Product Specifications for Aluminum Vertical Break Switches

1. General

a) This specification covers the design, manufacture, and shipment of aluminum vertical break switches, both air-break and load-break configurations, for substation and transmission switching applications.
b) All switches furnished shall conform to all applicable IEEE, NEMA, and ANSI standards
c) The switch manufacturer shall furnish all parts required to install a complete operating switch, including insulators, switch bases, operating mechanism, and equipment mounting hardware; if insulators are not required, this shall be specified by the customer.
d) The pole or mounting structure, bus conductor, terminal connectors, dead-end assemblies, guying and grounding materials, through bolts and miscellaneous pole or structure hardware will be provided by others.
e) This equipment will be factory assembled when supplied with insulators and field assembled when supplied without insulators; field assembly and installation will be by others.

2. Applicable Standards and Specifications

a) The following standards shall form a part of this specification unless otherwise stated:

ANSI C29.9	Wet-Process Porcelain Insulators
ANSI C37.32	Schedules of Preferred Ratings, Manufacturing Specifications, and Application Guide for High Voltage Air Switches
ANSI C37.34	Test Code for High-Voltage Air Switches
ASTM 123	Zinc Coating (Hot Dip) on Iron and Steel Hardware
NEMA SG6	Power Switching Equipment

b) All switches furnished shall be in accordance with the latest versions of the appropriate specifications.
c) The switch shall be a vertical break, SEECO type “VIPA” or approved equal.

3. Materials and Workmanship

a) The equipment shall be new and of standard commercial, first-grade quality as to materials, workmanship, and design, in accordance with the best engineering practice, and shall be such as has been proven to be suitable for the intended purpose.
b) All welding shall be done by welders experienced in the process to be used and in a manner evidencing good workmanship.

4. Environmental Conditions

a) Temperature - Equipment supplied shall be adequate for an operating range of -40 degrees C to +55 degrees C.
b) Humidity - Equipment supplied shall be operated under humidity of up to 95% at a temperature of 40 degrees C.
c) Environment - Equipment supplied shall provide reliable performance in environments with high exposure to salt, minerals, chemicals, or windborne particulate.

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d) Ice - Equipment supplied shall operate adequate with a build-up of 3/4" clear ice

5. Ratings and Type

a) Type - Switches shall be group operated vertical break switches, mounted horizontal upright, vertical, underhung, with parallel, slant 'Vee' or full 'Vee' insulator configurations

b) Ratings - Switches shall meet or exceed the following ratings

Rated Voltage	15 kV through 345 kV
Rated Maximum Voltage	15.5 kV through 362 kV
Rated Frequency	60 Hz
Rated Continuous Current	600 Amp through 3000 Amp
Rated Momentary Current	40 kA through 100 kA
Rated Withstand Voltage (BIL)	110 kV through 1300 kV

6. Switch Design and Construction

a) Jaw and Hinge Contacts

i) All contacts shall be silver to silver and designed so that wiping action is provided with a minimum of roughening or wear on the silver surfaces

ii) The design of the jaw contacts shall be of the reverse current loop style, such that the resultant magnetic forces during short circuit will tend to hold the blade in the closed position and maintain contact pressure. Blade locks or other latching devices are not permitted.

iii) The design of the hinge contacts shall also be of the reverse current loop style. The design will insure that sufficient contact pressure shall be maintained throughout the full range of blade movement, from fully opened to fully closed. Hinge contacts shall be completely shielded in the closed position.

iv) Engagement of the blade end and contact fingers shall result in a minimum of 125 lbs pressure and 1/8" deflection on each contact finger.

v) Contact pressure shall be maintained by separate insulated, stainless steel, pre-compressed backup springs, independent of the main current path.

vi) Wear of contacts shall not result in diminished contact performance due to reduction of contact pressure. The number and size of contact fingers shall be sufficient to ensure adequate transfer of rated current from the blade to the jaw

vii) All contacts shall be self-aligning and self-adjusting and designed to insure firm positive contact.

viii) The current path shall not conduct through moving pins, laminated shunts or other moving components that serve a primarily mechanical function. No exceptions will be permitted.

b) Switch Blade

i) Switch blades shall be high conductivity aluminum alloy and of tubular construction

ii) Each switch blade shall form one solid piece and shall be so assembled that no part of the blade can move relative to another

iii) Blade stops shall be provided on each phase to prevent accidental over travel of the blade when rotating insulator bearing stops are improperly set.

iv) The mechanical linkage between the rotating insulator and the blade carrier

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shall overtoggle when the blade is fully closed, insuring constant contact pressure and prohibiting the unintended rotation of the blade towards the open direction due to insulator displacement, vibration or other forces.

v) The mechanical linkage between the rotating insulator and the blade carrier shall not be used for conduction of current in the main current path. No exceptions will be permitted.

vi) Blades shall be counterbalanced at 115 kV and up to minimize operating effort. Counterbalances shall be insulated and out of the current path; non-insulated counterbalances are not acceptable.

c) Terminal Pads

i) Terminal pads on each end of the switch shall be located at the same height above the insulator

ii) Terminal pads shall be of aluminum alloy and have flat, machined surfaces

iii) Terminal pads shall be NEMA standard 4-hole for switches rated 600 to 2000 amperes. Switches rated 3000 ampere shall utilize three sided terminal pads with NEMA standard 4-hole pattern on each pad.

d) Switch Assembly

i) Switches of the same rating and design shall have interchangeable parts

ii) The switch shall be so designed that when installed, its operation will not be prevented by excessive accumulated water, sleet, ice, snow, dirt, or other atmospheric contamination.

iii) Metal live parts shall be non-rusting and corrosion resistant. All current carrying parts shall be non-ferrous.

iv) Live parts shall be designed to use at least two of the four mounting holes in the insulator or insulator adapter.

v) Bolts, screws, and pins shall be provided with lock washers, keys, or equivalent locking facilities

vi) No part of the switch blade or jaw assembly shall project lengthwise beyond the terminal pads

e) Switch Mechanism

i) The mechanism shall be so designed that all three phases are in positive continuous control throughout the entire operating cycle.

ii) Each rotating insulator stack shall have double roller or double ball bearings in the base bearing assembly. Bearing housings shall be weatherproof. Open type bearing assemblies must be rustproof and non-corroding, and they shall be designed to completely drain water and moisture accumulation.

iii) All roller or ball bearings shall be greaseless or maintenance free type

iv) Rotating insulator stacks with 5” bolt circles (115 kV and greater) shall have leveling provisions at the base of each stack; rotating insulator stacks with 3” bolt circles (69 kV and below) may employ shims for alignment

v) All operating pipes shall be sufficiently rigid to maintain positive control under the most adverse conditions, including a heavily iced switch and operating mechanism.

vi) It shall be impossible, after proper and final adjustment has been made, for any part of the mechanism to be displaced sufficiently, at any point in the travel, to allow improper functioning of the switch when the switch is opened or closed at any operating speed.

vii) All ferrous parts, except springs, shall be hot-dip galvanized in accordance with ASTM A153, latest revision.

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f) Operating Mechanism
- i) The operating mechanism shall be positively toggled when the switch is closed to ensure correct, complete switch operation and to provide operating personnel with visual confirmation.
- ii) All vertical operating shafts shall be supported on ball or roller thrust bearings. Guides shall be provided on the vertical shaft at regular intervals to ensure proper operation.
- iii) Switches of all voltages will be furnished with a horizontal swing handle. Geared mechanisms shall be acceptable, if required by customer, to ensure proper operation.
- iv) Provision shall be made for padlocking the mechanism in the open or closed position.
- v) A flexible tinned copper braid shunt shall be provided on the operating mechanism for ground connections by Others.
- vi) The maximum operating effort shall be fifty pounds for a swing handle operator or thirty-five pounds for a manually operated gear mechanism

g) Switch Bases
- i) Switch bases shall be constructed of ASTM A36 steel with sufficient rigidity to maintain proper insulator alignment and contact engagement under all climatic and loading conditions. All steel shall be hot-dipped galvanized in accordance with ASTM A123.
- ii) Switch bases shall be single channel construction for switches rated 69 kV and below; for switches rated 115 kV and up, switch bases shall be welded or bolted double channel construction.
- iii) When application design considerations require reduction of installed weight, switch bases may be constructed of 6061-T6 aluminum, with member sizes specified to maintain proper rigidity.

h) Insulators
- i) Insulators will be supplied as standard equipment on all voltage ratings unless specified otherwise on customer's RFQ or manufacturer's proposal
- ii) Insulators will conform with ANSI C29.8 and C29.9.
- iii) Insulators supplied will be standard strength, ANSI 70 sky-tone gray unless specified otherwise on customer's RFQ or manufacturer's proposal
- iv) Insulators will be wet-process porcelain; polymer style insulators can also be supplied at customer request; consult the manufacturer for guidance on appropriate applications.

i) Arcing Horns
- i) Switches will be supplied with standard wipe-type arcing horns of corrosion resistant stainless steel rod.
- ii) Switches requiring reduced current, full voltage interruption capability (line charging or transformer magnetizing applications) shall utilize a high-speed, whip-type arcing horn.
  - a) Horns to be constructed from stainless steel alloy with appropriate mechanical and electrical attributes to maintain function throughout the life of the switch without degradation of spring characteristics.
  - b) Horn shall be of a design to provide maximum tip speed
  - c) Arcing horn assembly shall include a mechanical stop to prevent return/rebound of the horn and possible re-strike.

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j) Interrupter
- i) Switches requiring reduced voltage, full current interruption capability (loop-splitting applications) shall utilize a single bottle, reduced voltage vacuum interrupter to provide a confined arc when switching.
- ii) Switches requiring full voltage, full current interruption capability shall utilize a multi-bottle vacuum interrupter.
  - a) The number of bottles per interrupter stack to be properly coordinated with the expected recovery voltage of the switching application and the open gap across the switch.
- iii) The interrupter unit shall be designed to ensure high speed interruption regardless of the operational speed of the switch.
- iv) When not being operated, the interrupter unit shall be out of the current path so that it is not subject to fault currents.
- v) When the interrupter employs a dielectric to enhance the interrupting rating of the enclosed vacuum bottle, accidental loss or disposal of the dielectric shall not pose a risk to the health of utility personnel or the environment; SF6 is not acceptable as a dielectric.

k) Nameplate
- i) All switches shall be equipped with a non-corrosive nameplate in accordance with ANSI C37.30, permanently attached with stainless steel screws or rivets.
- ii) Nameplate shall include the appropriate catalog number, electrical ratings, and manufacturer's sales order number for proper and complete identification of the switch.

l) Shipping
- i) Switches rated 69 kV and below shall be shipped completely assembled and adjusted, with insulators, base bearings, and live parts bolted into position on bases
- ii) Switches rated 115 kV and up can also be shipped completely assembled and adjusted; consult the manufactuer for details
- iii) Switches shipped without insulators shall have live parts and base bearings assembled and bolted into position on bases
- iv) Operating pipe will be shipped unassembled and banded together, with proper identification to the switch.
- v) All other switch components shall be shipped in a wooden crate, with proper identification to the switch.
- vi) All switches and accessories shall be shipped FOB factory, freight prepaid and add unless otherwise noted.

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