

Technical Data **TD009001EN**

Effective April 2013

# NEMA Premium efficient transformers



## Contents

Description	Page
Product overview, efficiency levels, product family and factory installed options . . . . .	2
Catalog number configuration—product selection . . . . .	3
General purpose transformers product selection . . . . .	4
K-factor rated transformers product selection. . . . .	5
Frame FR912B. . . . .	6
Frames FR914D and FR915D . . . . .	7
Frame FR916A. . . . .	8
Frame FR917 . . . . .	9
Frame FR918A. . . . .	10
Frames FR919, FR919E, FR920 and FR920E . . . . .	11
Frame FR923. . . . .	12
Frame FR924. . . . .	13
Frame FR928. . . . .	14
Frame FR929. . . . .	15
Transformer wiring diagrams. . . . .	16–17
NEMA Premium dry-type distribution transformers (1000 kVA and below) specification. . . . .	18–20

Eaton's family of NEMA Premium® efficiency transformers provides **30 percent less losses** than similarly sized NEMA® TP-1 efficiency models. In the United States, Department of Energy regulation 10 CFR Part 431 requires low voltage dry-type distribution transformers to meet NEMA TP-1 efficiency levels. Installing lower-loss NEMA Premium transformers **reduces energy consumption, resulting in lower operating costs while reducing harmful emissions.** Eaton® is one of the original manufacturers who supported and joined NEMA's Premium efficiency transformers program.

Like NEMA TP-1 efficient transformers, the recognized efficiency of NEMA Premium efficient transformers is measured at 75°C and with a linear load of 35 percent of full load rating. The table below shows the difference between the various transformer efficiency levels that have become common over the past few years.

**Table 1. Low voltage dry-type distribution transformer efficiency levels for three-phase transformers**

kVA	NEMA TP-1 efficiency	NEMA Premium efficiency	NEMA TP-1 losses (at 35% load and 75°C) (watts)	NEMA Premium losses (at 35% load and 75°C) (watts)	NEMA Premium improvement in losses
15.0	97.0%	97.90%	162.4	112.6	30.7%
30.0	97.5%	98.25%	269.2	187.0	30.5%
45.0	97.7%	98.39%	370.8	257.7	30.5%
75.0	98.0%	98.60%	535.7	372.7	30.4%
112.5	98.2%	98.74%	721.7	502.5	30.4%
150.0	98.3%	98.81%	907.9	632.2	30.4%
225.0	98.5%	98.95%	1199.2	835.6	30.3%
300.0	98.6%	99.02%	1490.9	1039.2	30.3%
500.0	98.7%	99.09%	2305.0	1607.1	30.3%

For additional information on NEMA's Premium efficiency transformers program, visit NEMA at:  
[www.nema.org/prod/pwr/trans/transformersprogram.cfm](http://www.nema.org/prod/pwr/trans/transformersprogram.cfm).

All NEMA Premium efficient transformers manufactured by Eaton are designed, manufactured and tested per applicable standards, including UL® 1561, NEMA ST20, NEMA TP-1, DOE 10 CFR Part 431 and the NEMA Premium efficiency transformers program. The results of all industry-standard production tests are electronically stored so the results can be retrieved at a later date. Along with other data, Eaton also records the no-load losses of every transformer that is shipped.

## Eaton's NEMA Premium product family

Eaton's NEMA Premium efficiency transformers are manufactured in an ANSI 61 gray polyester powder-coat-painted NEMA Type 2 enclosure, which is easily converted to NEMA 3R when fitted with a weathershield kit.

### General purpose

- Three-phase 15–500 kVA
- Aluminum windings (copper optional)
- 220°C insulation system and 150°C rise (115°C or 80°C rise optional)
- 200°C insulation system and 130°C rise (115°C or 80°C optional)

### K-factor

- Three-phase 15–300 kVA
- K-4, K-9 or K-13 ratings
- Aluminum windings (copper optional)
- 220°C insulation system and 150°C rise (115°C or 80°C rise optional)
- Single electrostatic shield between primary and secondary winding
- 200 percent rated neutral

### Harmonic mitigating

- Three-phase 15–300 kVA
- 0°, -15°, +15° or 30° phase shift
- Aluminum windings (copper optional)
- 220°C insulation system and 150°C rise (115°C or 80°C rise optional)
- Single electrostatic shield between primary and secondary winding
- 200 percent rated neutral

## Additional factory-installed options

- Surge protective device installed on primary or secondary (120 kA or 160 kA)
- Infrared viewing window (3", 4" or 5")
- Stainless steel enclosure (grade 304 or 316)
- Core-coil only
- CE mark
- Custom paint colors
- Hinged and lockable front covers

Table 2. Catalog number configuration—product selection

V 48 M 28 T 75 N3						
Type	Primary voltage	Taps	Secondary voltage	Temp rise	kVA	Suffix options
<b>V</b> = DT-3 (three-phase ventilated) <b>X</b> = Harmonic mitigating (three-phase ventilated) <b>Nonlinear</b> <b>H</b> = KT-4 (three-phase ventilated) <b>B</b> = KT-9 (three-phase ventilated) <b>N</b> = KT-13 (three-phase ventilated) <b>G</b> = KT-20 (three-phase ventilated) <b>J</b> = KT-30 (three-phase ventilated)	29 = 208 72 = 200 25 = 220 23 = 230 24 = 240 27 = 277 38 = 380 39 = 400 43 = 416 44 = 440 45 = 450 48 = 480 57 = 575 60 = 600	<b>D</b> = 2 at +2.5%, 2 at -2.5% <b>E</b> = 1 at +5%, 1 at -5% <b>G</b> = 2 at -5% <b>M</b> = 2 at +2.5%, 4 at -2.5% <b>N</b> = None <b>R</b> = 1 at +5%, 2 at -5%	19 = 190Y/110 28 = 208Y/120 29 = 208 25 = 220 delta 31 = 220Y/127 26 = 220 delta/110 midtap 22 = 240 delta/120 midtap 64 = 240Y/139 24 = 240 delta 27 = 277 38 = 380 delta 37 = 380Y/220 34 = 400Y/231 51 = 416Y/240 35 = 440Y/254 62 = 460Y/266 47 = 480Y/277 48 = 480 delta 60 = 600 delta 61 = 600Y/346	<b>B</b> = 80°C rise <b>F</b> = 115°C rise <b>E</b> = Electrostatic shield <b>T</b> = 150°C rise	15 = 15 25 = 25 30 = 30 45 = 45 50 = 50 75 = 75 99 = 100 12 = 112.5 49 = 150 22 = 225 33 = 300 55 = 500 77 = 750	<b>CU</b> = ❶ <b>SS</b> = ❷ <b>ZZ</b> = ❸ <b>NV</b> = ❹ <b>X</b> = ❺ <b>LS</b> = ❻ <b>AF</b> = ❼ <b>TR</b> = ❽ <b>SR</b> = ❾ <b>CE</b> = ❿ <b>T</b> = ⓫ <b>EE</b> = ⓬ <b>NON</b> = ⓭ <b>POS</b> = ⓮ <b>NEG</b> = ⓯ <b>THR</b> = ⓰ <b>E3</b> = ⓱ <b>Z</b> = ⓲ <b>S6</b> = ⓳ <b>I2</b> = ⓴ <b>I3</b> = ⓵ <b>I4</b> = ⓶ <b>N3</b> = ⓷

❶ Copper windings.

❷ Grade 304 stainless steel enclosure (does not imply a NEMA 4X rating).

❸ Open-type core and coil assembly.

❹ Totally enclosed non-ventilated DS-3 or DT-3.

❺ 50/60 Hz.

❻ Low sound design. LS47 indicates low sound equal to 47 dB; LS42 indicates 42 dB.

❼ Fungus-proof.

❽ Certified test report of standard production tests for the specific serial number to be shipped.

❾ Certified sound level report.

❿ CE marked.

⓫ Thermal indicator embedded in center coil. Suffix "TT" indicates two thermal indicators of different temperature ratings are installed.

⓬ NEMA TP-1 efficient.

⓭ 0° phase-shift (used with HMTs).

⓮ +15° phase-shift (used with HMTs).

⓯ -15° phase-shift (used with HMTs).

⓰ -30° phase-shift (used with HMTs).

⓱ CSL3 DOE 2007 energy-efficient.

⓲ Easy install base.

⓳ Grade 316 stainless steel enclosure (does not imply NEMA 4X rating).

⓴ Integral 2-inch infrared viewing window.

⓵ Integral 3-inch infrared viewing window.

⓶ Integral 4-inch infrared viewing window.

⓷ NEMA Premium efficiency.

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.

## General purpose transformers product selection

**Table 3. 480V Delta-208Y/120V, aluminum windings, K-1, three-phase**

kVA	Style	°C temp. rise	Frame <sup>①②</sup>	Wiring diagram <sup>②</sup>	Weight (lbs.) <sup>②</sup>	Weathershield	Wall-mount bracket
15	V48M28T15N3	150	FR912B	280B	280	WS38	WMB01
30	V48M28T30N3	150	FR912B	280B	400	WS38	WMB01
45	V48M28T45N3	150	FR914D	280B	580	WS39	WMB01
75	V48M28T75N3	150	FR914D	280B	600	WS39	WMB01
112.5	V48M28T12N3	150	FR915D	280B	800	WS39	WMB01
150	V48M28T49N3	150	FR917	275A	1350	WS34	—
225	V48M28T22N3	150	FR918A	275A	1700	WS34	—
300	V48M28T33N3	150	FR918A	275A	2810	WS34	—
15	V48M28F15N3	115	FR912B	280B	280	WS38	WMB01
30	V48M28F30N3	115	FR912B	280B	400	WS38	WMB01
45	V48M28F45N3	115	FR914D	280B	580	WS39	WMB01
75	V48M28F75N3	115	FR914D	280B	600	WS39	WMB01
112.5	V48M28F12N3	115	FR915D	280B	800	WS39	WMB01
150	V48M28F49N3	115	FR917	275A	1350	WS34	—
225	V48M28F22N3	115	FR918A	275A	1700	WS34	—
300	V48M28F33N3	115	FR919E	275A	2810	WS35	—
15	V48M28B15N3	80	FR912B	280B	310	WS38	WMB01
30	V48M28B30N3	80	FR912B	280B	350	WS38	WMB01
45	V48M28B45N3	80	FR914D	280B	600	WS39	WMB01
75	V48M28B75N3	80	FR915D	280B	670	WS39	WMB01
112.5	V48M28B12N3	80	FR916A	280B	1360	WS19	—
150	V48M28B49N3	80	FR918A	275A	1444	WS34	—
225	V48M28B22N3	80	FR918A	275A	2900	WS34	—

① NEMA Type 2 enclosure. Use weathershield to convert to a NEMA Type 3R enclosure.

② Frames, wiring diagrams and weights are subject to revision without notice.

**Note:** For transformers in addition to those included in the above table, contact Eaton Care at 1-877-386-2273, Option 2, then Option 1.

**Table 4. 480V Delta-208Y/120V, copper windings, K-1, three-phase**

kVA	Style	°C temp. rise	Frame <sup>①②</sup>	Wiring diagram <sup>②</sup>	Weight (lbs.) <sup>②</sup>	Weathershield	Wall-mount bracket
15	V48M28T15CUN3	150	FR912B	280B	320	WS38	WMB01
30	V48M28T30CUN3	150	FR912B	280B	370	WS38	WMB01
45	V48M28T45CUN3	150	FR912B	280B	420	WS38	WMB01
75	V48M28T75CUN3	150	FR915D	280B	660	WS39	WMB01
112.5	V48M28T12CUN3	150	FR915D	280B	870	WS39	WMB01
150	V48M28T49CUN3	150	FR916A	275A	1040	WS19	—
225	V48M28T22CUN3	150	FR918A	275A	1460	WS34	—
300	V48M28T33CUN3	150	FR919E	275A	2300	WS35	—
15	V48M28F15CUN3	115	FR912B	280B	330	WS38	WMB01
30	V48M28F30CUN3	115	FR912B	280B	420	WS38	WMB01
45	V48M28F45CUN3	115	FR912B	280B	430	WS38	WMB01
75	V48M28F75CUN3	115	FR915D	280B	720	WS39	WMB01
112.5	V48M28F12CUN3	115	FR915D	280B	950	WS39	WMB01
150	V48M28F49CUN3	115	FR916A	275A	1250	WS19	—
225	V48M28F22CUN3	115	FR918A	275A	1900	WS34	—
300	V48M28F33CUN3	115	FR919E	275A	3400	WS35	—
15	V48M28B15CUN3	80	FR912B	280B	330	WS38	WMB01
30	V48M28B30CUN3	80	FR912B	280B	430	WS38	WMB01
45	V48M28B45CUN3	80	FR915D	280B	650	WS39	WMB01
75	V48M28B75CUN3	80	FR915D	280B	880	WS39	WMB01
112.5	V48M28B12CUN3	80	FR916A	280B	1300	WS19	—
150	V48M28B49CUN3	80	FR917	275A	1890	WS34	—
225	V48M28B22CUN3	80	FR918A	275A	2250	WS34	—
300	V48M28B33CUN3	80	FR919	275A	2493	WS35	—

① NEMA Type 2 enclosure. Use weathershield to convert to a NEMA Type 3R enclosure.

② Frames, wiring diagrams and weights are subject to revision without notice.

**Note:** For transformers in addition to those included in the above table, contact Eaton Care at 1-877-386-2273, Option 2, then Option 1.

**K-factor rated transformers product selection****Table 5. 480V Delta-208Y/120V, aluminum windings, K-13<sup>①</sup>, three-phase**

kVA	Style	°C temp. rise	Frame <sup>②③</sup>	Wiring diagram <sup>③</sup>	Weight (lbs.) <sup>③</sup>	Weathershield	Wall-mount bracket
15	N48M28T15N3	150	FR912B	283B	300	WS38	WMB01
30	N48M28T30N3	150	FR912B	283B	390	WS38	WMB01
45	N48M28T45N3	150	FR914D	283B	580	WS39	WMB01
75	N48M28T75N3	150	FR915D	283B	780	WS39	WMB01
112.5	N48M28T12N3	150	FR917	283B	960	WS34	—
150	N48M28T49N3	150	FR918A	292A	1230	WS34	—
225	N48M28T22N3	150	FR919E	292A	1900	WS35	—
300	N48M28T33N3	150	FR919E	292A	2450	WS35	—
15	N48M28F15N3	115	FR912B	283B	350	WS38	WMB01
30	N48M28F30N3	115	FR912B	283B	450	WS38	WMB01
45	N48M28F45N3	115	FR915D	283B	580	WS39	WMB01
75	N48M28F75N3	115	FR915D	283B	810	WS39	WMB01
112.5	N48M28F12N3	115	FR917	283B	1040	WS34	—
150	N48M28F49N3	115	FR918A	292A	1820	WS34	—
225	N48M28F22N3	115	FR919E	292A	2400	WS35	—
300	N48M28F33N3	115	FR919E	292A	3200	WS35	—
15	N48M28B15N3	80	FR912B	283B	350	WS38	WMB01
30	N48M28B30N3	80	FR912B	283B	450	WS38	WMB01
45	N48M28B45N3	80	FR915D	283B	600	WS39	WMB01
75	N48M28B75N3	80	FR916A	283B	900	WS19	—
112.5	N48M28B12N3	80	FR917	292A	1400	WS34	—
150	N48M28B49N3	80	FR918A	292A	1840	WS34	—
225	N48M28B22N3	80	FR919E	292A	2660	WS35	—

① K-4, K-9, K-20 rated transformers are an available option.

② NEMA Type 2 enclosure. Use weathershield to convert to a NEMA Type 3R enclosure.

③ Frames, wiring diagrams and weights are subject to revision without notice.

**Note:** For transformers in addition to those included in the above table, contact Eaton Care at 1-877-386-2273, Option 2, then Option 1.**Table 6. 480V Delta-208Y/120V, copper windings, K-13<sup>①</sup>, three-phase**

kVA	Style	°C temp. rise	Frame <sup>②③</sup>	Wiring diagram <sup>③</sup>	Weight (lbs.) <sup>③</sup>	Weathershield	Wall-mount bracket
15	N48M28T15CUN3	150	FR912B	283B	340	WS38	WMB01
30	N48M28T30CUN3	150	FR912B	283B	460	WS38	WMB01
45	N48M28T45CUN3	150	FR912B	283B	700	WS38	WMB01
75	N48M28T75CUN3	150	FR915D	283B	950	WS39	WMB01
112.5	N48M28T12CUN3	150	FR917	283B	1220	WS34	—
150	N48M28T49CUN3	150	FR917	292A	1700	WS34	—
225	N48M28T22CUN3	150	FR918A	292A	2150	WS34	—
300	N48M28T33CUN3	150	FR919E	292A	3900	WS35	—
15	N48M28F15CUN3	115	FR912B	283B	350	WS38	WMB01
30	N48M28F30CUN3	115	FR912B	283B	460	WS38	WMB01
45	N48M28F45CUN3	115	FR912B	283B	680	WS38	WMB01
75	N48M28F75CUN3	115	FR915D	283B	900	WS39	WMB01
112.5	N48M28F12CUN3	115	FR917	283B	1500	WS34	—
150	N48M28F49CUN3	115	FR917	292A	1700	WS34	—
225	N48M28F22CUN3	115	FR918A	292A	2200	WS34	—
300	N48M28F33CUN3	115	FR919E	292A	4000	WS35	—
15	N48M28B15CUN3	80	FR912B	283B	440	WS38	WMB01
30	N48M28B30CUN3	80	FR912B	283B	510	WS38	WMB01
45	N48M28B45CUN3	80	FR915D	283B	710	WS39	WMB01
75	N48M28B75CUN3	80	FR917	283B	1150	WS34	—
112.5	N48M28B12CUN3	80	FR918A	292A	1930	WS34	—
150	N48M28B49CUN3	80	FR918A	292A	2200	WS34	—

① K-4, K-9, K-20 rated transformers are an available option.

② NEMA Type 2 enclosure. Use weathershield to convert to a NEMA Type 3R enclosure.

③ Frames, wiring diagrams and weights are subject to revision without notice.

**Note:** For transformers in addition to those included in the above table, contact Eaton Care at 1-877-386-2273, Option 2, then Option 1.

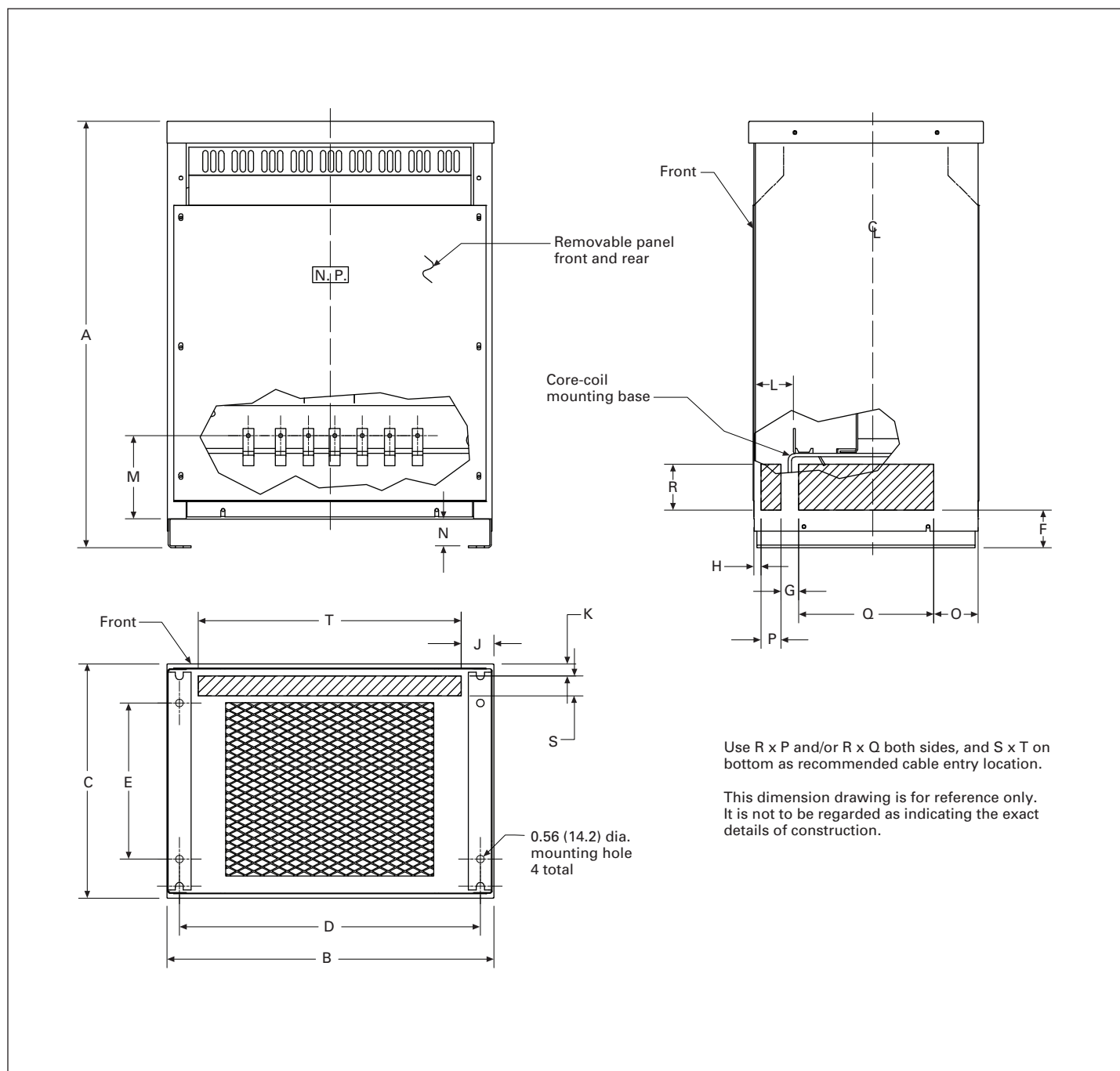


Figure 1. Frame FR912B

Table 7. FR912B dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T
30.00 (762.0)	23.00 (584.2)	16.50 (419.1)	21.04 (534.4)	11.00 (279.4)	2.62 (66.5)	1.25 (31.8)	.50 (12.7)	2.29 (58.2)	0.86 (21.8)	3.60 (91.4)	5.85 (148.6)	1.89 (48.0)	3.12 (79.2)	1.40 (35.6)	9.51 (241.6)	3.25 (82.6)	1.40 (35.6)	18.50 (469.9)

Table 8. FR912B accessories

Name	Serial number
Weathershield	WS38
Wall-mount bracket	WMB01
Rodent screen	RS16

Table 9. FR912B replacement enclosure parts

Name	Serial number
Front/back panel①	47-49323-1
Side panel	47-49321-1
Top cover	47-49322-1
Bottom panel	47-51964-1

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

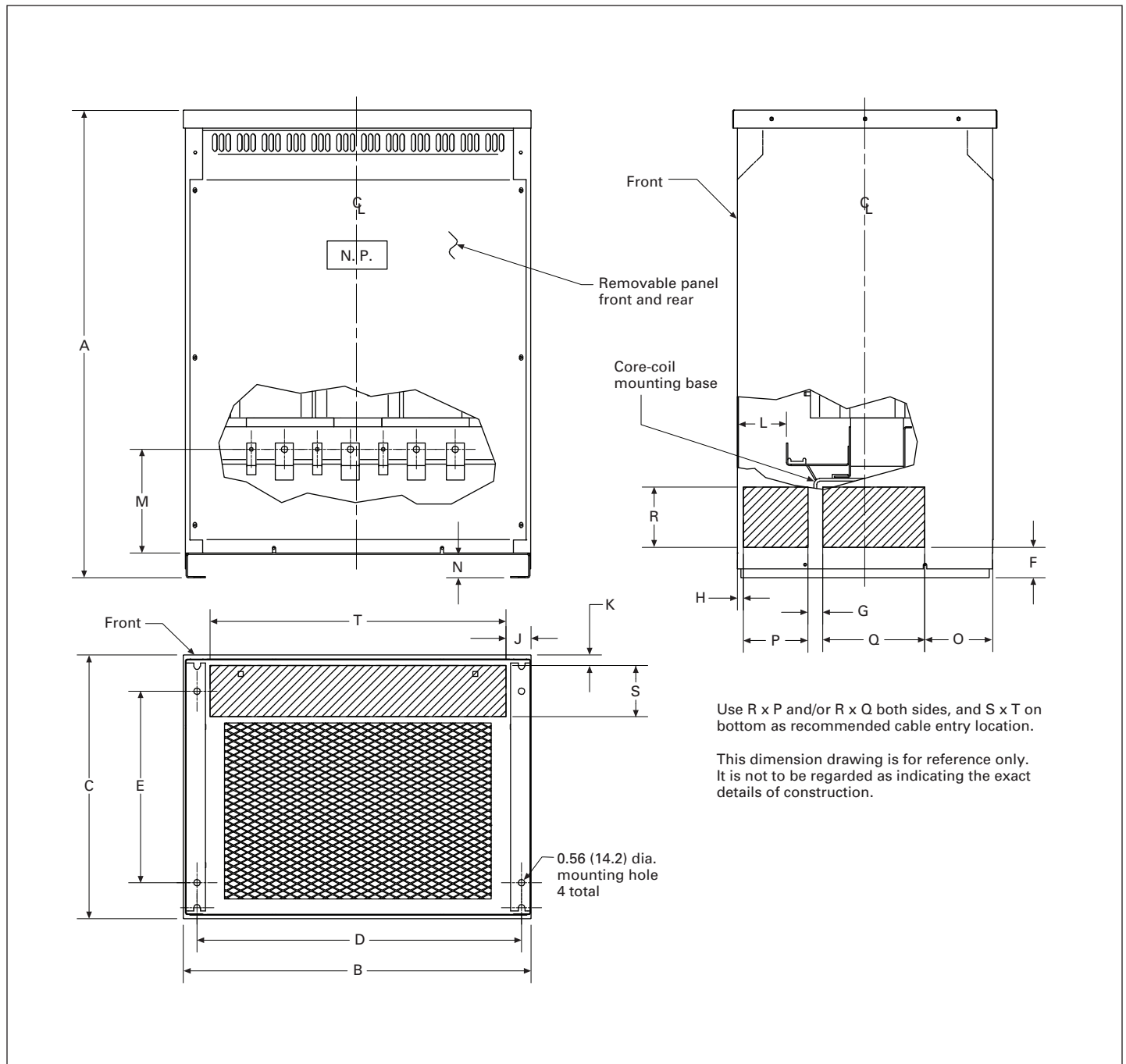


Figure 2. Frames FR914D and FR915D

Table 10. FR914D and FR915D dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T
39.00 (990.6)	29.00 (736.6)	22.00 (558.8)	27.00 (685.8)	15.98 (405.9)	2.55 (64.8)	1.25 (31.8)	.50 (12.7)	2.10 (53.3)	.90 (22.9)	4.00 (101.6)	8.61 (218.7)	1.83 (46.5)	7.70 (195.6)	5.37 (136.4)	8.50 (215.9)	5.00 (127.0)	4.25 (108.0)	24.66 (626.4)

Table 11. FR914D and FR915D accessories

Name	Serial number
Weathershield	WS39
Wall-mount bracket	WMB01
Rodent screen	RS17

Table 12. FR914D and FR915D replacement enclosure parts

Name	Serial number
Front/back panel①	47-49317-1
Side panel	47-49315-1
Top cover	47-49318--1
Bottom panel	47-51965-1

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

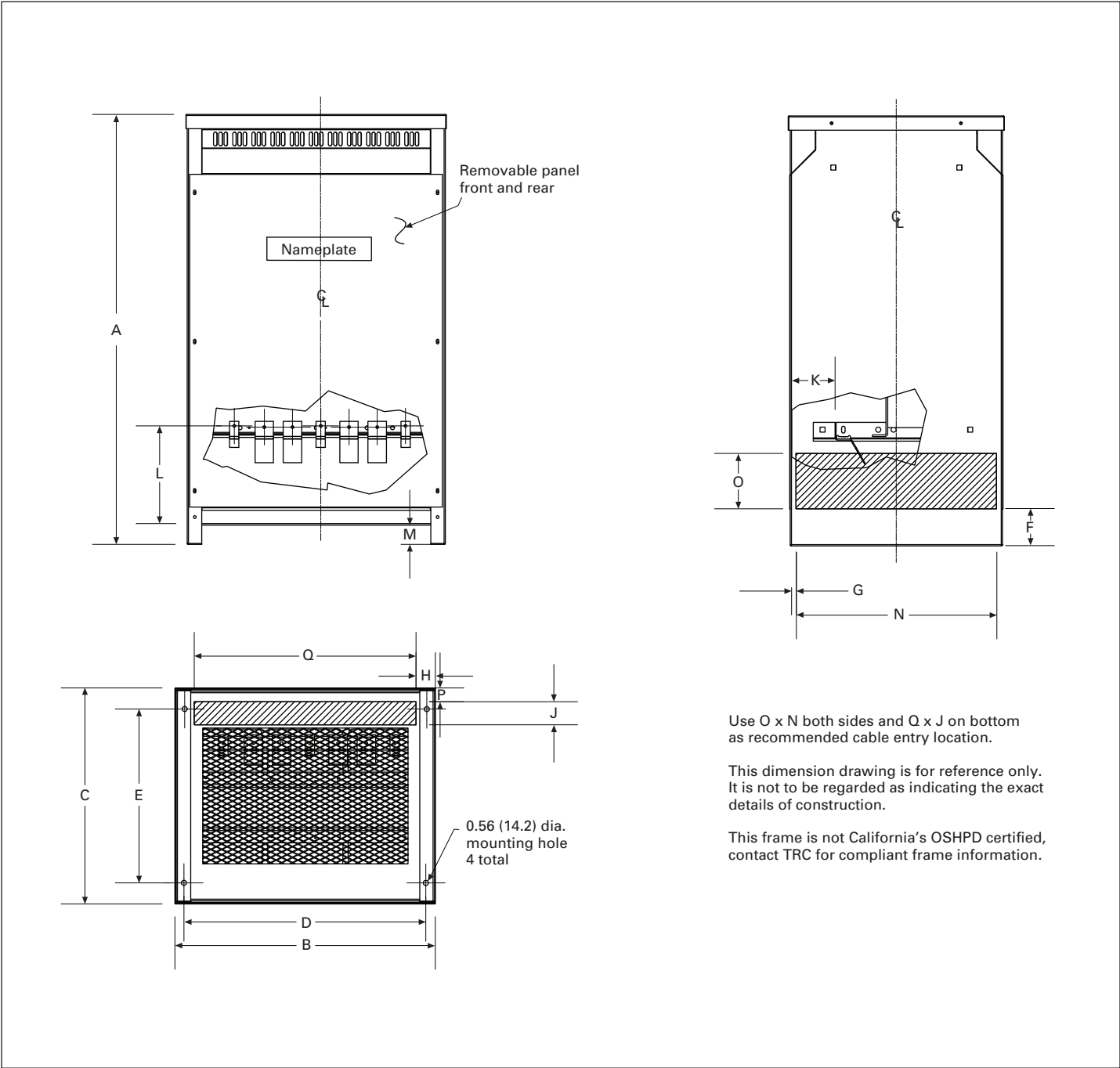


Figure 3. Frame FR916A

Table 13. FR916A dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q
48.56 (1233.4)	28.19 (716.0)	23.39 (594.1)	26.22 (666.0)	18.82 (478.0)	4.01 (101.9)	0.50 (12.7)	2.09 (53.1)	2.50 (63.5)	4.67 (118.6)	12.81 (325.4)	2.10 (53.3)	21.70 (551.2)	6.00 (152.4)	1.50 (38.1)	24.00 (609.6)

Table 14. FR916A accessories

Name	Serial number
Weathershield	WS19
Wall-mount bracket	Not available
Rodent screen	RS07

Table 15. FR916A replacement enclosure parts

Name	Serial number
Front/back panel①	47-41790-1
Side panel	47-41789-1
Top cover	47-41791-1
Bottom panel	47-51966-1

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

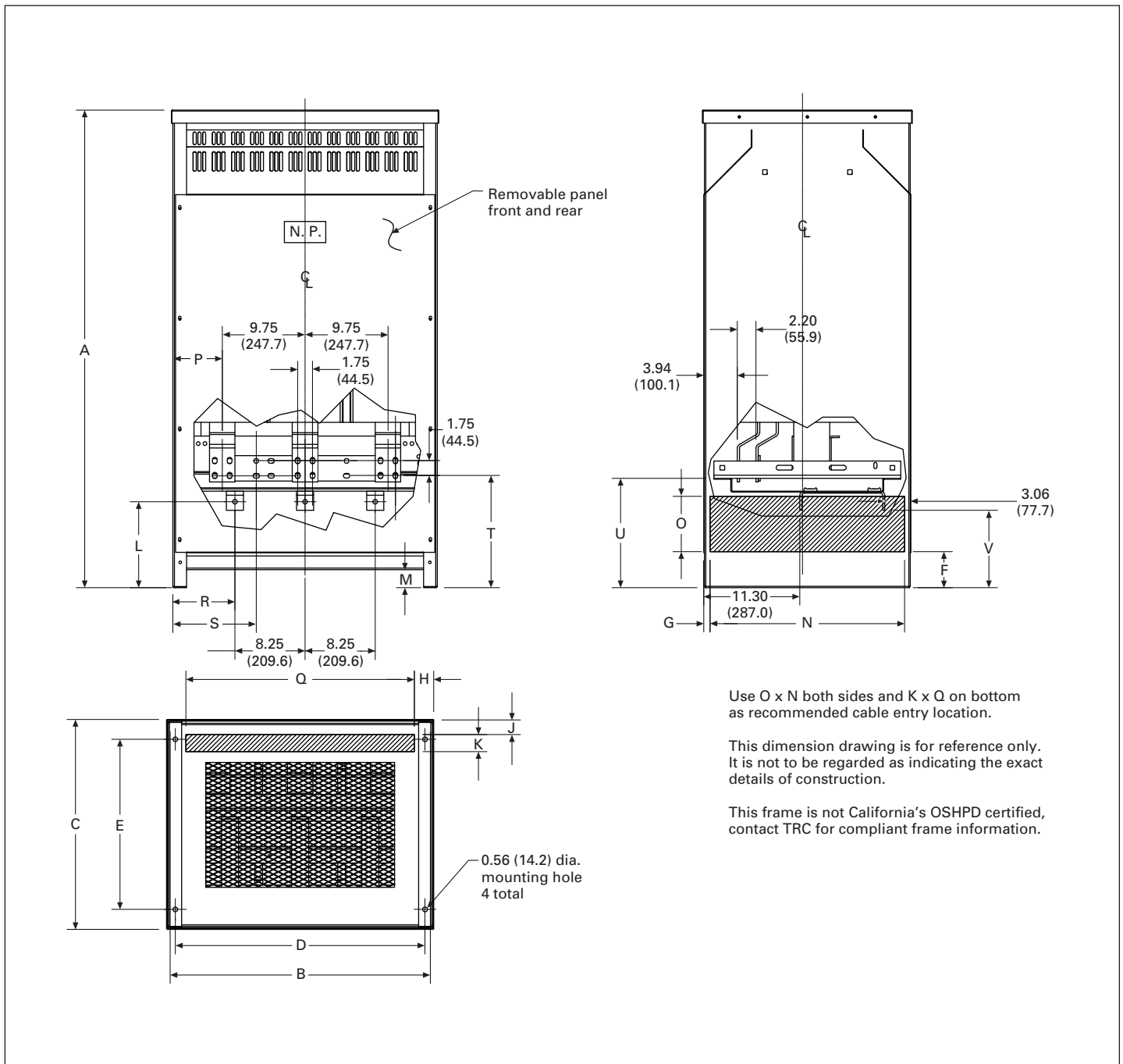


Figure 4. Frame FR917

Table 16. FR917 dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V
56.17 (1426.7)	30.61 (777.5)	24.67 (626.6)	29.37 (746.0)	20.00 (508.0)	4.23 (107.4)	0.75 (19.1)	2.28 (57.9)	1.73 (43.9)	2.01 (51.1)	10.11 (256.8)	2.12 (53.8)	22.88 (581.2)	6.52 (165.6)	5.80 (147.3)	26.87 (682.5)	7.30 (185.4)	9.80 (248.9)	13.19 (335.0)	12.86 (326.6)	9.11 (231.4)

Table 17. FR917 accessories

Name	Serial number
Weathershield	WS34
Wall-mount bracket	Not available
Rodent screen	RS05

Table 18. FR917 replacement enclosure parts

Name	Serial number
Front/back panel①	47-44973-1
Side panel	1714C64G01
Top cover	1714C67H01
Bottom panel	47-51967-1

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

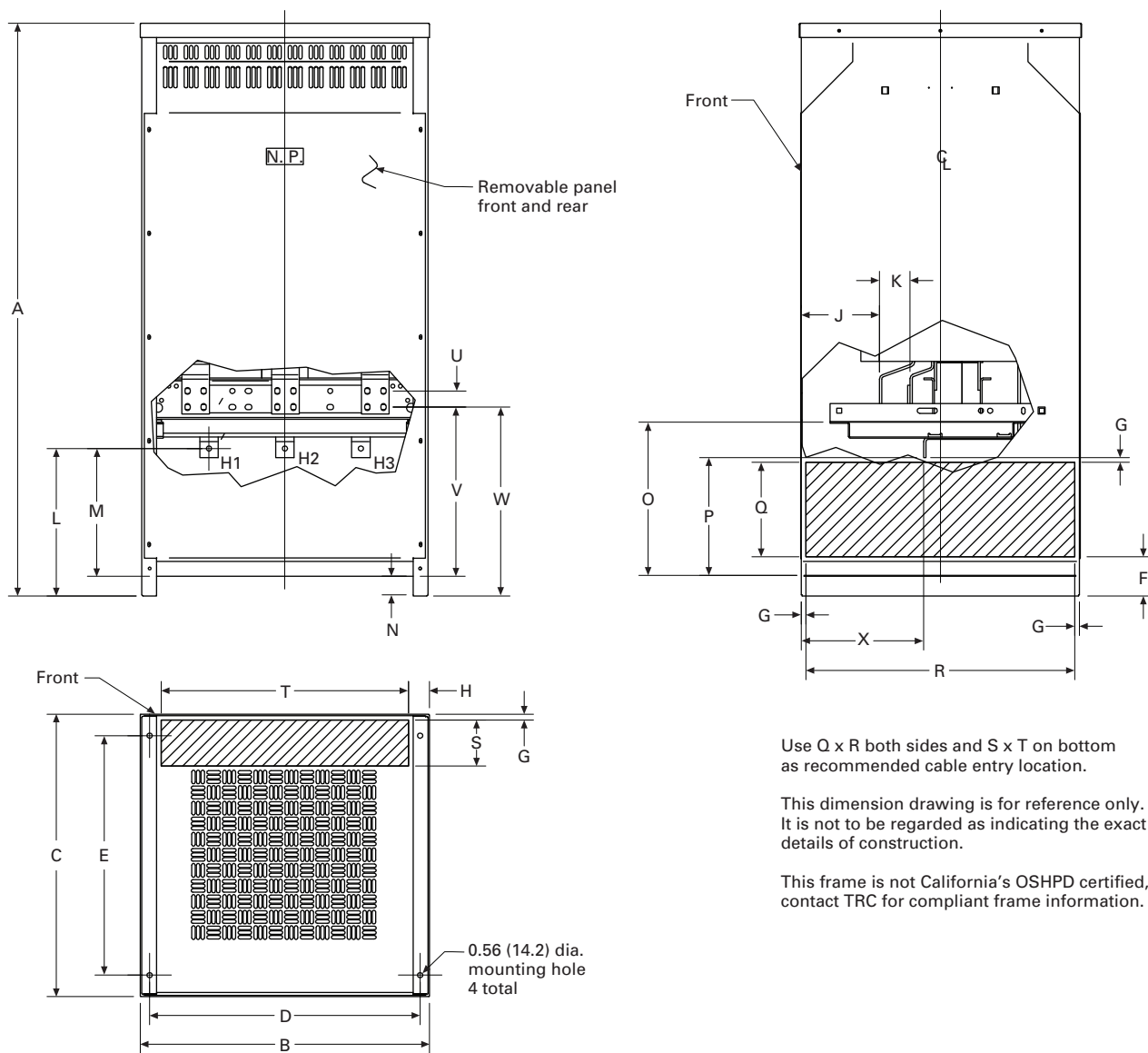


Figure 5. Frame FR918A

Table 19. FR918A dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
62.18	31.41	30.65	29.38	26.00	4.12	0.50	2.26	8.85	3.00	16.00	13.88	2.01	16.62	12.77	10.27	29.22	4.97	26.88	1.75	18.38	20.50	13.30
(1579.4)	(797.8)	(778.5)	(746.3)	(660.4)	(104.6)	(12.7)	(57.4)	(224.8)	(76.2)	(406.4)	(352.6)	(51.1)	(422.1)	(324.4)	(260.9)	(742.2)	(126.2)	(682.8)	(44.5)	(466.9)	(520.7)	(337.8)

Table 20. FR918A accessories

Name	Serial number
Weathershield	WS34
Wall-mount bracket	Not available
Rodent screen	RS05

Table 21. FR918A replacement enclosure parts

Name	Serial number
Front/back panel <sup>①</sup>	47-41801-1
Side panel	47-41800-1
Top cover	47-41802-1
Bottom panel	47-41799-1

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

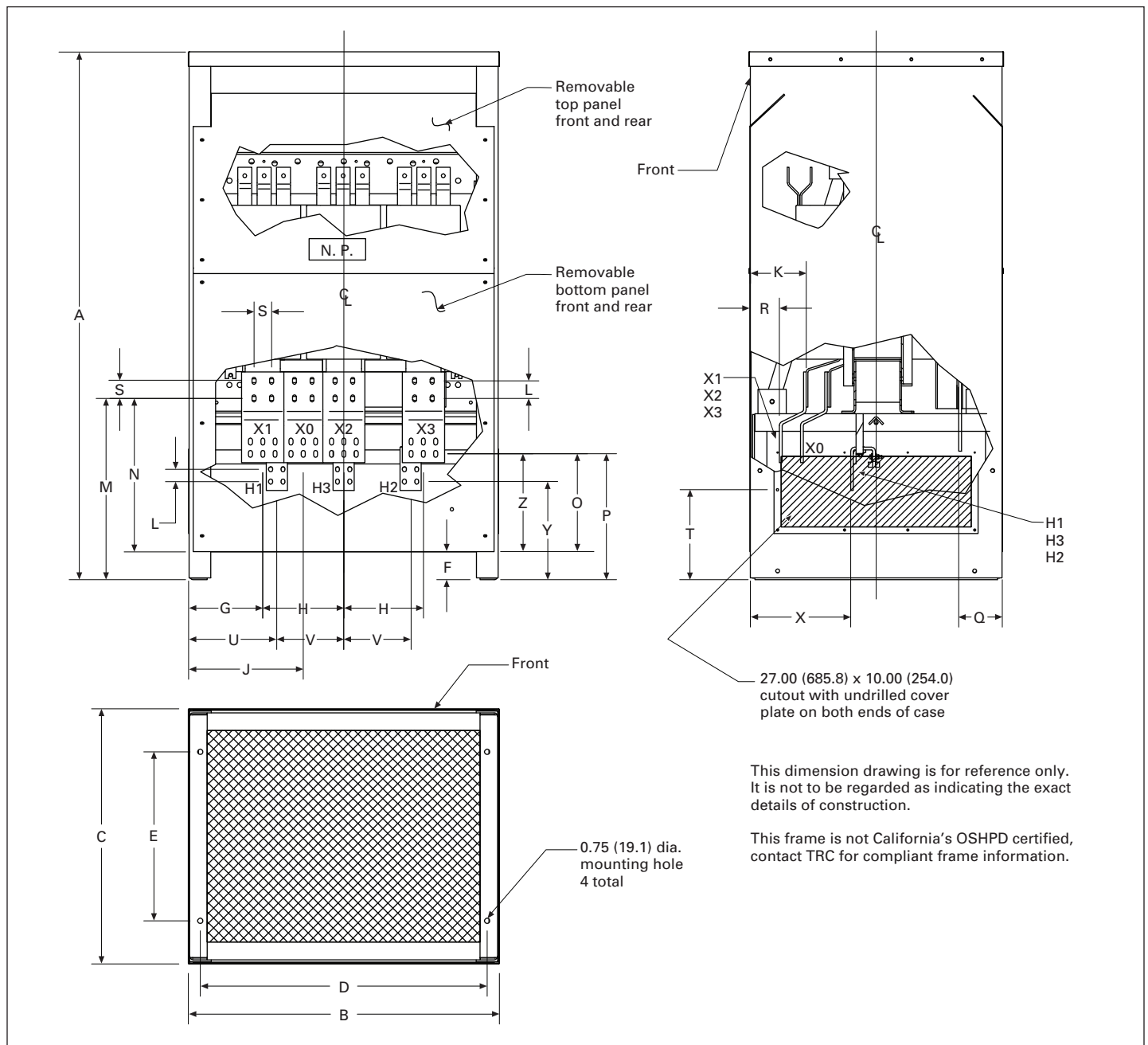


Figure 6. Frames FR919, FR919E, FR920 and FR920E

Table 22. FR919, FR919E, FR920 and FR920E dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	X	Y	Z
75.00 (1905.0)	44.20 (1122.7)	36.23 (920.2)	40.76 (1035.3)	24.00 (609.6)	4.00 (101.6)	10.47 (265.9)	11.52 (292.6)	16.22 (412.0)	7.94 (201.7)	1.75 (44.5)	26.00 (660.4)	22.00 (558.8)	13.89 (352.8)	17.87 (453.9)	5.76 (146.3)	4.13 (104.9)	2.50 (63.5)	12.56 (319.0)	12.56 (319.0)	9.50 (241.3)	13.75 (349.3)	14.18 (360.2)	10.20 (259.1)

Table 23. FR919, FR919E, FR920 and FR920E accessories

Name	Serial number
Weathershield	WS35
Wall-mount bracket	Not Available
Rodent screen	RS06

Table 24. FR919, FR919E, FR920 and FR920E replacement enclosure parts

Name	Serial number
Upper front/back panel	2D46331H03
Lower front/back panel <sup>①</sup>	2D46331H01
Side panel	2D46332H01
Top cover	2D46331H02
Bottom panel	2D46331H04

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

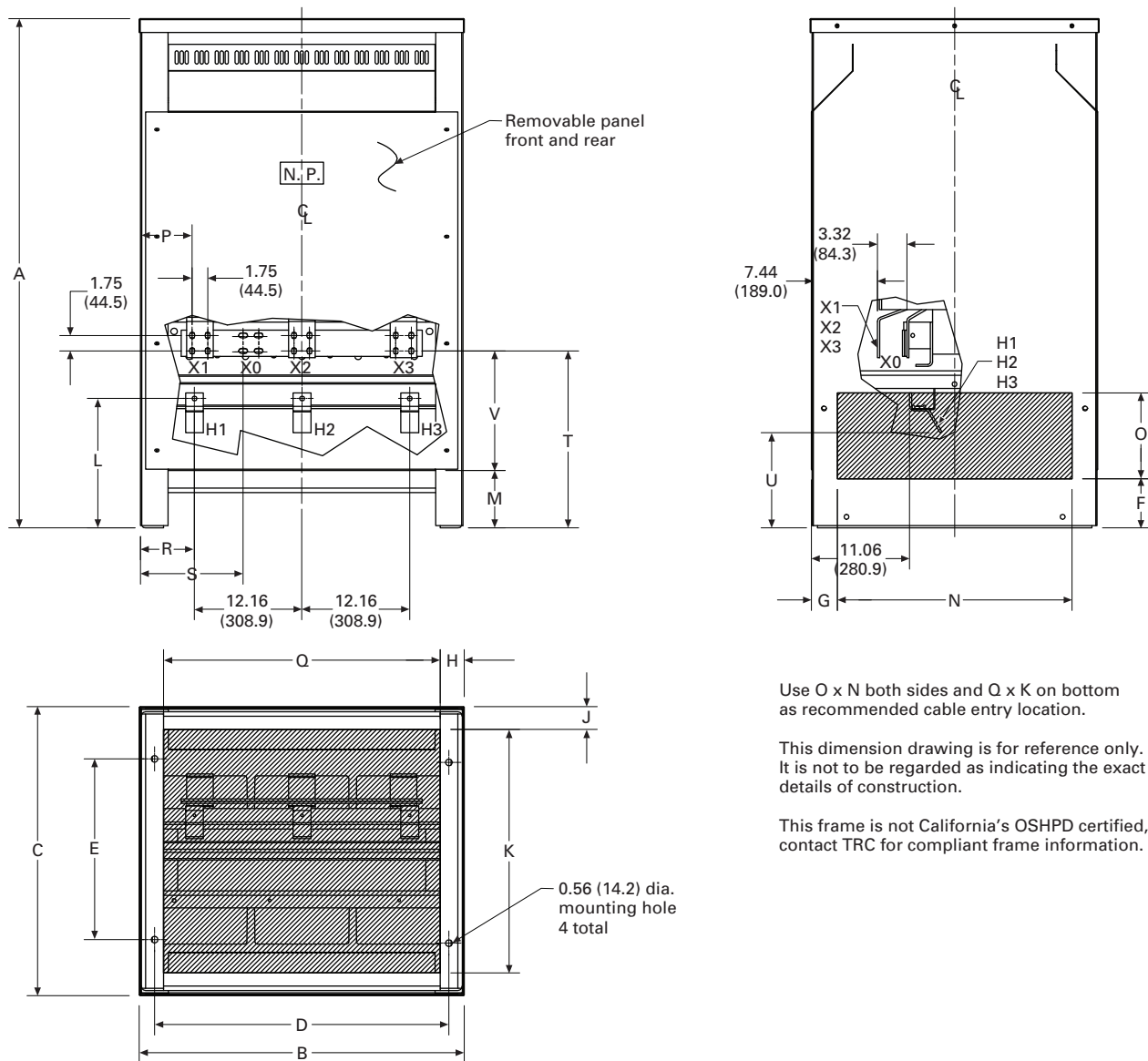


Figure 7. Frame FR923

Table 25. FR923 dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U
57.54 (1461.5)	36.69 (931.9)	32.65 (829.3)	33.25 (844.6)	20.42 (518.7)	5.57 (141.5)	2.91 (73.9)	2.72 (69.1)	2.58 (65.5)	27.50 (698.5)	14.62 (371.3)	6.50 (165.1)	26.50 (673.1)	9.68 (245.9)	5.83 (148.1)	31.25 (793.8)	6.08 (154.4)	11.58 (294.1)	20.00 (508.0)	10.75 (273.1)

Table 26. FR923 accessories

Name	Serial number
Weathershield	WS37
Wall-mount bracket	Not available
Rodent screen	RS09

Table 27. FR923 replacement enclosure parts

Name	Serial number
Front/back panel①	47-45927-1
Side panel	47-45925-1
Top cover	47-45926-1

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

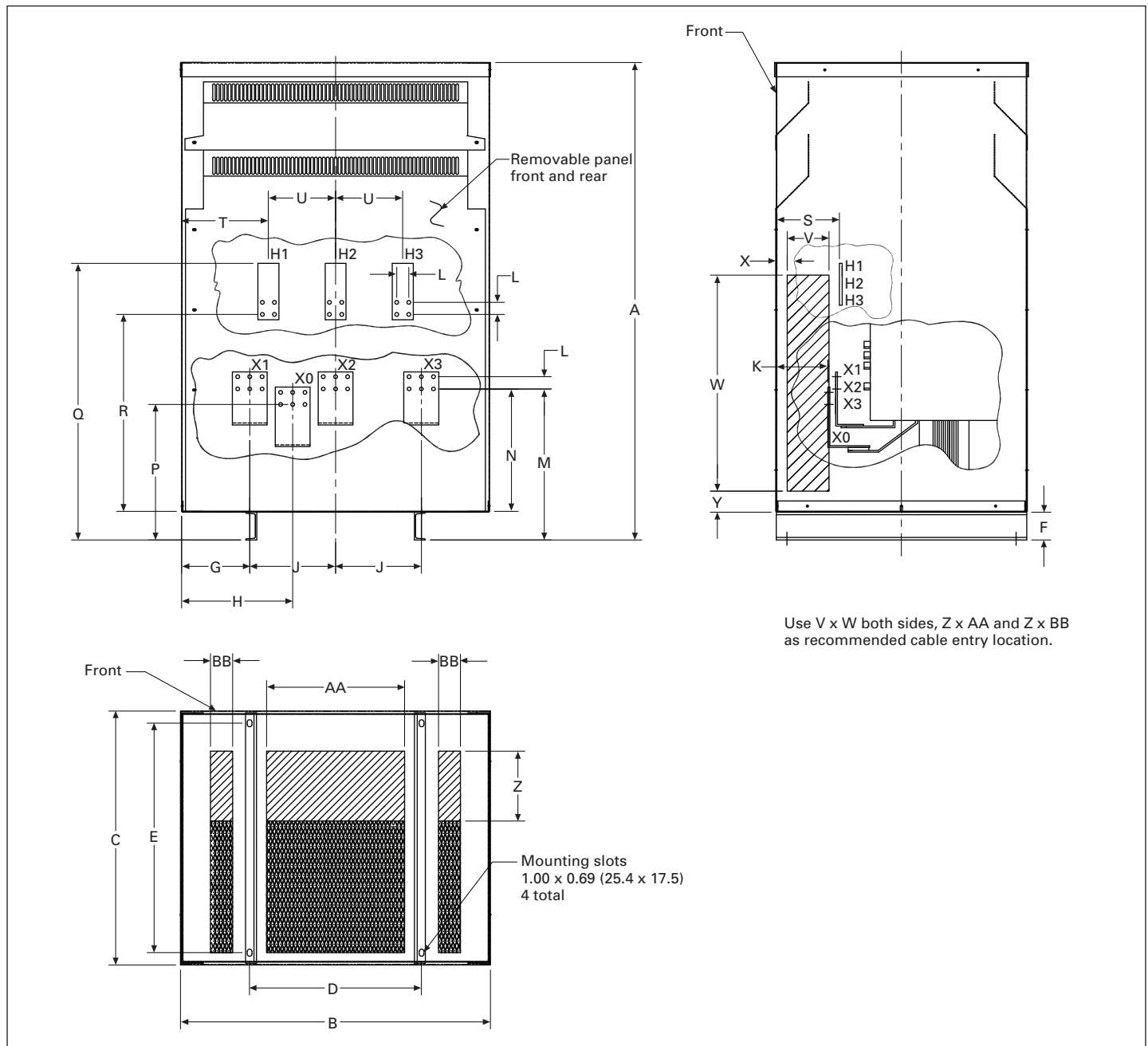


Figure 8. Frame FR924

Table 28. FR924 dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB
68.37 (1736.6)	44.46 (1129.3)	36.44 (925.6)	24.68 (626.9)	32.91 (835.9)	4.00 (101.6)	9.80 (248.9)	15.95 (405.1)	12.30 (312.4)	7.34 (186.4)	1.75 (44.5)	21.68 (550.7)	17.56 (446.0)	19.43 (493.5)	43.02 (1092.7)	34.15 (867.4)	9.00 (228.6)	12.46 (316.5)	9.64 (244.9)	6.00 (152.4)	31.00 (787.4)	1.50 (38.1)	3.00 (76.2)	10.00 (254.0)	19.83 (503.7)	3.17 (80.5)

Table 29. FR924 accessories

Name	Serial number
Weathershield	WS40
Wall-mount bracket	Not available
Rodent screen	RS18

Table 30. FR924 replacement enclosure parts

Name	Serial number
Upper front/back panel	47-53089-2
Lower front/back panel①	47-53089-1
Side panel	47-53088-1
Top cover	47-53089-4
Bottom panel	47-53087-1

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

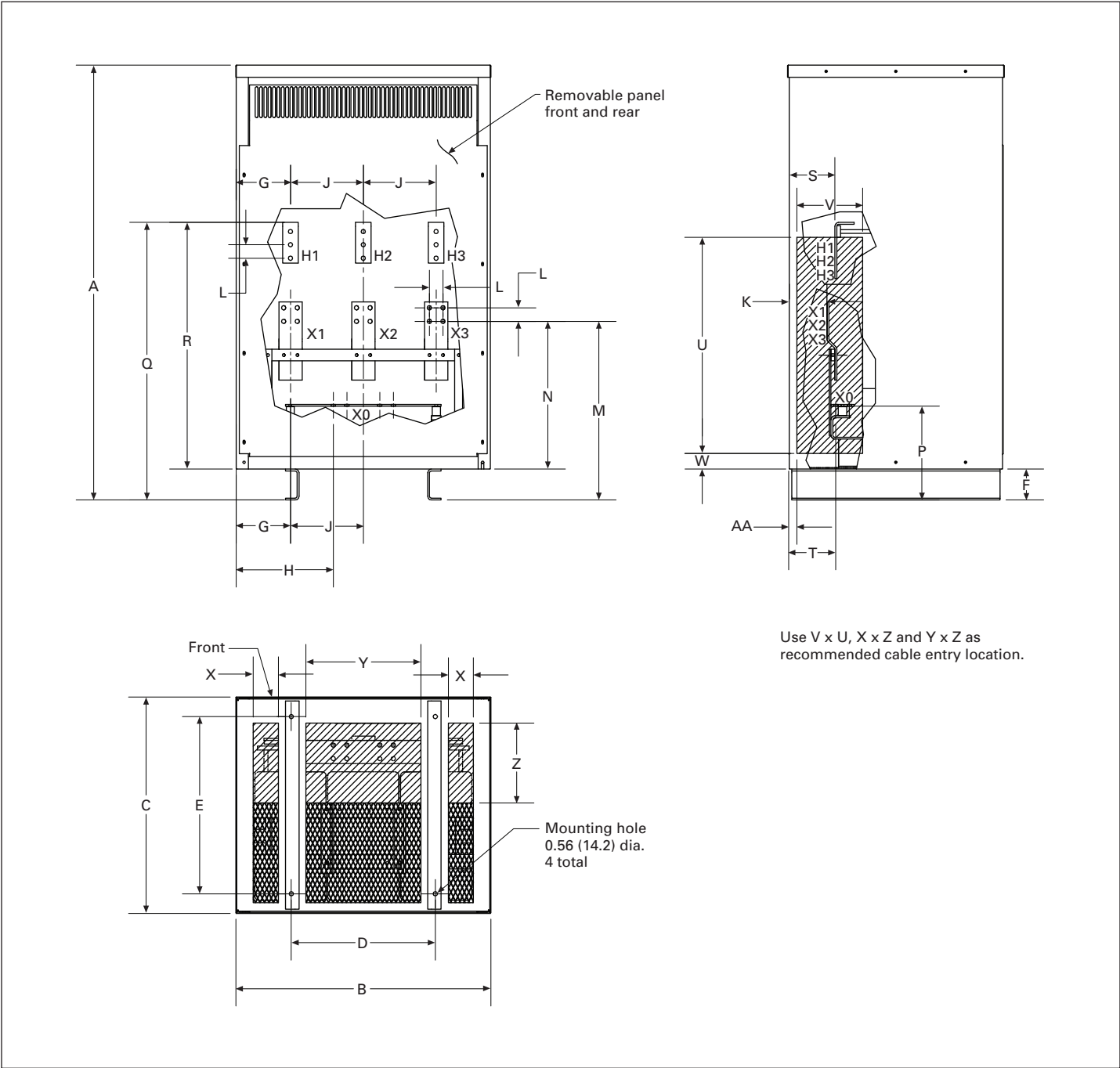


Figure 9. Frame FR928

Table 31. FR928 dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	AA
56.16 (1426.5)	32.93 (836.4)	27.97 (710.4)	18.60 (472.4)	22.88 (581.2)	4.00 (101.6)	7.10 (180.3)	12.54 (318.5)	9.40 (238.8)	4.88 (124.0)	1.75 (44.5)	23.07 (586.0)	19.07 (484.4)	12.11 (307.6)	35.85 (910.6)	31.85 (809.0)	5.97 (151.6)	6.10 (154.9)	31.00 (787.4)	8.48 (215.4)	2.00 (50.8)	3.24 (82.3)	14.86 (377.4)	10.32 (262.1)	1.07 (27.2)

Table 32. FR928 accessories

Name	Serial number
Weathershield	WS41
Wall-mount bracket	Not available
Rodent screen	RS19

Table 33. FR928 replacement enclosure parts

Name	Serial number
Front/back panel①	47-53777-1
Side panel	47-53779-1
Top cover	1714C67H15
Bottom panel	47-53778-1

① When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

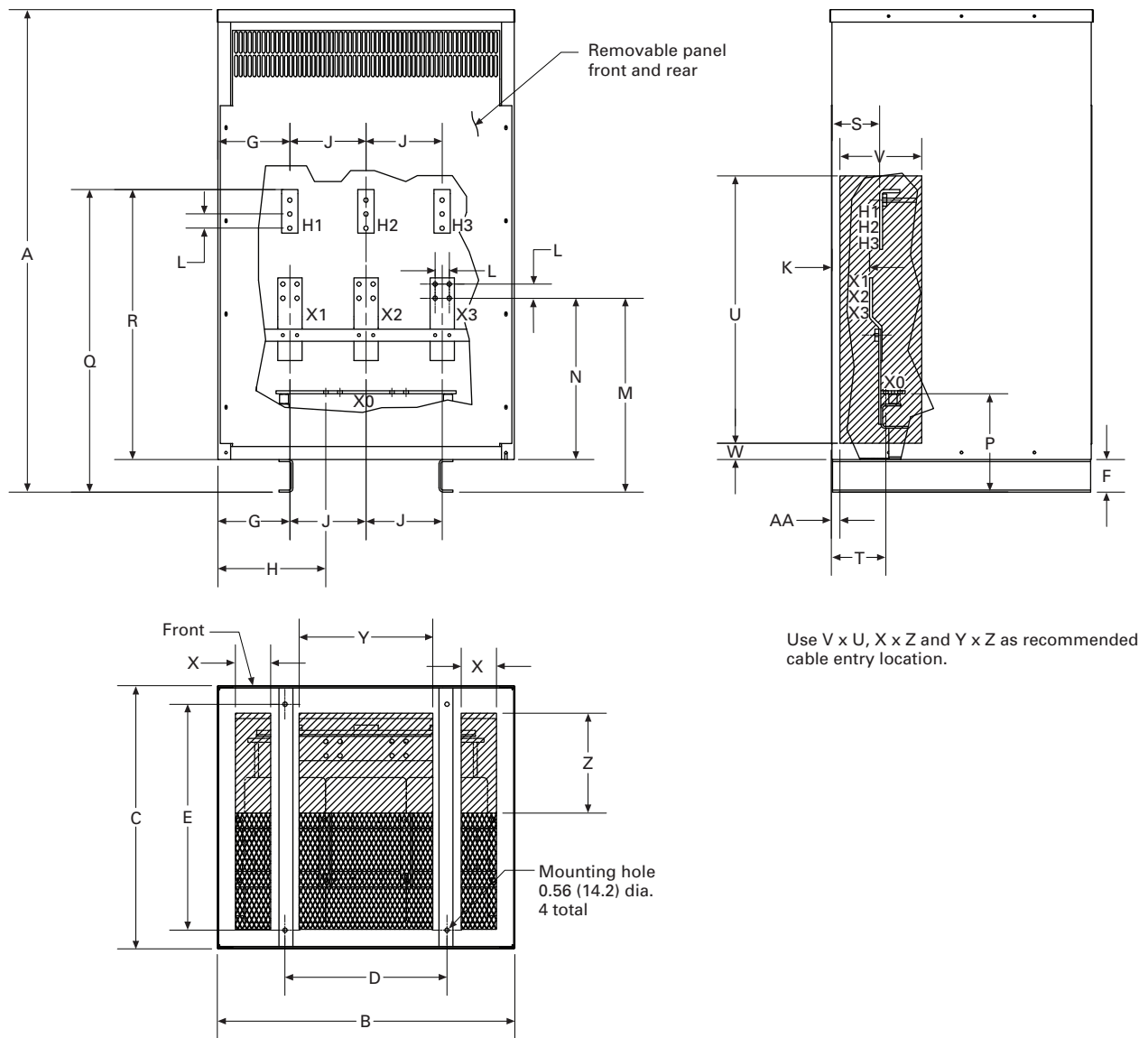


Figure 10. Frame FR929

Table 34. FR929 dimensions in inches (mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	AA
56.56 (1436.6)	36.72 (932.7)	32.50 (825.5)	20.00 (508.0)	27.89 (708.4)	4.00 (101.6)	8.90 (226.1)	13.34 (338.8)	9.40 (238.8)	4.67 (118.6)	1.75 (44.5)	23.91 (607.3)	19.91 (505.7)	12.11 (307.6)	37.32 (947.9)	33.33 (846.6)	5.90 (149.9)	6.75 (171.5)	33.00 (838.2)	10.11 (256.8)	2.00 (50.8)	4.35 (110.5)	16.50 (419.1)	12.34 (313.4)	1.07 (27.2)

Table 35. FR929 accessories

Name	Serial number
Weathershield	WS42
Wall-mount bracket	Not available
Rodent screen	RS20

Table 36. FR929 replacement enclosure parts

Name	Serial number
Front/back panel <sup>①</sup>	47-53786-1
Side panel	47-53788-1
Top cover	47-41802-3
Bottom panel	47-53787-1

<sup>①</sup> When ordering a replacement front panel, identify the serial number off the existing nameplate and reference it in the order notes so a replacement nameplate can be provided.

Transformer wiring diagrams

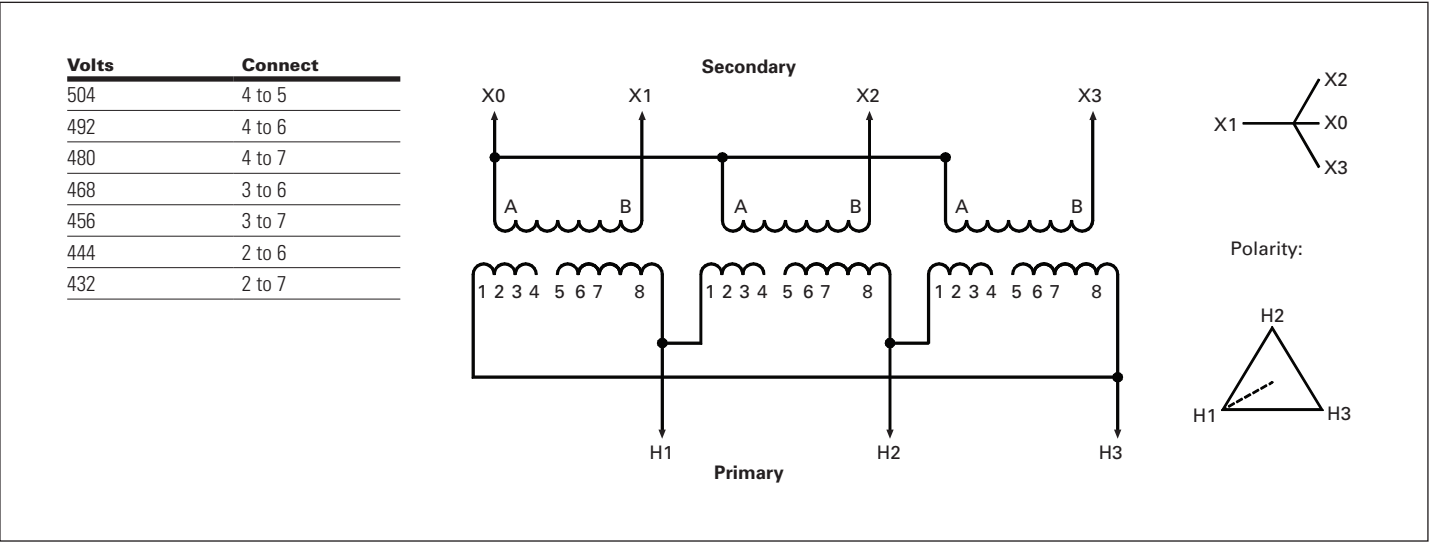


Figure 11. Wiring diagram 275A

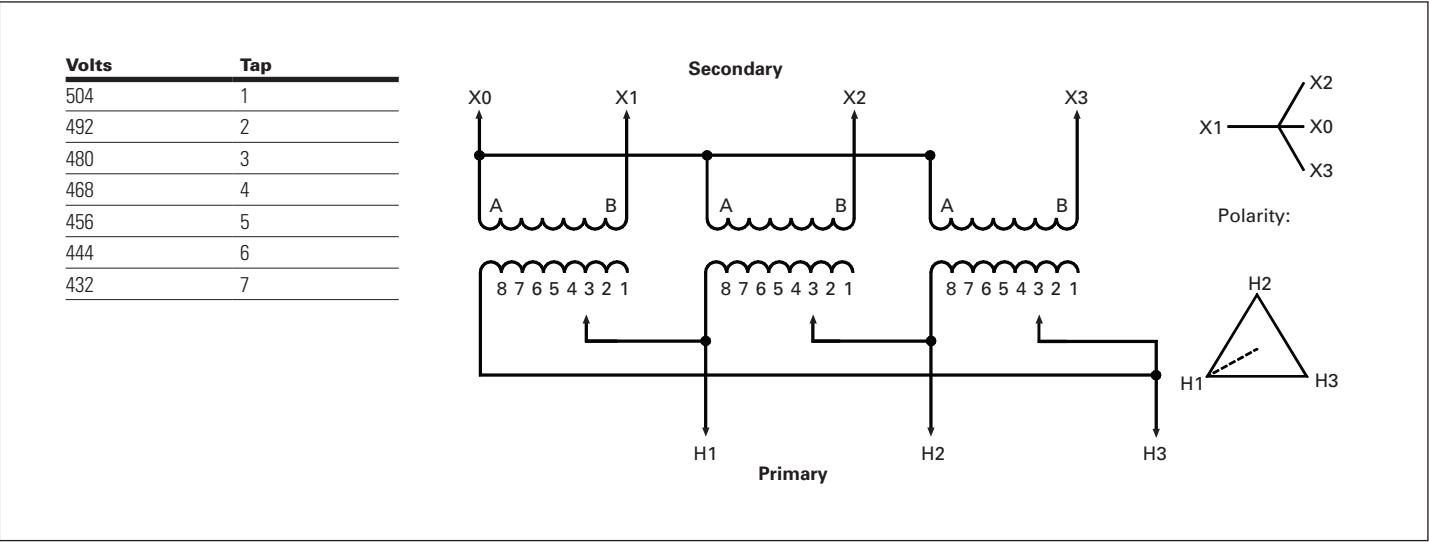


Figure 12. Wiring diagram 280B

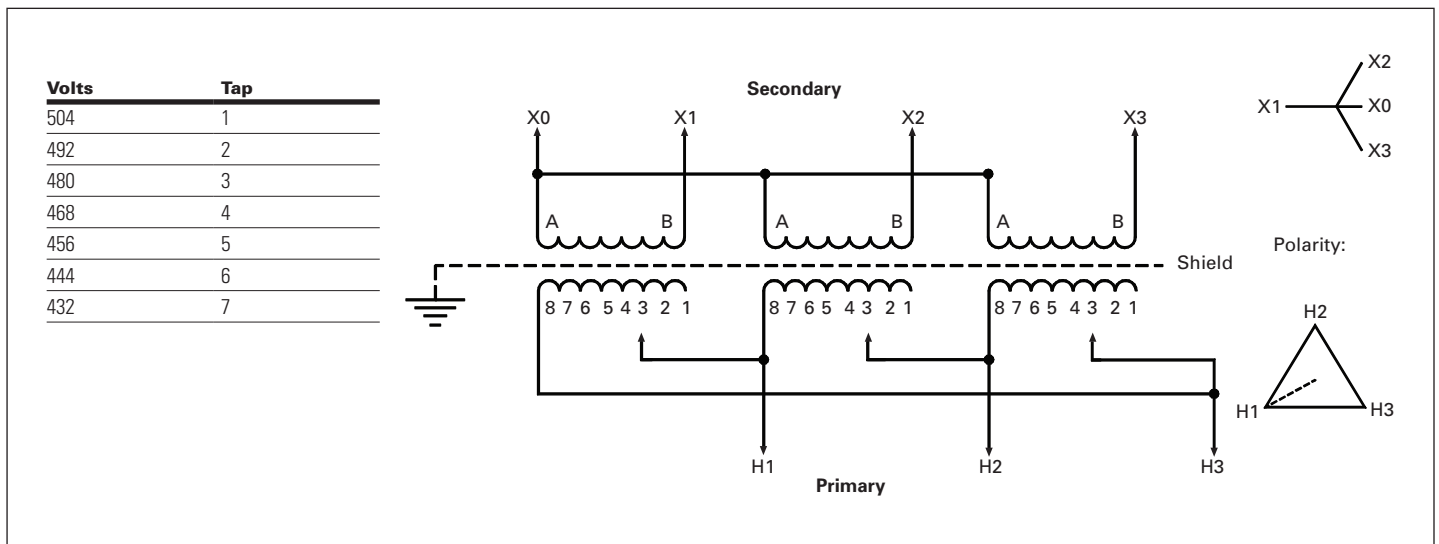


Figure 13. Wiring diagram 283B

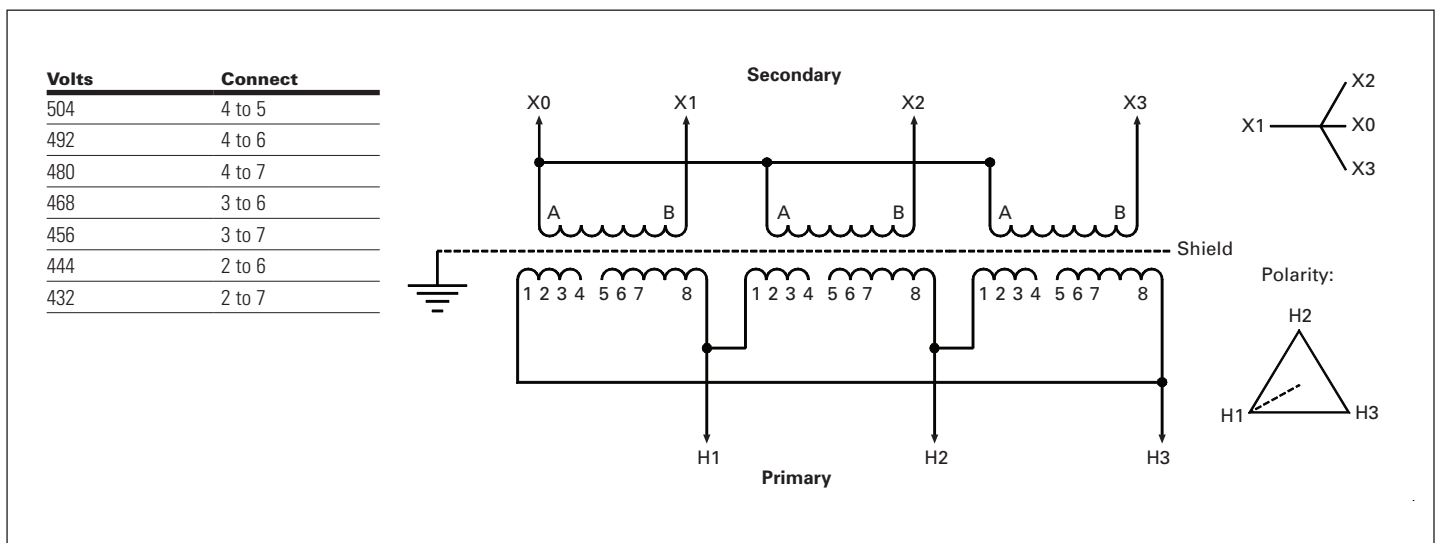


Figure 14. Wiring diagram 292A

# NEMA Premium dry-type distribution transformers (1000 kVA and below) specification

## Part 1—general

### 1. Scope

- a. The contractor shall furnish and install general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

### 2. Related sections

### 3. References

- a. The transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, NEMA and UL.
- b. Transformers shall meet the requirements of federal law 10 CFR Part 431 “Energy Efficiency Program for Certain Commercial and Industrial Equipment” and NEMA Premium efficiency transformer program.

### 4. Submittals—for review/approval

- a. The following information shall be submitted to the engineer:
  1. Outline dimensions and weights
  2. Transformer ratings including:
    - a. kVA
    - b. Primary and secondary voltage
    - c. Taps
    - d. Basic impulse level (BIL) for equipment over 600V
    - e. Design impedance
    - f. Insulation class and temperature rise
    - g. Sound level
  3. Product data sheets

### 5. Submittals—for construction

- a. The following information shall be submitted for record purposes.
  1. Final as-built drawings and information for items listed in section four (Submittals—for review/approval), and shall incorporate all changes made during the manufacturing process
  2. Connection diagrams
  3. Installation information
  4. Seismic certification and equipment anchorage details as specified

### 6. Qualifications

- a. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- b. For the equipment specified herein, the manufacturer shall be ISO® 9001 or 9002 certified.
- c. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- d. Provide seismic tested equipment as follows:①

#### Note to spec. writer:

To help understand the 2006 IBC/2007 CBC seismic parameters for a specific location, the attached link to the US Geological Survey will be extremely helpful: <http://earthquake.usgs.gov/research/hazmaps/design/>

Download the file “Java Ground Motion Parameter Calculator—Version 5.0.8 (4.6 MB)” and save it to your hard drive, then run the executable (.exe) that was downloaded.

Enter the latitude and longitude of your project location.

(To find exact latitude and longitude, go to <http://geocoder.us/> and type in the address.)

The IBC seismic criteria for that location will then be displayed. It is simply a matter of verifying that the criteria shown for your specific building location is correct.

1. The equipment and major components shall be suitable for and certified **by actual seismic testing** to meet all applicable seismic requirements of the 2006 International Building Code (IBC) Site Classification (**Enter classification from above website**). The site coefficients  $F_a = (\text{Enter value from above website})$ , and spectral response accelerations of  $S_s = (\text{Enter value from above website})g$ ,  $S_1 = (\text{Enter value from above website})g$  are used. The test response spectrum shall be based upon a five percent damping factor, and a peak ( $S_{ps}$ ) of at least (**Enter value from above website**)g’s (3–12 Hz) applied at the base of the equipment in the horizontal direction. The forces in the vertical direction shall be at least 66 percent of those in the horizontal direction. The tests shall cover a frequency range from 1–100 Hz. Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs.

..... OR② .....

1. The manufacturer shall certify the equipment based upon a dynamic and/or static structural **computer analysis** of the entire assembly structure and its components, provided it is based upon **actual seismic testing** from similar equipment. The analysis shall be based upon all applicable seismic requirements of the 2006 International Building Code (IBC) Site Classification (**Enter classification from above website**), site coefficient  $F_a = (\text{Enter classification from above website})$ ,  $F_v = (\text{Enter classification from above website})$  and spectral response accelerations of  $S_s = (\text{Enter classification from above website})g$ ,  $S_1 = (\text{Enter classification from above website})g$ . The analysis shall be based upon a five percent damping factor, and a peak ( $S_{ps}$ ) of at least (**Enter classification from above website**)g’s (3–12 Hz), applied at the base of the equipment in the horizontal direction. The forces in the vertical direction shall be at least 66 percent of those in the horizontal direction. The analysis shall cover a frequency range from 1–100 Hz. Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs.
2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
  - a. The contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.

① Note to spec. writer—optional

② Note to spec. writer—select one

- b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

## 7. Regulatory requirements

- a. All transformers shall be UL listed and bear the UL label.

## 8. Delivery, storage and handling

- a. Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

## 9. Operation and maintenance manuals

- a. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

## PART 2—products

### 1. Manufacturers

- a. Eaton
- b. \_\_\_\_\_<sup>③</sup>
- c. \_\_\_\_\_<sup>③</sup>

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the engineer ten days prior to bid date.

### 2. Ratings

- a. The kVA and voltage ratings shall be as indicated on the drawings.
- b. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
- c. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

0	to	9 kVA	40 dB
10	to	50 kVA	45 dB
51	to	150 kVA	50 dB
151	to	300 kVA	55 dB
301	to	500 kVA	60 dB
501	to	700 kVA	62 dB
701	to	1000 kVA	64 dB
1001	to	1500 kVA	65 dB

- d. Where K-factor transformers are indicated on the drawings, the transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of 4, 9, 13 or 20<sup>④</sup> without exceeding 80, 115, 130 or 150°C<sup>④</sup> temperature rise.
  - 1. K-factor transformers shall have a neutral sized to carry 200 percent of the rated full load current.

- e. Transformers shall meet or exceed the efficiency levels specified in the NEMA Premium efficiency transformers program. Efficiencies are measured at 35 percent loading and 75°C.

3-phase kVA	Minimum efficiency
15	97.90%
30	98.25%
45	98.39%
75	98.60%
112.5	98.74%
150	98.81%
225	98.95%
300	99.02%
500	99.09%
750	99.16%
1000	99.23%

## 3. Construction—NEMA Premium transformers

- a. Insulation systems
  - 1. Transformer insulation system shall be as follows:
    - a. 15 kVA and above: 200 or 220°C<sup>④</sup> insulation system with 80, 115, 130 or 150°C<sup>④</sup> rise, ventilated design.
  - 2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient, and a 24-hour average ambient of 30°C
  - 3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635
- b. Core and coil assemblies
  - 1. Transformer core shall be constructed with high-grade, nonaging, 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 ten percent above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum or copper with continuous wound construction.
  - 2. On three-phase units rated 15 kVA and above, 30 kVA and above, 45 kVA and above, 75 kVA and above or 112.5 kVA<sup>④</sup> and above the core and coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. Enameled conductors may also be used. The assembly shall be installed on vibration-absorbing pads that prevent metal-to-metal contact between the core and mounting base.
- c. Taps
  - 1. Three-phase transformers rated 15–225 kVA shall be provided with six (6) two and a half percent taps, two above and four below rated primary voltage. Three-phase transformers rated more than 225 kVA shall be provided with manufacturer's standard taps.
- d. Electrostatic shielding
  - 1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.
    - a. Electrostatic shield shall provide primary to secondary winding capacitance between 18 and 24 picofarads over the range of 100 Hz to 20 kHz.

<sup>③</sup> Note to spec. writer—insert data in blanks

<sup>④</sup> Note to spec. writer—select one

- b. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique:
- c. Common mode noise attenuation: minus 80 dBA minimum at 0.1–1.5 kHz; minus 55 dBA minimum at 1.51–100 kHz. Normal mode (Transverse mode) noise attenuation: minus 35 dBA minimum at 1.5–10 kHz.
- e. Enclosure
  - 1. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 50°C rise above a 40°C maximum ambient (90°C). The core of the transformer shall be grounded to the enclosure with a flexible copper strap that is fully-rated as a grounding conductor.
  - a. The enclosure construction shall be ventilated, NEMA 2 drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt. On outdoor units, provide weathershields over ventilated openings.
  - b. Enclosures shall be finished with ANSI 61 color, weather-resistant enamel.

#### 4. Accessories

- a. On ventilated outdoor units provide suitable weathershields over ventilation openings.
- b. Lug kits<sup>⑤</sup> shall be provided by the manufacturer of the transformer

### PART 3—execution

#### 1. Factory testing

- a. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
  - 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

#### 2. Installation

- a. The contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

#### 3. Field adjustments

- a. Adjust taps to deliver appropriate secondary voltage.

#### 4. Field testing

- a. Measure primary and secondary voltages for proper tap settings.

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⑤ Note to spec. writer—optional