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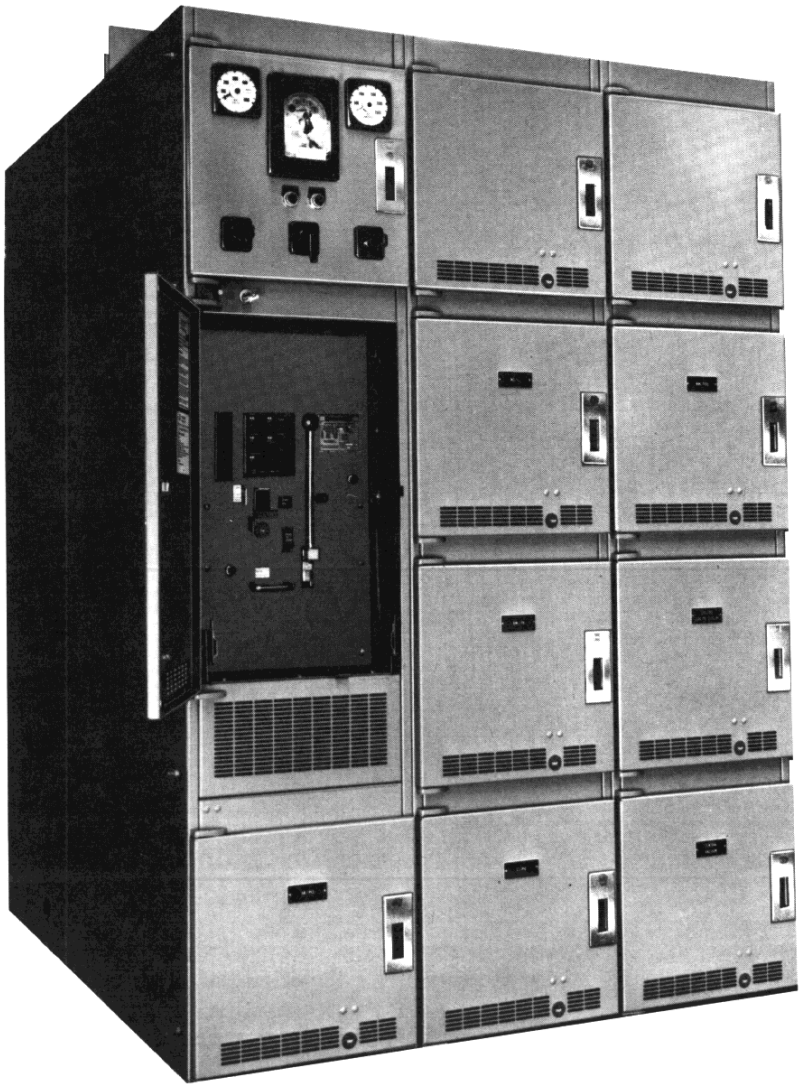
INSTRUCTION MANUAL

POWER-ZONE®II Low Voltage Metal-Enclosed Drawout Switchgear

• INSTALLATION • OPERATION • MAINTENANCE



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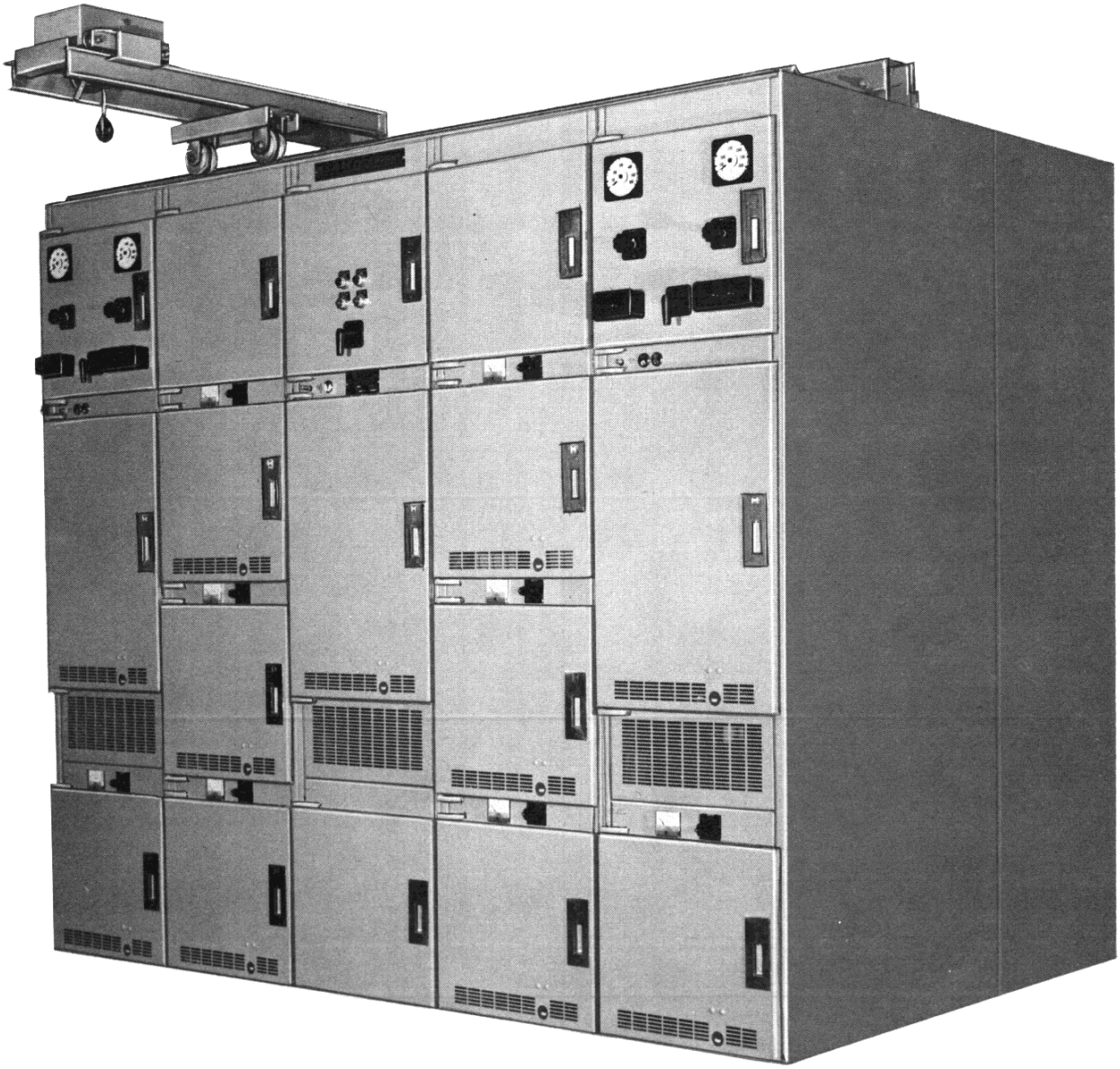

Indoor Metal-Enclosed Unit

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IMPORTANT PRECAUTIONS

Low voltage metal-enclosed switchgear is strongly built and provided with many safety features. Nevertheless, it controls power circuits with high fault capacity which are dangerous. The list of recommended *PRECAUTIONS* should be studied and followed during handling, installation, and operation of the equipment.

1. Only authorized personnel should be permitted to handle or operate the switchgear.

2. Handle all switchgear (even if crated) with extreme care as it contains delicate instruments and relays which may be damaged by rough handling.

3. When uncrating switchgear, exercise care not to scratch or mar the panel finish.

4. If any relays are included, remove blocking of relay armatures. Check control circuits (except potential and current transformer circuits) for grounds and short circuits before applying control power (Refer to "Testing and Inspection" page 9).

5. Check the main power circuit insulation system in both the switchgear and the circuit breakers using an insulation test device to insure insulation integrity and that no foreign material has accidentally come in contact with live parts before power is applied.

6. Connect the switchgear to the station ground before applying any power.

7. Do not work with "live" parts. If it is necessary to work on a circuit in the rear cable compartment, the main bus should be de-energized and all other circuits checked for feedback from other sources. If this is not possible, only the rear covers for the compartment involved should be removed and all parts covered with adequate insulating material.

8. In case of fire do not use liquid fire extinguishers until all circuits have been made electrically "dead."

9. An ounce of prevention is worth a pound of cure. All personnel responsible for supervision and operation should be familiar with the switchgear and its functions. In time of emergency there is seldom time to consult the instruction material.

10. CAUTION. If indoor switchgear is to be stored prior to installation, it must be protected from the weather and be kept free of condensation.

INTRODUCTION

Power-Zone II® metal-enclosed switchgear with type DS/DSL drawout air circuit breakers controls and protects power circuits up to 600 volts. The switchgear assembly is composed of units that are arranged to suit the Customer's requirements. Each unit is divided into three or four compartments to accept the type DS/DSL drawout air circuit breaker. An instrument compartment may be included that will contain potential transformers, instruments, meters, relays and secondary control devices. The rear of the unit will include busses and space for the main cables.

The metal-enclosed switchgear is designed, manufactured, and tested in accordance with industry standards. A typical indoor assembly is shown in Fig. 1, 2 and 3. The type DS air circuit breaker is shown and described in Instruction Manual 6030-2.

This instruction book has been prepared to familiarize the Purchaser's engineering, installation, and operating staffs with the metal-enclosed switchgear supplied by the Square D Co. Personnel responsible for supervision, operation or maintenance should become well acquainted with the appearance and characteristics of each piece of equipment contained in or mounted on the switchgear.

Proper installation, operation, and maintenance are necessary to assure continued satisfactory service from the equipment. It should not be installed in places where it will be called upon to operate at voltages, currents, or fault capacities greater than those for which it was designed. (Reference ANSI C37.20)

The following descriptions apply to standard metal-enclosed construction and wiring. Extra features and special control schemes are often incorporated when specified by the Purchaser's order. These special features are evident on the drawing and diagrams for the switchgear assembly. Instructions on standard apparatus such as relays, instruments, control switches, and circuit breakers are included elsewhere in the complete instruction book for a particular metal-enclosed assembly.

DESCRIPTION

Low voltage (600 volts or below) indoor metal-enclosed switchgear having drawout mounted air circuit breakers is factory assembled and tested. It is designed to require a minimum amount of labor for installation. Shipments are made with the lineup completely assembled (less circuit breakers), or may be divided into one or more shipping groups, to suit the handling facilities at the point of installation.

The switchgear consists of the fixed part or stationary structure that includes one or more free standing units mechanically and electrically joined to make a single coordinated installation. Each unit is divided into three or four compartments which can contain the drawout-type air circuit breakers called the removable elements. See Figs. 8, 9 and 10. If desired, the top or two top compartments may be used for auxiliary equipment, in which case the air circuit breaker and its associated parts are omitted. The hinged door then becomes available for mounting instruments, meters, relays, or other auxiliary control equipment. This is shown in the upper left compartment in Fig. 1.

The breaker compartment provides for four positions of the removable element, namely; "Connected," "Test," "Disconnected," and "Remove."

In the "Connected" position, both the primary and secondary disconnecting devices are engaged, and the circuit breaker is ready for operation. See compartment "B" Fig. 5. In the "Test" position, only the secondary disconnecting devices are engaged, and the circuit breaker can be operated without energizing the power circuit. See compartment "C" Fig. 5. In the "Disconnected" position, both the primary and secondary disconnecting devices are disengaged, and the entire circuit breaker is isolated, but mechanically held in its compartment. See compartment "D" Fig. 5. The compartment door may be closed and latched with the removable element in any one of the above positions. In the "Remove" position, the breaker may be withdrawn from its compartment.

The breakers are provided with finger clusters that engage the stationary main contact stabs at the rear of the compartment when in the "Connected" position. Secondary disconnecting contacts connect the control circuits when in the "Test" and "Connected" positions. The positive interlock on the levering-in device insures proper operating sequence, and is described in detail in the air circuit breaker Instruction Manual, 6030-2.

Many installations will have the lineup close-coupled to the main power transformer to form a power center. These may be single-ended with only one power transformer, or double-ended with a power transformer on both ends. If a transformer is used, it may be necessary to have an auxiliary compartment to contain the transition bus.

Indoor Construction

Figure 5 is a section drawing of a typical four-compartment unit with 1600 ampere welded aluminum bus. This particular arrangement includes an instrument compartment in the top or "A" position, and three feeder breakers in the "B, C, and D" compartments. The units are also divided into three sections front to rear.

Front Enclosure

As previously described this contains the removable elements. The main portion is formed from heavy gauge sheet steel and welded with members across the top and bottom to provide a rigid enclosure. Figures 11 and 12 are close-ups of compartments with breakers removed. Between the four compartments are three bolted-in channels that may be blank or may be used for mounting instruments and transfer switches. The compartment door employs two pintle-type hinges to insure rigidity. The bolted-in cradle supports the wheels of the removable element, and includes the stationary ground contact and trip linkage.

A molded glass polyester plate at the rear of the compartment supports the six stationary disconnecting contacts as well as three metering current transformers, if required.

Secondary control disconnecting contacts when required are located on the rear wall above the stationary primary contacts and provide the connections for the control circuits to the drawout unit.

Bus Compartment

The bus compartment, located between the front breaker enclosure and the rear cable compartment, contains the horizontal main bus that ties the units together electrically and the vertical bus that feeds the individual breaker compartments. It also includes all supporting insulators. The bus compartment is available in different depths depending upon bus rating.

Feeder Cable and Bus Duct Compartment

The cable and terminal compartment is located behind the bus compartment and provides adequate room for easy cable installation. Copper bars extend the load side of the stationary disconnecting contacts into the cable compartment. See Fig. 3. Drillings are provided on the plated ends for the outgoing cables for exit through either the top or bottom of the units. The drilling will accommodate either single or multiple terminals on each phase. On higher current installations, bus duct may be connected to the copper bars.

On four wire systems, an insulated neutral bus extends the length of the line-up and includes taps for the outgoing neutral cables in each unit. Feeder breaker neutral sensors (current transformers) are provided on these taps when ground fault protection is desired. See Fig. 4. A link to the ground bus is furnished in one of the units for grounded four wire systems.

Ground Bus

CAUTION

A permanent low resistance ground is essential for adequate protection.

The ground bus consists of a .25 inch x 2.5 inch plated aluminum (or optional copper) bus bar bolted to the rear frames of the units near the floor, and extending the length of the group. A clamp type terminal accommodating a cable range of #2 SOL to 600 MCM is included for connection to the station ground. Where the line-up is split into several shipping groups, a splice plate and hardware will be furnished to bridge the shipping break at installation.

Indoor Ventilation

The front hinged doors have slots to allow ventilating air to enter each compartment. The air passes upward at the sides of the breaker support cradles and is exhausted through the grillwork in the top compartment roof. A drip pan immediately below the grill prevents any foreign material from reaching the equipment.

The bus and cable compartments are ventilated by means of air entering the grillwork at the bottom of the bolted rear sheets. This leaves through a grill in the bus compartment roof and grill openings near the top of the rear sheets, as shown in Fig. 2.

Current Transformers

When required for metering, ring-type current transformers are positioned around the stationary main contacts as shown in Fig. 11. Each is held in place by two bolts to the molded glass polyester main contact support plate. These may be used to feed a small ammeter and transfer switch located on the fixed instrument panel

between compartments or a meter on the hinged instrument compartment door The metering accuracies are given in the following table:

TABLE 1 METERING ACCURACIES

Ratio	Accuracy Classification	
	B0.1 *	B0.2 *
100-5	1.2	-
150-5	1.2	-
200-5	1.2	1.2
300-5	0.6	0.6
400-5	0.6	0.6
600-5	0.6	0.6
800-5	0.3	0.3
1200-5	0.3	0.3
1600-5	0.3	0.3
2000-5	0.3	0.3
2500-5	0.3	0.3
3000-5	0.3	0.3
4000-5	0.3	0.3

*At 60 Hz Standard Burden

RECEIVING, HANDLING AND STORAGE

General

Power-Zone II® metal-enclosed switchgear is shipped assembled in one group or several groups, depending upon the size of the order and the handling facilities at the installation site. Indoor shipping groups are mounted on wooden skids and enclosed in a covering to protect them from light environmental conditions. Each crate or box is plainly marked with an identification number, the Factory Order number, and the shipping weight. A list of the contents of each is included in the shipping papers. All units are given commercial tests at the factory, after which they are carefully inspected and prepared for shipment by personnel experienced in the proper handling of electrical equipment.

Receiving

When the switchgear reaches its destination, the Purchaser should check the material actually received against the shipping list to be sure that all parts have been received. This should be done prior to discarding the packing material to avoid the loss of small parts. If damage is found or suspected, file claims as soon as possible with the transportation company and notify the nearest representative of the Square D Company. If the switchgear is to be installed as soon as received, it is recommended that the unpacking and handling be done as outlined in the paragraphs that follow. If the switchgear is to be stored or held for some time it is advisable to unpack sufficiently to check the shipment for completeness and condition; then reseal packing for protection until installation.

The purchaser shall be responsible for the protection of the equipment commensurate with the environmental condition of the storage area. The equipment must be kept clean and dry, with humidity less than 80% and the temperature between 30°C and 50°C.

Indoor Handling

For ease of handling by a crane, each shipping group is equipped with a lifting bar extending the length of the group. The bar has two 2 inch diameter holes to accept the crane hooks. On long lineups, a suitable spreader should be used with the crane sling to prevent any horizontal compressive load on the lifting bar. The bar is located at approximately the center of gravity, but variations in equipment may cause a slight tilt either forward or backward. The lifting bar may be removed and discarded after installation is complete.

It is preferable to lift the groups into position by a crane. However, if a crane is not available, they can be skidded into place on rollers placed under the shipping skid. Timbers must be placed between the switchgear and the rollers to protect the units from damage. A method of lowering subsequent groups is the use of long wedges fabricated from 4 x 4's cut on the diagonal. With a large crow bar each corner may be lowered alternately a fraction of an inch. Two 1.75 x .50 inch slots are also provided in the front of the unit for this purpose as shown in Fig. 16.

Handle all crated or uncrated switchgear with extreme care since the front panels may contain delicate instruments, meters, or relays which can be damaged by rough handling. When uncrating the units, care should be exercised to avoid breakage and scratching or marring of the panel finish.

After the crates have been removed, both the stationary units and the drawout elements should be covered during construction period for protection against dust and dirt.

Indoor Storing

Indoor switchgear which cannot be installed and put into service immediately should be stored in a dry, clean place, preferably indoors, in a heated building. Trouble and delay will be avoided by having good storage facilities arranged so that the apparatus will be accessible only to authorized persons, and can be quickly located when required in the erection program. Conditions such as dampness, changes in temperature, cement dust, and corrosive atmosphere should be carefully guarded against. If necessary to store outdoors, special precautions will be required to keep it clean and warm enough to control condensation. It will be necessary to cover the switchgear and install temporary heating equipment. Approximately 250 watts per unit are required for average conditions. During storage the shipping groups should be placed on level surfaces to prevent unnecessary strain and possible distortion.

INSTALLATION

Prior to Installation

Proper installation of Square D Power-Zone II® Low Voltage Metal Enclosed Switchgear is of prime importance. Too much emphasis cannot be placed upon this phase of the work. Study the associated instruction books and all drawings carefully. In most cases, all drawings will be sent to the Purchaser some time previous to the shipment of the gear to enable adequate advance planning. These drawings will include general assembly, front view, plan view, floor plan, schematic and connection diagrams.

Location

In locating the switchgear, consideration must be given to the aisle space required at the front and rear of the equipment as well as space at the ends of the lineup. The recommended minimum aisle space is shown on the floor plan drawing furnished with the order. Figure 17 shows a typical floor plan, and Table 5, page 21 shows dimensions for the various depth units. The space at the front must be sufficient to permit the opening of doors, the insertion and withdrawal of the breakers and their transfer to other compartments by means of a hoist. The space at the rear must be sufficient for installation of cables, inspection, and maintenance.

Foundation

Square D Power-Zone II metal-enclosed switchgear is fabricated in welding fixtures and assembled on true and level floors to insure ease of operation at all times. Since the tolerances and adjustments are kept to a minimum, it must be installed on a smooth level base.

Extra care by the Purchaser in laying out and preparing the foundation will result in reduced installation costs as well as good switchgear performance.

The station floor or foundation must be strong enough to support the weight of the equipment without sagging. Table 3 page 8 tabulates the approximate weights for the various ratings of indoor switchgear. Actual weights will vary depending upon the type and amount of equipment in the individual units. Adequate safety factors must be used. If the foundation is subject to vibration, special mounting must be provided to prevent the transmission of vibration or shock to the equipment.

The preferred method of anchoring the indoor switchgear is by fastening it to steel channels which are properly embedded in the concrete floor. Figures 17-20 show typical floor plans that may be used for estimating purposes. Detailed floor plans for drilling and locating this steel are supplied with each order.

Floor Steel

Anchor bolts, floor steel, and other foundation material are to be furnished by the Purchaser.

A 4 inch (5.4#/ft.) structural channel is recommended as a minimum size for the average lineup of equipment. When large power center transformers are included with high voltage switching equipment, a larger channel must be used. It is preferred that the channel be located with its web at top and horizontal.

IMPORTANT

The front,center, and rear channels must be set level and aligned with each other and must be level over their entire length to avoid distortion of the switchgear structure. The finished floor may have a slight pitch away from the channels, but in no case should the finished floor be higher than the channels.

Each unit is fastened to the floor channels by either bolting or welding as shown in Fig. 18. If bolting is to be used, the mounting bolts must be placed in the floor steel before the concrete is poured to assure that the tapped holes will not fill with concrete. Welding is a quick and easy method of securing the switchgear in place and eliminates the layout of the mounting holes in the channels.

Figure 19 shows floor mounting arrangement typical for some seismic conditions. Consult with the factory concerning the adequacy of this arrangement for the specific installation in question.

Conduits

Provisions must be made in the foundation for the conduits which carry the main cables, control wiring, and ground cable when such conduits enter the switchgear from below. The specific floor plan must be used for determining the final conduit layout, spacing of floor channels, and floor space required for each switchgear unit.

Encircling loops of reinforcing or building steel around individual conductors of a single or three phase circuit should be avoided in the areas for main cables when these circuits are rated at 600 amperes or above.

Conduits should project above the finished floor approximately two inches for indoor switchgear. It will simplify moving the groups into place if the conduits are flush with the concrete surface and appropriate extension sleeves added after the units are in their final location. Otherwise it will be necessary to raise the units on timbers a sufficient height to clear the tops of the conduits.

Consideration should be given to installing conduits for future circuits at this time.

Shipping Skids

If possible, the shipping skid should remain on each group until it is at or near its final location. This will allow the use of pipe rollers for moving the group; and will also lessen any chance of distortion during final positioning.

Shipping Circuit Breakers

Circuit breakers are shipped separate from the switchgear structure. The circuit breaker crank used to operate the breaker levering device is shipped in a box of separate accessories. Install the breakers in accordance with Instruction Manual 6030-2.

ASSEMBLY OF SHIPPING GROUPS

When correctly installed, the units for indoor metal-enclosed switchgear should conform to the following requirements:

1. Front panels form a straight true line; and when transformers and/or other gear are included, the fronts should line up or form parallel lines. Consult the Square D substation line-up drawing for exceptions.

2. Units correctly spaced from center to center and plumb.

3. Entire assembly of housings securely fastened to floor channels or base pad.

4. Shipping groups must be securely bolted together, and all bus and control wiring connections properly made.

A suggestion for lining up the units is to establish a base line a few inches in front of the housings and parallel to the final location. Equalize the distances from the front of the housings to the base line, thus making the face of the group parallel to the base line.

Check the plumbness of the units by dropping a plumb line from the exact center of the horizontal steel member at the top front of the unit. It should align with the center of the bottom cross channel.

After the first group has been located, the second group should be moved into position and similarly checked. The steel housings are fastened together at eleven (11) locations which are shown in Fig. 21. .38-16 x .75 inch steel carriage bolts are furnished for this purpose. It will facilitate assembly to locate the bolt head in the right hand unit with the nut and washers in the left hand unit.

Bus Connections

All connections of the main and neutral busses and the ground bus at shipping breaks are made by means of bolted splice plates. These are always plated and no field welding is required. All necessary hardware and splice plates are included. All Bus joint bolts must be tightened to the torque shown in Table 4, page 8.

The following drawings show in detail the methods employed for joining the various types of main bus.

1. 1600 Amp Aluminum Bus – Fig. 22

A single .25 x 6.0 inch plated aluminum splice plate is used at each phase. A total of six (6) .50-13 x .87 inch high strength steel bolts and Belleville washers are used in each plate. The heads of the bolts face toward the rear of the units. They must be tightened to the torque shown in Table 4 page 8.

2. 3200 Amp Aluminum Bus – Fig. 23

This rating employs two (2) .50 x 4.0 inch aluminum bars per phase. Each bar is joined by means of two (2) .25 x 4.0 inch plated aluminum splice plates. The splice plate that is located toward the front of the unit, or nearest to the polyester bus support, contains spline nuts while the plate toward the rear has clearance holes for .50-13 bolts. Each pair of splice plates uses four (4) .50-13 x 1.38 inch high strength steel bolts and "Belleville" washers. It will be easiest to join the bus bar that is nearest to the breaker first (front).

3. 2000 Amp Copper Bus – Fig. 24

4. 3200 & 4000 Amp Copper Bus – Fig. 25

NOTE

If a neutral bus is employed, the joint is similar to the corresponding phase bus/material.

Aluminum Ground Bus – Fig. 26

The joint in the .25 x 2.5 inch plated aluminum (or optional copper) ground bus is made by means of a single aluminum splice plate bolted directly to the inside of the rear steel frame. The bolting areas of all items are plated to provide the optimum joint.

Barriers (Optional)

If any of the barriers separating the bus and cable compartments have been removed, they should be returned to their proper locations at this time. Those barriers located between the runbacks from the feeder compartments will be fastened by means of four .38-16 hex head steel bolts and lockwashers.

Main Power Connections

Low voltage metal-enclosed switchgear is usually provided with solderless cable connectors for terminating the main power cables.

Before making up the connections, the phase of each cable must be determined. Normally, switchgear is supplied with connections for phase rotation A-B-C unless otherwise required on the particular order. Viewing the switchgear from the front, standard bus sequence is phased A-B-C top to bottom, or front to rear, or left to right.

Non-standard arrangements may be necessary to meet specific requirements. If so, the bus is marked "A" – "B" – "C" in the order intended.

When forming cables for termination within switchgear assemblies, avoid sharp turns, corners, and edges in order to prevent damage to, or weakening of, the cable insulation. The cable manufacturer's instructions should be followed closely in determining the minimum bending radii of cables. This will vary with the type and size of cable involved.

Adequate electrical and mechanical clearances must be provided between cables, conduits, and bus in this compartment. Where the cables enter the unit, they must be securely lashed and supported to withstand any short circuit forces, and to prevent any strain or load on the terminals. Normally, one inch of clearance through air is considered adequate clearance.

Ground Bus Connections

Terminals of the solderless type are provided on the aluminum ground bus in one or more of the units, depending upon the number in the lineup. These are shown on the single line diagram, and are for the connections to the station ground which should be as direct a connection as possible, and should not be run in metal conduit. The grounding conductor should be capable of carrying the maximum line-to-ground current for the duration of the fault.

CAUTION

A permanent low resistance ground is essential for adequate protection. A poor ground may be worse than none since it gives a false feeling of safety to those working around the equipment.

Control Connections

All inter-unit control wires that cross a shipping break must be reconnected to their correct points on the terminal blocks provided for this purpose. These have been properly tagged at the factory and will be shown on the connection diagrams for the order.

Any control connections to remote mounted relays, control switches, instruments, etc. will be brought to a set of terminal blocks located either on the rear frame of the unit or in the instrument compartment.

Control wiring should be checked with the connection diagram to make certain that all connections have been properly made, all fuses installed, current transformer circuits completed, and loose connections tightened. Before applying control energy, check all control circuits, except current and potential transformer secondary circuits for grounds; and make sure that all circuits are clear.

If the control power source is other than a self-contained control power transformer, the cables from the source to the switchgear must be of adequate size to avoid excessive voltage drop during operation.

Breaker Rating Interlock

Breaker compartments rated 2000 amperes or less are physically the same size. To prevent inserting a non-compatible breaker, an interlock system blocks the breaker element out of the disconnected position as shown in Table 2 below.

TABLE 2
BREAKER RATING INTERLOCKS

This compartment	Will accept these breakers
DS-206	DS-206
DS-206S	DS-206S, DS-416S, DS-420
DS-416	DS-416, DS-416S, DS-420
DS-416S	DS-416S, DS-420
DS-420	DS-416S, DS-420
DSL-206	DSL-206
DSL-416	DSL-416

Figures 27 & 28 show the positions of the interlock brackets for the five frame ratings. The type DS632 does not require this interlock as its height is considerably greater than breakers of the above ratings.

Key Interlocks

Key interlocks are often supplied in conjunction with disconnecting switches, other circuit breakers, external equipment, and special compartments where access is to be denied unless the circuit breaker in the compartment containing the interlock is withdrawn to the "Remove" position. The operation of key interlock schemes is generally described by a note or keying chart on the order assembly drawings.

To facilitate manufacture and installation procedures, a key is supplied with each lock.

CAUTION

Before placing switchgear with key interlocks in operation, the key scheme must be carefully checked; and only the proper keys left in the locks. All extra keys must be removed and destroyed or stored where not available to operating personnel.

This procedure is necessary since improper use of spare keys will defeat the interlocking scheme.

TABLE 3
APPROXIMATE WEIGHTS OF TYPICAL UNITS
(Single vertical sections without Breakers add breaker weights from table below.)

Unit	Approx. Weight Lbs.*
1600 Amp Aluminum Bus, 21" wide	1000
3200 Amp Aluminum Bus, 21" wide	1200
3200 Amp Copper Bus, 21" wide	1400
2000 Amp Copper Bus, 21" wide	1300
4000 Amp Copper Bus, 21" wide	1600
4000 Amp Copper Bus, 34" wide	2000
Top mounted breaker lifting device	230
*Weight without drawout elements	

Drawout Breaker Element

Type	Manually Operated	Electrically Operated
DS-206	142 lbs.	152 lbs.
DS-206S	142 lbs.	152 lbs.
DS-416	185 lbs.	195 lbs.
DS-416S	185 lbs.	195 lbs.
DS-420	185 lbs.	195 lbs.
DS-632	280 lbs.	290 lbs.
DS-840	394 lbs.	404 lbs.
DSL-206	205 lbs.	215 lbs.
DSL-416	255 lbs.	265 lbs.
DS-3000 Fuse Truck	325 lbs.	–
DS-4000 Fuse Truck	430 lbs.	–

TABLE 4

BOLT TIGHTNESS FOR BUS CONNECTIONS

Bolt Material	Torque in Foot-Pounds for Bolt Diameter				
	.25-20	.31-18	.38-16	.50-13	.62-11
Grade 5 Heat Treated Steel	7	16	27	70	140

Moving Parts

There are few moving parts in the stationary structures of metal enclosed switchgear; and in general, they do not require installation as they are factory-installed. However, it is recommended that all moving parts be carefully operated by hand (even if normally operated automatically) to assure that no binding or damage has occurred during shipment or handling. In some cases, accessories may be blocked or braced for shipment; or foreign matter may have accumulated or lodged in the equipment during long periods of storage under unfavorable conditions.

Some devices, such as meters and relays, must be thoroughly checked for forms of blocking or bracing which must be removed. Follow the instructions furnished with these devices.

TESTING AND INSPECTION

Pre-Operation Checks

After the switchgear equipment and apparatus to be controlled have been installed and all interconnections made, the equipment should be tested and given a final check before being placed in service. This is necessary to assure that the equipment has been correctly installed and that all connections are complete and have been properly made.

CAUTION

Extreme care must be exercised to prevent the equipment from being connected to the power system while the preliminary tests are being conducted. If disconnecting switches are not available, line leads should be disconnected to accomplish this.

The testing equipment will depend on the size and type of installation. Portable voltmeters, of the multi-scale type if available, will be required. For large and complicated installations, ammeters should be available in case unexpected trouble developes. An ohmmeter and "megger" will prove invaluable in checking insulation and continuity of the circuits; or a simple portable device for "ringing" or "lighting-out" circuits may be substituted for the continuity check.

Wire connections, accessible bolted bus connections, and insulated joints should be examined to make sure that they have not been loosened or damaged during shipment or installation.

The connections to the equipment apart from the switchgear such as remote control and interlock circuits, and auxiliary switches should be "lighted-out" to make sure that they are also correct. The extent to which this will have to be done depends on the thoroughness of the installation work. There must be definite assurance that connections are correct before an attempt is made to operate the equipment.

Any relays included on the hinged instrument panel have been checked at the factory and are normally set at "minimum" for shipment. The final settings of the relays should be coordinated with other parts of the system in accordance with the Purchaser's standards or operating practice. If it becomes necessary to modify these relay settings, the instruction leaflet for the relay involved should be carefully studied. These instruction leaflets show typical connection diagrams only and may not necessarily agree with the connections furnished. The schematic diagrams furnished for the order should be referred to for the actual connections.

The covers for meters, relays, and other devices which have to be removed during the course of installation and test should be carefully handled when removed. The covers should be put back in place promptly to keep dust and dirt from collecting on the vital relay parts.

The power circuit insulation system must be tested in both the switchgear and each circuit breaker. Potential control circuits must be disconnected from the power bus before the following tests are started. Each ungrounded power conductor should be tested for one minute at a potential of 1650 volts line to line and line to ground. (Reference ANSI @ 37.20, paragraphs 5.5, 5.2.1 and table 1.) If no insulation failures are noted after one minute, the equipment is considered to have passed the test. Megger readings may be substituted at the users request. A device having an output of 1000 volts or better is recommended. Readings above one megohm are considered adequate for energization. As the system is used and insulation systems dry out, readings of several megohms can be expected. Equipment having readings below 1 megohm should be dryed out before energization. This can be accomplished by placing non-combustion heat into the system. If readings cannot be improved beyond 750,000 ohms, the factory should be consulted.

Drawout Element

The testing and calibration of the *Amptector® on the type DS air circuit breaker can be performed with a special test set developed for this purpose. Complete instructions on its use and operation will be found in the test set.

The operation, test, and maintenance of the breaker is covered by Manual 6030-2.

*Note: Amptector® is a registered trademark for the solid state trip unit manufactured by the Westinghouse Electric Corp., Pittsburgh, Pa.

INSPECTION AND MAINTENANCE

Inspection and Maintenance Schedule

To assure high quality service, a definite maintenance schedule, systematically followed, is essential. Plant, operating, and local conditions vary to such an extent that the schedule must be prepared to suit the conditions. However, the following general requirements should be helpful in setting up the program.

Individual Devices

The maintenance schedule for individual devices such as circuit breakers, relays, meters, etc. should be based upon recommendations contained in the individual instruction book for the device. These operations should be coordinated with the overall program to result in the least operating inconvenience and circuit shutdown.

Overall Installation

The switchgear installation should be given a thorough overall maintenance check at least annually, when plant, operating, and local conditions are normal. Where conditions are abnormal, more frequent inspection and maintenance is necessary. The following items require attention:

1. Buses and Connections – De-energize primary circuits and remove rear cover from the primary compartment. Before cleaning take "megger" readings between phases and to ground. Inspect for symptoms which might indicate overheating or weakened insulation. Remove dust from buses, connections, supports, and enclosure surfaces. A vacuum cleaner with a long nozzle will be of assistance. Wipe clean with a solvent such as Stoddard's Solvent.

CAUTION

KEEP SPARKS AND FLAMES AWAY. DO NOT BREATH LARGE QUANTITIES OF VAPOR. AVOID EXCESSIVE CONTACT WITH SKIN.

After buses have been dusted and wiped clean, take "megger" readings again between the buses and ground and between phases. Keep a record of these readings for future reference in determining when trends occur that would indicate a lowering of the insulation resistance.

2. Main Disconnecting Contacts and Supports -- Remove each breaker from its housing. De-energize all circuits and expose primary contacts and their supports. Wipe clean with a cloth moistened in Stoddard's Solvent. (See preceding paragraph.) Inspect for abnormal wear or overheating. Discoloration of the surfaces is not harmful unless corrosion due to atmospheric conditions is severe, leaving deposits on the surface. Any deposits must be removed by rubbing with a clean cloth, or a new contact installed. Check each breaker while it is out of the housing for all items recommended in the instruction book applying to that particular type of breaker.

3. Other Disconnecting Contacts – Inspect all secondary disconnecting contacts for abnormal wear, fatigue, or overheating. Replace if necessary; otherwise clean the same as Main Disconnecting Contacts above.

4. Instruments, Relays and Other Panel Mounted Devices – Individual devices should be maintained according to the specific instructions supplied for each device. Remove all relay covers and inspect the interiors for dust or dirt. This operation can most readily be performed by relay test personnel during periodic relay tests. Control switches, transfer switches, and instrument switches should have their contacts inspected, according to the instructions furnished with these switches.

5. Secondary Wiring – Check all wiring connections for tightness including those at the current and potential transformers and at the terminal blocks where circuits leave the switchgear. Make sure that all secondary wiring connections are properly connected to the switchgear ground bus where so indicated.

6. Mechanical Parts – Visually check and manually operate mechanical moving parts such as drawout operated switch assemblies, the position interlock, emergency trip linkage, and hinged doors. Examine mechanical parts such as the levering-in arms, and the rail extensions.

7. Ventilation – Check all labyrinths, grillwork, and air passages for obstructions and accumulations of dirt.

8. Records – The condition of each switchgear unit at the time of inspection should be listed in a permanent record to become a guide for anticipating the need for replacement parts or for special attention between the regular maintenance periods.

9. Abnormal Conditions – Local conditions such as high humidity, salt-laden atmosphere, corrosive gases, heavy dust, or severe circuit operating conditions, are considered to be abnormal; and will require more frequent inspections.

10. The circuit breaker Amptector operation should be checked in accordance with the Breaker Instruction Manual 6030-2.

It should be emphasized that a series of inspections should be made at quarterly intervals until the progressive facts of the local conditions can be analyzed to determine a schedule which will maintain the equipment in satisfactory condition.

In some locations local conditions may be so bad that the frequency of maintenance will interfere with operating and production schedules. In such cases, consideration should be given to the possibility of enclosing the switchgear equipment in a relatively tight room and to supplying a sufficient quantity of clean air so as to maintain a positive pressure in the room. Under such conditions maintenance schedules may then be established on a more normal basis. Such an arrangement might also provide for cooling the air where the ambient temperature is relatively high, thus further improving operating conditions.

Lubrication

The lubrication of the drawout breaker is covered in its Instruction Manual. In general, there is little that will require any lubrication in the stationary housings.

The main disconnecting finger clusters and stationary contacts should be cleaned periodically but *KEPT DRY*. Vaseline or grease should *NOT* be applied to these contact surfaces as it will hold dirt and particles of plating which will cause an increase in the levering-in force required.

RENEWAL PARTS

When ordering renewal or spare parts include as much information as possible. In many cases the style number of the new part can be obtained from identification on the old part. Always include a description of the part. Specify the rating, unit number, and factory order number of the metal enclosed housing in which the part is to be used.

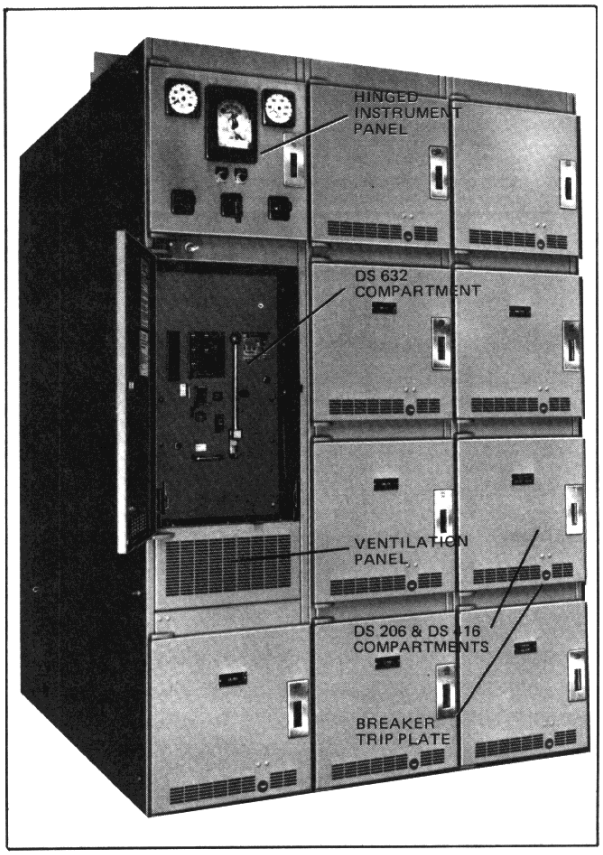


Fig. 1 *Indoor Metal Enclosed Units Front View*

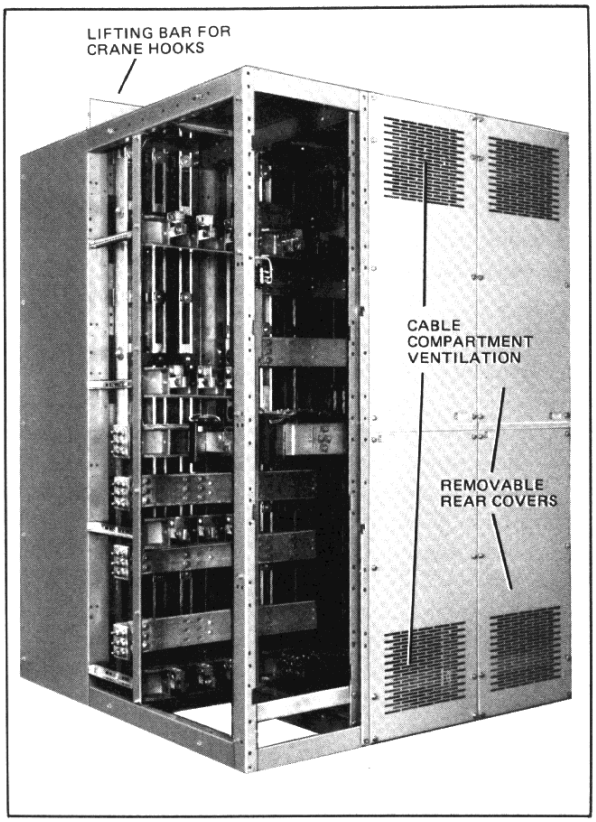


Fig. 2 *Indoor Metal Enclosed Units Rear View*

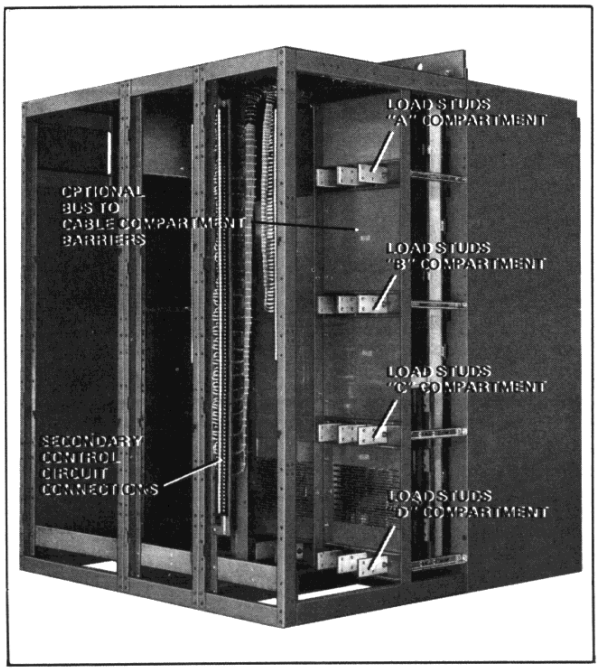


Fig. 3 *Rear View with Covers Removed*

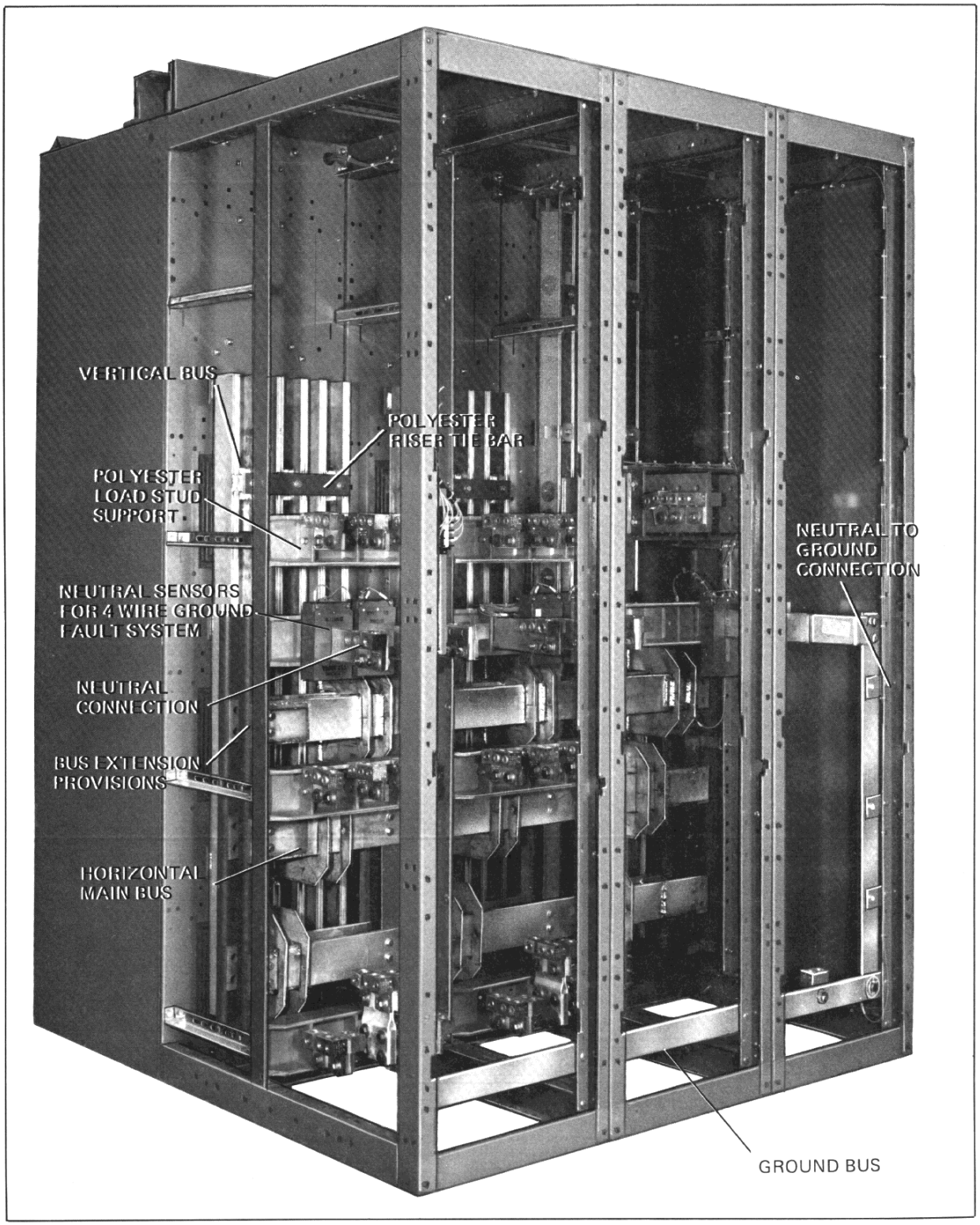


Fig. 4 *Aluminum Bus System Rear View*

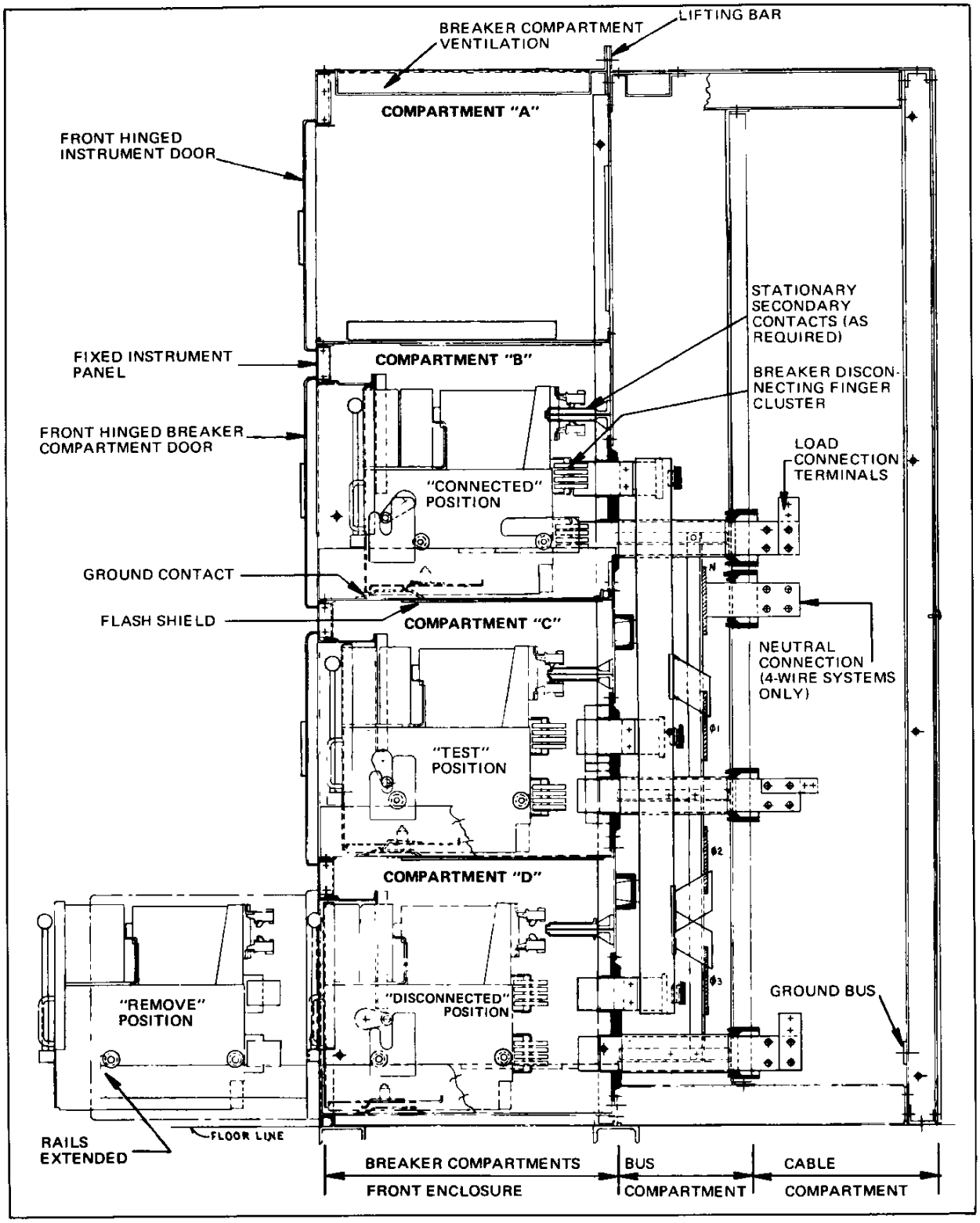


Fig. 5 *Side View 1600 Amp Unit with Welded Aluminum Bus*

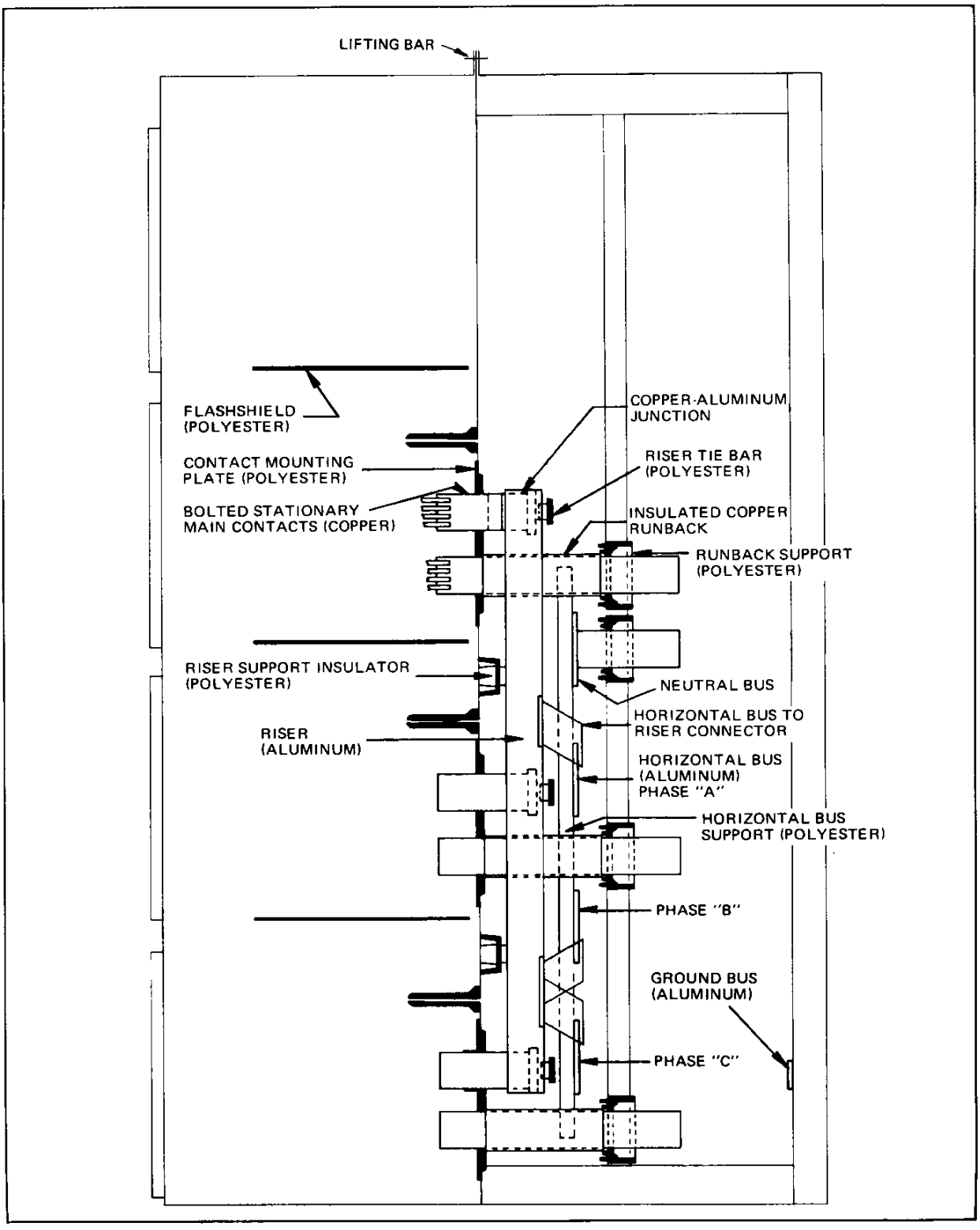


Fig. 6 *Bus and Insulation Details 1600 Amp Aluminum*

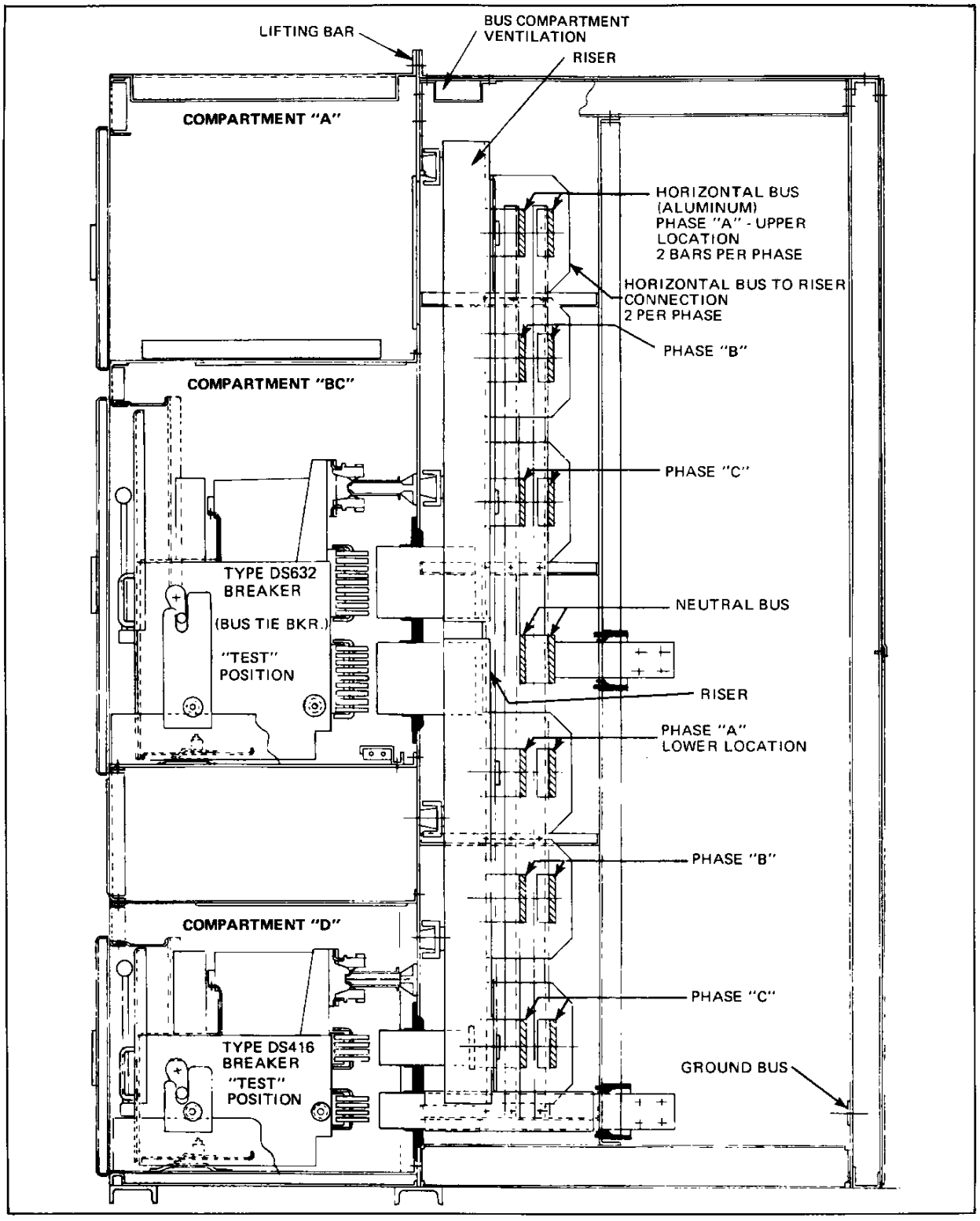


Fig. 7 *Side View 3000 Amp Unit with Welded Aluminum Bus Risers Arranged as a Bus Tie Unit*

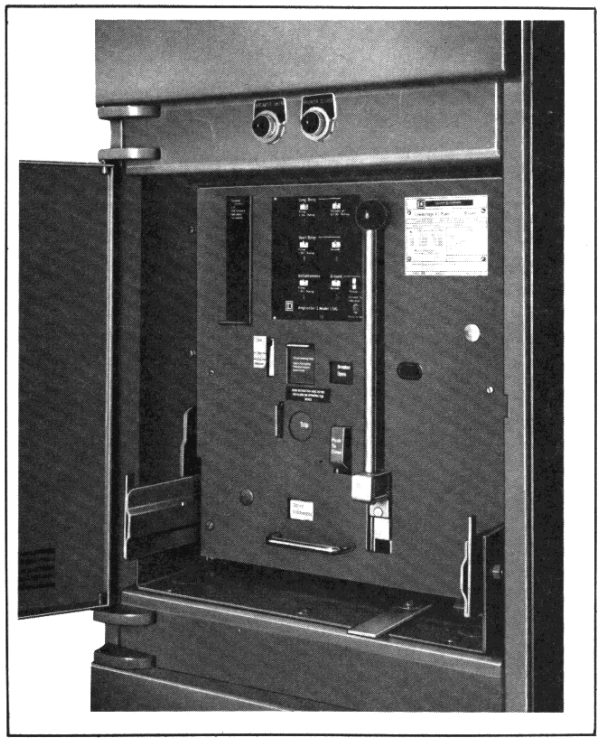


Fig. 8 *Type DS206/DS416/DS420 Breaker in Compartment – "Connected" Position*

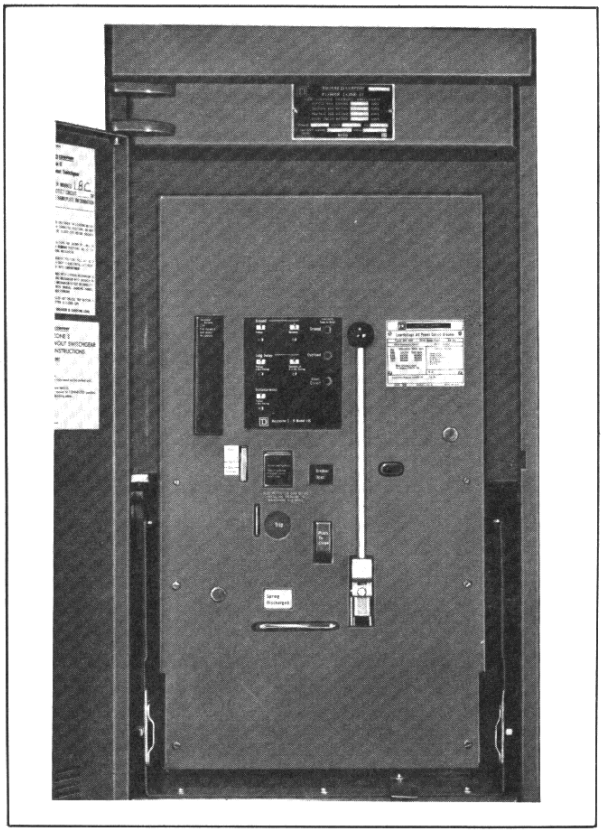


Fig. 10 *DS632 Breaker in "Connected" Position*

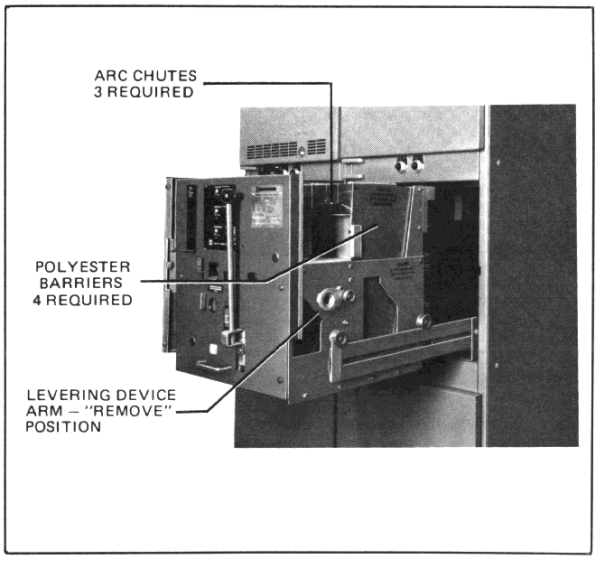


Fig. 9 *Breaker Withdrawn onto Extended Rails*

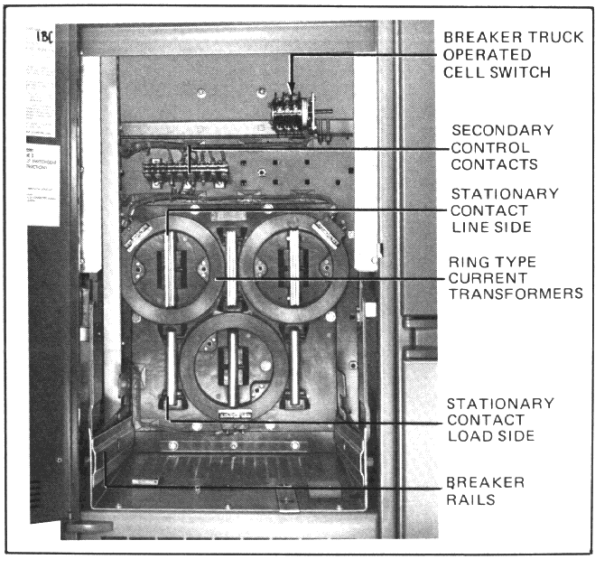


Fig. 11 *3000 Amp Compartment Ready to Receive Breaker*

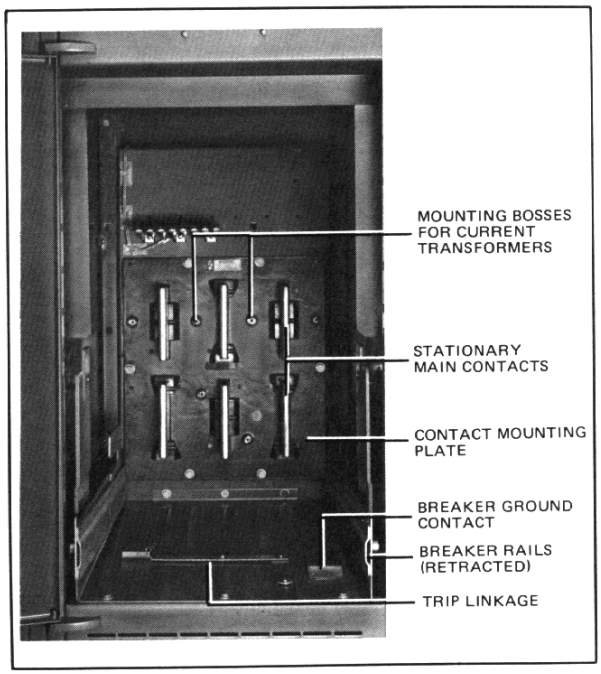


Fig. 12 *3000 Amp Compartment*

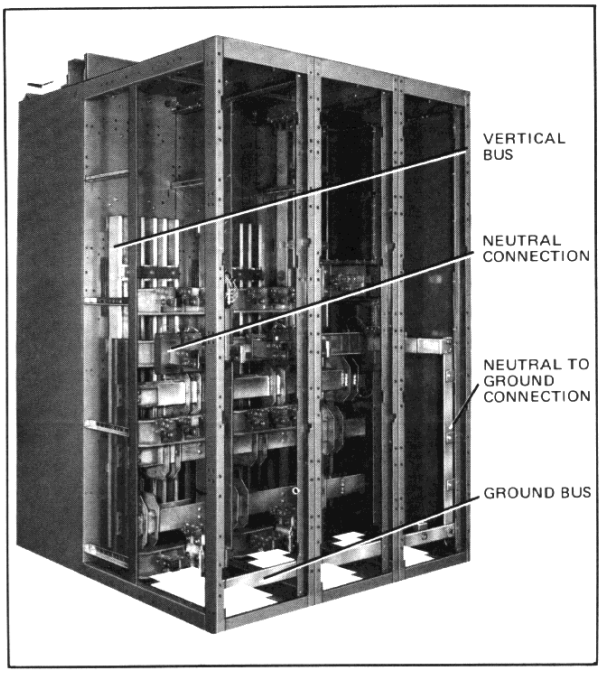


Fig. 13 *3000 Amp Welded Aluminum Bus*

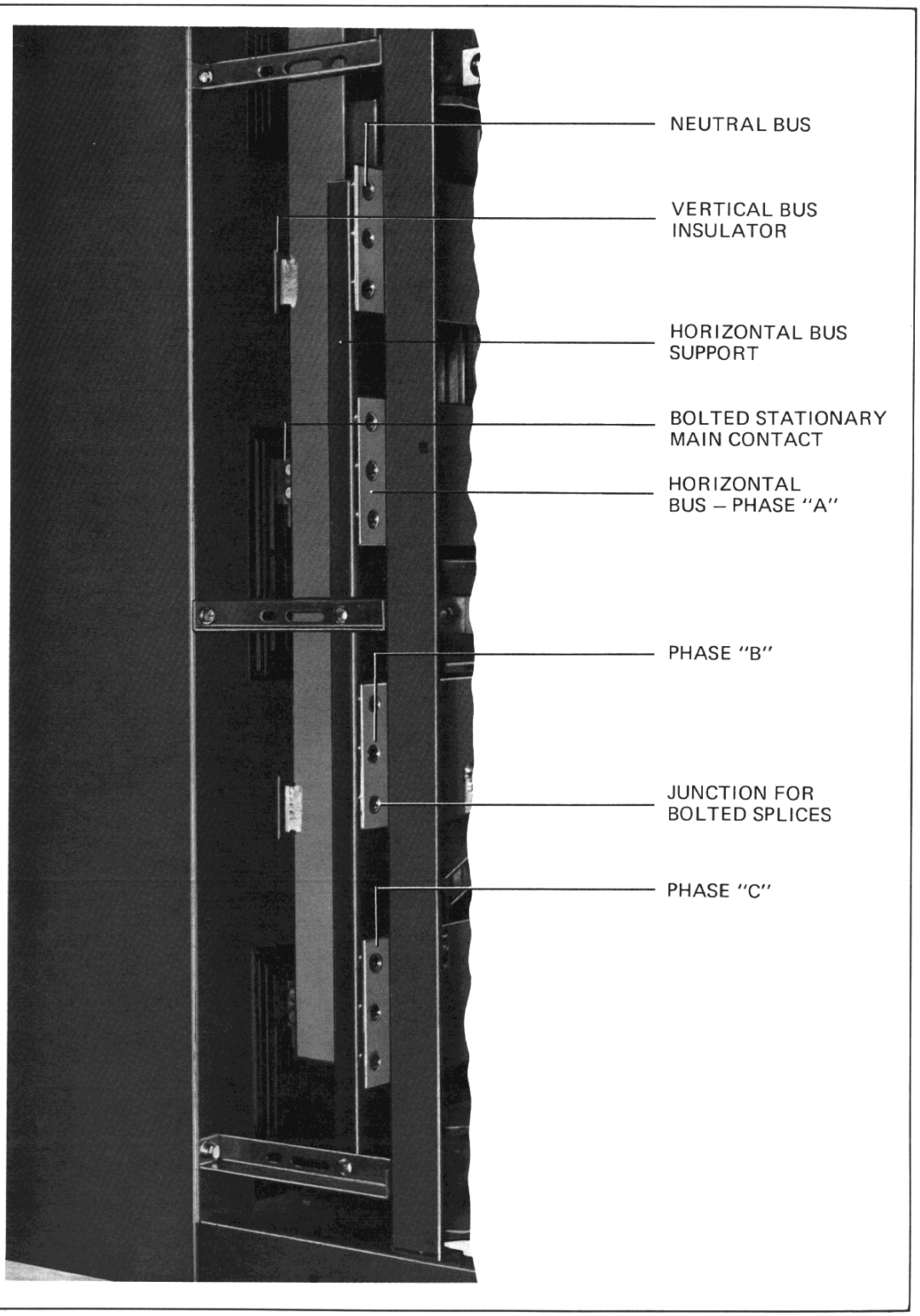


Fig. 14 *Closeup of 1600 Amp Aluminum Bus*

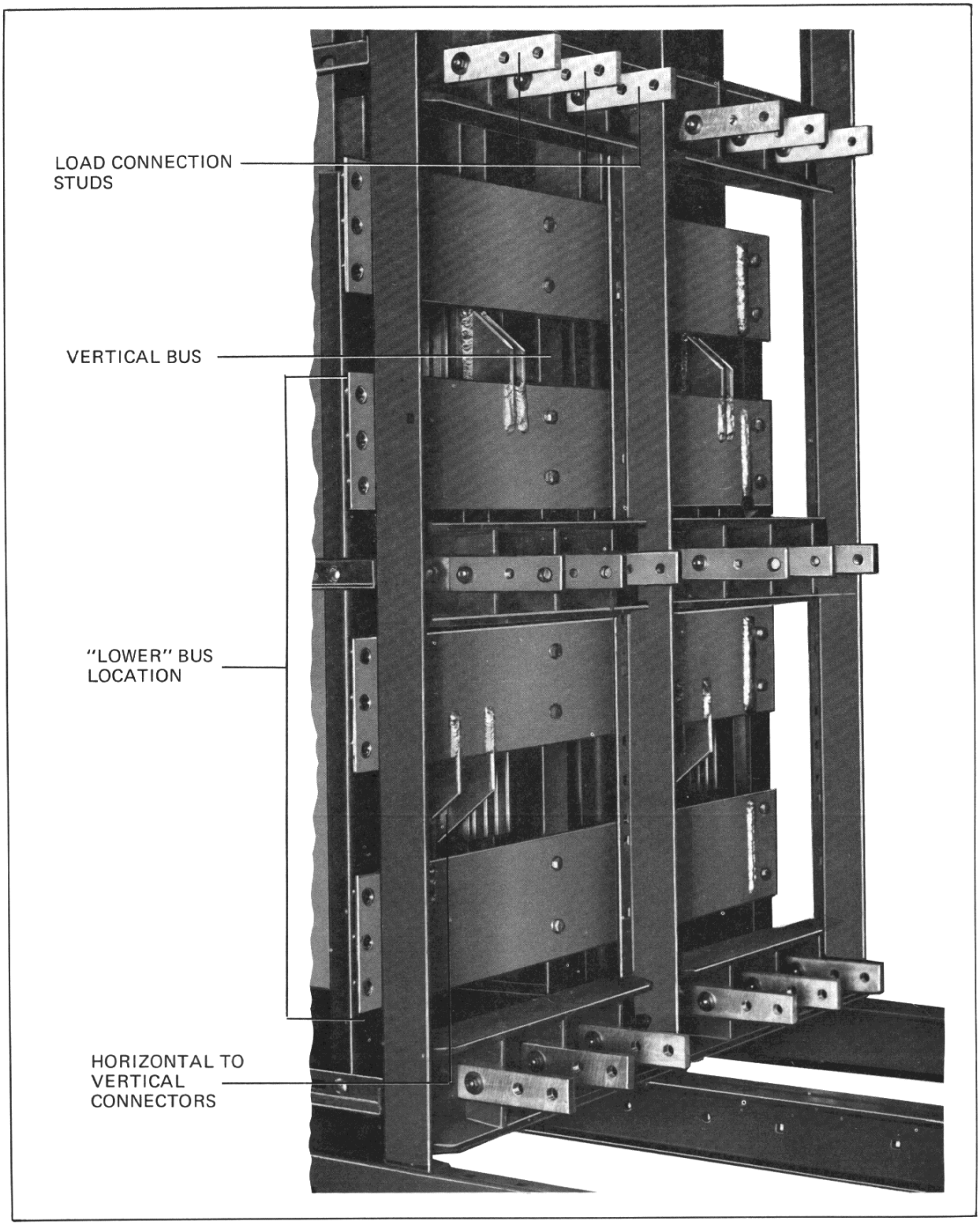


Fig. 15 *1600 Amp Welded Aluminum Bus*

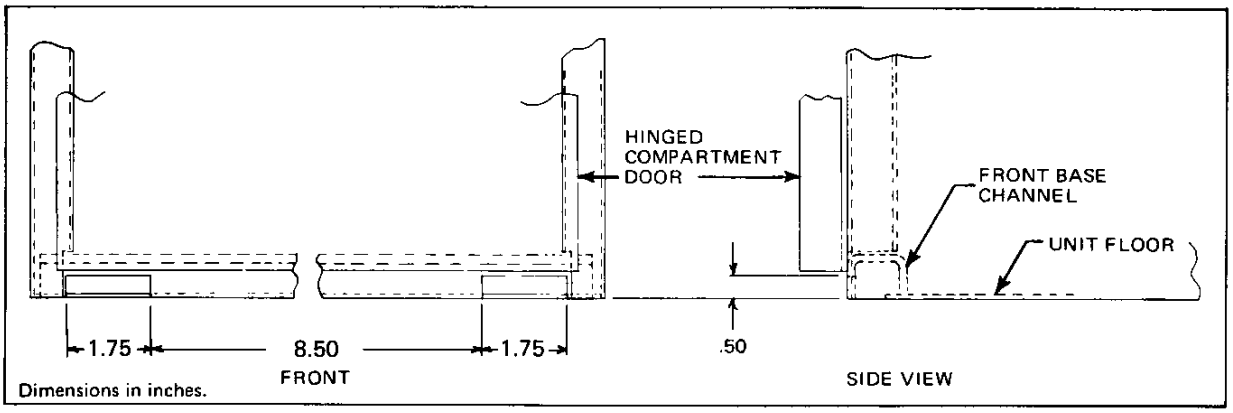


Fig. 16 *Location of Pry Slots at Unit Front*

Table 5 *Indoor Switchgear Depth (See Figure 17)*

BUS RATING AMPS	DEPTH — INCHES			
	OVERALL A		BUS COMPT. B	CABLE COMPT. C
	DS	DSL		
1600 2000	55.12 60.12 66.12 72.12	63.12 68.12 74.12 80.12	10.0	15.25 20.25 26.25 32.25
3000	60.12 66.12 72.12	68.12 74.12 80.12	15.0	15.25 21.25 27.25
DS-840 & DSL-840				
4000	68.12 74.12 80.12	68.12 74.12 80.12	15.0	23.25 29.25 35.25

NOTE: For more precise information refer to drawings supplied with the equipment purchased.

TYPICAL FLOOR PLAN MOUNTING METHOD FOR INDOOR SWITCHGEAR

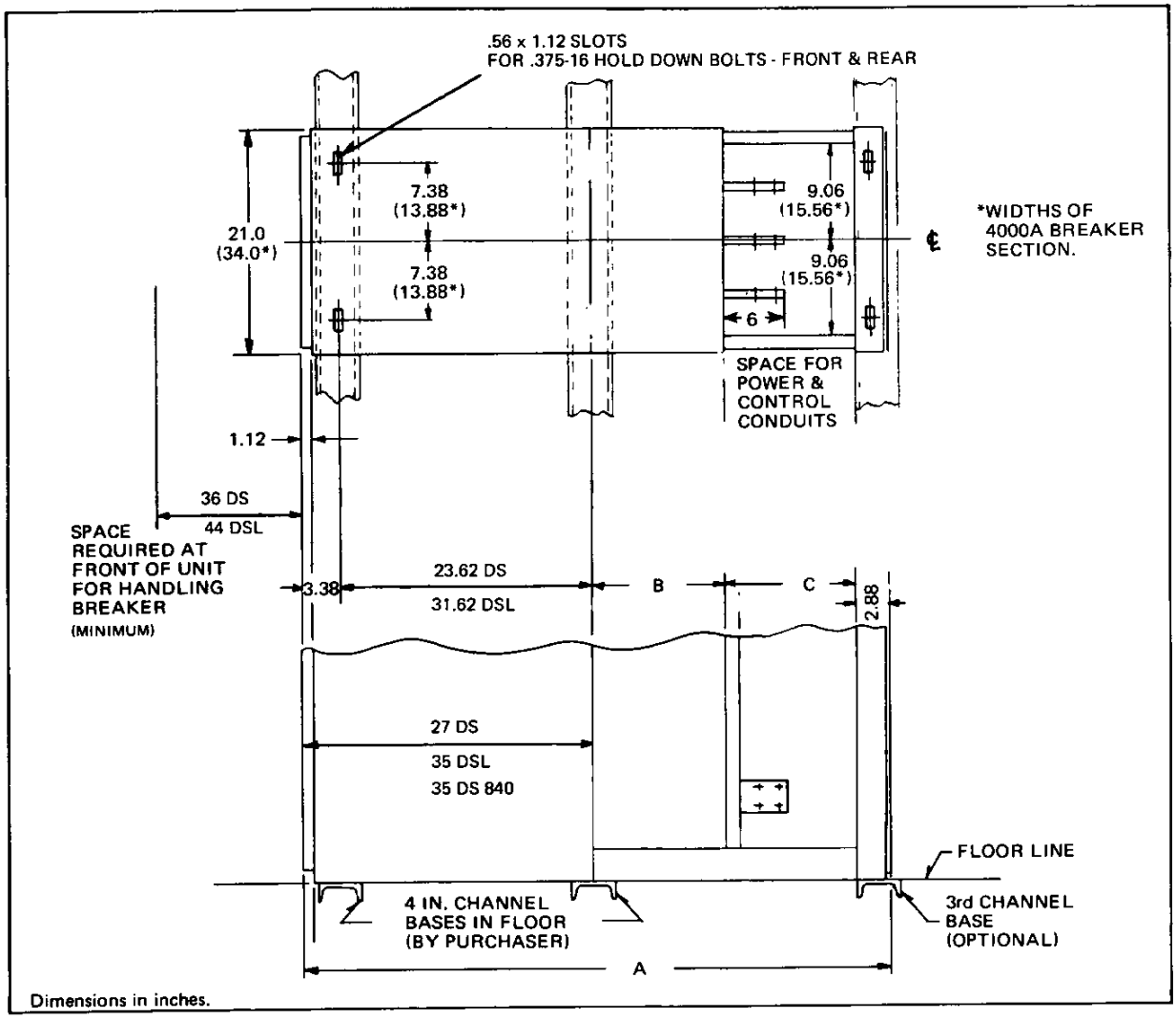


Fig. 17 *Standard Floor Plan*

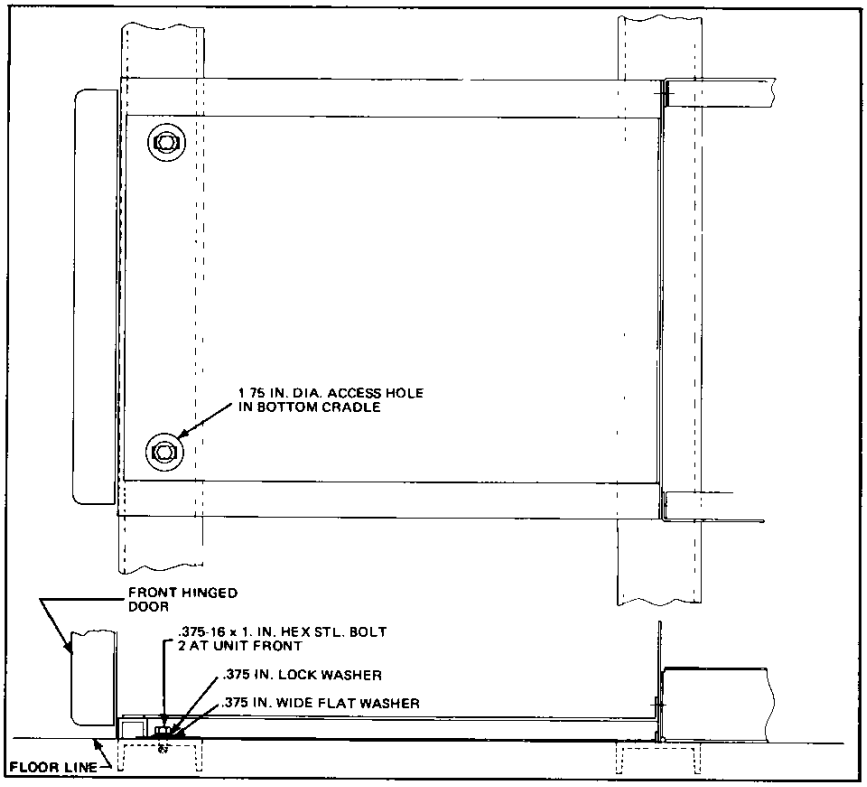


Fig. 18 *Anchor Bolt Detail*

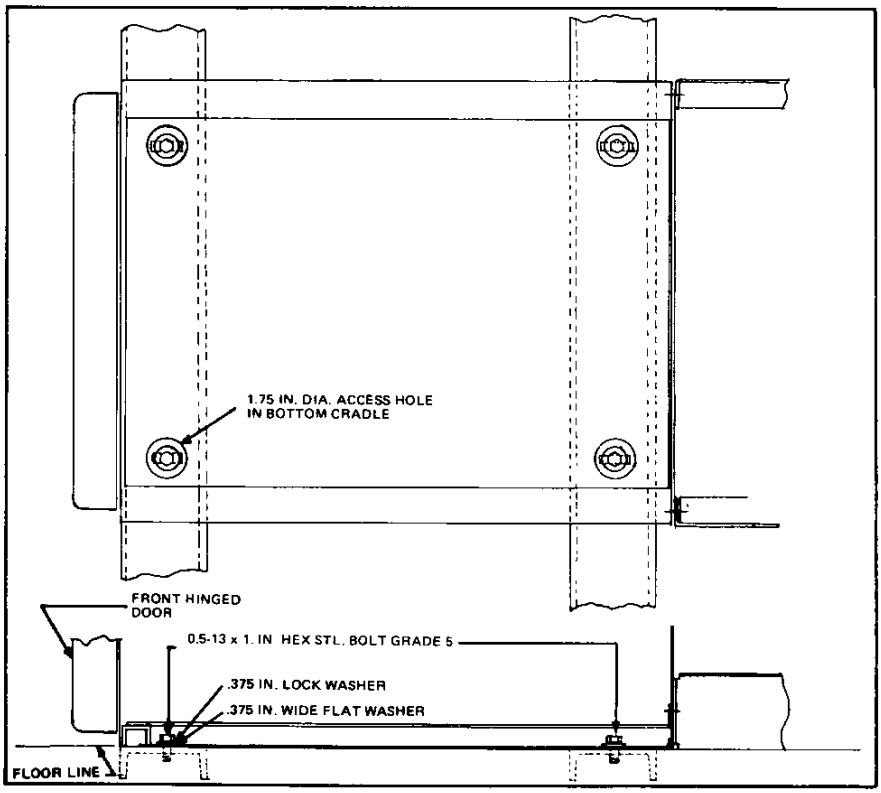


Fig. 19 *Anchor Bolt Detail (Seismic)*

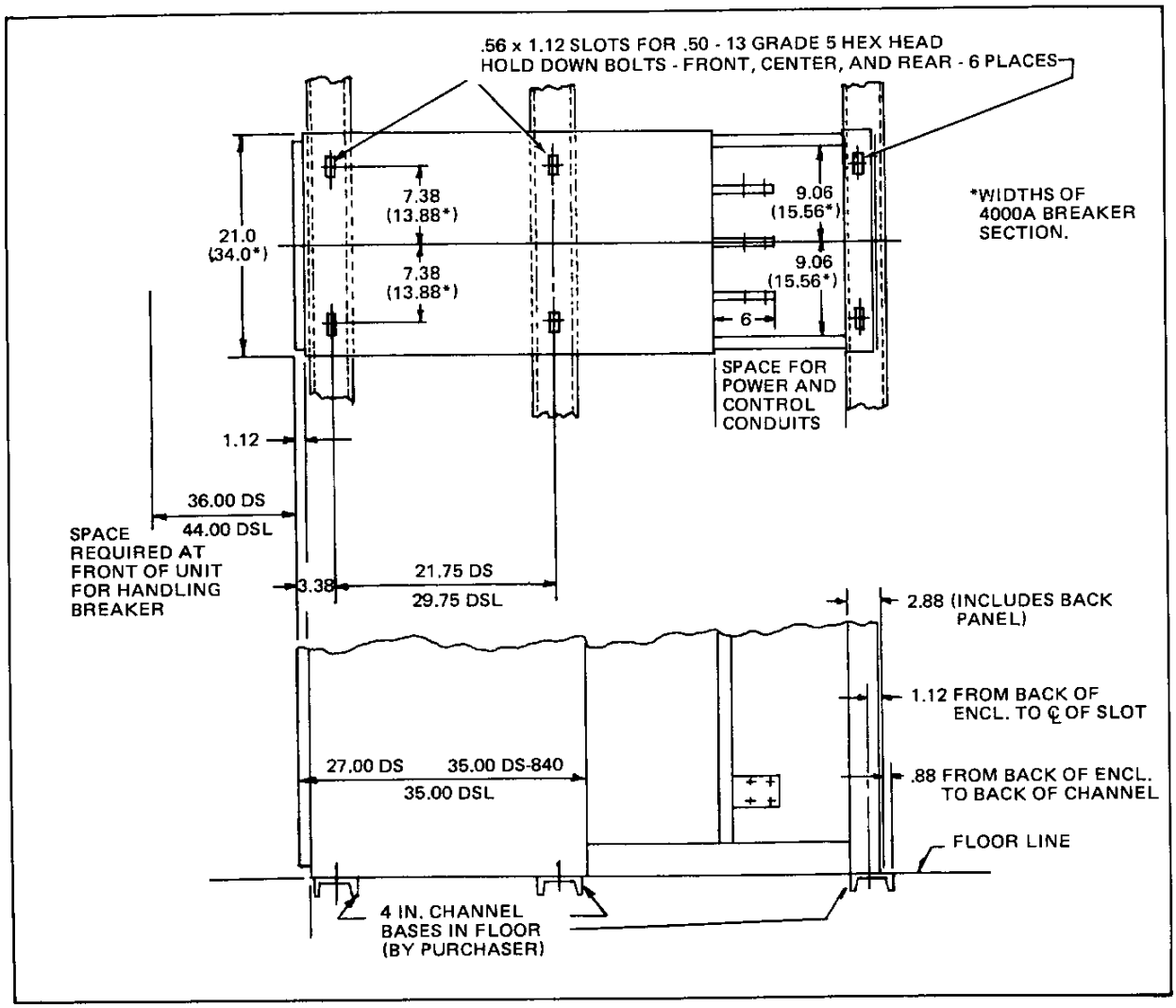


Fig. 20 *Seismic Floor Plan*

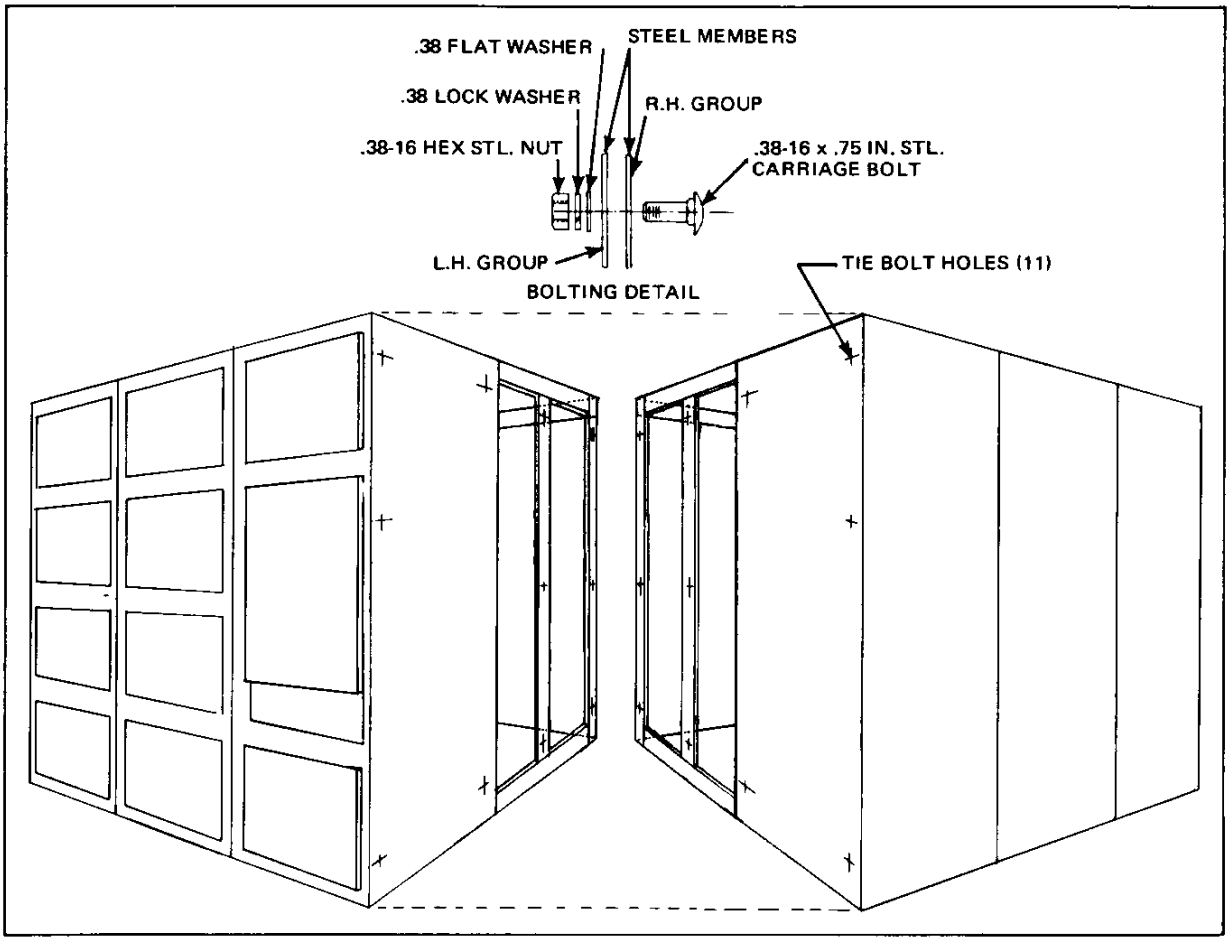


Fig. 21 *Tie Bolt Locations for Joining Units at Shipping Break*

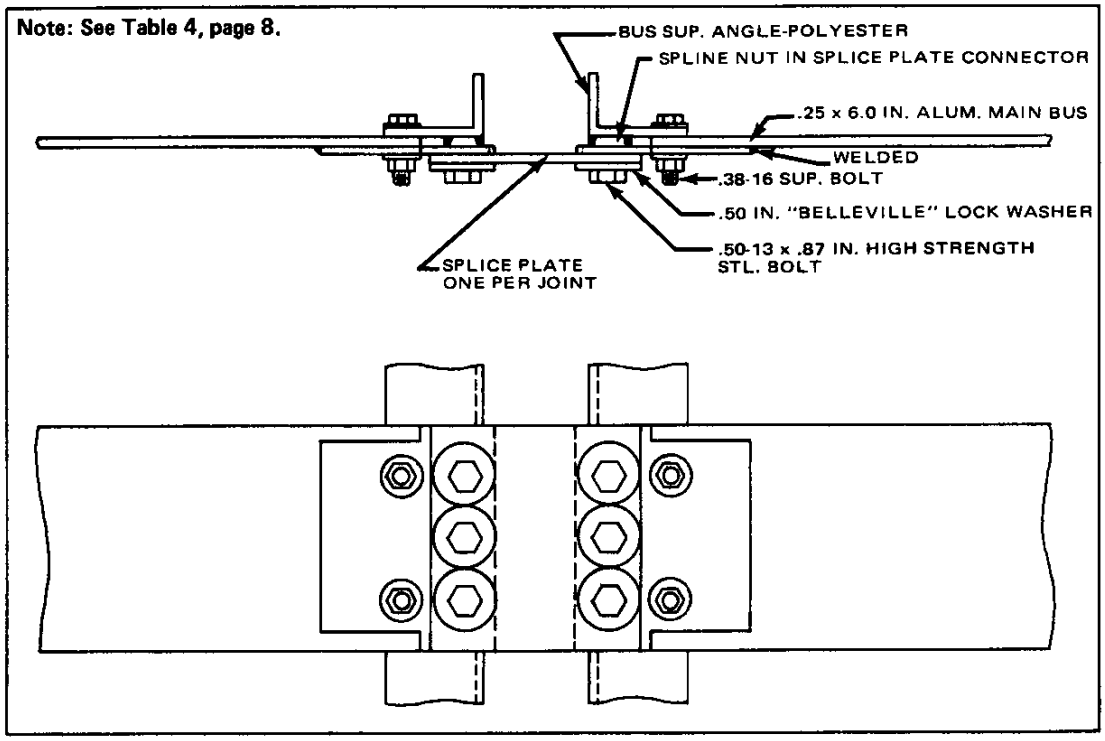


Fig. 22 *Field Assembly of Joints in 1600 Amp Aluminum Horizontal Bus*

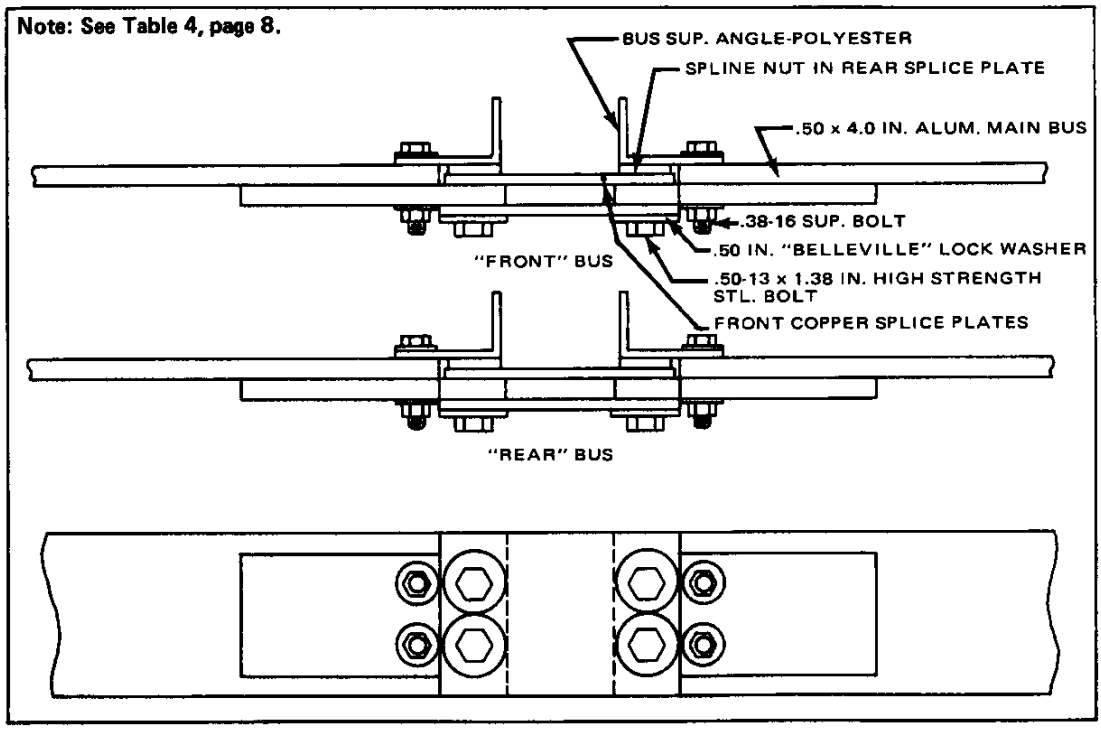


Fig. 23 *Field Assembly of Joints in 3000 Amp Aluminum Horizontal Bus*

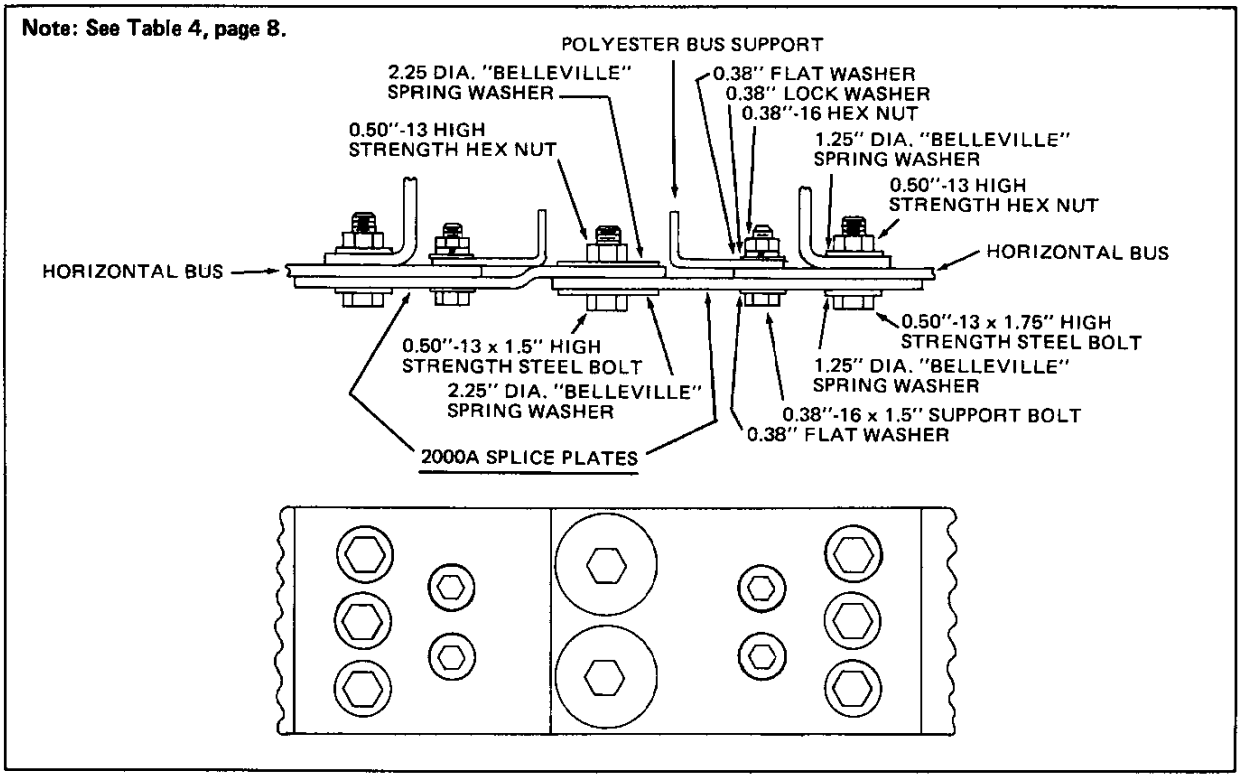


Fig. 24 *Field Assembly of Joints in 2000 Amp Copper Horizontal Bus*

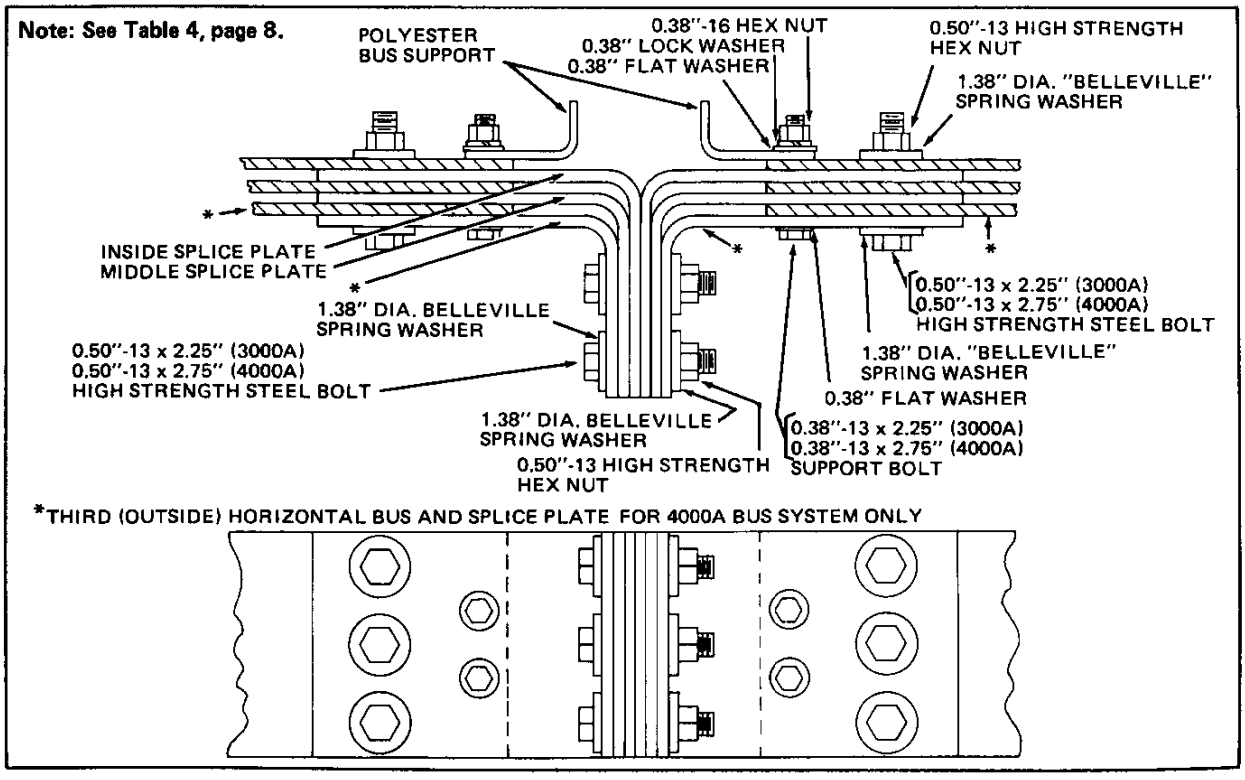


Fig. 25 *Field Assembly of Joints in 3000 Amp and 4000 Amp Copper Horizontal Bus*

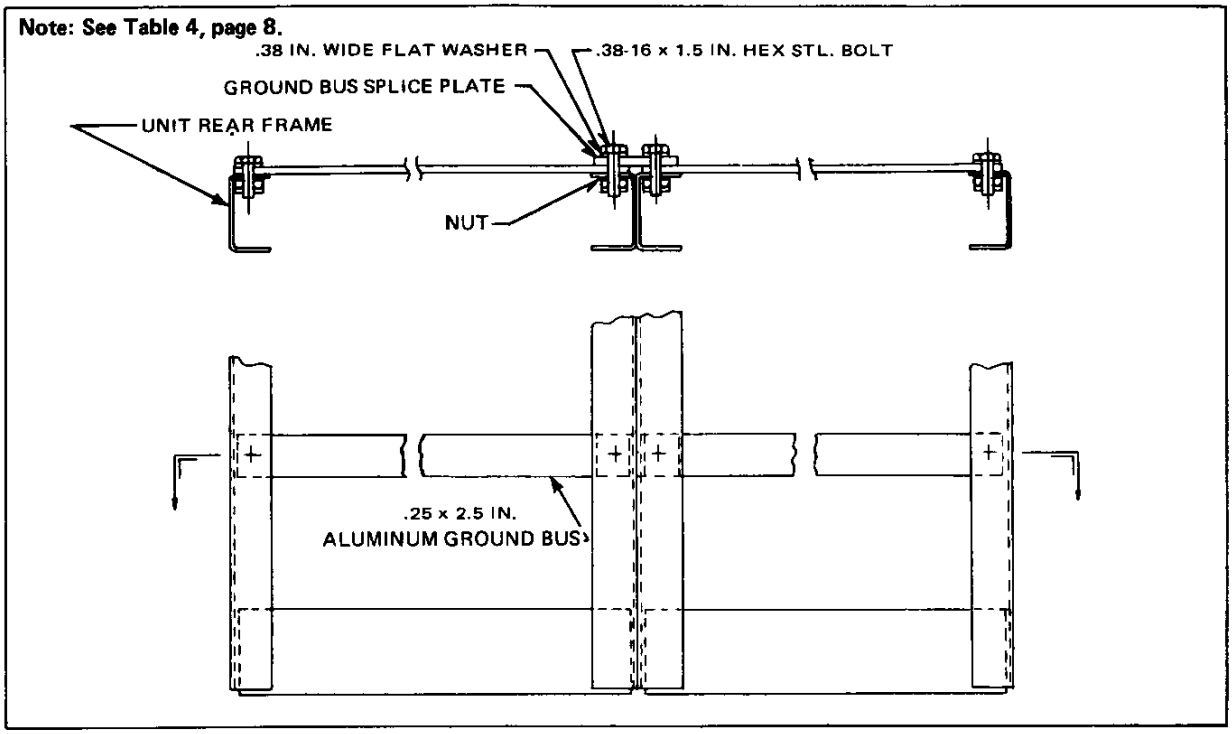


Fig. 26 *Field Assembly of Splice in Ground Bus*

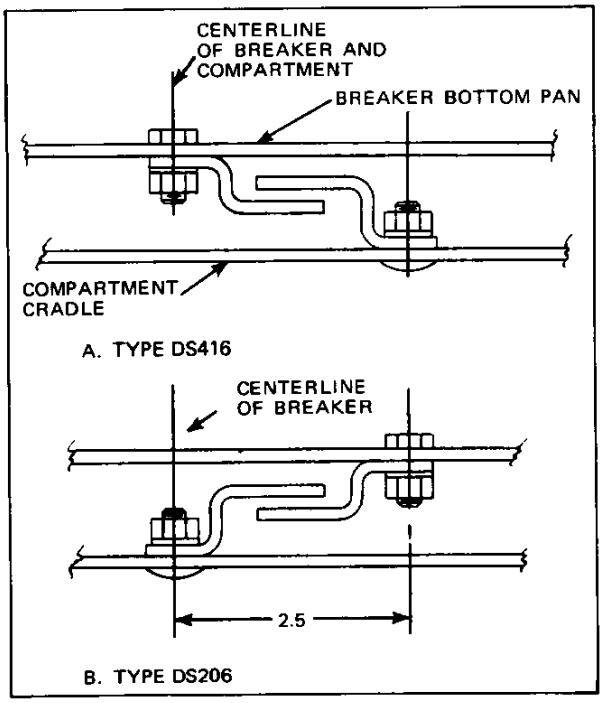


Fig. 27 *Breaker Interference Interlock (Viewed From Front)*

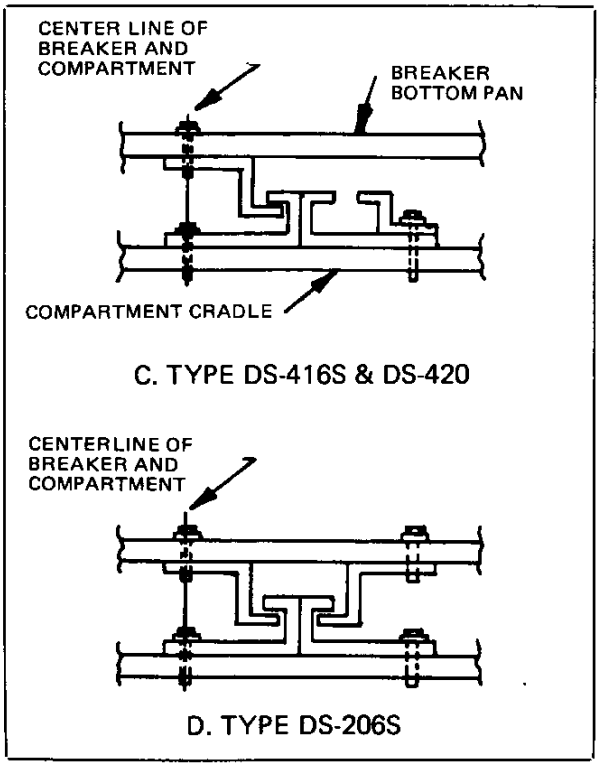
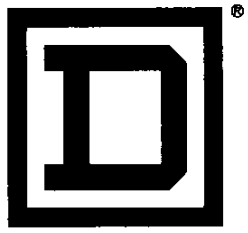


Fig. 28 *Breaker Interference Interlock (Viewed From Front)*



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