

## Fire Safety Labeling System for Household Goods to Prevent House Fires

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### 〈Abstract〉

Data released by the National Fire Agency showed that the total incidence of fires from 2014 to 2023 was 410,497, among which 75,215 were house fires, constituting 18% of the total occurrences. The fatalities resulting from house fires numbered 1,435. Fatalities stemming from prior house fires occurred between midnight and 6 am, coinciding with periods of sleep and diminished responsiveness to fire emergencies. A fire safety labeling system is proposed to prevent fire hazards associated with household products. This system primarily entails indicators of thermal energy and inherent fire attributed to household products. Furthermore, the Korea Fire Safety Institute has suggested adopting a risk label as a concrete measure plan for implementing the fire safety labeling system for household products. The results promise to safeguard the public against fires and increase the exports of household commodities by enhancing the corporate reputation through positive association with fire safety measures.

*Keywords : Household Goods, Fire Safety Labeling System, Korea Fire Institute, Korea Fire Safety Institute*

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## 1. Introduction

Individuals can now use complex and precise products owing to advancements in modern science and technology, enhancing their quality of life with convenience and richness. However, products integrating cutting-edge science and technology may inadvertently accelerate fire propagation and generate secondary toxic gases, leading to significant casualties and property damage.

Despite efforts of companies to educate the public on the use and potential hazards of their products, this information is often disregarded due to its complexity, making it challenging for consumers to remain vigilant about the products around them.

Consequently, the general public frequently fails to comprehend and respond appropriately to fire hazards associated with household goods. For example, the fire at a seafood stew restaurant in Nowon-gu, Seoul, in 2016 was identified as an oil fire exacerbated by incorrectly pouring water onto cooking oil. This incident underscores the difficulty the general public faces in understanding fire characteristics and responding effectively.[1]

This study aims to assess the fire safety of electronic devices and household goods used daily and investigate methods for making risk recognition straightforward and convenient for the public. This study focuses on enhancing the overall safety of manufactured goods by enabling consumers to quickly identify the safety of products during selection, management, and use.

## 2. Discussion

### 2.1 Statistics of House Fire

According to data released by the National Fire Agency, the total number of fires from 2014 to 2023 was 410,497, of which 75,215 occurred in houses, accounting for 18% of all fires. The number of deaths caused by house fires was 1,435.[2]

(Table 1) show the status of house fires and the number of deaths over the past five years. Approximately 7,000 house fires occurred annually from 2019 to 2023, with deaths increasing from 122 in 2019 to 158 in 2022 before decreasing to 133 in 2023. This trend is likely due to the National Fire Agency's distribution project for household fire extinguishers and stand-alone alarm detectors. However, it cannot be predicted with certainty.

(Table 2) present the status of residential fires and death statistics by period over the past ten years. The period when most house

**Table 1. Status of number of fire incidents and deaths**

Division	Fire incidents (Numbers)	Deaths (Peoples)
2019	7,559	122
2020	7,163	145
2021	6,663	150
2022	7,040	158
2023	6,870	133
Total	35,295	708

**Table 2. Status of number of fire incidents and deaths**

Division (Hours)	Fire incidents (Numbers)	Deaths(Peoples)
0~6	11,507	443
6~12	17,838	319
12~18	25,206	303
18~24	20,665	3708

fires occurred was from noon to 6:00 pm, whereas deaths were predominantly found to occur between midnight and 6:00 am when individuals were asleep and unable to respond to the fire.[2](Fig. 1)

The fire safety labels for household appliances proposed in this study do not directly prevent or extinguish house fires. However, these labels can contribute to long-term psychological fire prevention and enhance fire awareness by raising awareness of the fire risk associated with household appliances, thereby aiding in preventing residential fires. Additionally, the National Fire Agency is implementing a project to supply basic firefighting facilities to each home.



**Fig. 1 (a) House fire being extinguished (b) After extinguishing a house fire**

## 2.2 Fire Safety Labeling System

The fire safety labeling system measures the fire risk of household appliances used in daily life and displays the heat generation and fire characteristics of the product in the event of a fire. It enables the general public to verify the minimum safety standards for the product easily.

It is a fire-safety labeling system designed to help the general public recognize the fire risk of specific household products without requiring additional learning or materials.

The fire safety labels for household products indicate two aspects of fire safety. The first aspect includes the heat and smoke generated when a fire occurs in a product. The total calorific value (UNIT, MJ) and the total amount of smoke generated in the event of a fire are specified by the producer for home appliances, such as refrigerators, washing machines, televisions, computers, as well as furniture items like beds, chairs, desks, and cooking oil (UNIT, 1/M).

The second aspect indicates the unique fire characteristics of a product. At the time of product shipment, the fire occurrence characteristics are categorized into general fires (Class A), oil fires (Class B), and electrical fires (Class C) according to the fire classification standards of the National Fire Protection Association (NFPA) 10 code. This classification facilitates individuals to take appropriate action or use the correct type of fire extinguisher.

### 2.3 Standards for Specification of Fire Safety Labeling System

The first standard for specifying a fire-safety labeling system is the labeling system for heat energy. Household products emit substantial amounts of heat and smoke during a fire. Specifically, total heat release is an indicator that predicts flashover, one of the critical factors determining fire risk.[3] Flashover marks the transition from the fire growth phase to the peak phase, referring to the rapid spread of fire throughout the compartments of a house when all combustible surfaces exposed to heat radiation reach ignition temperature. Post-flashover, the fire state shifts from fuel-dominated to ventilation-dominated, significantly impacting fire spread and evacuation dynamics.[4]

Smoke is a mixture of various products generated during the thermal decomposition and combustion of combustibles, comprising gases, liquids, and solid particles around the flame. It contains carbon dioxide, carbon monoxide, aldehydes, and carbon particles. Incomplete combustion produces denser smoke and more toxic gases than complete combustion.[5] The quantity of smoke produced increases with the amount of air introduced at the height of the fire source and further increases when the smoke plume is disturbed.[6] Smoke is a major threat during fires, darkening rooms, complicating breathing, and accounting for over 60% of fire-related deaths. Smoke rises to the ceiling in

residential spaces due to the thermal currents and then gradually descends. The descent time of smoke is crucial for occupant evacuation, making it a vital factor in designing smoke control equipment.[7]

The specific fire classification method defined in the NFPA 10 code is as follows: General fires (Grade A) involve household goods that leave ash after combustion, such as wall moldings, paper, and polyethylene furniture. Oil fires (Grade B) involve substances like household boiler oil or cooking oil, which leave no residue after combustion. Electrical fires (Grade C) involve electrical and electronic products such as televisions, refrigerators, air conditioners, washing machines, and computers.[8]

### 3. How to Implement the Fire Safety Labeling System for Household Products

(Fig. 2) illustrates a schematic of implementing a fire-safety labeling system for household products. ① Manufacturers and importers of household necessities report the completed products to the Korea Fire Safety Institute. ② The Korea Fire Safety Institute, upon receiving such report, tests the total calorific value and the total amount of smoke generated by the product through the Korea Fire Industry & Technology Institute and notifies the Korea Fire Safety Institute of the results. The Korea Fire Safety Institute

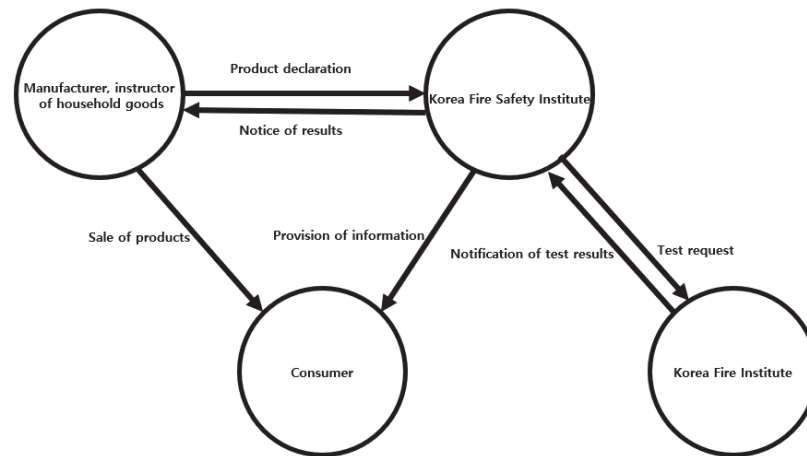


Fig. 2 How to implement the fire safety labeling system for household products

informs manufacturers and importers of the test results, enabling them to produce fire-safe products. Additionally, posting the results on the Korea Fire Safety Institute website facilitates consumers to compare and estimate fire risk before purchasing a product. Manufacturers and importers attach fire indicator marks issued by the Korea Fire Safety Institute to household goods before shipping them to consumers.

#### 4. Conclusion

This study aims to ensure public safety from fires occurring in household products through a fire safety labeling system. Delivering accurate information about the fire risk of the product to each consumer is feasible if a credible organization conducts experiments on the heat and smoke generated by household products and informs the public. Additionally, consumers

can select safer household goods by comparing the fire risk of similar products. Moreover, producing fire-safe products will improve the positive image of the company, leading to increased exports of household goods.

Future research should be conducted to minimize the cost burden on producers and consumers through a cost-benefit analysis from a management perspective. We expect that the design of the fire safety mark will differ from similar systems, such as the energy rating mark and KS certification mark. Lastly, researching and developing fire-safe household goods is essential for public safety from an industrial perspective.

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