MECS
Modern Energy Cooking Services

Non-Technical Guidelines on Safety Standards, Minimal Performance, and End of Life for Energy Efficient Electrical Cooking Appliances

(Electric Pressure Cookers, Air Fryers, and Induction Hobs)

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FOREWORD

These non-technical guidelines on safety, minimal performance and end of life for energy efficient cooking appliances are based on following as fundamental knowledge on cooking:

Cooking is practice or skill of preparing food by combining, mixing, and heating the food ingredients wherein appropriate heating of mixed ingredients is key to process of cooking. Cooking is fundamental part of human life that brings families together. But beyond that, it has far-reaching national, regional or ethnic, cultural, and social significance too.

Traditional cooking uses biofuels for cooking using stoves of various technologies for burning the fuel to cause the heat for cooking. Traditional cooking uses open cook wares like stock pot, wok, fry pan or skillet, sauté/sauce/braise/grill pan etc. that cook the food at atmospheric pressure.

Modern cooking uses fossil fuels or electricity for cooking. Environmental concerns related to use of fossil fuels and their scarcity has caused an increasing trend in use of electricity for modern cooking. Cook stoves of various technologies are in use for these modern fuels including electricity. Few of the electric cooking appliances like electric pressure cooker and air fryer have combined function of cook top (stove) as well as cook ware and do not need separate cookware.

Pressure Cooking is the process of cooking food at a pressure higher than the atmospheric pressure. Cooking at higher pressure using the heavy weight lid and/or flexible sealing of dough to create the steam pressure inside the cooking vessel has been in practice since long to cook special foods. Food is cooked faster in pressure cooking compared to cooking at atmospheric pressure for two reasons:

(a) At atmospheric pressure, when the liquid boils and turns into steam, the liquid will stay at the same temperature no matter how long we continue to boil it. Boiling point of a liquid is proportional to the pressure it is subjected to and higher pressure increases the boiling point of the liquid accordingly. Thus, by increasing pressure inside the cooking vessel, we can increase the boiling point i.e., temperature of fluid and steam beyond its boiling point at the atmospheric pressure. This extra hot steam cooks the food faster.

(b) High pressure forces the extra hot liquid into the food. Steam is very efficient to transfer the heat and hence with pressure cooking, it's like there's an extra force pushing this extra hot and fast heat energy into the food. That's why the food cooks faster than usual. This is why cooking with a pressure cooker always requires some form of liquid to produce steam and pressure.

Apart from open lid cooking at atmospheric pressure and closed lid cooking under pressure, air frying is a new concept of cooking where food to be cooked is subjected to hot air in closed pot. Cooking appliance using this technology for cooking is called air fryer.

General section of this document is commonly applicable for all three appliances (Electric pressure cooker, Air fryer, and Induction hob) whereas **Particular section** is applicable to concerned appliances.

PART 1:

GENERAL SECTION OF GUIDELINES

1. Power Supply and Internal wiring of Appliances

1.1 Rated Power

1.1.1 Basic Information

The three appliances in reference i.e., Electric Pressure Cookers (EPC), Air fryers, and Induction hobs are comparatively high-power consuming kitchen appliances that have maximum power rating upto 2500 W. But these appliances may be operated at lower power capacities also using the capacity selector switch or the regulator. Performance and uptake of electric cooking appliances is contingent to availability of adequate, reliable and quality power supply within national standards.

1.1.2 Customer Requirement

The three appliances in reference should have rated power capacity upto 2500 W with facility to select the required power capacity through a dial selector / regulator switch so that normally the appliance is operated at power range of 1000 W to 1500 W and the power range of 2000 W to 2500 W is occasionally used for cooking only special dishes. There should not be excessive deviation in the actual power output of the appliance compared to its rated power capacity at standard voltage and frequency. Limits of such deviation correspond to Clause 10.1 of IEC 60335-1 and IEC 60335-2-15.

1.1.3 Test for Acceptance

Visual inspection and power output test at standard voltage and frequency. The figure below shows an example for inspection.

Figure 1: **Appliance nameplate showing rated power, voltage, and frequency**

1. 2 Rated Supply Voltage and Frequency

1.2.1 Basic Information

Standard supply voltage and frequency in Nepal is 230 Volts (single phase) and 50 Hz respectively. Allowable deviation of voltage is +/- 10% whereas allowable deviation of frequency is +/- 2.5%.

1.2.2 Customers' Requirement

The three appliances in reference for use in Nepal should have rated voltage and frequency equal to standard voltage and frequency of supply in Nepal as mentioned in sub-article 1.2.1. However, the appliance should operate in normal conditions under deviations in supply voltage and frequency at least within the range of allowable deviations in standard voltage and frequency.

1.2.3 Test for Acceptance

Visual inspection and test operation at Nepalese standard voltage and frequency within allowable deviations.

1.3 Power Supply Cord

1.3.1 Basic Information

Different types of Power Supply plug and sockets are in use in different parts of the world. If the type of socket and plug are not compatible, it may cause loose contact of socket and plug resulting in heating at contact point, frequent supply disconnection as well as imperfect earthing leading to accidents. So proper type of plug should be attached to the end of power supply cord and the power supply socket should be compatible with type of plug. Current capacity of a D-type plugs (220 – 240 V, 6 A, 3 numbers of round pins, grounded) commonly available and is in use in Nepal is not suitable for the three appliances in reference due their power capacity so another suitable type of plug and socket set should be used for these appliances.

1.3.2 Customers' Requirement

Being portable, the three appliances in reference should have a power supply cord attached to it to connect with the power supply. One end of the cord should be assembled with the appliance by type X attachment i.e., it can be easily replaced and the other end should be fitted with a plug to be inserted into the supply outlet. The power supply cord should be sheathed with heat resistant polyvinyl chloride or similar material. The current rating and voltage rating of the plug should not be less than the corresponding ratings of the appliance and should not be provided with any alternative means of connection to the supply mains.

The plug attached to supply cord should be of Type M (220 – 240 V, 15 A, 3 numbers of round pins, grounded) and the power supply socket should be compatible with this M type plug for perfect contact and connection to earth circuit. Type D and Type M plugs are similar in look but differ in their current carrying capacity. Conductors of supply cord fixed with the appliance should be identified by standard wiring color code i.e., Black/ red for phase conductor; white/grey for neutral conductor and green/yellow for earth conductor.

Type D Plug

Type M plug

Figure 2: **Type D and Type M plug**

1.3.3 Test for Acceptance

Visual inspection.

1.4 Internal Wiring of Appliances

1.4.1 Basic Information

The capacity, quality and workmanship of internal wiring of appliances should be perfect to avert accidents due to faults in internal wiring.

1.4.2 Customers' Requirement

Wire ways of internal wiring of the appliances in reference are required to be smooth and free from sharp edges so that no damage to insulation of wires is caused. Parts of appliances that move relative to each other during normal operation or during maintenance should not cause undue stress to electrical connections and internal conductors, including those providing earthing continuity. Any beads and similar ceramic insulators on live wires as well as bare internal wiring should be rigidly fixed so that, in normal use, clearances or creepage distances cannot be reduced below the allowable values. Wiring should be protected by flexible metallic tubes instead of open spring coils. The insulation of internal wiring that is subjected to the supply mains voltage should withstand the electrical stress likely to occur in normal use. Sleeves used in the internal wiring as supplementary insulation should be retained in position by clamping at both ends such that it can only be removed by breaking or cutting. Stranded conductors should not be consolidated by soldering where they are subjected to contact pressure, unless the contact pressure is provided by spring terminals. Aluminium wires should not be used for internal wiring.

1.4.3 Test for Acceptance

Visual Inspection.

2. Appliance Class

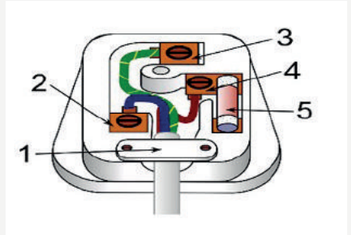
2.1 Basic Information

IEC 61140 classifies electrical appliances into several protection classes. Before an electrical appliance can be released for consumer consumption, it must undergo portable appliance testing (PAT) prescribed for that particular class of appliances. According to this classification, portable electrical appliances with relatively higher Power Rating are designed and manufactured as Class 1 appliances. Appliances under Class 1 have two levels of protection i.e., the basic insulation and the earth connection. Inside the appliance, there are three wires connected to three different pins. The wires are called Live, Neutral, and Earth. Their usual colors are respectively brown, blue, and green/yellow (green in the US, Canada, and Japan). Electricity is carried from a power source to an appliance through a circuit. If a circuit is working properly, the power flows from the source to the appliance and returns to the source. The Live wire brings electric current to the appliance. The Neutral wire brings the current back to the power source. The Earth

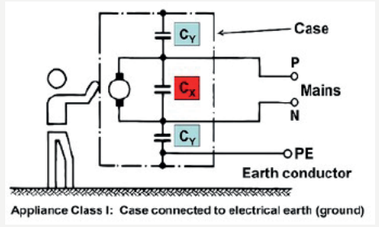
wire provides a way for the current to flow into the ground in the event of a circuit malfunction. The Live and Neutral wires are connected to the plastic connector. The connector holds them in place to prevent them from touching the metal case. This isolation is called basic insulation. Should the Live or Neutral wire touch the metal case, there will be a fault in the circuit. If the basic insulation fails, the earth connection will act as the next level of protection. The earth connection uses the Earth wire, which is connected to the metal case. Without the presence of the Earth wire, the current could flow through the end user's body. As a result, the end user may experience an electric shock. To prevent such an incident, the Earth wire will divert the current into the ground. The fuse should then blow either in the plug or the fuse box, or there should be a power trip.

The required PAT tests for Class I appliances are the Earth Continuity and Insulation Resistance tests which will check the basic insulation and earth connection.

Class Symbol



Supply Connections inside



Connection to Electrical Earth

(1- cable grip, 2-Neutral Terminal, 3-Earth Terminal, 4- Live Terminal, 5-Fuse)

Figure 3: **Appliance class, inner supply connection, and earthing connection**

2.2 Customers' Requirement

Considering the power rating of the three appliances in reference, all of these three appliances should be designed and manufactured as Class I appliances. As Class I appliance, these appliances should be made of metal having three cables, a metal earth pin and a fuse in the plug as depicted in the picture above.

2.3 Test for Acceptance:

Visual inspection, insulation resistance test and earth continuity tests. However, the only way to confirm whether the appliance is Class I is to look for the Class I symbol on the appliance.

Without the presence of the Earth wire, the current could flow through the end user's body. As a result, the end user may experience an electric shock

3. Reliability Considerations

3.1 Basic Information

Reliability refers to time availability of appliance for normal operation over a period. In the event of frequent technical problem in main and/or auxiliary parts to cause the non-availability of appliance for normal operation, reliability of the appliance is understood to be poor. Hence reliability includes fewer number of calls for appliance service in its life span, response to service calls and customer satisfaction. Compliance to national and/or international standards for safety and performance on design, manufacture and customer services is key to reliability of household appliances and must be evidenced through compliance testing and certification.

IECEE CB scheme provides the assurance that appliances tested and certified under this scheme meet the strictest levels of safety, reliability and performance stipulated by relevant IEC standards. Additionally, IECEE CB-FCS scheme is an extension of IECEE CB for mutual recognition of Conformity Assessment Certificates includes factory surveillance and goes beyond product testing.

3.2 Customers' Requirement

The appliances in reference should be highly reliable. Design and manufacturing should ensure that high quality materials are used for main and auxiliary parts of appliances and these parts are assembled with high quality workmanship. This in other words means:

- Main and auxiliary parts of appliances shall be mechanically and electrically strong, well-protected and assembled with excellent workmanship.
- Electrical interconnections of internal wiring and heating mechanism should be made to ensure perfect contact as well as they do not get loosened and disconnected due to heat and small vibrations caused while moving the appliance.
- Mechanical joints, bolts, screws hinges should be strong enough so that they do not get loosened, unscrewed and dislocated due to heat, rust and vibrations caused while moving the appliance.
- Time, temperature and pressure regulation and control devices including sensors; process unit and action unit including microprocessor; indication and signal alarm as well as workmanship of installation of these elements shall ensure their long life with appropriate and accurate functionality.

3.3 Test for Acceptance

Rely on routine tests performed in the factory as well as feedback and rating by users.

Design and manufacturing should ensure that high quality materials are used for main and auxiliary parts of appliances

4. Interoperability Considerations

4.1 Basic Information

Interoperability is the ability of a product or system to cooperate with other products or systems to share resources. Interoperability is often confused with compatibility but compatibility simply means that two products or services can operate in the same environment without adversely affecting the other whereas interoperability refers to attribute of the product in different environment or system also. The product that is working in a system by communicating and sharing resources with other elements of a system can do the same in different system and environment also.

Although there are different types of interoperability in practice, interoperability of household appliances refers to interface between consumer and the appliances for status information or control. Interoperability provides choice to consumers such that they are not locked in one particular type of technology and system. Since smart technology is getting more and more space in the household appliances also and hence interoperability of smart appliances is very important because no consumer will like to get locked in one particular technology or system of data transmission, storing and processing of appliance operation.

4.2 Customers' Requirement

Since these are portable appliance and the owner may move to different location, the appliance should offer wide range of interoperability. It should be possible to operate with different power supply system i.e., at 230 V, 50 Hz as well as 110 V, 60 Hz. The appliance should be designed to operate at slightly different power supply systems also.

In case of smart appliances, which is trending now and is future of operation and control of appliances, it should be possible to operate and control such appliances with any system and protocol of communication.

4.3 Test for Acceptance

Visual inspection, information available in the manual as well as test operation.

5. Comparative Energy Efficiency

5.1 Basic Information

Comparative Energy Efficiency has its commercial as well as environmental aspects as the appliances with higher energy efficiency will not only ensure lower energy consumption but lower emissions also compared to other similar appliances. Comparative energy efficiency of a model of an appliance is contingent to its rated power, time taken for cooking a particular meal, energy consumed by it for warm keeping and the standby power.

5.2 Customers' Requirement

Values of energy efficiency and other related figures of the appliance of particular energy efficiency grade (grade of selected model of appliance) should be better than or at least equal to the indicated values of the respective energy efficiency grades in the following table:

Table 1: **Energy Efficiency Values, Energy Consumption in "Keep warm" function, and Standby power**

Energy efficiency grade	Energy efficiency value Л (%)			Warm keeping Energy consumption W*h	Standby power* (W)	
	V⩾7.5 L	3.5L<V<7.5L	V⩽3.5L		Electric heating element heating	Electromagnetic Induction heating
1	85	79	75	⩽45	⩽1.0	⩽1.8
2	79	72	68			
3	72	65	60	⩽60	⩽1.8	⩽2.0
NOTE: V is the rated volume of the electric pressure cooker, in liters (L).						

5.3 Test for Acceptance

Manufacturer's Test Certificate; Factory Acceptance Test; Onsite Sample Test.

6. Circular Economy and e-Waste

6.1 Basic Information

Nationally Determined Contributions as submitted in COP26 in 2021 stress on substantial reduction of emissions associated with the production, use and end-of-life of appliances and hence the appliance should be aligned with these objectives. Extending the service life of the appliance can substantially reduce CO_2 emissions associated with the appliance. Accordingly, the appliances in reference for use in Nepal should meet following requirements associated with circular economy and reduction of emissions.

6.2 Customers Requirement

(a) Packaging and all inserts of the appliance unit or consignment should be produced from 100% recyclable material.

(b) All the body parts including housing unit, inner pot, lid, valves, gaskets and extended body parts like handle/knob for lifting, control box and its electronic elements and power connection chord etc. are produced from 100% recyclable metals and materials.

(c) Manufacturer/supplier should provide warranty on the supplied appliance unit for a minimum of 1 year from the date of retail purchase by the user.

(d) Manufacturer/supplier should ensure "right to repair" to end user for at least 10 years from the second year of date of retail purchase of the appliance by the end use customer. Under the "right to repair" obligation, repair (or replacement of defective part/s if not repairable) of appliance for 100% functionality, the manufacturer /supplier should be obligated to repair the appliance at reasonable charge.

(d) Manufacturer/supplier should ensure that repair of appliance during the warranty period and/or "right to repair period" is available within the country instead of sending back the appliance to overseas to the country of manufacture. Manufacturer / supplier should also ensure that cost of repair under "right to repair" period shall not exceed 50% of price of similar new appliance in the market at the time of repair.

(e) Manufacturer/supplier should ensure that every piece of appliance is supplied along with an instructional manual in English language that covers the more frequent problems and instruction on how to clean the appliance.

(f) Considering the e-waste problem, the manufacturer/ supplier should provide "send back" warranty under which supplier must receive the appliance when it reaches its end of life.

PART 2: PARTICULAR GUIDELINES

ELECTRIC PRESSURE COOKERS

1. General Construction or Build for functionality of EPC

1.1 Basic Information

Heating a fluid under pressure (i.e., inside a sealed vessel) increases its boiling temperature compared to heating it in open air. If some raw food is also inside the vessel along with the fluid, this food will be subjected to higher temperature. This will not only cook the food in lesser time with less energy consumption, but the food will also be tastier as the high temperature steam will have entered the food under pressure. An EPC is also an under-pressure liquid boiling appliance for cooking various food items and hence its construction should meet this basic objective. However, various traditional cooking methods can also be used for cooking in EPC to cook typical recipes at atmospheric pressure also.

1.2 Customers' Requirement

For the required multi-cooking functionality to cook various foods under pressure and at atmospheric pressure, an EPC should consist of at least following main parts:

(a) The Outer Body
EPC should have a housing unit as its outer body.

(b) The Heating Element
EPC should have an electrical heating element to radiate heat to cook the food. The heating element should be mounted at the base of the outer body.

(c) The Inner Pot
EPC should have a pressure-cooking unit or inner pot placed inside the housing unit. The inner pot should be removable so that it can be taken out from the housing unit for placing the food for cooking, pouring the cooked food or to clean. It should be generally made from aluminum or stainless steel. Aluminium inner pots are suitable for cost effective normal EPCs whereas relatively higher cost variants offering multi-cooking should use high quality stainless steel inner pots made with sturdy, three-ply, or copper-clad bottom for uniform heating. The inner pot should sit over the base where heating element is mounted.

(d) The lid
EPC should be provided with a lid as the cover of the EPC to create the pressure inside. It should have a gasket or sealing ring. When the lid is placed on the cooker in the sealed position, the lid and inner pot should form an airtight chamber. The pressure inside this chamber should increase when heat is applied to the inner pot.

(e) Control Unit to regulate Temperature and Pressure
EPC should be provided with temperature and pressure sensors and a control box as the heart of the intelligence of the electric pressure cooker. The control box should be equipped with a microprocessor to control the timing, pressure, heating and complex cooking cycles and thus should provide positive feedback to achieve precise cooking conditions. As special feature, the control box should also allow one-key operation to activate pre-programmed cooking cycles for various dishes like fresh corns/peas/ cauliflower/broccoli; frozen corns/peas/ cauliflower/broccoli; dry beans etc. In addition to this, the control box should cause sound audible alarm or cut off the power supply to the heating element in the event an unsafe operating condition is detected. The control box should be mounted on the housing unit.

In the standby mode when the EPC is connected with mains only, control box indications should be activated but when EPC is switched on, the heating mechanism (heating element) should get supply and activated to transfer heat to the inner pot where steam is produced by heating the liquid and the food is cooked.

(f) Excessive Pressure Safety Valve
In the event that pressure in the inner pot increases and reaches beyond the safe limit due to failure of pressure regulating system, a last level safety mechanism should be provided to avoid the accident. This protection should be a safety valve fitted with the lid.

An EPC can cook under pressure with higher temperature. This means it can cook faster, but it also demands the unit must have various safety mechanisms.

Figure 4: **EPC and its main parts**


Inner pot


Pressure valve


Heating element


The lid

All components of the electric pressure cookers including the vessel, gasket, pressure regulating device and internal accessories which come in contact with food or steam should be made of the materials satisfying the following requirements:

(i) They should not discolor the food or spoil the flavor or odor of the cooked food in the cooker or cause it to become toxic; and

(ii) They should not be affected by contact with foods cooked in the cooker in such a way that the operational efficiency or safety of the cooker is impaired.

1.3 Test for Acceptance

Visual inspection and rely on manual for design specification.

2. Safety Considerations

2.1 Basic information

Portable household electrical appliances may suffer accidents due to:

(a) Physical instability caused by improper design and manufacture;

(b) Failure of electrical insulation, leakage current, contact with live parts and improper earth connection;

(c) Failure of temperature regulation and heat insulation;

(d) Failure of pressure regulation and increase of pressure to unsafe limits;

(e) Failure of water seals resulting in water ingress inside;

(f) Chemical reaction and rusting of body parts etc.

Nepal Bureau of Standards and Metrology (NBSM) has issued NS 564: 2076 "Household and similar electrical appliances Safety Part 1: General Requirements" as national standards on safety requirements as well as tests prescribed for such household electrical appliances to ensure the safety from potential accidents. EPC for use in Nepal should meet these national standards on safety of household electrical appliances and should pass the prescribed tests.

2.2 Customers' Requirement for Safety against Electrical and other Accidents

2.2.1 Safety against Access to Electrically Live Parts

As basic requirements to this, EPC should be constructed and enclosed such that there is adequate protection against accidental contact with electrically live parts. This requirement applies for all positions of the EPC when it is operated as in normal use, and after the removal of detachable parts. In addition to this, a single switching action of the switch of the supply circuit should ensure full supply disconnection even if the plug attached to supply cord is inserted in the socket of supply circuit. However, it is advisable to make off the switch as well as withdrawal of the plug from socket for foolproof disconnection of supply when the EPC is not in use. In case there is no switching device in the supply circuit, a single switching action may be obtained by the withdrawal of the plug from a socket-outlet. *This requirement corresponds to clause 8.1.1, 8.1.2, 8.1.3 of IEC 60335-1 and IEC 60335-2-15.*

Test for Acceptance

Visual inspection followed by switching on and off as well as withdrawal of supply cord plug from the supply socket.

2.2.2 Safety against Leakage Current

(a) Electrical Strength

Construction of EPC should ensure that the leakage current at operating temperature does not exceed its specified value which is 0.21 mA for all Class I portable appliances. Similarly, EPC construction should ensure required electrical strength i.e., voltage withstand of 1250 V without breakdown of insulation between accessible metal parts and the supply cord which is applicable for all Class I appliance. *This requirement corresponds to Clauses 13.1 to 13.3 of IEC 60335-1 and IEC 60335-2-15.*

(b) Earthing

Accessible metal parts of EPC, as class I appliance, should be permanently and reliably connected to an earthing terminal within the EPC or to the earthing contact of the EPC inlet. Earthing terminals and earthing contacts should not be connected to the neutral terminal. The clamping means of earthing terminals shall be adequately secured against accidental loosening. All parts of the earthing terminal intended for the connection of external conductors shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor or any other metal in contact with these parts. Parts providing earthing continuity, other than parts of a metal frame or enclosure, shall be of metal having adequate resistance to corrosion. The plug at the end of the supply cord to be inserted into the supply socket and the socket of power supply shall be matched to ensure the body earthing of the EPC at all times when supply is connected. *This requirement corresponds to Clause 27.1 to 27.5 of IEC 60335-1 and IEC 60335-2-15.*

Test for Acceptance

Visual inspection, voltage withstand test and earthing continuity test.

2.2.3 Safety against water and moisture ingress

EPCs intended to be partially or completely immersed in water for cleaning shall have adequate protection against the effects of immersion including the water ingress.

The enclosure of EPC should provide the degree of protection against moisture in accordance with its IP classification for which the EPC shall withstand the specified electrical strength test as per its IP Class. *This requirement corresponds to Clause 15.1, 15.1.2, 15.2, 15.3 of IEC 60335-1 and IEC 60335-2-15.*

Test for Acceptance

Manual Water ingress test by immersing the EPC in the water and electrical strength withstand test on spillage of a solution comprising water containing approximately 1 % NaCl and 0.6 % rinsing agent while the EPC connector in position and the EPC deviating from the normal position of use by an angle not exceeding 5°.

2.2.4 Safety against over voltages and transient voltages

Insulation should be the primary protection of EPC against under and over voltages but EPC shall also withstand the transient over-voltages to which it may be subjected.

Test for Acceptance

Insulation resistance test and Impulse Withstand Test. Under impulse withstand test, each clearance of EPC having its rated impulse voltage value shall be tested for withstanding its corresponding Impulse test voltage.

2.2.5 Safety against abnormal operation

EPC should be constructed such that as a result of abnormal or careless operation, the risk of fire, mechanical damage impairing safety or protection against electric shock is obviated as far as is practicable. Electronic circuits should be designed and applied so that a fault condition will not render the appliance unsafe with regard to electric shock, fire hazard, mechanical hazard or dangerous malfunction.

The electronic control system of EPC should detect the abnormal position when the inner pot is not placed inside or lid is not in the desired fully closed position and should not allow the switching on of the power for heating. Similarly, the unsafe operation of EPC to lid not locked in position by mistake from lid locked in position when significant amount of pressure has already been generated should be prevented by a mechanical and/or electrical interlock. For this purpose, EPC should be provided with a float valve, a pin lock mechanism to prevent the lid from being accidentally opened while there is significant amount of pressure inside. If there is enough pressure inside the inner pot, the float valve should be pushed up by the pressure. Once pushed up, the pin of the float valve should serve as latch lock and prevent the lid from turning, even under force.

However, these protections that block the heating operation corresponding to lid position, should not block the function while EPC is to be used for open air cooking methods.

Test for Acceptance

Visual inspection and test operation.

2.2.6 Safety against pressure beyond safe limit

For cooking in normal condition, the pressure inside the EPC is required to be regulated such that the retained pressure suits the cooking of a particular type of food as well as does not increase to unsafe limits.

For this purpose, the EPC should be provided with a pressure regulating mechanism, generally a pressure release valve on or in the lid, to regulate the pressure inside EPC for normal cooking. The pressure release valve should have an anti-block shield inside the lid. As first level of regulating the pressure, the pressure sensor which is electronic based sensing circuitry should cutoff the power supply when operating pressure is reached. But in case the pressure sensor fails and the pressure continues to increase above the normal level, the pressure release valve should automatically be pushed up to open. This is process of releasing excessive pressure by valve action is very similar to the conventional pressure cooker except that conventional pressure cookers do not have pressure sensors and power cutoff. But in the event that pressure release valve fails to regulate the pressure, pressure inside EPC continues to grow beyond safe limit inviting the accident. As second and final line of defense in the conventional stove top pressure cooker, the pin of the float valve is self-destroyed by excessive temperature or pressure. The float valve then, without the pin, becomes a pressure escape hole, and the pressure inside the chamber is released through this hole. Although in such a case the float valve is permanently damaged and possibly a lid replacement may be required, this is an effective last line of defense from the safety perspective. Similar mechanism as third and final line of defense against pressure beyond safe limit may be used in low-cost models of EPC. But advanced and relatively high- cost models of EPC should employ an innovative push-down pressure release mechanism to release excessive pressure, even in the unlikely case where the pin of the float valve could not be destroyed. Thus, the advanced models should provide a multi-level in-depth defense system to offer unprecedented safety assurance to the consumers. It is advisable to use the modern advanced models of EPC using push down pressure release mechanism.

Test for Acceptance

Inspection and factory test report to rely on.

2.2.7 Device Temperature and Safety against temperature beyond safe limits

The EPC and its surroundings should not reach excessive temperatures in normal use to endanger the safety of the personnel and the property. A contact for less than 30 seconds with the outer body surface should not burn the hands of the cook or any third person. For this, temperature of outer body surface should be 40 to 60 degree Celsius when the inner temperature of EPC is 110 degree Celsius. For inner temperature 110 degree Celsius, temperature of the lid may be little higher than temperature of outer body surface. *Requirements for this correspond to Clause 11.1 to 11.4, 11.7, 11.8 of IEC 60335-1 and IEC 60335-2-15 and 11.7.105 of IEC 60335-2-15.*

External parts of non- metallic material, parts of insulating material supporting live parts including connections, and parts of thermoplastic material providing supplementary insulation or reinforced insulation, should be sufficiently resistant to heat. Design and construction of EPC should ensure this. *This corresponds to Clause of 30.1, 30.2, 30.2.1 to 30.2.3 of IEC 60335-1 and IEC 60335-2-15.*

EPC should be equipped with temperature sensor to cut-off the power supply once the operating temperature is reached. As second line of defense to control the temperature from reaching beyond safe limits in the event of failure of temperature sensor, a thermal fuse should be provided to cut-off the power supply when temperature reaches above expected.

Test for Acceptance

Visual inspection and factory test reports.

2.2.8 Safety against accidents related to stability

EPC should have adequate stability when it is used by placing it on a surface like a floor or table. Design and construction of EPC should ensure this. *This corresponds to Clause 20.1 of IEC 60335-1 and IEC 603335-2-15.*

Test for Acceptance

Stability of EPC placed on a surface like floor or table shall also be ensured when it is empty, filled with water upto various levels and when fully filled with water so that stability is maintained in most unfavorable quantity and level of water filling. In none of these cases, EPC should get overturned when subjected to an angle of inclination increased upto 15°.

2.2.9 Safety against accidents related to Mechanical Strength

EPC should have adequate mechanical strength and be constructed to withstand such rough handling that may be expected in normal use. Protective enclosures, guards and similar parts of EPC should be non-detachable and should have adequate mechanical strength. However, enclosures that can be opened by overriding an interlock by applying the test probe are considered to be detachable parts. The unexpected closure of self-resetting thermal cut-outs and overcurrent protective devices shall not cause a hazard. Accessible parts of solid insulation shall have sufficient strength to prevent penetration by sharp implements. EPC shall have supply cord fitted with plug so that it does not cause any stability and mechanical strength related issue originated from supply arrangement. Design and construction of the EPC should be strong enough to meet these requirements. *This corresponds to Clause 21.1 of IEC 60335-1 and IEC 60335-2-15.*

Test for Acceptance

Visual inspection.

2.2.10 Safety against Chemical reaction

Internal and external metallic and non-metallic parts of EPC should not be subjected to chemical reaction to deteriorate them in the event of spillage of hot saline and spicy soup, broth and gravy cooked in the EPC over these parts. Design and construction of EPC should ascertain this.

Test for Acceptance

Spillage of a solution comprising water containing approximately 1 % NaCl and 0.6 % rinsing agent while the EPC connector in position and the EPC deviating from the normal position of use by an angle not exceeding 5°.

2.2.11 Safety against rusting, toxicity and radiation

To the extent possible, use of ferrous parts should be avoided in the EPC. If it becomes unavoidable to use ferrous material in any part, such ferrous parts should be adequately protected against rusting.

EPC shall not emit harmful radiation or present a toxic or similar hazard due to their operation in normal use. This should be ascertained through material selection for manufacturing EPC and the manufacturing process.

3. Minimum Level of Performance

3.1 Basic Information

International standards on minimum performance level of EPC are not available although there are documented studies on comparative performance of different models of EPCs. EPC cooking offers following advantages compared to cooking in traditional cookware:

(i) An EPC eliminates the need of separate cooktop.

(ii) There is saving of time and energy and ultimately cost of cooking energy.

(iii) Insertion of high temperature steam under pressure makes food tastier.

(iv) A number of cookware used in traditional cooking are replaced by a single piece of EPC due to its multi-cooking functionality.

Traditional Nepalese cooking generally involves, boiling, simmering, frying (sauté), and deep frying at atmospheric pressure. A unique cooking method is used for typical recipe Dhindo.

3.2 Customer Requirement

3.2.1 Customers' Requirement on Performance Regarding Cooking Method

To entertain the comparative advantages of cooking in EPC, EPC is expected to facilitate following cooking methods and associated recipes:

(a) Cooking under Pressure to boil, steam, stew, roast, water poach.

(b) Cooking in the open air without lid locked in position to brown, braise, sauté, roast and bake the food. This cooking method is exercised when the EPC does not have air frying functionality. Besides this there should be facility to deactivate power supply block in lid not locked in position as safety function. There should be facility of temperature regulation and control to cook in lid not locked in position as cooking is not performed by high temperature steam in this cooking mode.

(c) Air frying with lid locked in position (if EPC is not standalone unit)

To brown, braise, sauté, roast and bake the food. This cooking method is exercised when the EPC has air frying functionality also. Effective temperature regulation is required for this mode of cooking.

(d) Deep frying in open air

For cooking typical Nepalese deep-fried type festive recipes. There should be facility to deactivate power supply block in lid not locked in position as safety function. In this cooking mode also, facility of temperature regulation and control to cook in lid not locked in position is required.

(e) Other Typical Nepalese Cooking Methods

Typical cooking method for dhindo that involves boiling water in a pan and gradually pouring and mixing flour (buckwheat/ Millet/corn) in it while the mixture is continuously stirred until it is cooked and formed like a sticky dough.

3.2.2 Customer Requirement regarding Performance on Recipes

Employing the above-mentioned cooking methods, EPC should be suitable to cook following major typical Nepalese recipes from the available food grain in the country apart from continental recipes:

Cooking under pressure: Rice/biryani, dal (soup of lentil or other such beans), gravy of chicken, mutton, pork, fish or vegetables, momo/wanton/dumplings.

Open air cooking with lid not locked in position: dry fry of chicken, mutton, pork, fish, single or mixed vegetable gravy and greens; gundruk (soup of fermented and dried vegetables); roti (Indian bread).

Air frying with lid locked in mode (In case EPC has Air Frying function also): air fried or roast of chicken, mutton, pork, fish; air fried wedges of potato, sweet potato, taro, yam etc.; air fried chips of potato, banana, sweet potato etc.; air fried shrimp, salmon, pork chops, meat balls etc.; air fried cauliflower, zucchini, pasta etc.

Deep frying in lid not locked in method: puri, sel-roti, fritters, samosa etc.

Other Typical Nepalese cooking method: dhindo from corn/ millet/buckwheat flour.

3.3 Test for Acceptance

EPC's performance related to cooking of typical Nepalese recipes through above mentioned five cooking methods was tested through experimental cooking in NEF lab. The different phases of cooking were cold start (CS), boiling (BO), sauté (S), browning (BR), pressurizing (P), deep frying (DF), and cooling (C). As per Nepalese cooking culture, heating oil, browning of spices (jeera, onions), sautéing of ingredients, and pressure/air cooking are common practices for vegetables and meat. And, these practices were followed while conducting the tests. Results of this experimental cooking are recorded below:

Table 2: **Results of Experimental Cooking in EPCs**

Cooking method	Recipe	Phases of cooking	Quality of cooked food	Remarks
Cooking under pressure	Rice	CS – P – C	Rice – Very good	
	Daal (Black Lentils)	CS-P-C	Good	Consistency of Black lentils was not achieved in comparison to normal pressure cooker, more time consumed
	Daal (Split Red Lentil)	CS-P-C	Very good	
	Vegetables gravy	BR – S – P – C	Good	
	Chicken and mutton gravy	BR – S – P – C	Very good	
	Rice pudding	CS – BO – P – C	Very good	
Open air cooking with lid not locked in position	Gundruk soup	BR- air cooking – BO	Very good	
	Green Vegetables	BR- cooking without locking lid	Very good	
Deep frying in lid not locked in method	Puri	Deep frying in oil	Puri was too crispy, required brownish color not achieved.	Required temperature not met, (i.e., temperature reaches to 153.4 °C and starts to decrease)
	Dry fry of chicken	Deep frying in oil	Ok, chicken was soft instead of crispy	Takes more time, required temperature not met (i.e., temperature reaches to 153.4 °C and starts to decrease)
Other Typical Nepalese cooking method	Dhido	CS-BO-Stirring	Good	Typical cooking method difficult to apply in EPC, but the taste was good.

Interpretations:

1. EPC is not an appliance meant for deep frying so failure of EPC to deep fry any item should not be taken as its failure to meet minimal performance requirement. But if deep frying (of certain items) is made possible in EPC, it should be considered as an additional advantage.
2. Similarly EPC is not the suitable appliance for cooking the typical Nepalese food Dhindo and hence failure of EPC to cook dhindo should not be taken as its failure to meet minimal performance requirement. However, if it could be possible to cook dhindo in the EPC it should be considered as an additional advantage.
3. Performance of EPCs should demonstrate acceptable quality of cooked food which in other words means that the food cooked in EPC should taste at least similar to that of traditional cooking, if not better.

The different phases of cooking were cold start (CS), boiling (BO), sauté (S), browning (BR), pressurizing (P), deep frying (DF), and cooling (C). As per Nepalese cooking culture.

AIRFRYERS

1. General Construction or Build for functionality of Air frying

1.1 Basic Information

The cooking process in air fryers relies on convection energy transfer in which energy (heat) is distributed through the movement of a liquid or gaseous medium. Rapid air technology is used for creating the convection media wherein heating element within the enclosed appliance radiates heat downward while a fan rapidly circulates air around the food to heat it evenly from all angles. Air fryer cooking is an alternative to deep fried cooking. Although traditionally deep-fried foods are delicious but harmful to health. Air frying offers healthy food with crispy exterior and a moist interior with far less oil than traditional deep frying.

Two types of air fryers i.e., cylindrical basket air fryer units and air fryer ovens are available in the international markets. Cylindrical basket air fryers require less counter space, have faster pre-heating (within 2 minutes), kitchen does not get heated and it is easy to toss in the basket but fan is louder, food cannot be seen during cooking, have limited capacity requiring batch cooking, accommodate only small baking dishes and are single function units. Air fryer ovens have large capacity, multi-cooking function, quieter fan, food can be viewed through glass door during cooking, can accommodate assorted baking dishes, food can be moved closer and away from heating element and most parts are dishwasher safe but these are more expensive, take more counter space, cannot shake food for even cooking, take longer time for pre-heating and kitchen gets heated.

1.2 Customers' Requirement

For the required functionality, air fryer should have following main parts:

(a) Outer Body
Cylindrical basket type air fryer should have a housing unit as its outer body.

(b) Cylindrical basket
Cylindrical basket type air fryers should have a removable basket inside the outer body to hold the food to be cooked.

(c) The lid
A lid should be provided to cover and air tight seal the body at the opening for taking in and out the cylindrical basket. Generally, the lid should be provided by the side of the outer body or at the top. The air-tight, compact design of air fryer ensures that all the hot air is contained in the chamber and actively flows around the food, promoting the intensity and efficiency of cooking.

> *Air fryer cooking is an alternative to deep fried cooking. Air frying offers healthy food with crispy exterior and a moist interior.*

(d) Heating and heat circulation mechanism
The top section of an air fryer holds a heating mechanism and fan. The heating element should radiate heat downward towards the food. A fan should be mounted above the heating element to blow the air downward towards the heating element. Air blown by the fan should get heated after coming in contact of the heating element and this hot air should circulate around the food evenly from all angles.

(e) Control and Protection System
Control system as an essential part of the air fryer to regulate the temperature and the fan should be mounted at suitable part.

Oven type air fryers work on the same principle of convection heating but should have racks inside to hold crisper and baking trays likewise a toaster oven. With such construction, unlike single function cylindrical basket air fryers, air fryer ovens have multi- cooking functions such as to bake, toast, rotisserie and broil.

All components of the air fryer including the basket, gasket, temperature regulating device and internal accessories which come in contact with food or hot air should be made of the materials satisfying the following requirements:

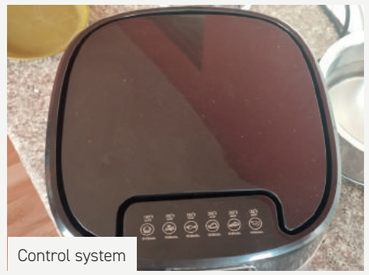
(i) They should not discolor the food or spoil the flavor or odor of the cooked food in the air fryer or cause it to become toxic; and

(ii) They should not be affected by contact with foods cooked in the air fryer in such a way that the operational efficiency or safety of the air fryer is impaired.

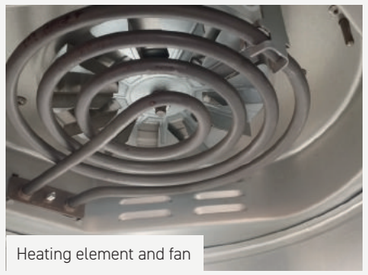
1.3 Tests for Acceptance

Visual inspection and rely on manual for design specification.

Figure 5: Air fryer and its main parts


Control system


Basket


Heating element and fan

2. Safety Considerations

2.1 Basic information

Air fryer as a portable household electrical appliance may suffer accidents due to:

(a) Physical instability caused by improper design and manufacture;
(b) Failure of electrical insulation, leakage current, contact with live parts and improper earth connection;
(c) Failure of temperature regulation and heat insulation;
(d) Failure of water seals resulting ingress of water and moisture inside while cleaning;
(f) Chemical reaction and rusting of body parts etc.

Air fryer is relatively a new device for Nepali markets and there are no national standards particular to air fryer. NS 564: 2076 "Household and similar electrical appliances Safety Part 1: General Requirements" is general requirement for safety of electric appliances and applicable to air fryer to as far as applicable.

2.2 Customers' Requirement for Safety against Accidents

2.2.1 Safety against Access to Electrically Live Parts

As basic requirements to this, air fryer should be constructed and enclosed such that there is adequate protection against accidental contact with electrically live parts. This requirement applies for all positions of the air fryer when it is operated as in normal use, and after the removal of detachable parts. In addition to this, a single switching action of the switch of the supply circuit should ensure full supply disconnection even if the plug attached to supply cord is inserted in the socket of supply circuit. However, it is advisable to turn off the switch as well as withdrawal of the plug from socket for foolproof disconnection of supply when air fryer is not in use. In case there is no switching device in the supply circuit, a single switching action may be obtained by the withdrawal of the plug from a socket-outlet. *This requirement corresponds to clause 8.1.1, 8.1.2, 8.1.3 of IEC 60335-1 and IEC 60335-2-15.*

Test for Acceptance

Visual inspection followed by switching on and off as well as withdrawal of supply cord plug from the supply socket.

2.2.2 Safety against Leakage Current

(a) Electrical Strength

Construction of air fryer should ensure that the leakage current at operating temperature does not exceed its specified value which is 0.21 mA for all Class I portable appliances. Similarly, air fryer construction should ensure required electrical strength i.e. voltage withstand of 1250 V without breakdown of insulation between accessible metal parts and the supply cord which is applicable for all Class I appliance. *This requirement corresponds to Clauses 13.1 to 13.3 of IEC 60335-1 and IEC 60335-2-15.*

(b) Earthing

Accessible metal parts of air fryer, as class I appliance, should be permanently and reliably connected to an earthing terminal within the air fryer or to the earthing contact of the air fryer inlet. Earthing terminals and earthing contacts should not be connected to the neutral terminal. The clamping means of earthing terminals shall be adequately secured against accidental loosening. All parts of the earthing terminal intended for the connection of external conductors shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor or any other metal in contact with these parts. Parts providing earthing continuity, other than parts of a metal frame or enclosure, shall be of metal having adequate resistance to corrosion. The plug at the end of the supply cord to be inserted into the supply socket and the socket of power supply shall be matched to ensure the body earthing of the air fryer at all times when supply is connected. *This requirement corresponds to Clause 27.1 to 27.5 of IEC 60335-1 and IEC 60335-2-15.*

Test for Acceptance

Visual inspection, Insulation Resistance or Voltage Withstand Test and Earth Continuity Test.

2.2.3 Safety against water and moisture ingress

Air fryer intended to be partially or completely immersed in water for cleaning shall have adequate protection against the effects of immersion including the water ingress.
The enclosure of the air fryer should provide the degree of protection against moisture in accordance with its IP classification for which the air fryer shall withstand the specified electrical strength test as per its IP Class. *This requirement corresponds to Clause 15.1, 15.1.2, 15.2, 15.3 of IEC 60335-1 and IEC 60335-2-15.*

Test for Acceptance

Manual Water ingress test by immersing the air fryer in the water and electrical strength withstand test on spillage of a solution comprising water containing approximately 1 % NaCl and 0.6 % rinsing agent while the air fryer connector in position and the air fryer deviating from the normal position of use by an angle not exceeding 5°.

2.2.4 Safety against under voltages, over voltages and transient voltages

Insulation should be the primary protection of air fryer against under and over voltages. Air fryer shall also withstand the transient over-voltages to which it may be subjected.

Test for Acceptance

Insulation resistance test and Impulse Withstand Test. Under impulse withstand test, each clearance of air fryer having its rated impulse voltage value shall be tested for withstanding its corresponding Impulse test voltage.

2.2.5 Safety against abnormal operation

Air fryer should be constructed so that as a result of abnormal or careless operation, the risk of fire, mechanical damage impairing safety or protection against electric shock is obviated as far as is practicable.

Electronic circuits shall be designed and applied so that a fault condition will not render the appliance unsafe with regard to

electric shock, fire hazard. The electronic control system of air fryer should detect the abnormal position when the inner pot is not placed inside or lid is not in the desired fully closed position. In such abnormal case, it should not allow the switching on of the power for heating. Similarly, the unsafe operation of air fryer to lid not locked in position by mistake from lid locked in position when the fan and the heating element is still operating should be prevented by a mechanical and/or electrical interlock.

Test for Acceptance
Visual inspection and test operation.

2.2.6 Device Temperature and Safety against temperature beyond safe limits

The air fryer and its surroundings should not reach excessive temperatures in normal use to endanger the safety of the personnel and the property. A contact for less than 30 seconds with the outer body surface should not burn the hands of the cook or any third person. For this, temperature of outer body surface should be 40 to 60 degree Celsius when the inner temperature of air fryer is around 200 degree Celsius. *Requirements for this correspond to Clause 11.1 to 11.4, 11.7, 11.8 of IEC 60335-1 and IEC 60335-2-15 and 11.7.105 of IEC 60335-2-15.*

External parts of non-metallic material, parts of insulating material supporting live parts including connections and parts of thermoplastic material providing supplementary insulation or reinforced insulation should be sufficiently resistant to heat. Design and construction of the air fryer should ensure this. *This corresponds to Clause of 30.1, 30.2, 30.2.1 to 30.2.3 of IEC 60335-1 and IEC 60335-2-15.*

Air fryer should be equipped with temperature sensor to cut-off the power supply once the operating temperature is reached. As second line of defense to control the temperature from reaching beyond safe limits in the event of failure of temperature sensor, a thermal fuse should be provided to cut-off the power supply when temperature reaches above expected.

Test for Acceptance
Visual inspection and factory test reports.

2.2.7 Safety against accidents related to stability

Air fryer should have adequate stability when it is used by placing it on a surface like a floor or table. Design and construction of air fryer should ensure this. *This corresponds to Clause 20.1 of IEC 60335-1 and IEC 603335-2-15.*

Test for Acceptance
Stability of air fryer placed on a surface like floor or table shall also be ensured when it is empty, filled with water upto various levels and when fully filled with water so that stability is maintained in most unfavorable quantity and level of water filling. In none of these case, air fryer should get overturned when subjected to an angle of inclination increased upto 15°.

2.2.8 Safety against accidents related to Mechanical Strength

Air fryer should have adequate mechanical strength and be constructed to withstand such rough handling that may be expected in normal use. Protective enclosures, guards and similar parts of air fryer should be non-detachable and should have adequate mechanical strength. However, enclosures that can be opened by overriding an interlock by applying the test probe are considered to be detachable parts. The unexpected closure of self-resetting thermal cut-outs and overcurrent protective devices shall not cause a hazard. Accessible parts of solid insulation shall have sufficient strength to prevent penetration by sharp implements. Air fryer shall have supply cord fitted with plug so that it does not cause any stability and mechanical strength related issue originated from supply arrangement. Design and construction of the air fryer should be strong enough to meet these requirements. *This corresponds to Clause 21.1 of IEC 60335-1 and IEC 60335-2-15.*

Test for Acceptance
Visual inspection.

2.2.9 Safety against Chemical reaction

Internal and external metallic and non-metallic parts of air fryer should not be subjected to chemical reaction to deteriorate them in the event of spillage of hot saline juicy fat from the food cooked in the air fryer. Design and construction of air fryer should ascertain this.

Test for Acceptance
Spillage of a solution comprising water containing approximately 1 % NaCl and 0.6 % rinsing agent while the air fryer connector in position and the air fryer deviating from the normal position of use by an angle not exceeding 5°.

2.2.10 Safety against rusting, toxicity and radiation

To the extent possible, use of ferrous parts should be avoided in the air fryer. If it becomes unavoidable to use ferrous material in any part, such ferrous parts should be adequately protected against rusting.

Air fryer should not emit harmful radiation or present a toxic or similar hazard due to its operation in normal use. This should be ascertained through material selection for manufacturing air fryer and the manufacturing process.

3. Minimum Level of Performance

3.1 Basic Information

Deep frying by dipping the food in boiling oil is very popular method of cooking traditional Nepali recipes especially on festive occasions. But there is severe health concern with the deep-fried food as it involves too much of boiled oil and retains fat excessively. Air fryer cooking as a substitute to deep fry cooking uses convection heating for cooking the food wherein food is placed in a fryer-style basket and when turned on, hot air rushes down and around the food. This rapid circulation of hot air makes the food crisp like deep-frying but without the oil. Doing so the cooked food has 90% less fat than the deep- fried item, is crispy from outside but juicy inside.

Recipes with substantial fluid content like soups, stews etc. are not suitable for air fryer cooking. Accordingly, day to day Nepalese cooking generally involves, boiling, simmering that are not suitable for air fryer cooking. Similarly battered foods, fresh and leafy greens, whole roasts, raw grains and pop corns, hamburgers, toast and cheese are also exceptions to cooking in air fryer.

3.2 Customer Requirement

3.2.1 Customers' Requirement Regarding Cooking Method

In light of the basic information, air fryer should facilitate cooking methods such as to fry, grill and roast, bake and reheat the already food like in oven. It should be possible to cook local Nepalese recipes as starters, main course and side dishes for which convection heating is suitable.

3.2.2 Customer Requirement regarding Recipes

1. Manufacturer/supplier should provide manual with cooking chart mentioning temperature and time for cooking each type of food as follows:

Air fryers can facilitate cooking methods such as to fry, grill, roast, bake and reheat. It is like a small energy efficient fan oven.

Table 3: Food type, cooking temperature, and cooking time for Air fryer

Food	Cooking Temperature	Cooking Time
Chicken breast	191 °C	22 -23 minutes
Pork chops	191°C	12-15 minutes
Shrimps	191°C	8 minutes
Salmon	204°C	5-7 minutes
Meat balls	204°C	7-10 minutes
Bacon	204°C	5-10 minutes
Potato fries	204°C	10-20 minutes
Cauliflower/ zucchini	204°C	10-12 minutes
Potato chips	182°C	15-17 minutes

2. Air fryer should have temperature and time adjustment facility which may be a dial adjustment in manual air fryer and push-button controls in a digital fryer.
3. It should be possible to make oil spray and flipping the food especially the meat items during its cooking in air fryer.
4. Air fryer should have a thermal process (pre-heat) equivalent to not less than 2 minutes at 70°C to reduce or eliminate levels of *E-coli and Salmonella*. For foods not considered 'ready-to-eat', we must ensure that cooking instructions facilitate the consumer achieving this thermal process equivalent so that the food is safe to eat.
5. For cooking the food after pre-heat session dial settings of 160°C, 180°C and 200°C should be available in the air fryer.
6. It should be possible to set temperature and time dial according to cooking chart for particular foods such that best cooking results are available following the cooking chart.

Meeting the above requirements, design, construction and control mechanism including temperature and pressure regulation to ensure appropriate heat for requisite time, air fryer should be able to facilitate cooking following Nepalese and intercontinental dishes that are becoming part of Nepalese meals:

Grilled or roasted mutton, chicken, duck, pork, fish, shrimp and meat balls; dry air fried wedges of potato, sweet potato, taro, yam; dry air fried cauliflower, zucchini, eggplant, okra etc.; chips of banana, potato, sweet potato; pasta.

3.3 Test for Acceptance

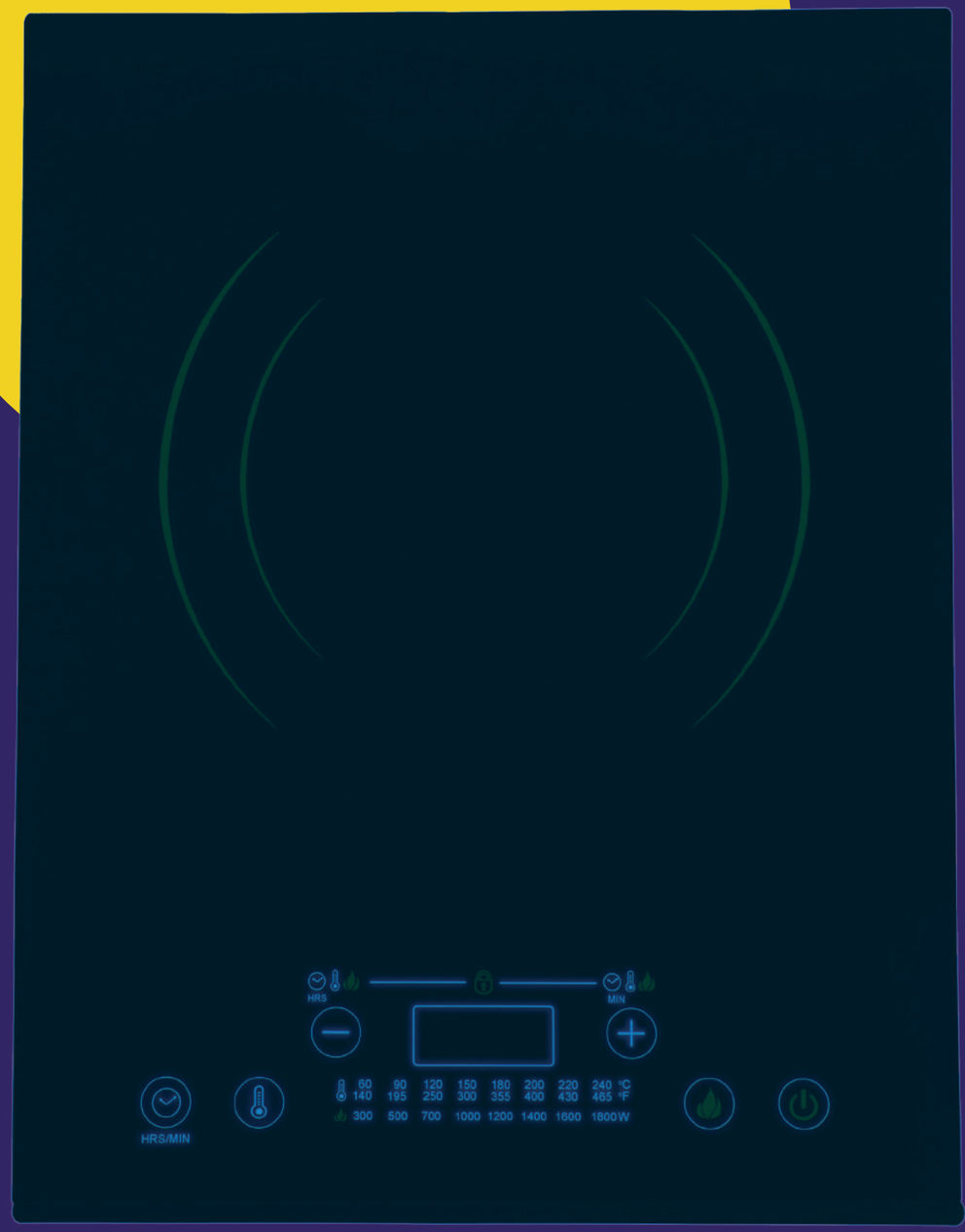
Air fryer performance related to cooking of typical Nepalese recipes through above mentioned cooking methods was tested through experimental cooking in NEF lab. And, the results of this experimental cooking are recorded below:

Table 4: Results of Experimental Cooking in Air fryer

Recipe	Phase of cooking			Cooked food quality
	Pre-heat	Temperature setting	Time setting	
Potato wedges		200 °C	25 mins	Good
Vegetables (mushroom, beans, cauliflower)		200 °C	20 mins	Good
Mashed potato fritters (Aloo Chop)		200 °C	12 mins	Very good
Pakora		200 °C	20 mins	Ok, it got stuck and was hard to flip
Chicken		200 °C	45 mins	Very good

Interpretation:
Air fryer cooking is basically an alternative to deep frying almost eliminating the oil or fat for cooking. Hence the taste of foods cooked in air fryer should be at least similar to traditional deep fry cooking, if not better.

INDUCTION HOBS



1. General Construction or Build for functionality of Induction Hobs

1.1 Basic Information

Induction cooking involves the electrical heating of a cooking vessel by magnetic induction instead of by radiation or thermal conduction from an electrical heating element or from a flame. Induction cooking is based on the principle of magnetic induction, in which a ferromagnetic cookware is placed in the presence of oscillating magnetic field which will cause eddy currents in the cookware. These induced currents dissipate heat by the Joule effect, generating the heat required for the cooking process. The heat for cooking is generated directly in the cooking vessel.

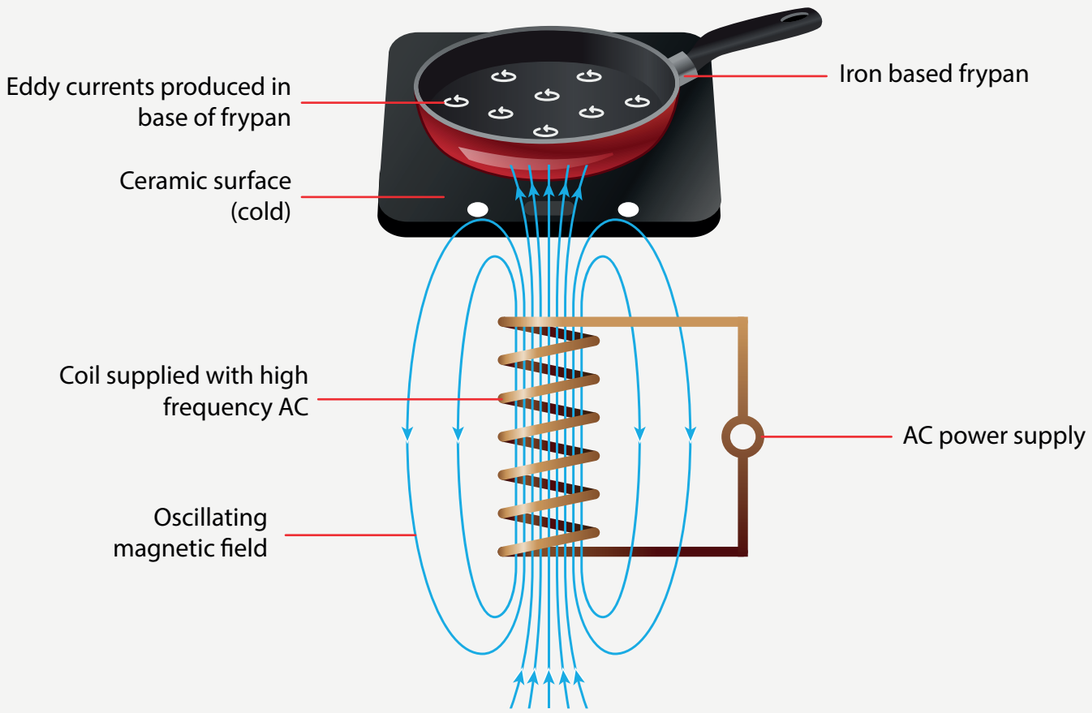
A typical induction hob is composed of power electronics circuit that generates current of high frequency. This current is delivered to a coil embedded in the cooking surface. The top of the cooking surface is covered with low-thermal expansion glass-ceramic. The cookware placed on the cooking surface is magnetically coupled with the planar coil similar to that of in a transformer. Small eddy current flows in the cooking vessel and generates heat.

Induction cookers are only able to couple with ferromagnetic cookware, such as cast iron and some alloys of stainless steel. These materials have relatively high permeability and resistivity to generate sufficient heat for cooking.

For nearly all models of induction cooktops, a cooking vessel must be made of, or contain, a ferromagnetic metal such as cast iron or stainless steel. However, copper, glass, non-magnetic stainless steels, and aluminum vessels can be used if placed on a ferromagnetic disk that functions as a conventional hotplate.

Because inductive heating directly heats the vessel it is quite efficient.

Figure 6: Basic Construction and working principle of Induction Hob
Source: https://www.researchgate.net/figure/Schematic-of-the-principle-of-induction-stove_fig1_350169241



1.2 Customers' Requirement

The cooking surface should be made material with low-thermal expansion glass-ceramic or similar materials so that the surface does not get overly heated during cooking. The cooking surface should be flat and smooth.

The planar coil in the induction hobs should be made of copper and should be attached strongly i.e., it doesn't move during normal operation.

Induction hobs shall be provided with touch controls to provide temperature and control of cooking modes. Induction hobs having touch controls shall incorporate visual means to indicate when each hob element is energized. Induction hob elements shall be constructed so that the hob element can only be operated when a vessel is placed on the cooking zone.

1.3 Tests for Acceptance

Visual inspection and rely on manual for design specification.

2. Safety Considerations

2.1 Basic information

Induction hobs as a portable household electrical appliance may suffer accidents due to:

(a) Physical instability caused by improper design and manufacture;
(b) Failure of electrical insulation, leakage current, contact with live parts and improper earth connection;
(c) Failure of temperature regulation and heat insulation;
(d) Ingress of water and moisture inside while spillage, cleaning, etc. resulting in insulation failure;
(f) Chemical reaction and rusting of body parts etc.

Nepal Bureau of Standards and Metrology (NBSM) has issued NS 561:2076- Household and similar electrical appliances Safety: Particular Requirements for Portable Induction hobs as national standards on safety requirements as well as tests prescribed for such household electrical appliances to ensure the safety from potential accidents. Induction hobs for use in Nepal should meet these national standards on safety of household electrical appliances and should pass the prescribed tests.

IEC has issued IEC 60335-1- Household and similar electrical appliances – Safety – Part 1: General requirements and IEC 60335-2-6- Household and similar electrical appliances – Safety – Part 2-6: Particular requirements for stationary cooking ranges, hobs, ovens and similar appliances that are applicable to induction hobs as well as other appliances such as griddles, grills, steam ovens, etc.

2.2 Customers' Requirement for Safety against Accidents

2.2.1 Safety against Access to Electrically Live Parts

As basic requirements to this, induction hob should be constructed and enclosed such that there is adequate protection against accidental contact with electrically live parts. This requirement applies for all positions of the induction hob when it is operated as in normal use. In addition to this, a single switching action of the switch of the supply circuit should ensure full supply disconnection even if the plug attached to supply cord is inserted in the socket of supply circuit. However, it is advisable to make off the switch as well as withdrawal of the plug from socket for foolproof disconnection of supply when the induction hob is not in use. In case there is no switching device in the supply circuit, a single switching action may be obtained by the withdrawal of the plug from a socket-outlet. *This requirement corresponds to clause 8.1.1, 8.1.2, 8.1.3 of IEC 60335-1 and IEC 60335-2-6*

Test for Acceptance

Visual inspection followed by switching on and off as well as withdrawal of supply cord plug from the supply socket.

2.2.2 Safety against Leakage Current

(a) Electrical Strength

Construction of induction hob should ensure that the leakage current at operating temperature does not exceed its specified value which is 0.21 mA for all Class I portable appliances. Similarly, induction hob construction should ensure required electrical strength i.e., voltage withstand of 1250 V without breakdown of insulation between accessible metal parts and the supply cord which is applicable for all Class I appliance. *This requirement corresponds to Clauses 13.1 to 13.3 of IEC 60335-1 and IEC 60335-2-6.*

(b) Earthing

Accessible metal parts of induction hob, as class I appliance, should be permanently and reliably connected to an earthing terminal within the earthing contact of the induction hob inlet. Earthing terminals and earthing contacts should not be connected to the neutral terminal. The clamping means of earthing terminals shall be adequately secured against accidental loosening. All parts of the earthing terminal intended for the connection of external conductors shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor or any other metal in contact with these parts. Parts providing earthing continuity, other than parts of a metal frame or enclosure, shall be of metal having adequate resistance to corrosion. The plug at the end of the supply cord to be inserted into the supply socket and the socket of power supply shall be matched to ensure the body earthing of the induction hob at all times when supply is connected. *This requirement corresponds to Clause 27.1 to 27.5 of IEC 60335-1 and IEC 60335-2-6.*

Test for Acceptance

Visual inspection, Insulation Resistance or Voltage Withstand Test and Earth Continuity Test.

2.2.3 Safety against water and moisture ingress

The enclosure of the induction hob should provide the degree of protection against moisture, humid conditions that may arise in normal use in accordance with its IP classification for which the induction hob shall withstand the specified electrical strength test as per its IP Class.

This requirement corresponds to Clause 15.1, 15.1.2, 15.2, 15.3 of IEC 60335-1 and IEC 60335-2-15. These tests are also available in IEC 60529 which deals with classification of degrees of protection provided by enclosures for electrical equipment.

Test for Acceptance

Electrical strength withstand test on spillage of a solution comprising water containing approximately 1 % NaCl and 0.6 % rinsing agent while the induction hob in position and when deviating from the normal position of use by an angle not exceeding 5°.

The appliance should withstand the electric strength test and inspection shall show that there is no trace of water on insulation that could result in a reduction of clearances or creepage distances. Humidity test shall be carried out.

2.2.4 Safety against over voltages and transient voltages

Insulation should be the primary protection of induction hob against over voltages. Induction hob shall also withstand the transient over-voltages to which it may be subjected.

Test for Acceptance

Insulation resistance test and Impulse Withstand Test. Under impulse withstand test, each clearance of induction hob having its rated impulse voltage value shall be tested for withstanding its corresponding Impulse test voltage.

2.2.5 Safety against abnormal operation

Induction hob should be constructed so that as a result of abnormal or careless operation, the risk of fire, mechanical damage impairing safety or protection against electric shock is obviated as far as is practicable.

Electronic circuits shall be designed and applied so that a fault condition will not render the appliance unsafe with regard to electric shock, fire hazard. Induction hob shall not attain excessive temperatures in abnormal use. The abnormal use is defined such as when induction hob elements are operated without a vessel with pan detectors being rendered inoperative, a vessel is placed on the cooking zone in stand-by-mode, induction hobs operated with empty vessels.

Test for Acceptance

Visual inspection and test operation.

2.2.6 Device Temperature and Safety against temperature beyond safe limits

The induction hob and its surroundings should not reach excessive temperatures in normal use to endanger the safety of the personnel and the property. *Requirements for this correspond to Clause 11.1 to 11.4, 11.7, 11.8 of IEC 60335-1 and IEC 60335-2-6.*

External parts of non-metallic material, parts of insulating material supporting live parts including connections and parts of thermoplastic material providing supplementary insulation or reinforced insulation should be sufficiently resistant to heat. Design and construction of the induction hob should ensure this. *This corresponds to Clause of 30.1, 30.2, 30.2.1 to 30.2.3 of IEC 60335-1 and IEC 60335-2-6.*

Induction hob should be equipped with temperature sensor to cut-off the power supply once the operating temperature is reached. As second line of defense to control the temperature from reaching beyond safe limits in the event of failure of temperature sensor, a thermal fuse should be provided to cut-off the power supply when temperature reaches above expected.

Test for Acceptance

Visual inspection and factory test reports.

2.2.7 Safety against accidents related to stability

Induction hob should have adequate stability when it is used by placing it on a surface like a floor or table even when the surface is slightly tilting. Design and construction of induction hob should ensure this. *This corresponds to Clause 20.1 of IEC 60335-1 and IEC 603335-2-6.*

Test for Acceptance

Stability of induction hob placed on a surface like floor or table shall also be ensured when a standard vessel filled with water upto various levels and when fully filled with water so that stability is maintained in most unfavorable quantity and level of water filling. In none of these cases, induction hob should get overturned when subjected to an angle of inclination increased upto 15°.

2.2.8 Safety against accidents related to Mechanical Strength

Induction hob should have adequate mechanical strength and be constructed to withstand such rough handling that may be expected in normal use. Hob surfaces of glass-ceramic or similar material shall withstand the stresses liable to occur in normal use. The mechanical strength of induction hob surface shall not decrease with the spillage of liquid that could occur in normal use. The unexpected closure of self-resetting thermal cut-outs and overcurrent protective devices shall not cause a hazard. Accessible parts of solid insulation shall have sufficient strength to prevent penetration by sharp implements. Induction hob shall have supply cord fitted with plug so that it does not cause any stability and mechanical strength related issue originated from supply arrangement. Design and construction of the induction hob should be strong enough to meet these requirements. *This corresponds to Clause 21.1 of IEC 60335-1 and IEC 60335-2-6.*

Test for Acceptance

Visual inspection.

2.2.9 Safety against Chemical reaction

Internal and external metallic and non-metallic parts of induction hob should not be subjected to chemical reaction to deteriorate them in the event of spillage of fluid, liduid and food during cooking. Design and construction of induction hob should ascertain this.

Test for Acceptance

Spillage of a solution comprising water containing approximately 1 % NaCl and 0.6 % rinsing agent while the induction hob in normal position and the induction hob deviating from the normal position of use by an angle not exceeding 5°.

2.2.10 Safety against rusting, toxicity and radiation

Induction hob should not emit harmful radiation or present a toxic or similar hazard due to its operation in normal use. This should be ascertained through material selection for manufacturing induction hob and the manufacturing process.

3. Minimum Level of Performance

3.1 Basic Information

Induction hobs should be suitable to cook following major typical Nepalese recipes from the available food grain in the country apart from continental recipes. Day to day Nepalese cooking generally involves pressure cooking, heating on skillet, stir frying, sautéing, deep frying, boiling and simmering. A unique cooking method is used for typical recipe Dhindo. Induction hobs are expected to support all the cooking techniques that occur in normal day cooking.

3.2 Customer Requirement

3.2.1 Customers' Requirement Regarding Cooking Method

In light of the basic information, induction cooktop should be able to perform satisfactorily as long as the cooking requires. It should withstand the temperature that reaches in the event of deep-frying vegetables and meat. The cooking culture requires different amount of heat/temperature and hence the induction hobs should be and are provided with power control in turn controls the heat output.

3.2.2 Customer Requirement Regarding Recipe

With the comparative advantage of faster cooking and uniform heating, users require the recipe prepared in Induction hobs to be tasty. Induction hobs should provide different cooking functions and heat control functions that is able to cook typical Nepalese recipes. Major functions required are following, and the functions are also classified as "required" and "optional" as per their importance and use. "Required" functions are the ones that will be most useful, and "optional" functions may be used by the users, but the same result can also easily be obtained using other function such as "hot pot" and "heat control" button.

An Induction hob does not emit harmful radiation or present a toxic or similar hazard during its normal use.

Hot pot: to enable cooking all types of food and allow heat control based on user's choice (required)

Rice: to cook rice in suitable heat (required)
Milk: boiling milk is a common activity of every Nepalese household; thus, this function should allow heating milk without spilling out (required)

Fry: to enable preparing deep fried recipes (required)

Roti/ Dosa/Chapati: to prepare roti (required)
Soup: to prepare soups (optional)
Induction hobs should be able to cook typical Nepalese food using the above-mentioned functions and heat control function. The major recipes are: low to mediums heat cooking (rice, daal – lentil soup, roti) as well as cooking in high heat (deep frying) such as preparing sel roti, puri, chicken roast, fish fry, pakauda (fritters), taruwa (deep fried vegetables).

3.3 Test for Acceptance

Induction hob's performance related to cooking of typical Nepalese recipes was tested through experimental cooking in NEF lab. And, results of this experimental cooking are recorded below:

Table 5: **Results of Experimental Cooking in Induction Cooktop**

Cooking method	Recipe	Quality of cooked food	Remarks
Low to medium heat	Rice	Very good	
	Daal	Very good	
	Vegetables	Very good	
	Chicken gravy	Very good	
	Mutton gravy	Very good	
	Rice pudding	Very good	
	Gundruk soup	Very good	
	Dhido	Good	
	Roti	Very good	
High heat	Chicken fry	Very good	
	Puri	Very good	Induction turned off itself when it is heated upto 211°C.

Interpretation:
Almost all traditional cooking methods can be applied for cooking on induction hobs also. The quality and taste of food cooked on induction hob depends very much on effective temperature regulation. So, the taste of food cooked on the induction hob should at least be similar to that of cooked on other fuel stoves like LPG or firewood, if not better.

PART 3:

RESULT OF COOKING TESTS

1. Introduction

Cooking tests have been conducted as a part of the project "Preparation of Non-Technical Guidelines on Safety Standards, Minimal Performance, and End of Life for Energy Efficient Electrical Cooking Appliances (Electric Pressure Cookers, Air Fryers, and Induction Hobs)". Typical Nepalese recipes were cooked in Electric Pressure Cookers (EPC), Air Fryer, and Induction Hob, and the results of the test is presented in this report.

The following EPCs, Air Fryer, and Induction Hobs were used for test purpose:

Electric Pressure Cooker 1:
Brand: Electron
Model: MRC-H20D
Capacity: 5 litres
Wattage: 1000W

Electric Pressure Cooker 2:
Brand: Midea
Model: MY-CS6037WP2
Capacity: 5.7 litres
Wattage: 1000W

Air Fryer:
Brand: CG
Model: CGMRAF40L1D
Capacity: 4 litres
Wattage: 1000W

Induction Hob:
Brand: CG
Model: CGIC20C02
Wattage: 2000 W

The following recipes were prepared in the lab of Nepal Energy Foundation and the results are presented in this report.

In Nepali kitchen, heating oil, frying the spices in oil, browning onion, and cooking food/ vegetables/meat is a common practice. All of these can be done either on an induction stove or in an EPC with the lid open and in 'open lid' mode.

2. Recipes prepared and the taste of food

2.1 Electric Pressure Cookers

2.1.1 Recipes prepared

The following recipes were prepared using EPCs, and the major findings are depicted in the table below:

Recipe	Amount of food cooked	Time taken (mins)	Energy Consumption (KWh)	Rating on tasted of food (XX/10)	Remarks
Rice	500 grams	12	0.3	9	
Daal	200 grams	45 mins	0.38	6	
Kidney beans	500 grams	22	0.42	7.3	
Windsor/Fava Beans (Bakulla)	500 grams	30	0.18	8.5	
Pulau (rice with mild spices)	500 grams	27	0.16	8.5	
Chicken gravy	1 kg	40	0.3	6.5	
Chicken roast	100 grams	26	0.19	5	
Mutton gravy	1 kg	47	0.4	8.5	
Gundruk	50 grams	10	0.23	8.5	
Dhido	300 grams	41	0.36	7.2	
Puri	2 pcs	20	0.15	3	
Rice Pudding	3L milk, 300 grams rice	47	0.48	8.6	

A variety of recipes were prepared and tested in NEF lab as listed in the table above. From the survey, it was found that EPC is suitable for cooking Nepalese food and some food tasted excellent in EPC. In Nepali kitchen, heating oil, frying the spices in oil, browning onion, and cooking food/vegetables/meat is a common practice. Therefore, open air cooking in EPC is required. It was noted that while heating oil, EPC turns off automatically in 3 minutes after being heated and again turns on back after sometime. Due to this, initial time taken to get food prepared for pressure cooking is a bit longer in comparison to Induction hobs. However, apart from few dishes, EPC gives best result for most of the food, and energy consumption is also lower in comparison to Induction hobs.

2.1.2 Perception of cooker

- Cooking food in EPC is easier, as monitoring time to time is not required.
- Rice, daal, and other food items that require cold start are the easier ones to cook in EPC.
- For meat and vegetables, EPC takes a bit longer time to bring them to the stage of pressure cooking. After completion of browning phase, it is easy to cook in EPC.
- Rice pudding is a food that requires continuous monitoring while cooking in Induction hobs, or LPG, because of spilling out problem of milk. However, cooking rice pudding in EPC is very easy, saves time, milk doesn't spill out, and the required consistency is achieved.
- Cooking vegetables under pressure may overcook the food, so a good judgement is required if it should be cooked with lid not locked position or in lid locked in position based on the type of vegetable being cooked.
- Deep frying is not suitable in EPC, because oil does not heat properly.
- Chicken gravy tasted good.
- Mutton gravy tasted very good and was one of the most liked recipes in EPC.
- Preparing chicken roast in EPC is not suitable, it takes a lot of time, and the crunchiness can not be achieved due to low temperature of oil.

2.1.3 Responses on taste of food

Rating on taste of food was collected while testing the food prepared in EPC. The rating is given in a scale of 1 to 10. The more rating the food gets, tastier is the food. Thus, the food which got 9 was tastier that the one that got 6. A brief description on the taste of food is presented in the points below.

- Quality of rice cooked in EPC is very good.
- Different types of lentils were used to prepare "daal" (lentil soup). In Black lentil soup, required consistency was not achieved. However, if it is mixed with yellow lentils, the result was best and it was very tasty. The common practice for preparing daal in Nepal is not only boiling, but pouring hot roasted spices (cumin, ginger, garlic etc.) in daal to give good flavor. But this is not a suitable one for EPC. However, it can be done in the initial stage before cooking daal in pressure, which was done during test too.
- Kidney beans, Windsor beans, and other vegetables tasted very good in EPC.
- Typical Nepali recipe "Gundruk" (dried mustard green) tasted very good.
- The other typical Nepali recipe "Dhido" tasted good. The typical stirring method for cooking "Dhido" cannot be applied in EPC, however the taste of Dhido cooked in EPC was good.
- A typical recipe that is cooked during festivals "Puri" was prepared in EPC. Puri is a roti fried in oil. However, the anticipated results couldn't be achieved because the temperature required could not be achieved. The maximum temperature that could be achieved in EPC was 153.4 °C while it was more than 200°C in Induction hob.
- Rice pudding tasted very good in EPC, even better than in LPG and Induction.

The pictures below show some of the recipes prepared in EPC.

Dhido served with green vegetable and radish pickle

"Kheer" (rice pudding) cooked in EPC

Kheer served with cauliflower and potato curry

Rice

Chicken fry

Rice cooked in EPC and vegetables prepared in Induction served in a plate

2.2 Air Fryer

2.2.1 Recipes prepared

The following recipes were prepared using Airfryer, and the major findings are depicted in the table below:

Recipe	Amount of food cooked	Time taken (mins)	Energy Consumption (KWh)	Rating on tasted of food (XX/10)	Remarks
Green vegetables (beans, mushroom, cauliflower)	200 grams	20	0.379	6	
Potato wedges	500 grams	25	0.498	7	
Aloo chop (potato fritters)	300 grams	12	0.15	7.75	
Chicken roast	1 kg	45	0.66	8.4	
Pakora (onion and cabbage fritters)	200 gms	20	0.27	4	

2.2.2 Perception of cooker

- Cooking in Air fryer is easy, however there are only few typical Nepali food items that can be cooked in Air fryer.

2.2.3 Responses on taste of food

- Food prepared in Air fryer got good responses.
- Green vegetables tasted good.
- Potato wedges tasted good, but were not crunchy enough.
- Aloo chop (potato fritters) tasted excellent.
- Chicken roast tasted very good and was one of the most liked food cooked in air fryer.
- Pakora (onion and cabbage fritters) were not perfect. The ones that looked good were not cooked perfectly, and when cooked more, they were a bit black instead of brown.

The pictures below show some of the recipes prepared in air fryer.

Potato wedges

Chicken roast

Aloo Chop (PotatoFritters)

2.3 Induction Hobs

2.3.1 Recipes prepared

The following recipes were prepared using Induction hob, and the major findings are depicted in the table below:

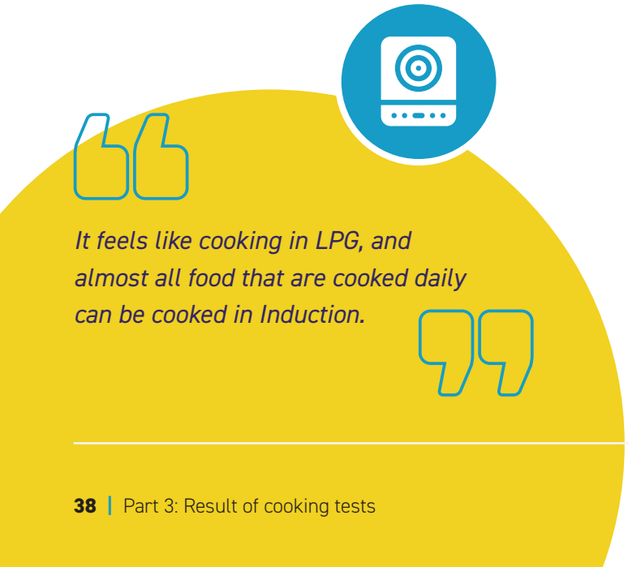
Recipe	Amount of food cooked	Time taken (mins)	Energy Consumption (KWh)	Rating on tasted of food (XX/10)	Remarks
Rice	0.5	12	0.4	7.5	
Daal	200 grams	30	0.47	7.5	
Roti	16 pcs	50	0.57	6.5	
Cauliflower	0.5 kg	23	0.39	7.5	
Puri	40 pcs	53	0.5	8.8	
Chicken (roast)	1 kg	25	0.52	7.9	
Chicken gravy	1 kg	35	0.45	8	
Green vegetables	0.2 kg	15	0.23	9	
Aalu Parotha (Potato stuffed roti)	7 pcs	35	0.4	8	
Haluwa	0.2 kg	20	0.27	8	

2.3.2 Perception of cooker

- Cooking in Induction hob is fast and easy.
- It feels like cooking in LPG, and almost all food that are cooked daily can be cooked in Induction.

2.3.3 Responses on taste of food

- All the recipes cooked in Induction hob were tasty.



The pictures below show some of the recipes prepared in induction hobs.

Puri

Aloo Paratha
(Potato stuffed roti)

Boiled and fried potato
(Aalu Jeera)

Haluwa and Aalu Jeera served

Preparing Roti in induction hob

Chicken fry

3. Conclusion

Electric Pressure Cookers, Air fryers, and Induction hobs all are useful appliances for Nepali kitchen. Being new technologies, it may get time for users to get used to on them.

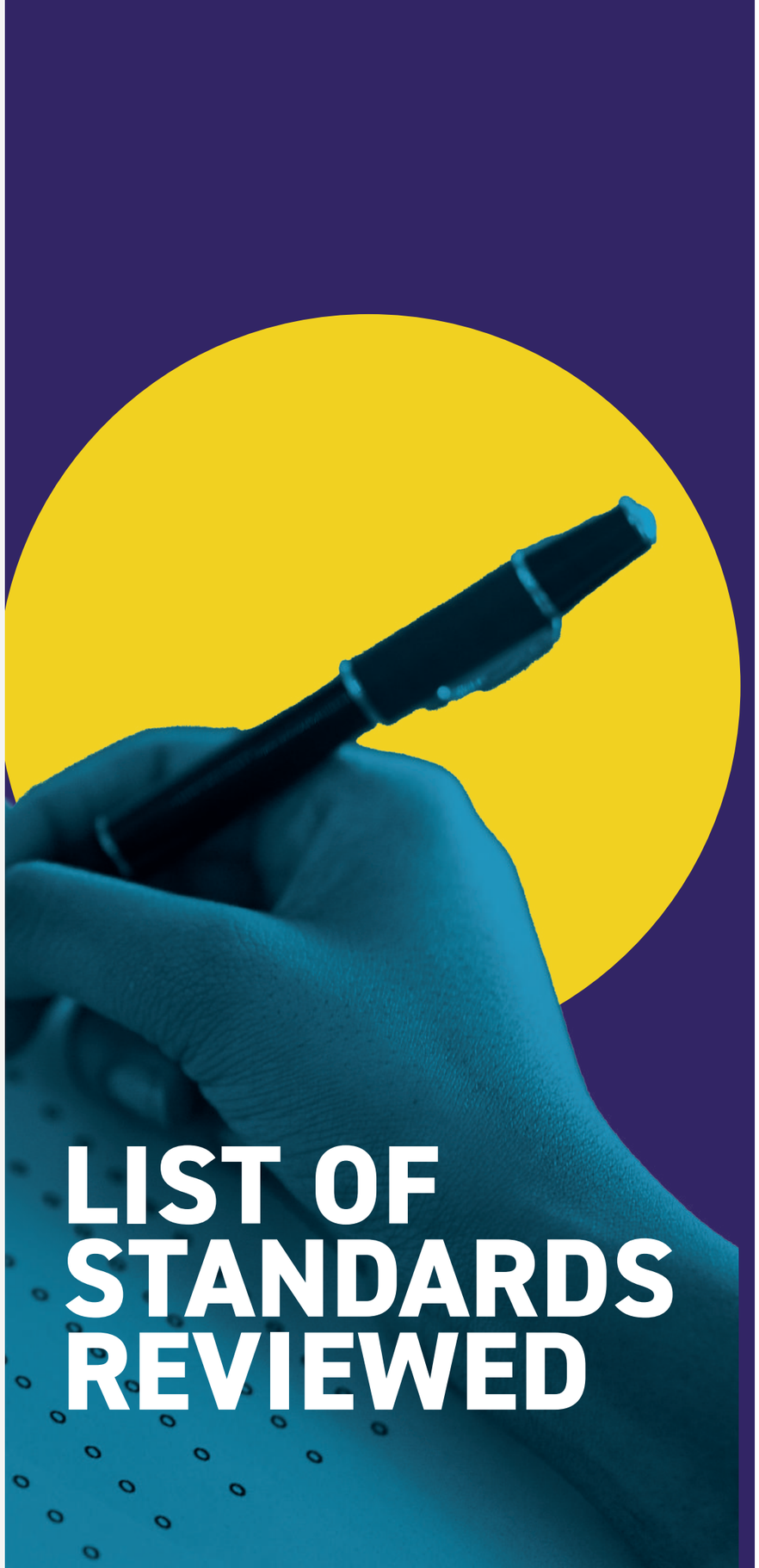
After conducting the test, it has been concluded that EPC is the one that consumes least energy among all, therefore using it would be suitable for households with smaller connection capacity. One drawback of EPC is it takes a bit longer time than Induction hob and recipes that require deep frying and dry cooking (e.g., roti) is not possible to prepare in EPC.

Air fryers are also a very useful technology for preparing deep fried items. The food cooked in air fryer are healthier without oil, which would otherwise consume a lot of oil if cooked in traditional way. However, there are only few recipes that typical Nepalese household would prepare in regular basis using air fryer. And, one of the uses of air fryer could be heating pre-cooked food like in microwave oven.

Induction hobs are one of the most useful appliances. The major benefit of it is that it can be operated in low, medium, and high heat as per requirement. They cook food very fast, taste is good, and cleaning is also very easy. However, it requires special utensils, and consume more energy than EPCs which are major drawbacks of Induction hobs.

Thus, it has been concluded that all these three technologies have their own specialty, and could be important for promoting e-cooking in Nepali kitchen. Cooking is completely a cultural activity, thus only one appliance may not be a complete solution. Based on the specific context, a combination these would be perfect for moving towards promoting electricity as the primary source of cooking fuel in Nepal.

ANNEX 1 :



LIST OF STANDARDS REVIEWED

4. IEC 60335-1:2020 Household and similar electrical appliances – Safety – Part 1: General requirements

This standard deals with the safety of electrical appliances for household and similar purposes, their rated voltage being not more than 250 V for single-phase appliances and 480 V for other appliances. This standard provides the appropriate level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the manufacturer's instructions. It also covers abnormal situations that can be expected in practice and takes into account the way in which electromagnetic phenomena can affect the safe operation of appliances.

This safety standard is applicable to all electrical appliances and if any appliance requires some specific requirements, test methods and clauses, a separate standard is made by IEC which will be Part 2- particular requirements.

Many national standards such as Nepal standards, Indian standards have taken this standard as reference.

5. IEC 60335-2-15: 2016 (amendment: 2018) Household and similar electrical appliances Safety – Part 2-15: Particular requirements for appliances for heating liquids

This International Standard deals with the safety of electrical appliances for heating liquids for household and similar purposes, their rated voltage being not more than 250 V. This standard provides particular safety requirements for the following appliances:

- coffee-makers;
- cooking pans;
- egg boilers;
- feeding -bottle heaters;
- kettles and other appliances for boiling water, having a rated capacity not exceeding 10 l ;
- milk heaters;
- pressure cookers having a rated cooking pressure not exceeding 140 kPa and a rated capacity not exceeding 10 l;
- rice cookers;
- slow cookers;
- steam cookers;
- soy milk makers;
- tea maker;
- wash boilers;
- yoghurt makers.

6. IEC 60906-1: 2009 IEC system of plugs and socket-outlets for household and similar purposes – Part 1: Plugs and socket-outlets 16 A 250 V ac.

This standard applies to the IEC System of plugs and socket-outlets rated 16 A 250 V ac for household and similar purposes for the connection of equipment to distribution systems having nominal voltages between 200 V and 250 V ac, insofar as dimensional requirements are concerned.

7. IEC 60884-1: 2013 Plugs and socket-outlets for household and similar purposes – Part 1: General requirements

This part of IEC 60884 applies to plugs and fixed or portable socket-outlets for ac only, with or without earthing contact, with a rated voltage greater than 50 V but not exceeding 440 V and a rated current not exceeding 32 A, intended for household and similar purposes, either indoors or outdoors.

8. IEC TR 60083:2015 Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC

IEC 60083 is a technical report prepared by the technical committee by collecting data of a different kind and from that which is normally published as an International Standard, for example "state of the art".

9. National Standard for electric plugs

Nepal Standard- NS 116 Electric Plug is Nepal Standard for electric plugs rated for 6 A and above.

BS 1363 is British standards for plugs and sockets rated for 13 A.

10. IEC 61140:2016- Protection against electric shock – Common aspects for installation and equipment

Appliances are classified based on protection class. The definitions and test conditions required for different class of appliances is given in IEC 61140. IEC 61140 classifies electrical appliances into several protection classes: Class 0, Class I, Class II and Class III.
This International Standard applies to the protection of persons and Livestock against electric shock. The intent is to give fundamental principles and requirements which are common to electrical installations, systems and equipment or necessary for their coordination, without limitations with regard to the magnitude of the voltage or current, or the type of current, and for frequencies up to 1000 Hz.

The detailed description of the classes is available in IEC 61140 whereas the definitions are provided in number of IEC standards such as IEC 60335-1, IEC 60050-195:1998, IEC 60050-826-2004, etc.

11. Electrical Vocabulary

The IEV (IEC 60050 series) is a general-purpose multilingual vocabulary covering the field of electrotechnology, electronics and telecommunication. It comprises terminological entries, each corresponding to a concept.
These entries are distributed in several parts, each part corresponding to a given field.

IEC 60050-826-2004: International Electrotechnical Vocabulary Part 826: Electrical installations. This part of IEC 60050 deals with electrical installations such as those of residential, industrial or commercial premises.

IEC 60050-195:1998, International Electrotechnical Vocabulary – Part 195: Earthing and protection against electric shock

IEC 60050-442:1998, International Electrotechnical Vocabulary – Part 442: Electrical accessories

12. IEC conformity tests

IECEE 02:2016 IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE System)- Rules of Procedure – CB Scheme- Scheme of the IECEE for Mutual Recognition of Test Certificates for Electrotechnical Equipment and Components (CB Scheme)

This document will facilitate to provide certification to products that will in turn facilitate international trade in electrotechnical equipment, and components primarily intended for use in homes, offices, workshops health care facilities and similar locations, for benefit of consumers, industries, authorities etc, The Scheme is based on the principle of mutual recognition (reciprocal acceptance) by its members of test results for obtaining certification or approval at national level.

13. IECEE 03 Rules of Procedure CB FCS Scheme of the IECEE for Mutual Recognition of Conformity Assessment Certificates for Electrotechnical Equipment and Components (CB FCS Scheme)

The IECEE Certification Body (CB) Full Certification Scheme (CB-FCS) is an extension of the international IECEE CB Scheme and is an option to be exercised by the participants in the CB Scheme. CB-FCS is a product Certification System 5 as defined in ISO/IEC 17067.

14. IEC 60529: 2013 Degrees of protection provided by enclosures (IP Code)

This standard describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment. This standard provides definitions, designations, requirements and test methods for degrees of protection provided by enclosures of electrical equipment as regards:

1) Protection of persons against access to hazardous parts inside the enclosure;
2) Protection of the equipment inside the enclosure against ingress of solid foreign objects;
3) Protection of the equipment inside the enclosure against harmful effects due to the ingress of water.

15. NS 564: 2076 “Household and similar electrical appliances Safety Part 1: General Requirements”

This standard provides general requirements for the safety against the hazards that could occur in normal use of person using the electrical appliances.

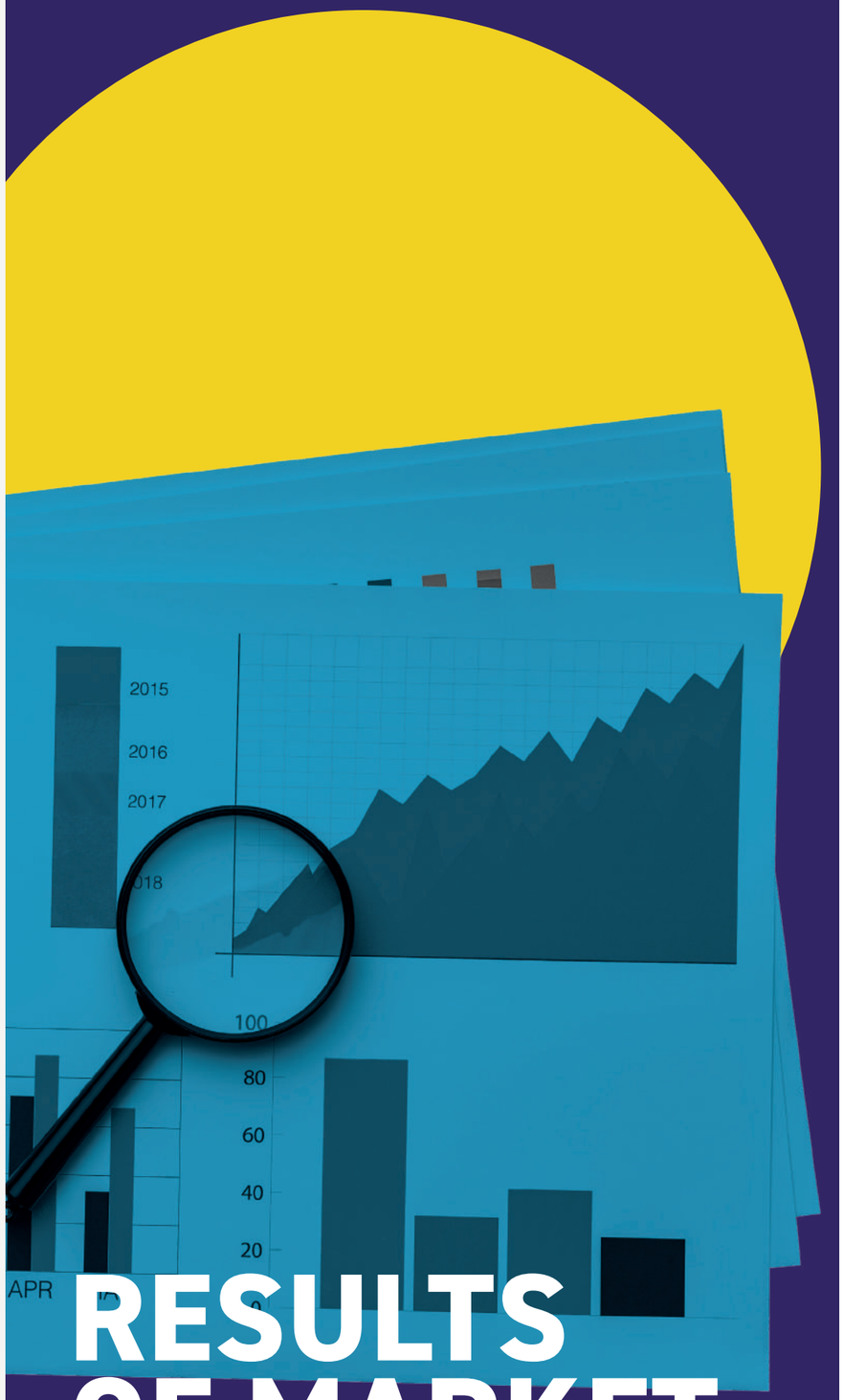
16. NS 561:2076 “Household and similar electrical appliances Safety Part 2-1: Particular Requirements for Portable Induction hobs”

This Nepal standard is particular requirement for safety regarding to induction hobs. This standard is read in conjunction to NS 564 for induction hobs.

17. NS 563:2076 “Performance Standards for Household Induction hobs”

This Nepal standard provided performance requirements for induction hob including the energy efficiency. The test procedure that includes cooking process, is, however not in line to traditional Nepali Dishes.

ANNEX 2:



RESULTS OF MARKET SURVEY

1. Background

This report has been prepared as a part of the background study for preparation of Non-Technical Guidelines on Safety Standards, Minimal Performance, and End of Life for Energy Efficient Electrical Cooking Appliances (Electric Pressure Cookers (EPCs), Air Fryers, and Induction Hobs). Brief survey of the available brands and variants of EPCs, Air Fryers, and Induction Hobs was conducted in the market of Kathmandu and the results are presented in the sections below.

2. Objective of the market survey

The objective of the market survey was to find out the availability of e-cooking appliances and their brand, model and price in the market. The survey was divided into two types: retailer survey and wholesale survey.

3. Methodology of Market survey

Market survey was segmented into two types: retailer survey and wholesale(manufacturer) survey. For both types of the surveys, a short questionnaire/checklist was prepared and was used to collect the data. The survey was conducted in different locations of Kathmandu and Lalitpur. Altogether, 10 retailers and 3 wholesales/distributors were surveyed. The table below shows the details of retailer and manufacturer market survey conducted:

Table 1: **List of Retailers Surveyed**

S.N.	Name of Retailer	Address
1	Sales berry	Batttisputali,Kathmandu
2	Bijaya stores	Battisputali, Kathmandu
3	Laxman Kitchenware	Mahabouddha, Kathmandu
4	Bhatbhateni Super Market	Siddhipur, Lalitpur
5	Annapurna Electronics	Mahaboudhha, Katthmandu
6	Bhatbhateni Super market	Pulchowk, Lalitpur
7	T.R. Store	Koteshwor, Kathmandu
8	Bhairav Traders	Mahabouddha, Kathmandu
9	Karmacharya Kitchenware	Sundhara, Kathmandu
10	Ganapati store	Mahabouddha, Kathmandu

Table 2: List of Wholesalers Surveyed

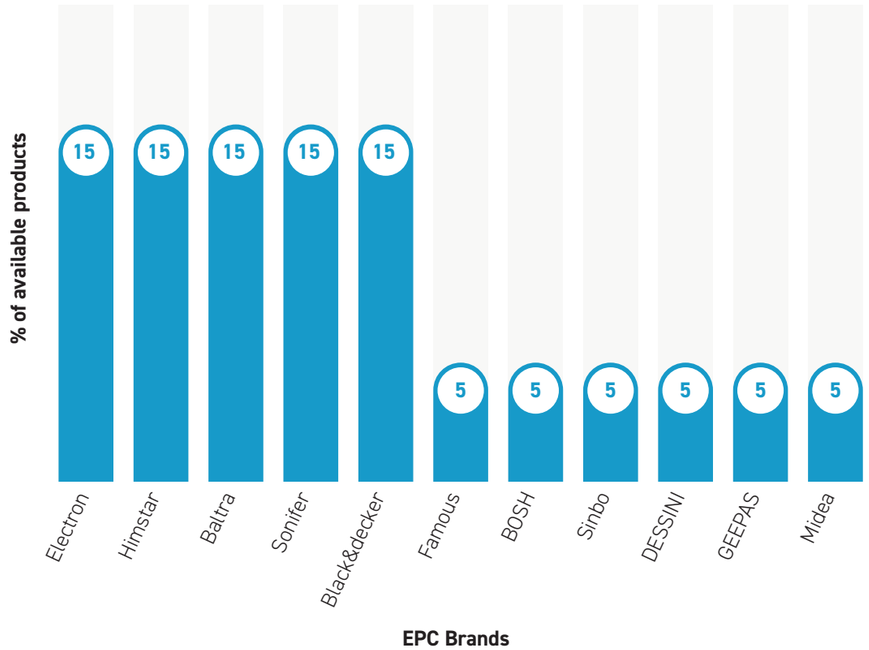
S.N.	Name of wholesaler	Address
Balajee NP Pvt. Ltd	Sitapaila, Kathmandu	Batttisputali,Kathmandu
Electron Kitchenware	Bhotebahal, Kathmandu	Battisputali, Kathmandu
SwitchOn retail Pvt. Ltd	Narayanchaur, Naxal	Mahabouddha, Kathmandu

4. Findings and Discussions

4.1 Electric Pressure Cookers

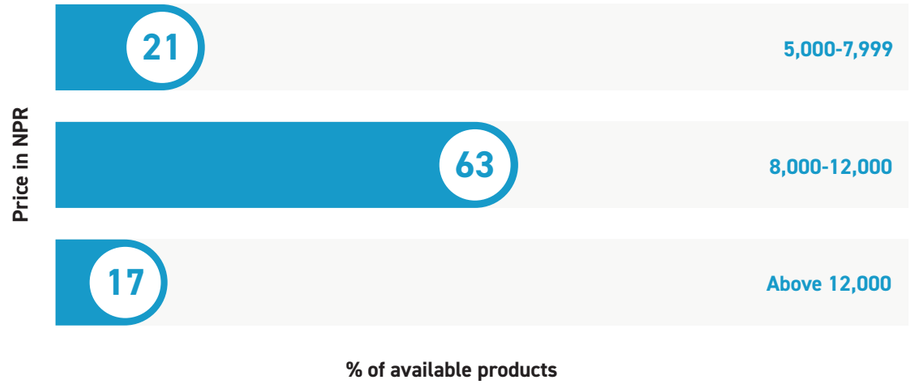
Electric Pressure Cookers (EPCs) are a new technology for Nepalese e-cooing appliance market. Only few consumers are aware of the EPCs. During the survey, Electron, Himstar, Baltra, Sonifer, and Black and decker are the major EPC brands available, with few other brands as shown in the figure below. Mostly, the capacity of EPCs available found in the market are 5 Litre and 6 Litre, and few brands also offered the ones with 3 Litre.

Figure 1: Available brands of EPC



Most of the brands available in Nepalese market cost around NPR 8000 – NPR 12000. Brands such as Electron, Baltra, Himstar, Bosch etc. come in this range. Some of the brands such as GEEPAS, Famous, some models of Electron, and some models of Himstar offer a bit lower costs under NPR 8000. And, the most expensive brand of EPC in the market is Black & decker, which costs NPR 23740. The survey explored that Electron, Baltra, and Himstar are the major brands that are demanded by the customers.

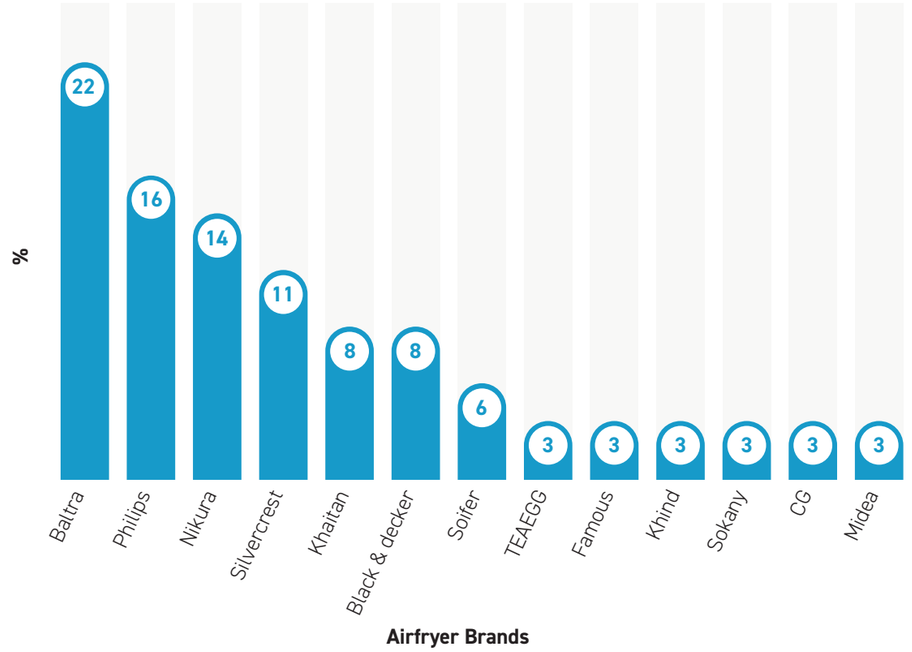
Figure 2: Price range of EPCs



4.2 Airfryers

Airfryer is an emerging technology for Nepalese e-cooking market. Not-many consumers have been familiar with it, however it is gaining popularity in the market and is also being taken by consumers as a replacement to microwave ovens. Most of the airfryers available has the capacity to operate at a maximum of 200°C and provide option for time and temperature setting. The mostly sold brands are Baltra, CG, and Black Decker. According to availability, Baltra, Philips, and Nikura comes in the first position, which is followed by numerous brands as shown in figure below.

Figure 3: Airfryer Brands available in the market



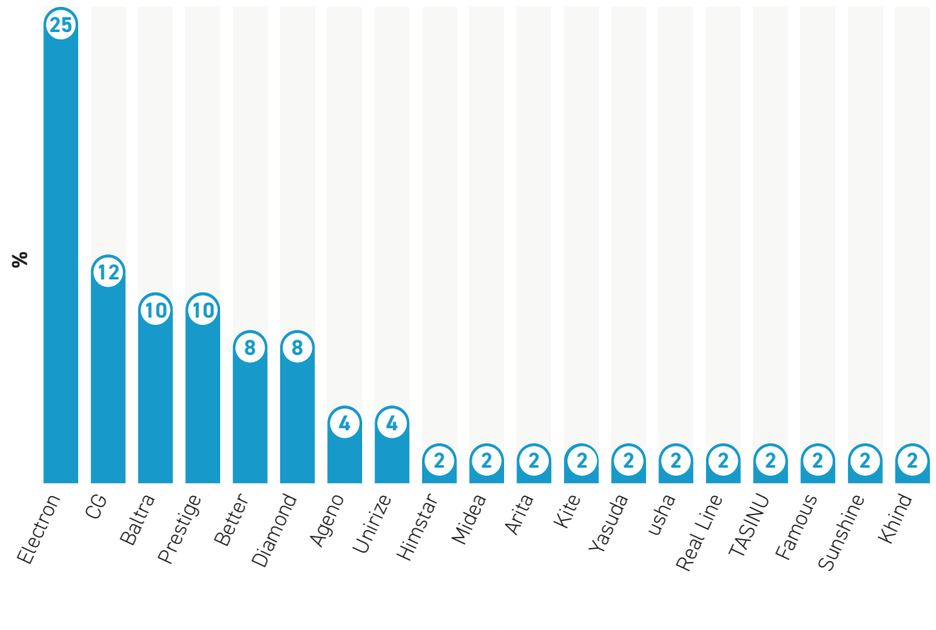
More than 60% of the air fryers that are available in the market costs around NPR 10,000 to NPR 15000. Few ones (about 12%) are a bit cheaper, and comes below NPR 10000, about 10% cost upto NPR 25000, about 12% cost upto NPR 35000, and a model of Philips airfryer costs NPR 48000, which the most expensive among the ones found during market survey. Some models of Silvercrest, Baltra, Teaegg, and Famous lie under cheaper ones, some models of brands such as CG, Baltra, Sokany, Sonifer, Nikura, Midea, and Khaitan are in middle range price, and brands such as Black & Decker, and Philips are expensive ones. The price also depends upon model and volume/capacity of the air-fryer. The figure below shows the price of airfryers available in the market.

Figure 4: Price range of Airfryers

4.3 Induction Hobs

Induction Hobs are mostly available and mostly sold electric appliance among three appliances. Electron, CG, Baltra, and Prestige are the mostly available and demanded brands of Induction hobs. Some retailers have only one brand of induction hobs whereas some have multiple brands of induction hobs. The maximum power consumption of Induction hobs available on the market is 2000 Watt, and the minimum operable capacity is between 200Watt – 500 Watt. The figure below shows the brands available in the surveyed market of Kathmandu and Lalitpur.

Figure 5: Available Brands of Induction Hobs



Similarly, price of Induction Hobs available in surveyed market ranges from 3000 to 13000. Brands like Electron and Baltra offer a variety of Induction hobs whose price range is available from NPR 3000 to NPR 5000, and Electron even has the models that costs NPR 6000. Price of more than 45% of the induction hobs is between NPR 4100- NPR 5000. Brands like Electron and CG come in this range. Two cooking zone hobs were also found in the market survey and their prices were around NPR 11000 – NPR 13000. Nepali brands CG, and Better offer these two zone cooking hobs, one with Induction and one with Infrared. One more Nepali brand: Ageno offered two zone Infrared hobs, which is not included in this study. The figure below demonstrates the prices in available Induction cooktops in the market.

Figure 6: Price of Induction Hobs in Nepalese market