

MANUFACTURING CIRCUIT BREAKERS

1. INTRODUCTION:

All fuses need to be replaced with MCB for better safety and control when they have done their job in the past. Unlike a fuse, an MCB operates as automatic switch that opens in the event of excessive current flowing through the circuit and once the circuit returns to normal, it can be re-closed without any manual replacement. MCBs are used primarily as an alternative to the fuse switch in most of the circuits. A wide variety of MCBs have been in use nowadays with breaking capacity of 10KA to 16 KA, in all areas of domestic, commercial and industrial applications as a reliable means of protection. A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by excess current, typically resulting from an overload or short circuit. Its basic function is to interrupt current flow after a fault is detected. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect low-current circuits or individual household appliance, up to large switchgear designed to protect high voltage circuits feeding an entire city. The generic function of a circuit breaker, RCD or a fuse, as an automatic means of removing power from a faulty system is often abbreviated as ADS (Automatic Disconnection of Supply).

2. PRODUCT & ITS APPLICATION:

An MCB or miniature circuit breaker is an electromagnetic device that embodies complete enclosure in a moulded insulating material. The main function of an MCB is to switch the circuit, i.e., to open the circuit (which has been connected to it) automatically when the current passing through it (MCB) exceeds the value for which it is set. It can be manually switched ON and OFF as similar to normal switch if necessary.

MCBs are of time delay tripping devices, to which the magnitude of over current controls the operating time. This means, these get operated whenever overload exist long enough to create a danger to the circuit being protected. Therefore, MCBs doesn't respond to transient loads such as switches surges and motor starting currents. Generally, these are designed to operate at less than 2.5 milliseconds during short circuit faults and 2 seconds to 2 minutes in case of overloads (depending on the level of current).

MCBs are manufactured in different pole versions such as single, double, triple and four pole structures with different fault current levels. Mostly, MCBs are linked to give two and three-pole versions such that a fault in one line will break the complete circuit and hence complete circuit isolation are provided. This feature will be helpful in case of single phasing in three phase motor protection.

Types of circuit breakers

Many classifications of circuit breakers can be made, based on their features such as voltage class, construction type, interrupting type, and structural features.

Low-voltage circuit breakers, Magnetic circuit breakers, Thermal magnetic circuit breakers, Magnetic-hydraulic circuit breakers, Common trip breakers, Medium-voltage circuit breakers, High-voltage circuit breakers, Sulphur hexafluoride (SF6) high-voltage circuit breakers, Disconnecting circuit breaker (DCB), Carbon dioxide (CO2) high-voltage circuit , ETC.

3. DESIRED QUALIFICATIONS FOR PROMOTER:

Graduate in any discipline.

4. INDUSTRY LOOK OUT AND TRENDS

The global circuit breaker market was valued at USD 6.62 Billion in 2016 and is projected to reach USD 8.68 Billion by 2022, growing at a CAGR of 4.85%, from 2017 to 2022. Growing access to electricity in developing countries, increasing construction and developmental activities, and the rising number of renewable power generation projects are the major drivers that would trigger growth in the circuit breaker market.

5. MARKET POTENTIAL AND MARKETING ISSUES, IF ANY:

The circuit breakers are one of the key contributors for the efficient and reliable power supply. Growing focus towards efficient transmission and distribution of electricity and sustained demand from end-user industries is driving the demand for circuit breakers in India. The government of India has set the target to add power capacity of about 88,536 MW (Mega Watt) during the 12th year plan, i.e., 2012-17 which in turn has led to the growth of high voltage circuit breaker in high power transmission and sub-transmission projects. According to "India Circuit Breakers Market Forecast & Opportunities, 2018", the circuit breakers market revenues in India are forecast to grow at the CAGR of around 15% during 2013-18. The market is currently dominated by low voltage circuit breakers. It is forecast that MCB and MCCB will account for more than 30% revenue share by 2018 due to high demand from low voltage segments. The leading players operating in Indian circuit breakers market are Schneider Electric, Siemens, L&T and ABB.

6. RAW MATERIAL REQUIREMENTS:

Components of a Miniature Circuit Breaker

Miniature circuit breakers have a simple construction, although, the parts that make up a miniature circuit breaker work in a very precise manner. The miniature circuit breaker does not offer replacement parts. It's not designed to be maintained, rather, when a unit goes bad, it is simply replaced. A typical miniature circuit breaker is made up of four main components: the Frame, the Operating Mechanism, the Trip Unit and the Contacts.

Frame - The miniature circuit breaker frame has a moulded case exterior. Its primary function is to provide a rigid, mechanically strong, insulated housing in which the other components are mounted.

Operating Mechanism - The operating mechanism of a miniature circuit breaker provides the means of opening and closing the circuit. It has a three-position switch ("on", "off", and "tripped"). It can only be in the "tripped" position as a result of an over current. When power

is removed manually, it can only be switched to the "off" position. This makes it easy for a maintenance person to determine why power has been cut.

Trip Unit - The trip unit of a miniature circuit breaker acts as the brain of the device. It activates the operating mechanism in the event of a prolonged overload or short circuit. This type of circuit breaker uses a thermal magnetic mechanism. This is the predominant trip unit technology used in the domestic market. A bi-metal and an electromagnet work together to provide overload and short-circuit protection.

Contacts - When an overload or short circuit situation occurs, the miniature circuit breaker contacts open to break the current flow. When this happens, an electrical arc is formed. The arc continues until the first possible zero point in the AC cycle. The zero point is the weakest point in the AC cycle and will not support the continuance of an arc. By breaking the arc, current flow is stopped. This is called zero point construction.

7. MANUFACTURING PROCESS:

An MCB embodies complete enclosure in a moulded insulating material. This provides mechanically strong and insulated housing. The switching system consists of a fixed and a moving contact to which incoming and outgoing wires are connected. The metal or current carrying parts are made up of electrolytic copper or silver alloy depending on the rating of the circuit breaker. As the contacts are separated in the event of an overload or short circuit situation, an electric arc is formed. All modern MCBs are designed to handle arc interruption process where arc energy extraction and its cooling are provided by metallic arc splitter plates. These plates are held in a proper position by an insulating material. Also, arc runner is provided to force the arc that is produced between the main contacts. The operating mechanism consists of both magnetic tripping and thermal tripping arrangements. The magnetic tripping arrangement essentially consists of a composite magnetic system that has a spring loaded dash-pot with a magnetic slug in a silicon fluid, and a normal magnetic trip. A current carrying coil in the trip arrangement moves the slug against spring towards fixed pole piece. So the magnetic pull is developed on the trip lever when there is a sufficient magnetic field produced by the coil. In case of short circuits or heavy overloads, strong

magnetic field produced by the coils (Solenoid) is sufficient to attract the armature of trip lever irrespective of the position of slug in the dash-pot. The thermal tripping arrangement consists of a bimetallic strip around which a heater coil is wound to create heat depending on the flow of current. The heater design can be either direct where current is passed through bi-metal strip which effect part of electric circuit or indirect where a coil of current carrying conductor is wound around the bimetallic strip. The deflection of bimetallic strip activates the tripping mechanism in case of certain overload conditions. The bi-metal strips are made up of two different metals, usually brass and steel. These metals are riveted and welded along their length. These are so designed such that they will not heat the strip to the tripping point for normal currents, but if the current is increased beyond rated value, strip is warmed, bent and trips the latch. Bimetallic strips are chosen to provide particular time delays under certain overloads. Miniature circuit breaker construction is very simple, robust and maintenance free.

8. MANPOWER REQUIREMENT:

The enterprise requires 19 employees as detailed below:

Sr. No.	Designation Of Employees	Salary Per Person	Monthly Salary ₹	Number of employees required				
				Year-1	Year-2	Year-3	Year-4	Year-5
1	Production Manager	18,000	18000.00	1	1	1	1	1
2	Operators	12,000	36000.00	3	3	3	4	4
3	Helpers	10,000	50000.00	5	5	5	6	6
4	Admin Manager	15,000	15000.00	1	1	1	1	1
5	Accounts/Stores Assistant	12,500	25000.00	2	2	2	4	4
6	Office Boy	9,000	27000.00	3	3	3	3	3
	Total		181000.00	15	15	15	19	19

9. IMPLEMENTATION SCHEDULE:

The project can be implemented in 4 months' time as detailed below:

Sr. No.	Activity	Time Required (in months)
1	Acquisition of premises	1.00
2	Construction (if applicable)	1.00
3	Procurement & installation of Plant & Machinery	2.00
4	Arrangement of Finance	2.00
5	Recruitment of required manpower	1.00
	Total time required <i>(some activities shall run concurrently)</i>	4.00

10. COST OF PROJECT:

The project shall cost ₹ 57.00 lacs as detailed below:

Sr. No.	Particulars	₹ in Lacs
1	Land 500 sq.mtrs@ 1000	5.00
2	Building	10.00
3	Plant & Machinery	24.00
4	Furniture, Electrical Installations	3.00
5	Other Assets including Preliminary / Pre-operative expenses	2.40
6	Working Capital	12.60
	Total	57.00

11. MEANS OF FINANCE:

Bank term loans are assumed @ 75 % of fixed assets.

Sr. No.	Particulars	₹ in Lacs
1	Promoter's contribution	14.25
2	Bank Finance	42.75
	Total	57.00

12. WORKING CAPITAL CALCULATION:

Sr. No.	Particulars	Gross Amt	Margin %	Margin Amt	Bank Finance
1	Inventories	6.30	0.25	1.58	4.73
2	Receivables	3.15	0.25	0.79	2.36
3	Overheads	3.15	100%	3.15	0.00
4	Creditors	-		0.00	0.00
	Total	12.60		5.51	7.09

13. LIST OF MACHINERY REQUIRED:

The main Plant and machineries required are :Injection moulding, spot welding, power press -5 tons/10tons/20tons, Revetting, welding, Air compressor, Drill , Bench Grinder, Hand press, Semi- automatic coil winding, sealing machine, Electric Oven, Calibration Bench, Shigh voltage tester, Megger 500 , Endurance test, Heating oven, Temperature measuring test, testing Lab, tooling, jigs etc.

A detail of important machinery is given below: Power Requirement: 50 HP

Sr. No.	Particulars	UOM	Qty	Rate (₹)	Value
					(₹ in Lacs)
	Plant & Machinery / Equipments				
	Main Machinery				
1	Moulding Plant	NO	1	800000	8.00
2	Winding Plant	NO	1	500000	5.00
3	Assembling Plant	NO	1	300000	3.00
4	<i>Ancillary Machinery</i>	L.S.	1	200000	2.00
5	Testing Laboratory	NO	1	100000	1.00
6	Installation, Electrification, Taxes And Transportation.	L.S.	1	400000	4.00
	<i>Sub-Total Plant & Machinery</i>				24.00
	Furniture / Electrical Installations				
a)	Office Furniture	LS	1	50000	0.50
b)	Stores Almirah	LS	1	100,000	1.00
c)	Computer & Printer	L. S.	3	50000	1.50
	<i>Sub Total</i>				3.00
	Other Assets				
a)	Preliminary And Preoperative				2.40
	<i>Sub-Total Other Assets</i>				2.40
	Total				29.40

All the machines and equipment are available from local manufacturers. The entrepreneur needs to ensure proper selection of product mix and proper type of machines and tooling to have modern and flexible designs. It may be worthwhile to look at reconditioned imported machines, dies and tooling. Some of the machinery and dies and tooling suppliers are listed here below:

1. Hifine Machine

5, New India Estate, Inside Relief Hotel,
Sanand Char Rasta, Sarkhej, Ahmedabad-382210, Gujarat

Phone: 079 26891274, 079 26890274

2. Heena Machine Product

No. 1, Samrat Industrial Area,
Near Ban Labs, Rajkot - 360004, Gujarat, India

3. Sagar Engineering Works

A-129, Road No. 9 D,
V. K. I. Area, Jaipur - 302013,
Rajasthan, India
Phone: +91-9829024358, +91-141-4064876

4. Meter Centre

No. 1778/6, Ground Floor, Gandhi Main Road,
Near HDFC Bank, Ahmedabad, Gujarat 380001
Phone: 098257 01297

5. Pulsar Electronics Private Limited

No. 127/128, Sonal Link Industrial Estate, No. 2,
Link Road Opposite Movie Time Cinema,
Malad West, Mumbai - 400064, Maharashtra, India
Phone: +91-7021000597, +91-9867024141

6. Cosmic Devices

No. 1702/307, Srinath Building, 3rd Floor Bhagirath Palace, Chandni Chowk, Delhi -
110006, India
Phone: +91-9810413218, +91-9313866166

14. PROFITABILITY CALCULATIONS:

Sr. No.	Particulars	UOM	Year-1	Year-2	Year-3	Year-4	Year-5
1	Capacity Utilization	%	60%	70%	80%	90%	100%
2	Sales	₹. In Lacs	37.80	44.10	50.40	56.70	63.00
3	Raw Materials & Other direct inputs	₹. In Lacs	26.19	30.56	34.92	39.29	43.65
4	Gross Margin	₹. In Lacs	11.61	13.55	15.48	17.42	19.35
5	Overheads except interest	₹. In Lacs	8.19	8.70	9.73	10.04	10.24
6	Interest	₹. In Lacs	4.28	4.28	2.85	2.14	1.71
7	Depreciation	₹. In Lacs	16.80	12.00	8.40	6.00	5.40
8	Net Profit before tax	₹. In Lacs	-17.66	-11.43	-5.50	-0.76	2.00

The basis of profitability calculation:

The growth of selling capacity will be increased 10% per year. (This is assumed by various analysis and study; it can be increased according to the selling strategy.)

Energy Costs are considered at Rs 7 per Kwh and fuel cost is considered at Rs. 65 per liter. The depreciation of plant is taken at 10-12 % and Interest costs are taken at 14 -15 % depending on type of industry.

15. BREAKEVEN ANALYSIS:

The project shall reach cash break-even at 6176 % of projected capacity as detailed below:

Sr. No.	Particulars	UOM	Value
1	Sales at full capacity	₹. In Lacs	63.00
2	Variable costs	₹. In Lacs	43.65
3	Fixed costs incl. interest	₹. In Lacs	11.95
4	$BEP = FC/(SR-VC) \times 100$	% of capacity	61.76%

16. STATUTORY / GOVERNMENT APPROVALS

As per the allocation of business rules under the Constitution, labour is in the concurrent list of subjects. It is dealt with by the MOLE at the Central and Departments of Labour under State Governments in respective States / UTs. The MOLE has enacted workplace safety and health statutes concerning workers in the manufacturing sector, mines, ports and docks and in construction sectors.

Further, other Ministries of the Government of India have also enacted certain statutes relating to safety aspects of substances, equipment, operations etc. Some of the statutes applicable in the manufacturing sector are discussed below:

The Manufacture, Storage and Import of Hazardous Electronic Rules (MSIHC), 1989

These MSIHC Rules are notified under the Environment (Protection) Act, 1986. These rules are aimed at regulating and handling of certain specified hazardous chemicals. The rules stipulate requirements regarding notification of site, identification of major hazards, taking necessary steps to control major accident, notification of major accident, preparation of safety report and on-site emergency plan; prevention and control of major accident, dissemination of information etc. These rules are notified by the Ministry of Environment and Forests (MOEF) but enforced by the Inspectorates of Factories of respective States / UTs in the manufacturing sector.

Entrepreneur may contact State Pollution Control Board where ever it is applicable.

17. BACKWARD AND FORWARD INTEGRATIONS

Both forward and backward integration for any Electrical Industry are strategies to gain better control over the supply chain, reduce dependency on the suppliers and increase their competitiveness. The two strategies can help companies reduce their dependency on suppliers and increase their influence over the customers. The benefits of these strategies can be big. Both impact the bottom line directly. Integration happens if a company moves

upward or downward in its supply chain. Starting from the suppliers from whom the raw materials are obtained, the chain moves downstream towards the distributors and the retailers. If the suppliers' power is very high, it can create financial burdens for the company. Suppose the number of suppliers of a company is low, then the control in their hands would be low. The burden in that case will fall upon company's shoulders. Its expenditure on raw materials will be high.

18. TRAINING CENTERS AND COURSES

There is no such training required to start this business but, basic Electrical or IC bachelor's degree is plus point for enterpriser. Promoter may train their employees in such specialized institutions to grow up the business. There are few specialized Institutes provide degree certification in chemical Technology, few most famous and authenticate Institutions are as follows:

1. Department of Electrical LD College of engineering
No.120, Circular Road, University Area, Navrangpura,
Opposite Gujarat University, Ahmedabad, Gujarat 380015

2. MIT College of Engineering, Pune
Gate.No.140, Raj Baugh Educational Complex,
Pune Solapur Highway,
Loni Kalbhor, Pune – 412201
Maharashtra, India

Udyamimitra portal (link : www.udyamimitra.in) can also be accessed for handholding services viz. application filling / project report preparation, EDP, financial Training, Skill Development, mentoring etc.

Entrepreneurship program helps to run business successfully is also available from Institutes like Entrepreneurship Development Institute of India (EDII) and its affiliates all over India.

Disclaimer:

Only few machine manufacturers are mentioned in the profile, although many machine manufacturers are available in the market. The addresses given for machinery manufacturers have been taken from reliable sources, to the best of knowledge and contacts. However, no responsibility is admitted, in case any inadvertent error or incorrectness is noticed therein. Further the same have been given by way of information only and do not carry any recommendation.