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The Alfa Standard Isolated Phase Bus systems are “continuous enclosure type”, bonded at the extremities and usually earthed on one end as standard; this configuration offers more electrical advantages than the “non-continuous enclosure type” solution.

The magnetic field produced by the conductor current induces in the enclosure a current, equal to about 90-98% of the conductor current, in the opposite direction. The resulting external magnetic field is negligible.

Structural works, grated panels and rods of reinforced concrete are therefore not influenced by losses due to the magnetic induction. The only remaining stresses are those due to the zero-current component in case of short circuit currents.

There is no problem with steelwork structures in the proximity of the continuous enclosure type Isolated Phase Buses because significant losses and the resultant rise in temperature cannot happen.
The conductors are normally made of aluminium sheets (Al - 99.5%) rolled and welded to one another so as to form of a cylinder (in some cases conductor can be copper 99.9%). Aluminium extruded tube is also used for diameters ≤ 330 mm.

Several IPB standard sizes carry currents up to 25kA with natural cooling and 50kA with forced ventilation cooling. For plant terminals and expansion joints (where required), flexible connections are provided. When expansion joints are used, one of the ends of the expansion connector is factory welded to a conductor while the other end is field welded to the matching conductor.

In order to increase the heat-dissipating capacity by radiation and reduce the temperature rise of the bus conductors, matt black paint is used on the external surface.

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### Iso Phase Bus Technical Data

Our IPB are classified into three types depending on the voltage and current rate.

- **Type CX for Large Power**: This Isolated Phase Bus characterized by the use of aluminum conductor that is supported by porcelain insulators in an enclosure that is also made of aluminum. Air is the main insulating medium. It is used primarily in the transport of large power from Generator to GSU Transformer in large Thermo-electric, Nuclear and Hydro Power Plants (up to 50 kA and 36 kV).

- **Type MP for Medium Power**: This Isolated Phase Bus using the same technologies of the types CX and MR, designed to have the most economical solution for the transport of power in Hydroelectric, Gas Turbine and Combined Cycle Power Plants of a smaller capacity, which adds the possibility of housing copper conductor (up to 10 kA and 24 kV).

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The three enclosures phases are short circuited at the ends by the welding of aluminium shunts sized in accordance with the nominal current carried. One of these shunts will be grounded for the service staff's protection.

As for the conductors, the enclosures are also matt black painted on the internal surface in order to increase the heat-dissipating capacity by radiation and reduce the temperature rise of the bus conductors, matt black paint is used on the external surface.

### Standard Technology

The enclosure is made of aluminium sheets (Al - 99.5%) rolled and welded to form a tubular shape. Inspection doors are provided to allow access for assembly or removal of current transformers, expansion joints, thermometers, flexible joints and other such equipment.

Conductor

The conductors are normally made of aluminium sheets (Al - 99.5%) rolled and welded to one another so as to form of a cylinder (in some cases conductor can be copper 99.9%). Aluminium extruded tube is also used for diameters ≤ 330 mm.

Several IPB standard sizes carry currents up to 25kA with natural cooling and 50kA with forced ventilation cooling. For plant terminals and expansion joints (where required), flexible connections are provided. When expansion joints are used, one of the ends of the expansion connector is factory welded to a conductor while the other end is field welded to the matching conductor.

In order to increase the heat-dissipating capacity by radiation and reduce the temperature rise of the bus conductors, matt black paint is used on the external surface.

### Enclosure

The enclosure is made of aluminium sheets (Al - 99.5%) rolled and butt-welded to form a tubular shape. Inspection doors are provided to allow access for assembly or removal of current transformers, expansion joints, thermometers, flexible joints and other such equipment.

Conductor temperature rise: 65°C (149°F). Enclosure temperature rise: 40°C (104°F).

**Reported values are given as a mere indication; these ones could be changed according to technical and environmental specific requirements.**

**Conductor temperature rise: 65°C (149°F). Enclosure temperature rise: 40°C (104°F).**
**Supporting insulators**

To assemble the conductor inside the enclosure, supporting insulators are required. They are used for holding the conductor at a required distance from ground and to support loads due to the conductor weight and stresses due to conductor expansion and short circuit faults.

Insulators are provided with shock absorber devices that allow the free expansion. The insulator is fixed into a box welded to the enclosure that permits easy maintenance. Alfa Standard uses insulators made of porcelain or epoxy resin. The number and the arrangement depend on the operating ratings.

**Expansion joints**

These components are required on conductors and on enclosures to permit expansion and contraction due to temperature changes. In this case, when needed, expansion joints will be usually installed along the IPB route; designing and engineering calculation will establish proper location of these items.

At the ends of the Isolated Phase Bus ducts (generator or transformers connections) non-metallic flexible joints connect enclosures to generator or transformer housings to prevent vibrations being transmitted to the bus duct and to permit access to the flexible terminal connectors.

**Bushing insulators**

When required, (i.e. to prevent hydrogen leakage from generator terminals from entering the IPB enclosure or when a pressurization system is used), seal-off bushings are provided at the IPB extremities. In this way the conductors are provided at the ends with seal-off bushings or bushing insulators. A synthetic silicone rubber ring allowing the free expansion of conductor provides sealing of these baffles.

**Flexible braids**

The conductor connections to generators and transformers are made by flexible braids to avoid transmission of vibration onto the IPB. These also act as removable isolation links.

Furthermore, during site installation, the use of flexible braids that can easily flex on all 3 axis, would enhance easiness of connection, even when a relatively slight difference of alignment between IPB and machines might occur.

**Current transformers**

Ring type current transformers are mounted on a flange inside the enclosure. Installation and removal of these transformers is carried out through an inspection door sized for this purpose. The secondary windings are wired out of the enclosure, via a sealed box provided with a cable inlet stuffing box.
Supporting structures

The enclosures are mounted on rolled aluminium sheet supports for support of the IPB from above or below, according to the installation requirement. These supports are secured to the supporting structure by means of insulated devices allowing the longitudinal expansion of the enclosures while maintaining electrical insulation from the structural work.

Transformer & Generator terminal casing

Conductor connections to the transformer or generator terminals are protected by aluminium bolted sheet casings. Solid aluminium segregations can be provided for phase to phase and phase to neutral segregation.

Pressurization

The superior degree of protection (IP65) provided by AS IPB makes it unnecessary to provide air conditioning of any type under normal conditions. However, in the case of a particularly aggressive environment or polluted air, the IPB system may be pressurized as an additional safety precaution.

The standard pressurization equipment uses the existing station air supply and consists of a panel containing: relief valves, filters, safety valves and control devices. A dryer and compressor may be also supplied if necessary.

Voltage Transformer Cubicle P.T.

Voltage Transformer Cubicles are commonly used to house P.T.'s for generator metering and protection. These cubicles also permit the installation of capacitors, surge arresters and earthing switches if required. The P.T. cubicles are normally phase segregated, although phase isolated cubicles may also be supplied if required. Low voltage wiring is brought to a common box for the three phases.

Wall passage

This assembly is available and designed even for passing through light walls, allowing the hermetically sealed enclosures to pass without exerting any forces on the walls. When required, wall passages can be supplied with fire barriers both inside and outside of the IPB. Wall passages are fully insulated from the busduct.
Neutral Grounding Cubicle & Star Point Cubicle

Neutral grounding cubicles (usually equipped with dry-type earthing power transformer, earthing stainless resistor and single-pole operating switch) and Star Point Cubicles can be also provided if requested.

Air Forced Cooling System

At higher current ratings (i.e. over 25 kA), in order to maintain temperature rise values within requested and specified limits, it may be necessary to force cool the IPB. This practice reduces the physical size of the IPB to overcome possible space limitations. A forced air-cooling system is used to achieve these objectives. Generally this unit consists of an air-water heat exchanger, two fans, one of which is on standby. Automatic devices should be included to give alarm signals in case of inadequate functioning of any part of the system.

The air blown into two phases is drawn into the third, cooled when passing through the heat exchanger and returned to the circuit (closed system). To remove the possibility of arc transfer, grounded deionizing grids are built into the ducting used to transfer the air from phase to phase.

However, the exact system for a particular IPB installation will depend on the general arrangement and specifications.

Hydrogen leakage monitoring

On the generator casing Hydrogen leakage protection may be provided when required.

This system comprises of a passive catalytic combustion sensor for detection of flammable gases and vapors in air in the range of 0-100% LEL, with the suitable control unit for protection.
Quality Control

All the materials are purchased from our Approved Suppliers List according to our technical specifications and to the standards IEC, ANSI, and UNI etc. The necessary quality controls are carried out during the different phases of working to guarantee that the finished product is according to the Customer’s specifications and to our qualitative standards. For example, on each completed IPB assembly we carry out tests of insulation at power frequency, measure of insulation resistance, checking of painting (adherence and thickness) and dimensional checks. Type tests such as, impulse voltage dry test and temperature rise test, might be also performed on IPB at the AS testing laboratory upon a specific request by client.