

# Study of manufacturing process and factory acceptance test of 6.6kv high voltage switchboard

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**Abstract :** The high voltage switchgear is also known as metal-enclosed switchgear. How the manufacturing process takes place and which are the factory acceptance test perform on high voltage switchboard. metal-enclosed switchgear assemblies have earthed metallic enclosures. These switchgears generally have three compartments, namely circuit breaker compartment, bus bar compartment, and current transformer and cable compartment, which are separated by partitions. This type of metal-enclosed switchgear is termed as cubicle switchgear. The factory acceptance test which proves that the equipment is designed properly according to the customer requirements. The factory acceptance test includes type test, routine test and special test as per international standards. The paper has developed to know various aspects/requirements of manufacturing process and factory acceptance tests.

**Index Terms - Cubicle, Factory acceptance test, High voltage, Switchgear, Switchboard**

## I. INTRODUCTION

Switchgear and control panels are used in power generation, substations, transformer station, industrial plants, factories and any other places where electric energy is consumed or electric power is distributed to any number of regions. The switchgear panels are enclosed with fabricated sheet metal which can be open or semi enclosed type. They can easily control with remote or local electric power to equipment and appliances.

A control panel is normally vertical, where control and monitoring instruments are displayed on metering compartment. It is an enclosed unit that is the part of a system that users can access, and easily control devices. The electrical switchgear panel is an essential item in industrial electrification. It regulates the function of electrical equipment. Electrical panels mounted with necessary relays and it is also used to protect electrical equipment from being damaged due to short circuit and overloading. Furthermore, the control panels are enclosures fabricated out of steel metal. It is open type, semi enclosed or totally enclosed type. In addition, they indicate the parameters like voltage, current, frequency & power factor on the face of the panel. Also, they can regulate the power supply with the help of switches/circuit breakers.

Switchgear has mainly the function like carrying, making and breaking at normal load current. It also clears the fault after metering and regulating the various parameters of the electrical system. circuit breaker, protection relay, auxiliary relay, voltage transformer, Current transformer, electrical fuse, electrical switch, miniature circuit breaker, measuring instrument, lightning arrester, electrical isolator and other required equipment are utilize in metal-enclosed switchgear.

## II. MANUFACTURING PROCESS OF SWITCHBOARD

Metal-enclosed switchgears are generally designed in horizontal draw-out pattern though some manufacturers also follow vertical isolation pattern. The design incorporates the single/double bus bar system as per the requirement.

A typical switchgear panel consists of a fixed portion (and a withdrawable portion) having three high voltage compartments, namely a breaker compartment, a current transformer compartment (CT), and a bus bar compartment as shown in fig. The instrument panel is a separate low voltage metering compartment. The movable portion of wheel-mounted circuit breaker is fitted with an operating mechanism and isolating contacts. Generally, there is a manual charging provision for springs to tackle the possibility of failure of auxiliary power to spring charging motor.

The primary isolating contact system has a self-aligning type female contact on the moving portion and male contact on the fixed portion of the switchgear panel. This compartment also includes an earthing contact which mates with earthing strip on the moving portion, and safety shutters. The circuit breaker (CB) has generally three positions, i.e. the 'service', 'test', 'and isolated positions. The position of the circuit breaker can be seen through the glass window on the door.

The bus bar compartment of earthed metal construction houses the bus bars, which consist of multiple parallel bars of aluminum or copper as the requirement of current. Bus bars are generally fitted with epoxy support insulators of adequate strength and voltage class. The bus bars are used mostly insulated type. The bus bar compartment is generally provided with a partition between two

adjacent bus bars chambers. The cable compartment is designed to be able to mount the current transformer and have a provision for cable terminals. The movable circuit breaker parts consist of a truck frame with four wheels. There are three interrupters and operating mechanism is mounted.

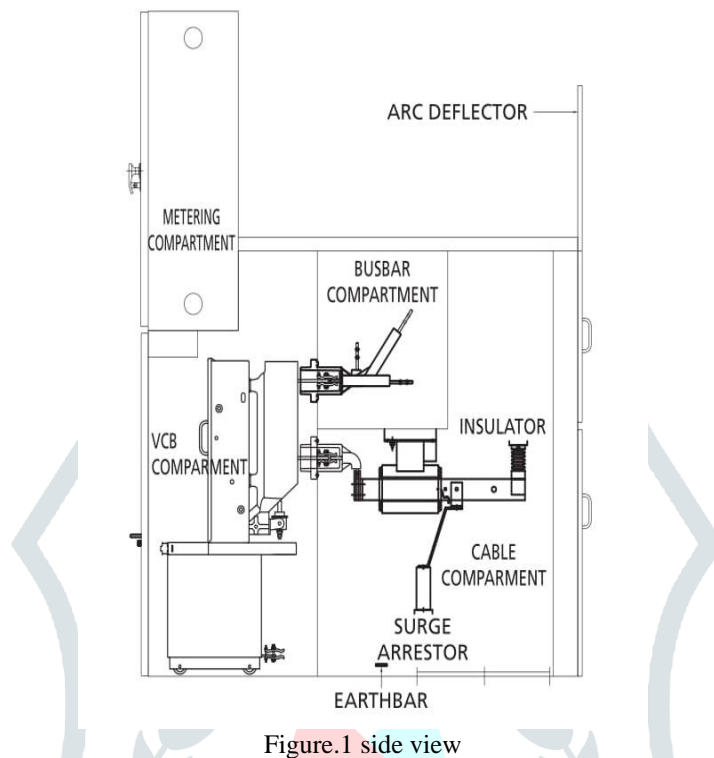


Figure.1 side view

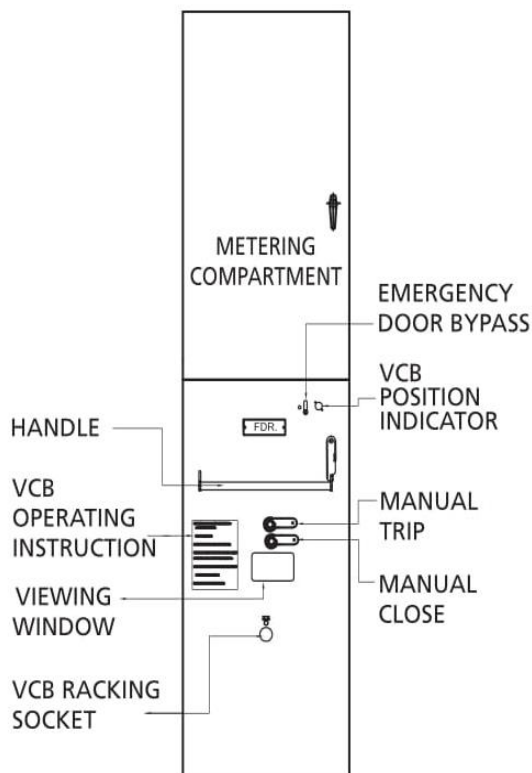


Figure.2 front view

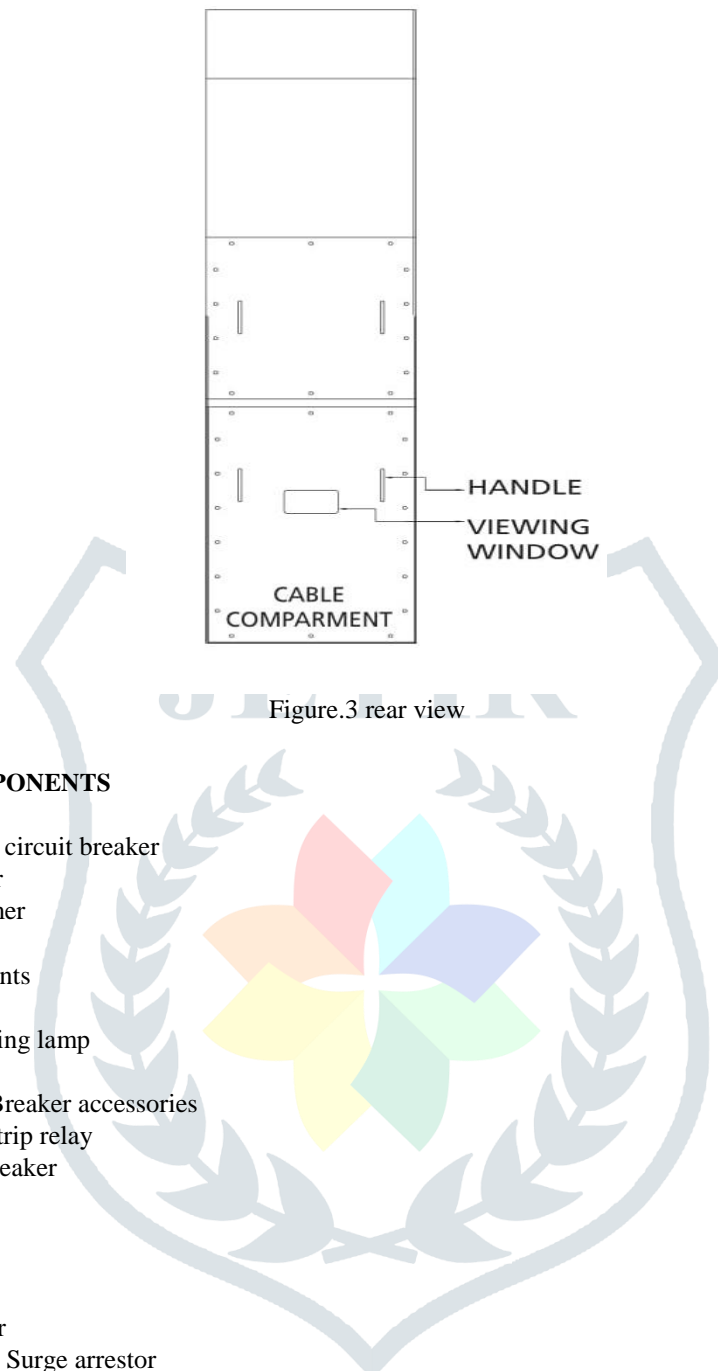


Figure.3 rear view

### III. SWITCHBOARD COMPONENTS

1. Drawout type VCB circuit breaker
2. Current transformer
3. Potential Transformer
4. IDMT relay
5. Meter and instruments
6. Main bus
7. Control and indicating lamp
8. Push button
9. Test switches and Breaker accessories
10. High speed master trip relay
11. Miniature circuit breaker
12. Space heater
13. Thermostat
14. Kilovolt meter
15. Amp meter
16. Multifunction meter
17. Lighting arrestor or Surge arrestor

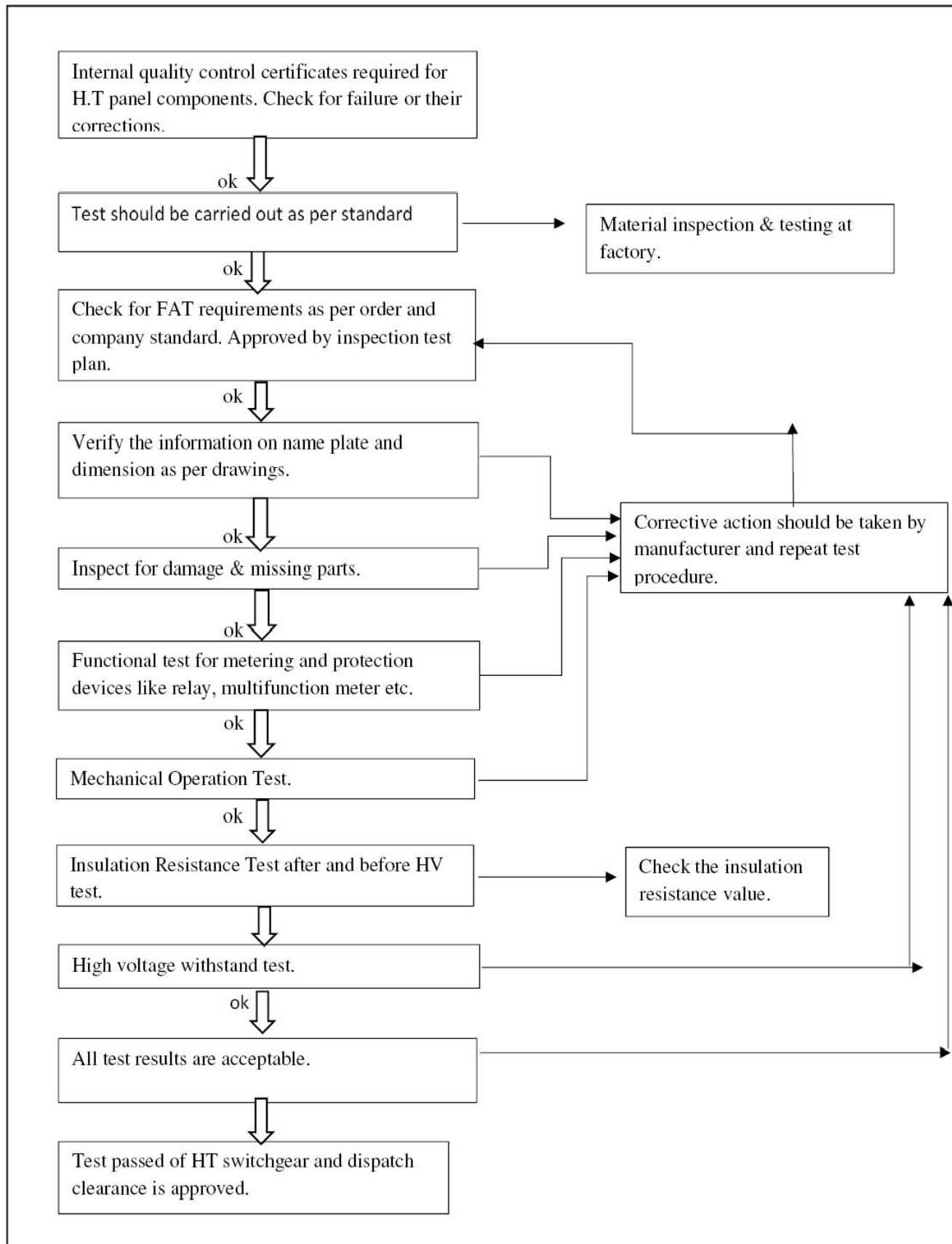
### IV. FACTORY ACCEPTANCE TEST

The factory acceptance test provides on all electrical equipment. It provides the information and testing procedure to be followed on high voltage switchgear. It improves quality control of high voltage switchgear and simplify procedure for engineers. Factory acceptance test consist of type test, routine test and special test if required. It is done as per international standard.

Type test are performed on switchgear of one type to confirm assigned ratings characteristic. Type test usually relates to the first unit manufactured by a firm to a given specification and certificates. Routine tests are made on high voltage switchgear before it leaves the factory, to ensure that it is in accordance with specification. Special test is are performed in the presence of client as specified in the tender or purchase order.

In the functional test verification of the switchgear panel wiring. And mechanical operation test is performed on the vacuum circuit breaker and test on auxiliary equipment's.

V. Factory acceptance flowchart



## VI. TESTING REPORT FOR 6.6KV HIGH VOLTAGE SWITCHGEAR

### 1. INSULATION RESISTANCE TEST (BEFORE HV TEST)

Insulation test is carried out with 1000V megger. There is possibility of occurrence if fault if the insulation resistance is less. It is measured between the phase and earth and phase to phase.

Details of Test	Unit (Giga Ohms)
R-Y	750
Y-B	625
B-R	700
R-E	552
Y-E	625
B-E	530

Table.1 IR test output

### 2. HIGH VOLTAGE TEST (DURATION 60 SECOND)

Any electrical equipment should be capable to withstand high voltage for short time. Time period is increased up to one minute. When the voltage reaches to the desired value and withstands it for one minute without spark being produced. If the value is found to be more than specified value, the insulation resistance is said to be good.

Details of Test	H.V value	mA Drop
R-Y	28kv	0.9
Y-B	28kv	1.0
B-R	28kv	1.1
R-E	28kv	1.1
Y-E	28kv	1.2
B-E	28kv	1.1

Table.2 high voltage

## VII. CONCLUSION

This paper has described manufacturing process of metal-enclosed switchgear and proper arrangement of different compartment. And factory acceptance test is done after completing the switchgear panel in operation mode as per international standards. Switchgear industrial application like steel plant, water pumping station, power generating station, distribution substation applications have suitable for a large switching operation. It also gives the protection against overload and short circuit with the help of relays and metering instruments.

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