



General Description

The ABB Type “LBOR – II” switch is a manually operated two-position load make or break, rotary switch. The “LBOR-II” switch is designed for use with padmounted or submersible distribution transformers or distribution switchgear.

The “LBOR – II” switch is a high performance, high quality switch that features a unitized rotor assembly and a unique contact structure. The unitized rotor assembly provides positive contact alignment while the unique contact structure provides a high momentary and making symmetrical/asymmetrical current rating.

Certification

To certify the ratings, production “LBOR – II” switches were tested at the following test facilities: CFE/LAPEM Power Laboratory, McGraw-Edison Power Laboratory, Westinghouse High Power Laboratory, and the ABB Engineering Laboratory.

Production switches were mounted in a padmounted distribution transformer tank. Testing was performed with the switches mounted in both the horizontal and vertical positions. Since all “LBOR – II” switches use the same contact structure and basic mechanical parts, representative switches of each rating category were tested for this certification.

Design Tests

The design tests are divided into three parts.

1. Power Tests

- Load Switching Test
- Magnetizing Current Interruption Test
- Cable Charging Current Test
- Momentary Current Test
- Making Current Test
- Two Second Current Test

2. Dielectric Test

- Impulse Withstand Test
- 60 Hertz Withstand Voltage Test
- Partial Discharge Level Test

3. Thermal

- Thermal Runaway Test
- Continuous Current Test

4. Mechanical Tests

- 1000 Operation Test

1. Power Tests

• Load Switching Test

The load switching tests were performed on the switches first. The purpose of this test is to verify that the switches are capable of switching all load currents up to and including the rated continuous current of the switch. The switches were subjected to 20 randomly timed open/close operations at rated continuous current followed by 30 open/close operations at 40% - 60% rated continuous current followed by 10 open/

close operations at 5% - 20 % rated continuous current. Each switch successfully passed this test.

• Magnetizing Current Interruption Test

Next, the magnetizing current interruption test was performed on the switches. The purpose of this test is to verify that the switches are capable of closing and interrupting magnetizing current. The switches were subjected to 10 randomly timed open/close operations at the ANSI specified magnetizing current. Each switch successfully passed this test.

• Cable Charging Current Test

Cable charging current tests were performed on a switch. The purpose of this test is to verify that the switches are capable of closing and interrupting the rated cable charging current. The switch was subjected to 20 randomly timed open/close operations at 27 kV and 25 amperes. The switch successfully passed this test.

• Momentary Current Test

Momentary current tests were performed on the switches. The purpose of this test is to verify that the switches are capable of withstanding the high current surges of typical reclosing operations. Each switch was subjected to 3 sets of momentary surges. Each set included a sequence of three momentary surges with 10 seconds between each surge. The three sets of surges were completed within 10 minutes. The minimum duration of each surge was 10 cycles. Each switch successfully passed this test.

• Making Current Test

The making current test was then performed on the switches. The purpose of this test is to verify that the switches are capable of making a faulted circuit following adverse conditions caused by the switching operations. The switches were subjected to 3 closing operations. The minimum duration of current for each operation was 10 cycles. Each switch successfully passed this test. The making current test concluded the group of power tests that are required to be performed on the same switch.

• Two Second Current Test

Following the making current test, the two second current test was performed. A single phase circuit was used in order to perform this test with two adjacent phases of the switch connected in series. Each switch successfully passed this test.

2. Dielectric Tests

• Impulse Withstand Test

The impulse withstand test voltage test consisted of three positive and three negative full wave voltage impulses without puncture or flashover. The voltage impulse used was a 1.2 x 50 microsecond wave having a crest value of the specified voltage. Each switch successfully passed this test.

Power Test Results

Switch Description	Test	Nominal Line Voltage (kV)	Nominal Current (Amperes)	Operations per Switch
272D923G13 & L150NC4003 Mounted Horizontally	Load Switching	27	400	20
		27	300	20
		27	140	30
		27	50	10
	Magnetizing Current	27	10.5	10
	Momentary Current	27	15,200 symmetrical 41,600 peak	9
	Making Current	27	40,800 Peak	3
Two Second Current	--	12,000	1	
272D913G13 Mounted Horizontally and Vertically	Load Switching	27	300	20
		27	140	30
		27	50	10
		Magnetizing Current	27	10.5
	Momentary Current	27	16,000 symmetrical 40,600 peak	9
	Making Current	27	40,800 Peak	3
	Two Second Current	--	12,000	1
272D914G13 Mounted Horizontally	Load Switching	15.5	300	20
		15.5	140	30
		15.5	50	10
		Magnetizing Current	15.5	10.5
	Momentary Current	15.5	16,400 symmetrical 42,400 peak	9
	Making Current	15.5	41,600 Peak	3
	Two Second Current	--	12,000	1

- **60 Hertz Withstand Voltage Test**

The purpose of the 60 Hertz Withstand Voltage Test is to verify the integrity of the insulation structure of the switch following the series of power tests. Each switch successfully passed this test.

- **Partial Discharge Level Test**

The partial discharge level test is performed to verify that the partial discharge extinction voltage level is within the rated limits. One half the rated 60 Hertz withstand test voltage is applied until partial discharge starts, or for one minute, and is then reduced to the specified partial discharge extinction voltage and held at this voltage for not less than two minutes. If at the end of the two minute period, discharge is evident only in the form of spurious or random spikes spaced at least two seconds apart, then partial discharge will be considered as having ceased. Each switch successfully passed this test.

Dielectric Test Results

Switch Design Type	Test	Voltage (kV)
272D923G13 & L150NC4003	Impulse Withstand	150
	60 Hz Withstand	70
	Minimum Partial Discharge Extinction Level	19
272D913G13	Impulse Withstand	180
	60 Hz Withstand	70
	Minimum Partial Discharge Extinction Level	19
272D914G13	Impulse Withstand	95
	60 Hz Withstand	35
	Minimum Partial Discharge Extinction Level	11

3. Thermal Tests

- **Thermal Runaway Test**

The purpose of the thermal runaway test is to verify that the switch, after being subjected to the power tests, will operate at a stable temperature while carrying rated continuous current. Each switch successfully passed this test.

Style Number	Continuous Current (Amperes)
272D923G13	400
L150NC4003	400
272D913G13	300
272D914G13	300

• **Continuous Current Test**

The continuous current test is performed to assure that the switch will operate at continuous current within the limits of observable temperature rise. Rated current was applied continuously to all three phases of the switch until the temperature stabilized.

Temperature was measured using thermal couples implanted at various current carrying locations on the switch. Each switch successfully passed this test.

4. Mechanical Tests

• **Mechanical Operation Test**

The purpose of the mechanical operation test is to verify that the switch can complete a verified number of opening and closing operations without maintenance or replacement of any parts. Each switch was successfully subjected to 1,000 de-energized operations.

Results and Discussion

All switches successfully passed the power, dielectric, thermal and mechanical tests. Following the complete series of tests, the switches were inspected and found to be in good condition, thus verifying the design and the following published ratings.

LBOR-II Switch Ratings (IEC 265-1)

Style Number	No. of Decks	Phase	kV ¹	BIL	Amps	Hz	60 Hz Withstand Voltage (kV)		Magnetizing Interrupting Current (Amperes)	Symmetrical Momentary Current (Amperes)	Momentary Peak and Peak Making (Amperes)	Two Second Current (Amperes)	Minimum Partial Discharge Extinction Voltage (kV)
							Design	Production					
272D914G11 L095NC3001	1	1	8.9	95	300	50/60	35	34	10.5	16,000	40,000	12,000	11
272D914G12 L095NC3002	2	1	8.9	95	300	50/60	35	34	10.5	16,000	40,000	12,000	11
272D914G13 L095NC3003	3	3	15.5	95	300	50/60	35	34	10.5	16,000	40,000	12,000	11
272D913G11 L150NC3001	1	1	21.9	180	300	50/60	70	70	10.5 ²	16,000	40,000	12,000	26
272D913G12 L150NC3002	2	1	21.9	180	300	50/60	70	70	10.5 ²	16,000	40,000	12,000	26
272D913G13 L150NC3003	3	3	38.0	180	300	50/60	70	70	10.5 ³	16,000	40,000	12,000	26
272D923G11 L150NC4001	1	1	15.5	150	400	50/60	70	50	10.5	16,000	40,000	12,000	26
272D923G12 L150NC4002	2	1	15.5	150	400	50/60	70	50	10.5	16,000	40,000	12,000	26
272D923G13 L150NC4003	3	3	27.0	150	400	50/60	70	50	10.5	16,000	40,000	12,000	26

¹ Single Phase Voltages are Line to Ground

Three Phase Voltages are Line to Line

² Tested at 15.5 kV

³ Tested at 27.0 kV

