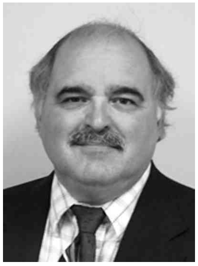
Rectifier Clinic



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Rectifier Bussing

One of the most basic requirements for effective transfer of direct current from the rectifier to the tank is correct bussing. Incorrect selection, installation or maintenance can create inefficiencies, ineffective power transfer or even damage to the facility.

Let's discuss the two basic methods for bussing—solid copper or aluminum bar, or cable—and the advantages and disadvantages of each, along with the needed maintenance requirements and effect on the process.

Solid Copper or Aluminum Bar

Solid buss has been used for many years and many people are comfortable with this type of installation. Most installations use copper because of its higher conductivity and resistance to corrosion. Aluminum is less expensive and weighs less in comparable sizes, but will not stand up in corrosive environments. Aluminum must always be protected at joints because of the higher possibility of oxidation.

Nominal sizing requires one square inch of cross-sectional area per 1000 amps (1000 A). Therefore, when bussing a 1000-A rectifier, use copper buss in the following sizes: 1/4-in. x 4-in., 1/2-in. x 2-in., or another combination to produce the same cross-sectional area. For a 6000-A rectifier, six pieces of these sizes or an equivalent (such as 4 pieces of 1/4-in. x 6-in., each of which would nominally carry 1500 A.

Because aluminum is less conductive, the rule of thumb is to use an amount of aluminum 50 percent greater to carry the equivalent amperage of copper.

Unless the rectifier is very high in output amperage, most manufacturers supply output buss stubs of 1/4-in. thickness with 1/4-in. spacing, which makes it impractial to use a greater thickness of material with the buss.

Advantages

Durability—Other than extreme environments, solid buss is relatively impervious to damage, although it can be bent if sufficient force is applied.

Overheat Resistance—Because solid buss is usually run in open air, some users may undersize the amount of buss used in an effort to save money. This is extremely short-sighted and inefficient, requiring more kwh to perform the same work. It may also create a safety hazard if temperatures become high enough.

Self-supporting—Because of its rigidity, solid buss will support itself for nominal distances as long as it is vertically oriented. If it is laid flat, it will bend of its own weight.

Material Cost—Although the material cost for solid buss is less than an equivalent size of cable, the installation cost will often cost more than the material itself.

Disadvantages

Installation Cost—Because solid buss must be cut, drilled and bent, labor costs for preparation and installation can be very high. The more convoluted the path from the rectifier to the tank, the more this is exacerbated. Bends, which require parallel runs for higher amperage units, are particularly difficult to install.

Short Circuits—Because many installers run the positive and negative buss in close proximity, there is a continuous risk of a tool, part, rack, or other piece of metal shorting one buss to the other. This may cause injury, or even damage to the rectifier. If the anode buss is common with building ground as is the case in some instances, a short circuit between a tank or building member and the negative bus is also possible.

Connection Integrity—Because it is possible for corrosion to migrate between joints, it is imperative that these be checked and cleaned periodically. A loose connection will also contribute to voltage and amperage loss along the buss run.

Rectifier Relocation—As a result of the rigidity of the buss, relocating a rectifier or a tank, even if it is just a few inches, will require that the buss be dissembled, recut, redrilled, and reassembled.

Cable

Because of the ease of installation, many shops have chosen to use cable for new rectifier installations. There are two basic options for cable: low-strand-count cable, usually THNN (which is very stiff and difficult to bend) and high-strand-count cable, either welding cable or Diesel Locomotive Cable (DLO, which is much more flexible and easier to install).

Both types of cable require a lug to be crimped onto the stripped end, which necessitates a high pressure crimper. To prevent corrosion migration between the lug and the cable, this joint must be sealed with electrical tape or heat shrink tube.

Sizing is dependent on the amperage and the conditions, such as open air versus conduit. Most electrical handbooks provide the correct size for your application. If aluminum cable is used, however, it will require proportionately larger sizes to accommodate its lower conductivity.

Advantages

Installation Cost —Because one piece of cable can carry 1000 A or more, depending on size, installation involves cutting the cable to the right length, crimping on the lugs, and bolting them at both ends.

This makes installation a very inexpensive proposition, unless cable trays or supports are required.

Insulation—DLO has two layers of insulation—one for electrical, and an outer layer for abrasion resistance. This means that both the positive and negative runs can be laid side by side without risk of short circuits.

Maintenance—Because there are only two connections, keeping the joints clean is much easier than with solid buss.

Relocation—The flexibility of cable means that tanks and rectifiers can often be moved without making any changes to the cables.

Order versus Fabrication—If the shop owner does not want to make cables, he or she can call a custom cable supplier who will cut the pieces, strip and crimp on the lugs, and ship the completed cables, often within a day or two.

Disadvantages

Cost—Although the cost per lineal foot is greater for cable than for solid buss, this is often more than offset by installation cost.

Rigidity —If long suspended runs are required, a cable tray or other support will be necessary.

Other Considerations

Voltage Drop—Regardless of the method of bussing employed, users may expect to encounter a lower voltage level at the tank than what the rectifier is producing. This drop will be proportionate to the length of the buss run, and also the number of connections, if solid buss is used. This may require the rectifier to be set to a higher voltage level to obtain the necessary voltage at the tank.

Ripple Reduction—Ripple, which is the amount of alternating current created by an SCR rectifier expressed as a percentage of the direct current output, will diminish over the length of a buss run. The longer the run, the lower the ripple. If cable is used, twisting the cables may reduce this effect. The outcome of this condition may obviate the need for a choke in ripple-sensitive processes.

Pulse Rectifiers—The same phenomenon that reduces ripple will also reduce the effectiveness of a pulsing rectifier. In this case, the user will want to twist a cable installation so that the pulse effect is maximized.

Although bussing is relatively simple, it is important to realize the ramifications of improper bussing and your options at installation. ***P&SF***

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