)	108 (2743.2)	77 (1955.8)	130 (3302.0)
5000	21,410 (9720)	680 (2572)	110 (2794.0)	77 (1955.8)	131 (3327.4)
7500	32,060 (14,555)	1010 (3821)	114 (2895.6)	116 (2946.4)	132 (3352.8)
10,000	41,850 (19,000)	1330 (5031)	122 (3098.8)	148 (3759.2)	116 (2946.4)

**Layout Dimensions — Liquid-Type**

**Table 13.0-20. Typical Losses for Liquid-Filled Transformers (Watts)**

kVA Rating	No Load Loss	Load Loss
500	1300	6000
750	1700	8200
1000	2100	10,200
1500	2800	14,000
2000	3500	17,000
2500	4100	20,000
3000	4800	24,000
3750	5300	28,000
5000	7000	35,000
7500	9500	48,000
10,000	12,000	60,000

## Standard Features

### VPI

- Aluminum windings — copper optional.
- Step-lap mitered core.
- 220°C insulation system — 150°C average temperature rise.
- Vacuum pressure impregnated in polyester resin.
- Four full-capacity taps on HV winding rated 2-1/2% 2-FCAN — 2-FCBN on units with voltage above 601 V.
- NEMA 1 heavy-gauge ventilated enclosure with removable panels front and rear.
- ANSI 61 gray paint electrostatically applied using dry powder.
- Vibration isolation pads between core and coil and enclosure.
- Base equipped with jacking pads and designed for rolling or skidding enclosure in any direction.
- Provisions for lifting core and coil assembly.
- Diagrammatic aluminum nameplate.
- 100% QC impulse test.
- Short circuit design verification.

### VPE

- Aluminum windings — copper optional.
- Step-lap mitered core.
- 220°C insulation system — 150°C average temperature rise.
- Vacuum pressure encapsulated silicone resin.
- Four full-capacity taps on HV winding rated 2-1/2% 2-FCAN — 2-FCBN on units with voltage above 601 V.
- NEMA 1 heavy-gauge ventilated enclosure with removable panels front and rear.
- ANSI 61 gray paint electrostatically applied using dry powder.
- Vibration isolation pads between core and coil and enclosure.
- Base equipped with jacking pads and designed for rolling or skidding enclosure in any direction.
- Provisions for lifting core and coil assembly.
- Diagrammatic aluminum nameplate.
- 100% QC impulse test.
- Short circuit design verification.



*Dry-Type Unit Substation Transformer*

### Cast Coil

- Windings cast in a mold. HV coils vacuum cast in epoxy in a metal mold. LV coils encapsulated/pressure-injected in epoxy for 600 V and below.
- Aluminum windings — copper optional.
- Step-lap mitered core.
- 180°C insulation system — 115°C average temperature rise.
- Four full-capacity taps on HV winding rated 2-1/2% 2-FCAN — 2-FCBN on units with voltage above 601 V.
- NEMA 1 heavy-gauge ventilated enclosure with removable panels front and rear.
- ANSI 61 gray paint electrostatically applied using dry powder.
- Vibration isolation pads between core and coil and enclosure.
- Base equipped with jacking pads and designed for rolling or skidding enclosure in any direction.
- Provisions for lifting core and coil assembly.
- Diagrammatic aluminum nameplate.
- 100% QC impulse test.
- Partial discharge-free (less than 20 pc at 120% rated voltage).

### RESIBLOC

- High-voltage windings cast in epoxy reinforced by fiber glass rovings.
- Copper high voltage, aluminum low voltage windings.
- Step-lap mitered core.
- 155°C insulation system — 80°C average temperature rise.
- Four full-capacity taps on HV winding rated 2-1/2% 2-FCAN — 2-FCBN on units with voltage above 601 V.
- NEMA 1 heavy-gauge ventilated enclosure with removable panels front and rear.
- ANSI 61 gray paint electrostatically applied using dry powder.
- Vibration isolation pads between core and coil and enclosure.
- Base equipped with jacking pads and designed for rolling or skidding enclosure in any direction.
- Provisions for lifting core and coil assembly.
- Diagrammatic aluminum nameplate.
- 100% QC impulse test.
- Partial discharge-free (less than 20 pc at 120% rated voltage).

Layout Dimensions — Dry-Type

Layout Dimensions

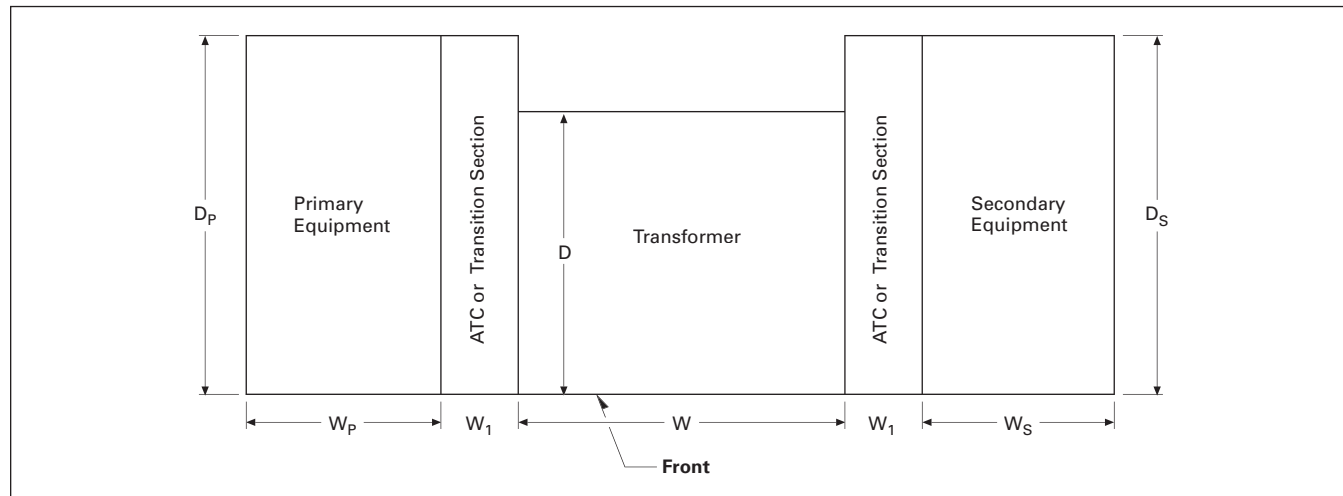


Figure 13.0-3. Indoor VPI/VPE/Cast/RESIBLOC Primary Unit Substations — Plan View

Table 13.0-21. Indoor Dimension References

Equipment	Dimensions	Reference
Transformer	W, D	<b>Page 13.0-11</b> <b>Section 10.0-25 through 10.0-37</b> <b>Section 8.0-15 through 8.0-23</b> <b>Section 7.1-4 through 7.1-5</b> <b>Section 5.5-1 through 5.5-6</b>
MVC	Ws, Ds	
MVS	Wp, Dp, Ws, Ds	
ME	Wp, Dp, Ws, Ds	
MC	Wp, Dp, Ws, Ds	

Legend:

- ATC = Air Terminal Chamber
- MVC = Medium Voltage Motor Control, Type AMPGARD
- MVS = Medium Voltage Metal-Enclosed Switches, Type MVS
- ME = Medium Voltage Metal-Enclosed Breakers, Type MEB, MEF, MSB
- MC = Medium Voltage Metal-Clad Breaker Assemblies, Type VacClad-W

Air Terminal Chamber (ATC) or Transition Section Dimensions in Inches (mm)

Primary or Secondary Equipment	W <sub>1</sub>			
	5 kV	15 kV	27 kV	38 kV
Air Terminal Chamber	18	18	30	36
MVC ①②	7.5	—	—	—
MVS	0	0	30	30
ME	20	20	30	30
MC	18	18	36	42

① Front to rear centerline aligns with centerline of the transformer.

② 4-wire connections are not available with MVC equipment.

**Note:** Surge arresters as discussed in Sections 7 and 8 can be located in the primary of dry-type transformers.

**Note:** Dimensions are APPROXIMATE.

**Layout Dimensions — Dry-Type**

**Table 13.0-22. VPI/VPE/Cast/RESIBLOC Ventilated Dry-Type — Dimensions in Inches (mm)**  
Aluminum Windings, Standard Design and Losses, Delta-Wye  
VPI/VPE = 150°C Rise, Cast/RESIBLOC = 80°C Rise

kVA	HV (kV)	HV BIL	Height	Width	Depth	Weight in Lbs. (kg)	
						VPI/VPE	Cast/RESIBLOC
<b>5 kV Secondary</b>							
2000	15	95	102 (2590.8)	120 (3048.0)	68 (1727.2)	11,000 (4994)	14,000 (6356)
	27	125	112 (2844.8)	130 (3302.0)	72 (1828.8)	13,000 (5902)	16,000 (7264)
	38	150	130 (3302.0)	148 (3759.2)	78 (1981.2)	13,500 (6129)	18,000 (8172)
2500	15	95	112 (2844.8)	124 (3149.6)	68 (1727.2)	13,500 (6129)	17,000 (7718)
	27	125	130 (3302.0)	140 (3556.0)	78 (1981.2)	15,000 (6810)	19,000 (8626)
	38	150	138 (3505.2)	150 (3810.0)	78 (1981.2)	15,500 (7037)	21,000 (9534)
3000	15	95	120 (3048.0)	130 (3302.0)	72 (1828.8)	16,500 (7491)	22,000 (9988)
	27	125	130 (3302.0)	140 (3556.0)	78 (1981.2)	18,500 (8399)	24,000 (10,896)
	38	150	138 (3505.2)	150 (3810.0)	78 (1981.2)	19,500 (8853)	26,000 (11,804)
5000	15	95	130 (3302.0)	140 (3556.0)	78 (1981.2)	22,000 (9988)	31,000 (14,074)
	27	125	138 (3505.2)	148 (3759.2)	78 (1981.2)	23,000 (10,442)	33,000 (14,982)
	38	150	140 (3556.0)	150 (3810.0)	82 (2082.8)	24,000 (10,896)	35,000 (15,890)
7500	15	95	140 (3556.0)	150 (3810.0)	78 (1981.2)	24,500 (11,123)	48,000 (21,792)
	27	125	140 (3556.0)	150 (3810.0)	84 (2133.6)	26,000 (11,804)	50,000 (22,700)
	38	150	140 (3556.0)	154 (3911.6)	88 (2235.2)	27,000 (12,258)	52,000 (23,608)
10000	15	95	140 (3556.0)	160 (4064.0)	78 (1981.2)	29,000 (13,166)	62,000 (28,148)
	27	125	140 (3556.0)	160 (4064.0)	84 (2133.6)	30,000 (13,620)	64,000 (29,056)
	38	150	148 (3759.2)	160 (4064.0)	90 (2286.0)	31,000 (14,074)	66,000 (29,964)
<b>15 kV Secondary</b>							
2000	27	125	102 (2590.8)	120 (3048.0)	72 (1828.8)	12,000 (5448)	18,000 (8172)
	38	150	112 (2844.8)	130 (3302.0)	72 (1828.8)	13,500 (6129)	20,000 (9080)
2500	27	125	112 (2844.8)	140 (3556.0)	78 (1981.2)	14,000 (6356)	21,000 (9534)
	38	150	120 (3048.0)	140 (3556.0)	78 (1981.2)	14,500 (6583)	23,000 (10,442)
3000	27	125	120 (3048.0)	148 (3759.2)	78 (1981.2)	15,500 (7037)	26,000 (11,804)
	38	150	124 (3149.6)	150 (3810.0)	82 (2082.8)	16,000 (7264)	28,000 (12,712)
5000	27	125	124 (3149.6)	150 (3810.0)	88 (2235.2)	17,500 (7945)	35,000 (15,890)
	38	150	130 (3302.0)	154 (3911.6)	88 (2235.2)	19,000 (8626)	37,000 (16,798)
7500	27	125	140 (3556.0)	154 (3911.6)	88 (2235.2)	20,500 (9307)	52,000 (23,608)
	38	150	140 (3556.0)	160 (4064.0)	90 (2286.0)	22,500 (10,215)	54,000 (24,516)
10000	27	125	148 (3759.2)	160 (4064.0)	90 (2286.0)	23,500 (10,669)	66,000 (29,964)
	38	150	148 (3759.2)	160 (4064.0)	90 (2286.0)	25,000 (11,350)	68,000 (30,872)

- Notes:** 1. Add 18 inches (457.2 mm) to Width dimension for each 15 kV air terminal chamber.  
2. Add 30 inches (762.0 mm) to Width dimension for each 25 kV air terminal chamber.  
3. Add 36 inches (914.4 mm) to Width dimension for each 38 kV air terminal chamber.  
4. Dimensions are APPROXIMATE. NOT FOR CONSTRUCTION.

**Table 13.0-23. Typical Losses for Dry-Type Transformers (Watts)**

kVA Rating	VPI/VPE		Cast Coil/RESIBLOC	
	No Load Loss	Load Loss	No Load Loss	Load Loss
2000	7000	30,000	6500	18,000
2500	8500	32,500	8000	20,000
3000	10,000	37,500	9000	25,000
5000	14,500	40,000	13,500	30,000
7500	17,000	45,000	20,000	40,000
10,000	23,500	55,000	22,500	50,000

Technical Data — Dry/Liquid-Type

### ANSI Segment Identification for HV and LV Bushings/Terminations on Dry and Liquid Transformers

The plan view below shows the ANSI segments used to identify the location of both the HV and LV bushings.

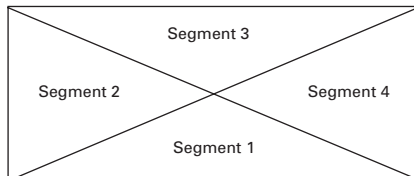


Figure 13.0-4. Front (Nameplate, Gauges, etc.)

HV: Segment 2 is standard for wall-mounted bushings (Optional Segment 4)  
Segment 3 is standard for cover-mounted bushings

LV: Segment 4 wall-mounted is standard (Optional Segment 2)

Note: See Section 9 for fuse selections.

Table 13.0-24. Dry-Type Transformer Rating Table — 112 to 10,000 kVA

Primary/Secondary	
BIL kV ①	Maximum Voltage (kV)
20/30/45	2.5
30/45/60/75/95	5.0
45/60/75/95	8.7
60/75/95/110/125	15.0
110/125	25.0
125	27.0
150	34.5

① First BIL rating given below is standard. Others shown are optional.

Table 13.0-25. Liquid Transformer Rating Table — 500 to 10,000 kVA

Primary		Secondary	
BIL kV ②	Voltage Range	BIL kV	Voltage Range
95/110	12000D, 12470D, 13200D, 13800D	45	2400Y, 2400D, 2520D
95/110	12000D, 12470D, 13200D, 13800D	60	4160Y, 4160D, 4360Y, 4800D, 5040D
125/150	22900D	45	2400Y, 2400D, 2520D
125/150	22900D	60	4160Y, 4160D, 4360Y, 4800D
125/150	22900D	75	6900D, 7200D, 7560D, 8320D, 8720D
125/150	22900D	95	12000D, 12470Y, 12600D, 13090Y, 13200Y, 13200D, 13800Y, 14400D
150/200	34400D, 34500D	45	2400Y, 2400D, 2520D
150/200	34400D, 34500D	60	4160Y, 4160D, 4360Y, 4800D, 5040D
150/200	34400D, 34500D	75	6900D, 7200D, 7560D 8320Y, 8720D
150/200	34400D, 34500D	95	12000D, 12470Y, 12600D, 13090Y, 13200Y, 13200D, 13800Y, 14400D
250	46000		
350	69000		

② First BIL rating given below is standard. Others shown are optional.

Transformers will have a minimum 98% efficiency for all ratings (maximum 2% losses).

Table 13.0-26. Standard Sound Levels — Decibels (per ANSI TR-1)

kVA	Liquid-Filled Transformers		Vent Dry-Type and Cast Coil Transformers	
	OA	FA	AA	FA
500	56	67	60	67
750	58	67	64	67
1000	58	67	64	67
1500	60	67	65	68
2000	61	67	66	69
2500	62	67	68	71
3000	63	67	68	71
3750	64	67	70	73
5000	65	67	71	73
6000	66	68	72	74
7500	67	69	73	75
10000	68	70	—	76

Table 13.0-27. Standard Impedances (Percent)

HV kV BIL Class	Low Voltage	
	Below 2400 V	2400 V and Above
45 – 150	5.75 ③	6.50 ④
200	7.25	7.00
250	7.75	7.50
350	—	8.00

③ 6.75% is also available as an option.

④ 5.50% is also available as an option.

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