

## Research on Innovative Design of Mobile Cooking Table

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### **Abstract**

*The innovative design of mobile cooking table is aimed to meet growing consumers' demand, on the basis of existing technical conditions. Mobile table is a mobile cooking equipment. But this 'mobility' is not defined as the moving of table while working. In other words, it realizes the function of the mobile cooking according to the different operating environment. This paper mainly on the basis of the principle of ergonomics and the concept of humanized design, conduct the design on the overall size and construction of the cooking table from the aspect of function, material and institution to develop a cooking table with strong practicality in order to meet demands of different consumers.*

**Keywords:** *mobile; cooking table; design; research*

### **1. Introduction**

With the improvement of life, acceleration of life rhythm and development of modern civilization, the traditional cooking environment and methods cannot adapt to the daily needs of modern family. With the acceleration of life rhythm, most people want to shorten the time of housework in kitchen, and allow more time for learning, leisure, entertainment to promote family life.

Since the beginning of the opening up policy, great changes have taken place in the traditional family kitchen utensils. Electric rice cooker, electric insulation thermos, electronic oven, microwave oven appearing one after another, brings about a number of revolution in kitchen, to try to free people from multifarious house work [1]. People cook at home less and less time partly because of the socialization of housework, increasing of eating out and improvement of cooking utensils. New kitchen utensils play an important role in improving the efficiency of cooking and saving cooking time.

A few years ago, series of stainless steel combined household kitchen equipment has been available in china for the first time that blew then horn of 'kitchen revolution'. In 1980s, the electromagnetic stove was launched in Canton fair for the first time, which used no flame while cooking. Its principle is the high-frequency induction heating with its thermal efficiency up to 80%. It attracted considerable consumers. Induction cooker is a typical product of home cooking revolution. Its biggest features are quick, easy, health, energy-saving and security. Delicious food can be cooked quickly without any lampblack [2].

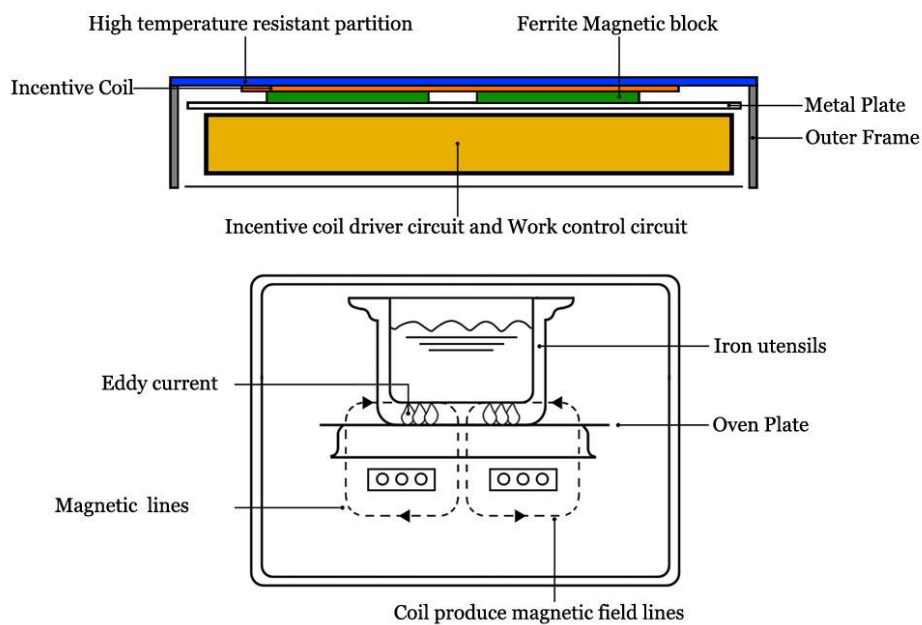
Currently, people have gas furnace, induction cooker, electric cooker, oven and other kitchen utensils in most modern families. These kitchen utensils are generally used in single function, and in the fixed space, this condition cannot satisfy the family without big kitchen and those people who rent houses. The small space in kitchen has become the stumbles of buying more kitchen utensils [3]. So we need a new kind of space-saving kitchen utensils to solve the problem that can cook in the small space in any circumstance.

The innovation design of mobile cooking table reflected in the following aspects.

## 2. Function and Structure

### 2.1. Function Principle

This innovative design is the combination of an induction cooker and a mobile table, using induction cooker as heating way of cooking. Induction cooker adopts the principle of magnetic field induction eddy current heating. It produces alternating magnetic field by electronic circuit board set. The magnetic lines of force in magnetic field can produce countless eddy current when it goes through the bottom of iron utensils. Eddy current forces the iron molecules to do random movement which causes the collision between molecules to generate heat. Then the iron utensils generate heat in high speed to heat and cook food [4]. The working principle of the induction cooker is shown as Figure 1.



**Figure1. Working Principle of the Induction Cooker**

Induction cooker has the characteristics of wide scope of application, convenience of operation, safety, health, high efficiency and energy-saving [5]. The contrast of the thermal efficiency of common fuel are shown as Table 1.

**Table 1. Contrast of the Thermal Efficiency of Common Fuel**

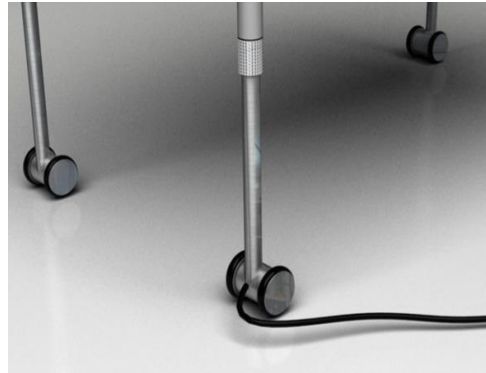
Name	Coal (%)	Liquid fuel (%)	Gaseous fuel (%)	induction cooker (%)
<i>Thermal efficiency</i>	10-20	20-40	50-60	70-80

## 2.2. Structure

According to the "mobile" functional requirements, we product the structure design of the table legs. In order to achieve the different users' functional requirements, the table legs are designed in a scaled manner, it is shown as Figure 2, we adjust the right height based on the height of the user and move with universal wheel, as shown in Figure 3.



**Figure 2. Scaled Structure of Table Legs**

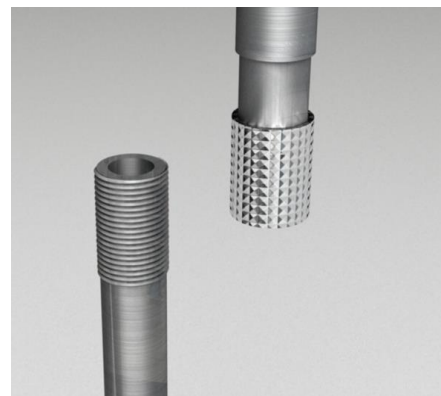


**Figure 3. Universal Wheel of Table Legs**

The mobile cooking table design to be folded in order to reduce the storage space and be convenient to move. The cooking table adopt the way of inward rotation, with shafts and sleeves on the both side. The table legs are folded to the middle while moving in order to reduce the storage space, as shown in Figure 4. The leg of the table can be flexible. In order to adjust the balance, an adjustment is installed between the upper and lower legs. The legs have external thread ends, set on the internal thread of regulator to adjust the height in order to meet the needs of different users, as shown in Figure 5.



**Figure 4. Folded State of Table Cooking**



**Figure 5. Structure of Height-Adjusted**

## 3. Colour Design

Color is a comprehensive phenomenon, involving light, material and vision. Colour is the light affecting on the vision and brain. The color of products plays an important role in the industrial design. People focus on the color before its shape and other factors. The color plays a decisive role in people's feeling. Only according with people's lifestyle and interest it can make people feel comfortable, completely and beautiful. Each color has its

own characteristics [6]. The common relationship between color and psychology are shown as Table 2.

**Table 2. Relationship between Color and Psychology**

colour	Psychological feelings
<i>Red</i>	Enthusiasm, Happy, Sexy, Authority, Confidence
<i>Yellow</i>	High brightness, Warning
<i>Green</i>	Fresh, Peace, Growth, Life, Safety
<i>Blue</i>	Calm, Broad, Eternal, Distant, Quiet, Refreshing, Sad
<i>Purple</i>	Elegant, Noble, History, Abstract, Wisdom, Indifference
<i>Black</i>	Noble, Steady, Technology, Heavy, Hard, Male, Industrial information
<i>White</i>	Pure, Noble, Clean, Cold
<i>Grey</i>	Soft, Elegant, Popular

People have different psychological feeling with different colours. The design of mobile cooking table choose grey as the main color which represents soft and elegant. The cooking table's different colours are shown as Figure 6.



**Figure 6. Different Colours of Cooking Table**

## 4. Material and Technology

### 4.1. Material

The choice of material has a great influence not only on intrinsic and exterior data, but also the function and the overall aesthetic of the product. We must take the intrinsic characteristics of the material into consideration, at same time, the relationship among material human and environment. According to the design requirements of the mobile cooking table, we choose the following materials.

#### 1. Adopt the 5083 Aluminum alloy as main body

Aluminum alloy is a kind of nonferrous metal structural materials which are widely used in industry. It has the advantage of low density, high strength, good plasticity(can be processed into various shapes), good electrical conductivity, good thermal conductivity, corrosion resistance, easy processing and punching resistance. It is widely used in industry. 5083 belong to the commonly used aluminum alloy series, whose main element is magnesium. It also can be called aluminum magnesium alloy [7]. Its characteristics are low density, high tensile strength, high elongation rate, fatigue strength, but cannot be

strengthened with heat treatment. 5083 aluminum alloy sheet's technical parameters and chemical composition are shown as Table 3, Table 4 and Table 5.

**Table 3. Typical Mechanical Properties of 5083 Aluminum Alloy Sheet**

Tensile strength (25°C,MPa)	yield strength (25°C,MPa)	Hardness 500kg nexuiz10mm ball	Thickness 1,6mm(1/16in) thickness
180	211	65	14

**Table 4. Typical Physical Properties of 5083 Aluminum Alloy Sheet**

Coefficient of expansion (20-100°C)µm/mk	Melting range (°C)	Electrical conductivity 20°C(68°F)(%ACS)	Resistivity 20°C(68°F)Ωmm <sup>2</sup> /m	Density (20°C)(g/cm <sup>3</sup> )
23.4	570-640	29	0.059	2.72

**Table 5. Chemical Composition Limit of Aluminum of 5083 Aluminum Alloy Sheet**

Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
23.8	0.4	0.1	0.3-1.0	4.0-4.9	0.05-0.25	0.25	0.15

## 2. Material of induction cooker panel of mobile cooking table

According to the actual work index of roof, the ceramic roof of induction cookers was classed in three grades. Grade A is Japanese NEG ceramic roof. It is micron grade crystals, and a once-molded product at 1500 high-temperature firing for 45 days. Its high temperature resistant is up to 1100 and resistance of temperature difference is 800. It has strong impact resistance. Because of the Compact texture, it can be washed easily without any color changes. Grade B is home-made white ceramic roof. The firing cycle of it is about 7 days, at 500-600. After that it need be sent to cooling cut in 200. It is not a once-molded product. Although it is white, but it is easy to become yellow and discolored. The thermal efficiency of it is low. It has an bad resistance to temperature difference. Roof crack can be burst in some ways. Grade C is home-made colorful ceramic roof, whose manufacturing process is simple. Once used, it will be became yellow in a short time [8].

Mobile cooking table induction cooker panel is micron-level black crystal panel. The main advantage of micron-level black crystal panel of induction cooker are high wear resistance ,good compression capability, excellent high temperature performance, no impurities, no color change, low damping factor magnetic field lines, good heat insulation performance, high intensity, good hardness and low coefficient of thermal expansion and contraction [9]. Those advantages could improve the cook's thermal efficiency, insulation anti-permeability, product performance and service-life time.

## 4.2. Crafts

Different materials have different processing. For mobile cooking table with the aluminum alloy material, its processing is relatively simple. It can be processed into plates, rods, tubes and profiles and other products by rolling, extrusion, drawing, forging and other hot and cold treatment.

Mobile cooking table desktop's aluminum alloy sheet can be cut according to its size. Curved portions can be processed by extrusion methods or rolling and finish it after its surface treatment. Part of the table legs are directly processed in accordance with design drawings with processed pipe, assembled to meet the requirements of structure and finally combined into finished products.

## 5. Man-machine Relationship

Ergonomics is a young science. It does research on the relationship between the machine which compose the man-machine system and the human beings. In order to improve overall system efficiency by using scientific knowledge of physiology, psychology and medicine [10]. With the development of mechanization, automation and electronic, the impact of human factors in the production becomes more and more important, so is the Man-machine coordination problems. Ergonomics is the created and developed in this context.

The import thing is to do the human-machine relationship analysis. Mobile cooking table's man-machine system is mainly constituted by the common man and the table. But this table does not refer to the table we eating with, and it using state is not sitting, but to stand. So it is designed in accordance with the man-machine size of the cooking table [11].

Kitchen table should be designed to suit the operator's height. Height of the kitchen table shall prevail when the operator stand and the operator's fingers are able to touch the bottom of the basin. If it is too high it will cause shoulder fatigue, and if it is too low will make people feel sour at waist and backache. The average height of the operator is different according to different countries and regions and gender. Several representative countries with man and woman's height situation is shown as Table 6.

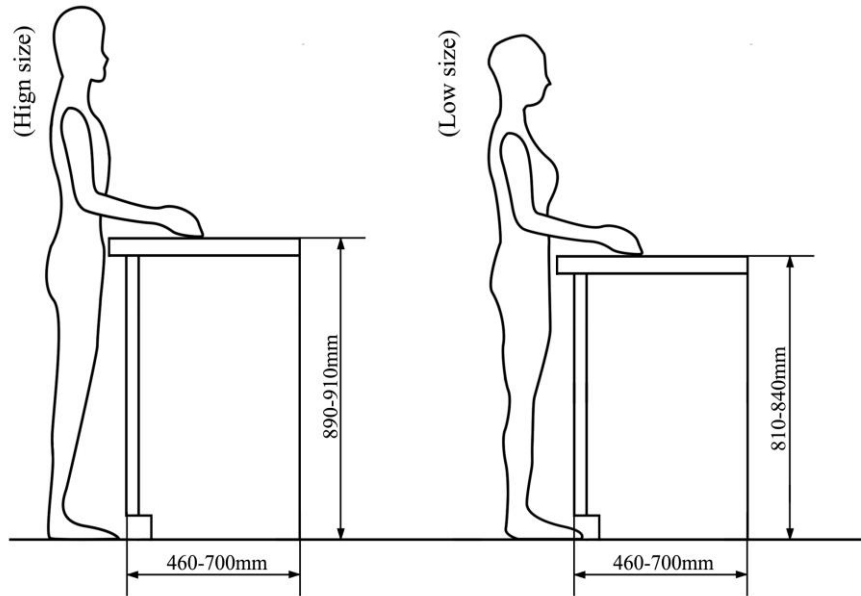
**Table 6. Populations in Different Countries Height Comparison Table**

	China	Japan	Australia	German	Canada	Korea	Danmark
Male	1752 mm	1718 mm	1784 mm	1810 mm	1800 mm	1737 mm	1826 mm
Female	1631 mm	1588 mm	1639 mm	1680 mm	1652 mm	1611 mm	1687 mm

Generally, Kitchen table are divided into high and low two levels. The size of high is 890-910mm, commonly used in Western countries. The lower size is 810-840mm, commonly used in China.

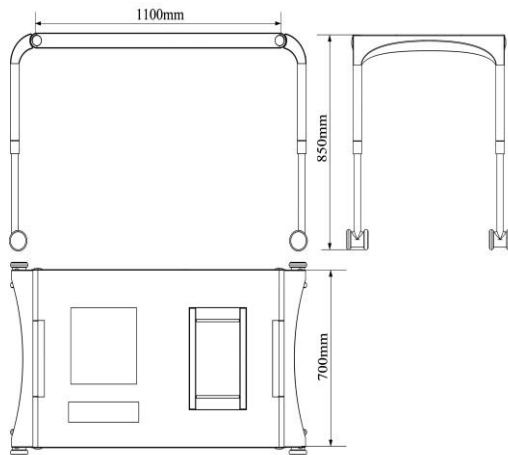
At present, some kitchen table' foot can be adjusted to make work surface to reach the appropriate scale. After putting double furnace, cooking bench is approximately at the same as height of the 810mm-high work surface after adding 150mm or 200mm. If it uses the plane furnace (four furnace, furnace tank), the furnace surface should be preferably 890mm high. The length and width of Kitchen table should not be smaller than 900mm × 460mm, otherwise, it is not enough for people to put items [12]. The man-machine relationship of the kitchen table is shown as Figure 7. According to the above conventional data, we design the table with the maximum height of 850mm and the desktop for 700mm × 1100mm, as shown in Figure 8.

We take ergonomic factors into consideration while designing the mobile cooking table. It has stylish and elegant exterior design with dynamic lines, reasonable man-machine relationship and meeting people's practical and aesthetic requirements.



**Figure 7. Man-machine Relationship of the Table**

After the research of the product in Function, Material and Man-machine relationship. To make the model with Solidworks software, 3D file and render by Keyshot software [13], The final result picture of the mobile cooking table is shown as Figure 9.



**Figure 8. Sizes of Cooking Table      Figure 9. Final Result Picture of Product**

## 5. Conclusion

The innovative design of mobile cooking table has abandoned the traditional model of the past, and takes the "mobile" concept into cooking tool designs, not rigidly stick to a fixed space to use. It has the advantage of agility, maneuvering and high level of integration. This is the development trend of modern products. The shape of table has broken the original rigid straight right angle, by using a combination of spherical and cylindrical to make mobile cooking table looks better visually vivid and simple. The theme of design is to meet people's demand for cooking function and allow consumers to experience a relaxed and pleasant life. The innovative design of mobile cooking table needs to solve not only the material selection, parts fit, processing and other technical issues, but also product

appearance, color, ergonomic, and other issues of industrial design. Aimed at the future development direction of the cooking equipment, the innovative design of mobile cooking table outline a new lifestyle for people in the future, making lives more beautiful.

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