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Indoor or Outdoor 2400 to 14,400 Volts
600 to 14,400 Kvac, 3 Phase, 60 Hz

Metal Enclosed Dyna-Vac Capacitor Equipments



Benefits

There are many capacitor applications in which factors such as physical location, personnel safety, appearance, etc., make the use of metal enclosed capacitor equipment much more desirable than open rack equipment. The Westinghouse metal enclosed Dyna-Vac capacitor equipment is specifically designed for these applications.

Packaged Design: Contained within a single, factory assembled, weatherproof, metal housing of modern design and pleasing appearance are the following:

1. Sufficient capacitors for the total Kvac rating required.
2. Current limiting fuses on each capacitor unit.
3. Thermostatically controlled fans for forced ventilation to prolong capacitor life.
4. A power entrance or switch compartment with appropriate provisions for terminating purchasers incoming lines and containing all desired accessories.

Safety: All live parts are completely enclosed in a grounded, weatherproof sheet metal housing. Capacitor doors are mechanically interlocked with maintenance ground switch and may be padlocked.

Small Size: New larger Kvac capacitor units reduce equipment dimensions compared to earlier metal enclosed designs.

Substation ground area required is substantially reduced compared to open rack designs since no electrical clearances to adjacent structures are necessary.

Low overall height, less than 9 feet, is much lower than most open rack installations where 8 foot supporting structures are common practice.

Low Installation Cost: Unlike open racks which are shipped as sub-assemblies requiring field assembly, erection, and interconnection most metal enclosed Dyna-Vac equipments are shipped completely assembled including switches and other accessories (when ordered). Fasten the enclosure to a pad or

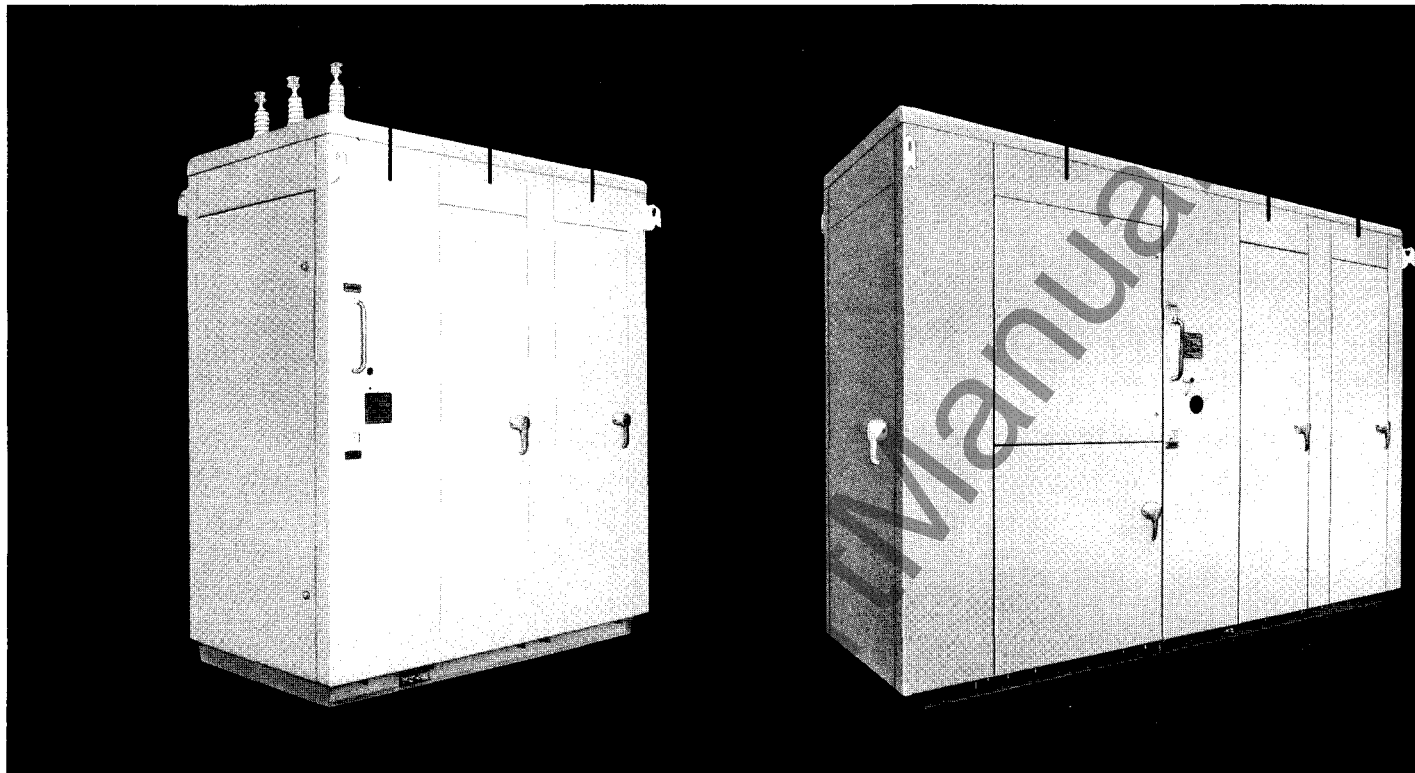
other foundation, bring in line and control leads, and the installation is complete.

Improved Capacitors: Latest designs incorporating a synthetic film dielectric system provide: low losses averaging less than 0.5 watts/Kvac; lower operating temperature with corresponding longer life; better transient voltage withstand characteristics.

Pleasing Appearance: Smooth contours and low height are much preferred to open rack structural designs.

Fewer Outages: Completely protected from outages caused by rodents, snakes, birds, debris, etc., which sometimes get into open rack equipments.

Summary: The above features all contribute to lower total operating costs and lower installation cost. Metal enclosed capacitors are a growing trend. Utilities or other purchasers not presently using metal enclosed capacitors are overlooking a desirable capacitor equipment design for many applications.



KVAC Ratings

Metal enclosed capacitor equipments are available from 600 Kvac and up.

Standard equipments with capacitor compartments sizes from 12 through 42 units have a 1-piece roof and are non-expandable. Equipments larger than 42 unit capacity are supplied in two sections, bolted together.

Voltage Ratings: Equipments are available from 2400 volts through 14,400 volts. Standard equipments use capacitor units rated for the line-to-neutral voltage of the system and are wye connected. The neutral may be grounded or ungrounded at the purchaser's option. For 2400 volts systems, 2400 volt capacitor units are used and connected in Delta.

The overall equipment BIL is 95 Kv. This is reduced to 75 Kv BIL whenever 2400 through 4800 volt capacitor units are installed, since these units are rated 75 Kv BIL in accordance with NEMA standards for shunt capacitors.

Metal enclosed Dyna-Vac capacitor equipments are available in 3 basic arrangements: unswitched (Type I); switched (Type II); and switched with an auxiliary entrance compartment (Type III).

① **Line Entrance Compartment:** Unswitched equipments include a power entrance compartment containing 3 phase buses and a neutral bus all insulated from the enclosure. Underground line leads may be brought in by conduit through a removable plate in the compartment floor, or connected to 3 roof bushings if they are specified.

The power entrance compartment will accommodate some small accessories such as potheads, cable terminators, control power transformer, etc.

② **Switch Compartment:** Switched equipments include an additional compartment with a barrier between it and the capacitor compartment. The switch compartment will accommodate any of the following electrically operated switching devices:

- 3 – 200 ampere, single pole, type CSL oil switches
- 1 – 400 ampere or 600 ampere, 3 pole, vacuum switch
- 1 – 600 ampere, 3 pole, vacuum circuit breaker
- 1 – 600 ampere, 3 pole, vacuum circuit breaker with disconnect provisions

In addition, small accessories such as: inrush limiting reactors; current transformers; control power transformer; and control panel may be included.

If an electrically operated switch is not included, the switch compartment may incorporate other devices such as 3 power fuses or isolating disconnect switches, either hook stick or gang operated.

③ **Auxiliary Compartment:** An auxiliary compartment, barriered from the switch compartment, is included with those equipments requiring a major accessory in addition to the switch. Devices which may be mounted in the auxiliary compartment include power fuses, hook stick or gang operated isolating switches, current transformers, control panel, etc.

Safety: A short circuiting and grounding switch is a standard feature with all metal enclosed Dyna-Vac capacitor equipments for safety during maintenance. The switch is mechanically interlocked with all capacitor compartment doors to prevent access to the compartment unless the phase and neutral buses are shorted and grounded. Conversely, the shorting and grounding switch cannot be opened until all capacitor compartment doors are closed and latched. As a further precaution, the short circuiting and grounding switch may be provided with a key interlock for coordinating with the capacitor switch if it is included in the capacitor equipment, or with the purchaser's remote main disconnect switch or circuit breaker, to prevent ground-



ing the capacitor buses while the breaker is closed and to prevent closing the breaker while the buses are grounded.

④ Capacitor Compartment: Standard capacitor compartment sizes available are: 12, 18, 30, 42, 48, 60 and 72 unit capacity. Intermediate Kvac ratings, or initial Kvac ratings with space for future uprating, will be supplied with a compartment suitable for the ultimate Kvac rating and omitting capacitor units and fuses in multiples of 3 to obtain the desired initial Kvac rating.

The capacitor compartment contains a welded steel frame which is solidly connected to the sheet metal weatherproof enclosure. This frame supports the capacitor units in a single row, 3 tiers high. The capacitors are edge mounted with the bushings facing the doors. Removal or addition of individual capacitor units is easily accomplished through the hinged doors on the front side of the enclosure.

Horizontal aluminum buses mounted on indoor bus support insulators support the current limiting capacitor unit fuses.

The floor of each capacitor compartment is made from expanded metal screen, and the top rear of the compartment is louvered and screened. This permits free air circulation and prevents the entrance of rodents, foreign

matter, wind driven rain, etc. One or more 1/4 horsepower, 115 volt single phase fans are mounted in the bottom of the capacitor compartment to provide forced ventilation.

Each capacitor compartment also contains one or more sets of thermostats. A set consists of two thermostats, one of which starts the fans when the temperature reaches 100°F and stops the fans when the temperature reaches 80°F. The second thermostat may be used as a safety feature to trip the capacitor switch and remove the capacitor from service or sound an alarm. It operates at 135°F and is manually reset.

Capacitor Units: Capacitor units are standard outdoor, single phase, 2 bushing, 60 Hertz, 100, 150, or 200 Kvac units of the type applied on distribution systems. These Dyna-Vac capacitors contain a synthetic film dielectric system which results in very low losses, higher Kvac per unit, reduced volume per Kvac, lower operating temperatures with corresponding longer life, and high transient voltage withstand ability.

Each capacitor contains an internal discharge resistor which will drain the residual voltage to 50 volts crest in less than five minutes after the unit has been disconnected from the circuit.



Fuses: All metal enclosed Dyna-Vac capacitor equipments, regardless of voltage rating or connection, include one current limiting fuse for each installed capacitor unit. These fuses provide visual indication of fuse operation. The ampere rating and voltage rating of the fuse is selected to coordinate with the particular capacitor unit with which it is used.

Finish: Each equipment is chemically cleaned and phosphated after fabrication to remove grease, oil, and dirt. This is followed by one coat of alkyd primer and a finish coat of outdoor weatherproof acrylic paint, light gray ASA-70 in color. As additional protection, all under surfaces are "undercoated" with a two coat rust and waterproof finish.

Shipping and Handling: Entire equipments, up to 20 feet in overall length, are designed to be shipped as one complete assembly. Longer equipments may be shipped in two or more sections to facilitate handling.

Lifting lugs on both sides of the equipment near the top provide for unloading or moving with slings where a crane is available. The heavy steel base permits jacking and may be used for skidding if necessary.



Optional Items

Following is a partial list of optional items and accessories which may be incorporated in standard metal enclosed equipments.

1. 200 ampere oil switches
2. 400 and 600 ampere vacuum switches
3. 600 ampere vacuum circuit breakers

4. Hookstick operated isolating switches
5. Gang operated isolating switches
6. Power fuses
7. Potheads
8. Roof bushings
9. Inrush limiting reactors
10. Moulded or bushing type current trans-
formers

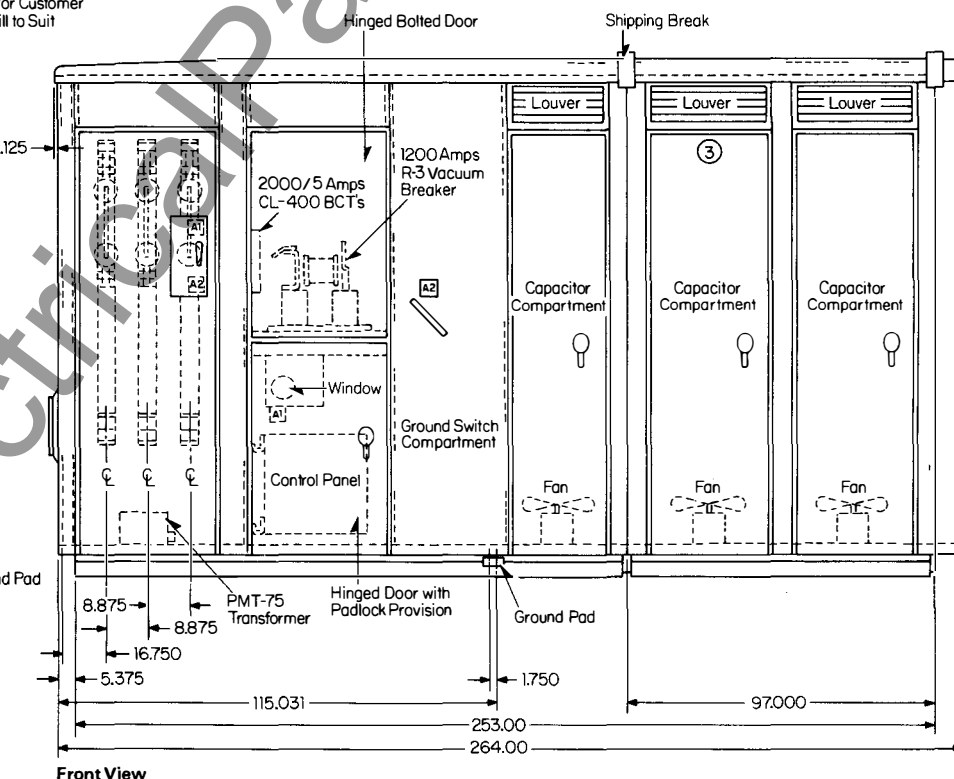
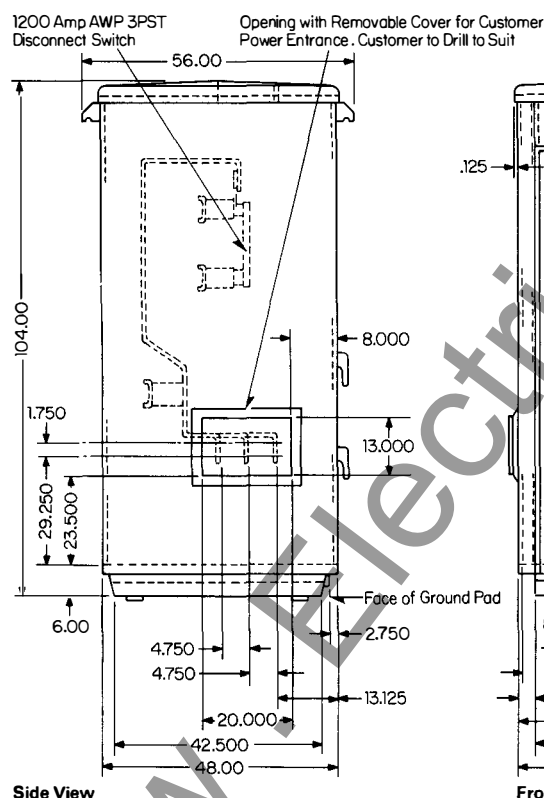
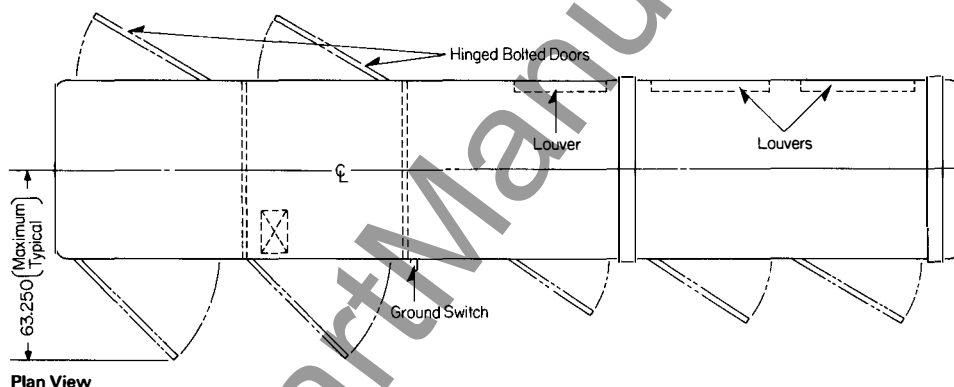
11. Small LV power transformer
12. Lightning arresters
13. Unbalance detection (CT and relay) for
wye-wye floating neutral banks
14. Current, voltage, VAR controls for electri-
cally operated switches

Interlock Sequence

1. Trip Breaker With "A1"; Key Released;
Breaker is Locked Open and "69" Device
is Tripped.
2. Unlock Disconnect Switch With "A1";
Key Retained.
3. Open Disconnect Switch and Lock Open With
"A2"; Key Retained.
4. Unlock Ground Switch With "A2"; Key
Retained.
5. Close Ground Switch; Capacitor
Compartment Doors can now be Opened.
6. To Energize Bank; Close and Latch Capacitor
Compartment Doors and Reverse Sequence.

Note: "69" Device must be Manually Reset.

Dimensions in Inches (Approximate)



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Metal Enclosed Dyna-Vac Capacitor Equipments

Indoor or Outdoor 2400 to 14,400 Volts
1200 to 10,800 Kvac, 3 Phase, 60 Hz



Benefits

There are many capacitor applications in which factors such as physical location, personnel safety, appearance, etc., make the use of metal enclosed capacitor equipment much more desirable than open rack equipment. The Westinghouse metal enclosed Dyna-Vac capacitor equipment is specifically designed for these applications.

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2. Current limiting fuses on each capacitor unit
3. Thermostatically controlled fans for forced ventilation to prolong capacitor life.
4. A power entrance or switch compartment with appropriate provisions for terminating purchaser's incoming lines and containing all desired accessories.

Safety: All live parts are completely enclosed in a grounded, weatherproof sheet metal housing. Capacitor doors are mechanically interlocked with maintenance ground switch and/or may be padlocked.

Small Size: New larger Kvac capacitor units reduce equipment dimensions compared to earlier metal enclosed designs. Substation ground area required is substantially reduced compared to open rack designs since no electrical clearances to adjacent structures are necessary. Low overall height, less than 9 feet, is much lower than most open rack installations where 8 foot supporting structures are common practice.

Low Installation Price: Unlike open racks which are shipped as sub-assemblies requiring field assembly, erection, and interconnection most metal enclosed Dyna-Vac equipments are shipped completely assembled including switches and other accessories (when ordered). Fasten the enclosure to a pad or other foundation, bring in

line and control leads, and the installation is complete.

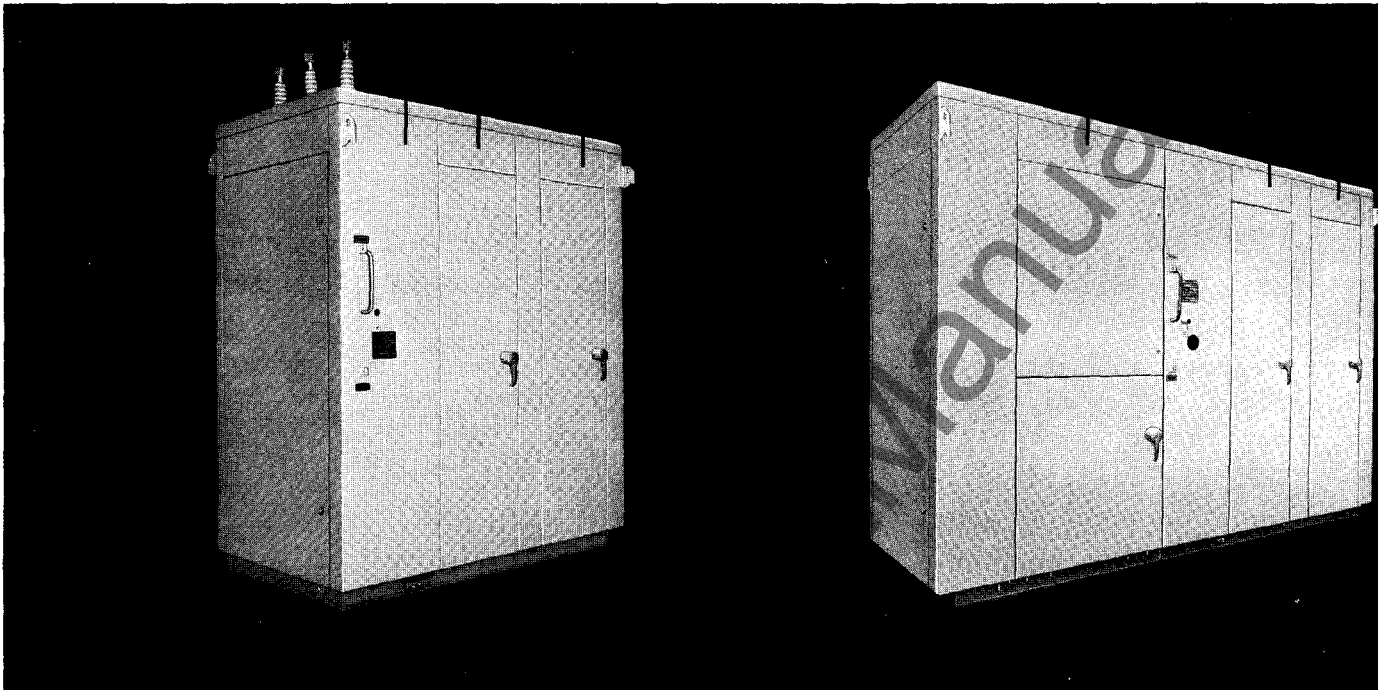
Improved Capacitors: Latest designs incorporating a synthetic film dielectric system provide: low losses averaging less than 0.5 watts/Kvac; lower operating temperature with corresponding longer life; better transient voltage withstand characteristics.

Pleasing Appearance: Smooth contours and low height are much preferred to open rack structural designs.

Fewer Outages: Completely protected from outages caused by rodents, snakes, birds, debris, etc., which sometimes get into open rack equipments.

Summary: The above features all contribute to lower total operating costs and lower installation cost. Metal enclosed capacitors are a growing trend. Utilities or other purchasers not presently using metal enclosed capacitors are overlooking a desirable capacitor equipment design for many applications.

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KVAC Ratings

Depending on the circuit voltage, metal enclosed capacitor equipments are available from 1200 Kvac up to 10,800 Kvac based upon using a 600 ampere continuous switch.

Standard equipments with capacitor compartments sizes from 12 through 42 units have a 1-piece roof and are non-expandable. Equipments larger than 42 unit capacity are supplied in two sections, bolted together at the factory, and include a removable end panel on the last capacitor compartment. This feature (which may be supplied with smaller equipments when specifically negotiated) does permit future expansion by bolting on additional capacitor compartments.

Voltage Ratings: Equipments are available from 2400 volts through 14,400 volts. Standard equipments use capacitor units rated for the line-to-neutral voltage of the system and are wye connected, except for 2400 volt systems. The neutral may be grounded or ungrounded at the purchaser's option. For 2400 volts systems, 2400 volt capacitor units are used and connected in Delta.

The overall equipment BIL is 95 Kv. This is reduced to 75 Kv BIL whenever 2400 through 4800 volt capacitor units are installed, since these units are rated 75 Kv BIL in accordance with NEMA standards for shunt capacitors.

Metal enclosed Dyna-Vac capacitor equipments are available in 3 basic arrangements: unswitched (Type I); switched (Type II); and switched with an auxiliary entrance compartment (Type III).

1 Line Entrance Compartment: Unswitched equipments include a power entrance compartment containing 3 phase buses and a neutral bus all insulated from the enclosure. Underground line leads may be brought in by conduit through a removable plate in the compartment floor, or connected to 3 roof bushings if they are specified.

The power entrance compartment will accommodate some small accessories such as potheads, cable terminators, control power transformer, etc.

2 Switch Compartment: Switched equipments include an additional compartment with a barrier between it and the capacitor compartment. The switch compartment will accommodate any of the following electrically operated switching devices:

- 3-200 ampere, single pole, type CSL oil switches
- 1-400 ampere or 600 ampere, 3 pole, type PRC oil switch
- 1-400 ampere or 600 ampere, 3 pole, vacuum switch
- 1-600 ampere, 3 pole, vacuum circuit breaker

1-400 or 600 ampere, 3 pole, type LBF fused load-break switch (manually operated)

In addition, small accessories such as: inrush limiting reactors; current transformers; control power transformer; and control panel may be included.

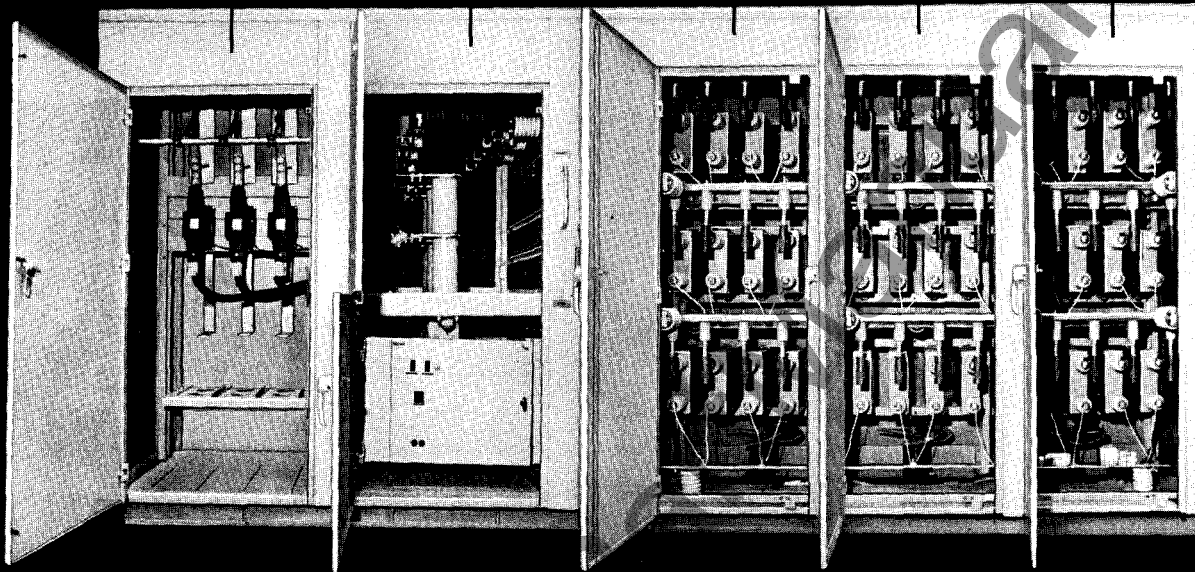
If an electrically operated switch is not included, the switch compartment may incorporate other devices such as 3 power fuses or isolating disconnect switches, either hook stick or gang operated.

3 Auxiliary Compartment: An auxiliary compartment, barred from the switch compartment, is included with those equipments requiring a major accessory in addition to the switch. Devices which may be mounted in the auxiliary compartment include power fuses, hook stick or gang operated isolating switches, current transformers, control panel, etc.

Safety: A short circuiting and grounding switch is a standard feature with all metal enclosed Dyna-Vac capacitor equipments for safety during maintenance. The switch is mechanically interlocked with all capacitor compartment doors to prevent access to the compartment unless the phase and neutral buses are shorted and grounded. Conversely, the shorting and grounding switch cannot be opened until all capacitor compartment doors are closed and latched. As a further precaution, the short circuit-

Metal Enclosed Dyna-Vac Capacitor Equipments

Indoor or Outdoor 2400 to 14,400 Volts
1200 to 10,800 Kvac, 3 Phase, 60 Hz



ing and grounding switch may be provided with a key interlock for coordinating with the capacitor switch if it is included in the capacitor equipment, or with the purchaser's remote main disconnect switch or circuit breaker, to prevent grounding the capacitor buses while the breaker is closed and to prevent closing the breaker while the buses are grounded.

4 Capacitor Compartment: Standard capacitor compartment sizes available are: 12, 18, 30, 42, 48, 60 and 72 unit capacity. Intermediate Kvac ratings, or initial Kvac ratings with space for future up-rating, will be supplied with a compartment suitable for the ultimate Kvac rating and omitting capacitor units and fuses in multiples of 3 to obtain the desired initial Kvac rating.

The capacitor compartment contains a welded steel frame which is solidly connected to the sheet metal weatherproof enclosure. This frame supports the capacitor units in a single row, 3 tiers high. The capacitors are edge mounted with the bushings facing the doors. Removal or addition of individual capacitor units is easily accomplished through the hinged doors on the front side of the enclosure. Horizontal aluminum buses mounted on indoor bus support insulators support the current limiting capacitor unit fuses.

The floor of each capacitor compartment

is made from expanded metal screen, and the top rear of the compartment is louvered and screened. This permits free air circulation and prevents the entrance of rodents, foreign matter, wind driven rain, etc. One or more $\frac{1}{4}$ horsepower, 115 volt single phase fans are mounted in the bottom of the capacitor compartment to provide forced ventilation.

Each capacitor compartment also contains one or more sets of thermostats. A set consists of two thermostats, one of which starts the fans when the temperature reaches 100°F and stops the fans when the temperature reaches 80°F. The second thermostat may be used as a safety feature to trip the capacitor switch and remove the capacitor from service or sound an alarm. It operates at 135°F and is manually reset.

Capacitor Units: Capacitor units are standard outdoor, single phase, 2 bushing, 60 Hertz, 100, 150, or 200 Kvac units of the type applied on distribution systems. These Dyna-Vac capacitors contain a synthetic film dielectric system which results in very low losses, higher Kvac per unit, reduced volume per Kvac, lower operating temperatures with corresponding longer life, and high transient voltage withstand ability. Each capacitor contains an internal discharge resistor which will drain the residual voltage to 50 volts crest in less than five

minutes after the unit has been disconnected from the circuit.

Fuses: All metal enclosed Dyna-Vac capacitor equipments, regardless of voltage rating or connection, include one current limiting fuse for each installed capacitor unit. These fuses have an interrupting rating of 60,000 amperes asymmetrical and provide visual indication of fuse operation. The ampere rating and voltage rating of the fuse is selected to coordinate with the particular capacitor unit with which it is used.

Finish: Each equipment is chemically cleaned and phosphated after fabrication to remove grease, oil, and dirt. This is followed by one coat of alkyd primer and a finish coat of outdoor weatherproof acrylic paint, light gray ASA-70 in color. As additional protection, all under surfaces are "undercoated" with a two coat rust and waterproof finish.

Shipping and Handling: Entire equipments, up to 20 feet in overall length, are designed to be shipped as one complete assembly. Longer equipments may be shipped in two or more sections to facilitate handling.

Lifting lugs on both sides of the equipment near the top provide for unloading or moving with slings where a crane is available. The heavy steel base permits jacking and may be used for skidding if necessary.



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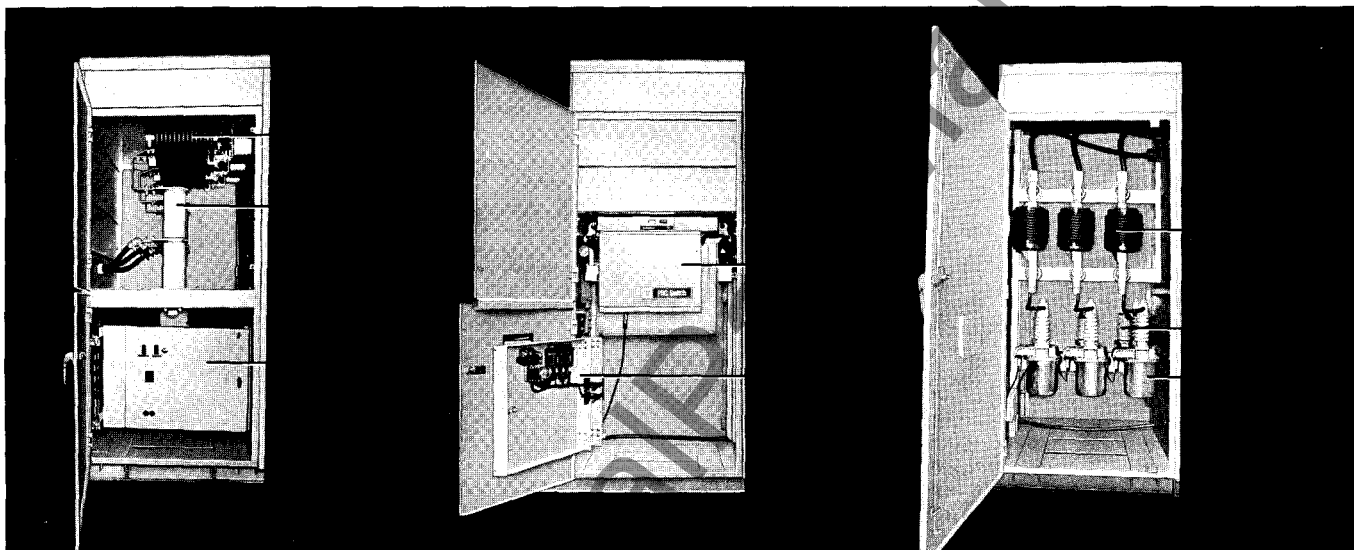
Indoor or Outdoor 2400 to 14,400 Volts
1200 to 10,800 Kvac, 3 Phase, 60 Hz

Optional Items

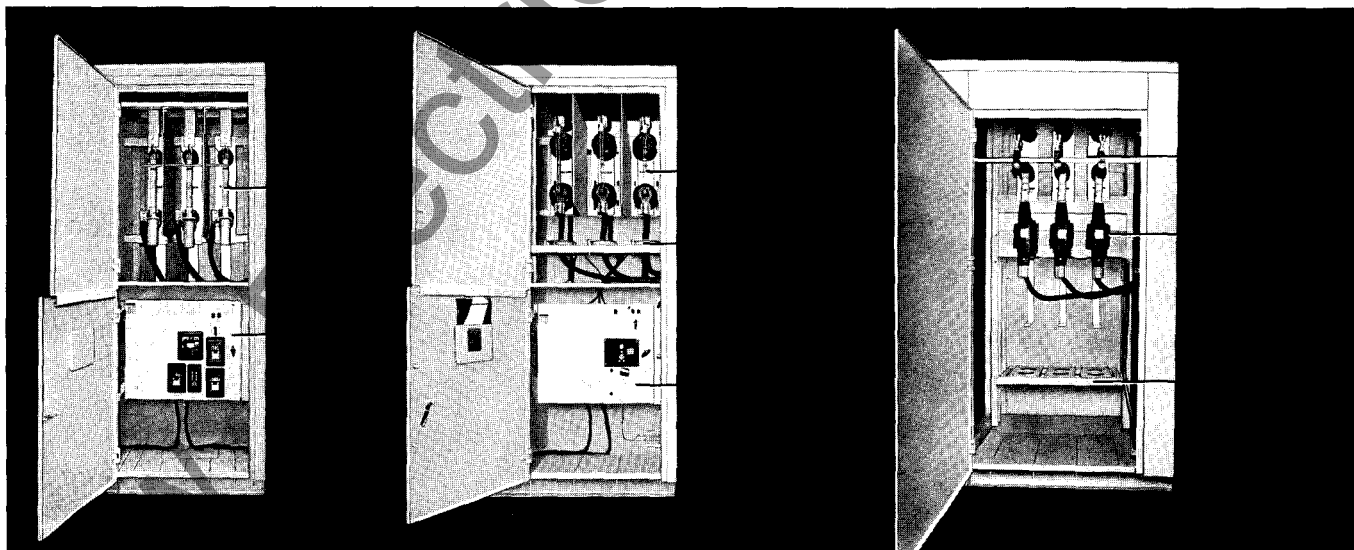
Following is a partial list of optional items and accessories which may be incorporated in standard metal enclosed equipments.

1. 200, 400 and 600 ampere oil switches
2. 400 and 600 ampere vacuum switches
3. 600 ampere vacuum circuit breakers
4. 400 and 600 ampere manually operated fused load-break switch
5. Hookstick operated isolating switches
6. Gang operated isolating switches
7. Power fuses
8. Potheads
9. Roof bushings
10. Inrush limiting reactors
11. Moulded or bushing type current transformers
12. Small LV power transformer
13. Lightning arresters
14. Unbalance detection (CT and relay) for wye-wye floating neutral banks
14. Current, voltage, VAR controls for electrically operated switches

Typical Switch Compartments



Typical Auxiliary Compartments



Further Information:
DS 39-486