

A Safety Approach to Find Reliability of Fire Extinguisher

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Abstract

Evaluation of the reliability of an engineering system, component, or element holds great significance in the anticipation of its availability, unavailability, and other pertinent indicators associated with the entirety of the system or component. In this paper, an examination centered on the analysis of the reliability of safety-installed fire extinguishers is conducted, and various factors are obtained. A fire extinguisher plays a critical role in managing fire incidents to ensure safety. The presence of a fire extinguisher holds great importance in safeguarding against fire hazards.

Keywords: Reliability, availability, unavailability.

INTRODUCTION

Now a days, Reliability evaluation of fire extinguisher systems is an important aspect of ensuring safety in various settings as it causes loss of property, life of people and casualties. Several papers have addressed this topic, providing innovative approaches and methods for assessing the reliability of fire extinguisher systems. [6] studies the number of fire incidences in Jakarta and evaluated the reliability of the building safety and [1] also consider the building safety and evaluated the reliability by using qualitative methods through observations. [4] finds the reliability of portable fire extinguisher by comparative efficiency assessment. The important safety device used to extinguish fire is fire extinguisher. In order to extinguish a modeled fire seat of any rank [2] evaluated the flow rate of fire – extinguishing agent. [5] proposed fire extinguishing agents based on aqueous solutions. [7] evaluated the reliability of fire extinguisher by considering constant hazard rate where as [8] used DEMATEL method to determine the criteria of weights and TODIM method for appropriate

selection of fire extinguisher. Evaluating the fire fighting abilities through sample analysis to present different measures for ascertaining the service life of fire extinguisher was done by [3]. Fire extinguishers are crucial for controlling fire in a specific location. Proper utilization, combined with dependability, will help to reduce the impact of fire at any location. One of the most important things to look out for is equipment reliability. Reliability analysis is therefore required. In this study, the reliability evaluation of fire extinguishers equipped for safety is conducted along with the assessment of several reliability factors. Different designs are used for different purpose. Figure 1 represents different types of fire extinguisher where as Figure 2 explains the different components of a fire extinguisher. A description of several fire extinguisher types is provided in Figure 3.



Figure 1 (i) Different Types of Fire Extinguisher



Figure 1(ii) Logo for Fire Extinguisher

Figure 2 Component description of Fire Extinguisher

Symbols found on fire extinguishers and what they mean











					
	Water	Foam spray	ABC powder	Carbon dioxide	Wet chemical
Wood, paper & textiles 	✓	✓	✓	✗	✓
Flammable liquids 	✗	✓	✓	✓	✗
Flammable gases 	✗	✗	✓	✗	✗
Electrical contact 	✗	✗	✓	✓	✗
Cooking oils & fats 	✗	✗	✗	✗	✓

Figure 3: Types of Fire Extinguishers and Their Descriptions

Reliability Evaluation for Different Fire Extinguisher

Weibull Distribution has the ability to adapt to different situations so it is widely used to find the reliability. It is a versatile distribution. The following formula is used to determine a system's reliability.

$$R(t) = e^{-(t/\lambda)^k}, t \geq 0 \quad (1)$$

Where

$R(t)$ denotes each component's dependability

λ stands for the scaling parameter

k represents the shape parameter

t represents the time

Fire Extinguisher	1	2	3	4	5	6	7
Failure rate(*10 ⁻⁴)	85	75	80	20	34	54	48

Table 1 Presents the initial statistics for various fire extinguishers. [7]

Fire Extinguisher	$t = 1$		$t = 2$	
	$k = 0.01$	$k = 0.02$	$k = 0.01$	$k = 0.02$
1	0.3503	0.3329	0.3478	0.3278
2	0.3499	0.3319	0.3473	0.3269
3	0.3501	0.3324	0.3476	0.3273
4	0.3450	0.3223	0.3425	0.3172
5	0.3470	0.3262	0.3444	0.3211
6	0.3487	0.3295	0.3461	0.3245
7	0.3482	0.3287	0.3457	0.3236

Table 2 Reliability evaluations of various fire extinguishers

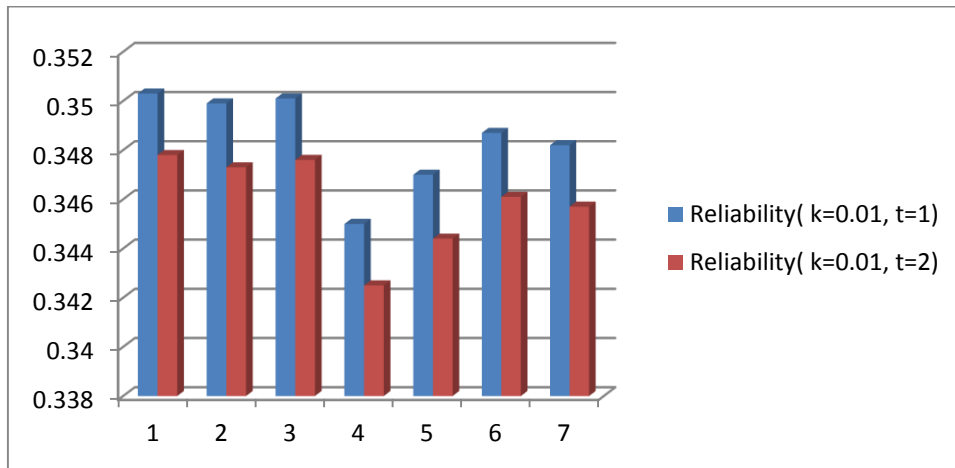


Figure: 4 Comparison of reliability for different time period at $k = 0.01$

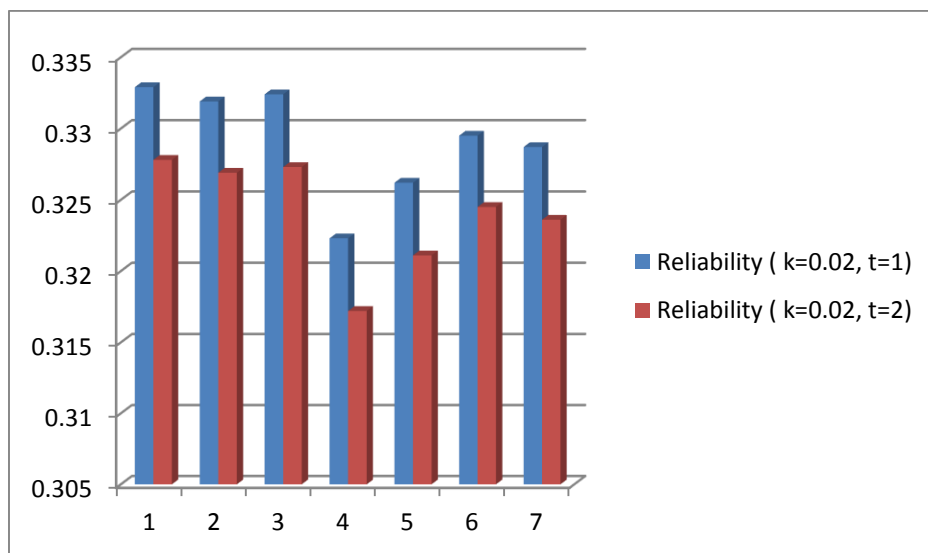


Figure: 5 Comparison of reliability for different time period at $k = 0.02$

CONCLUSION

Table 1 presents the initial statistics for various fire extinguishers, which is considered for the study. Reliability is evaluated for different fire extinguisher, which is shown in table 2. Reliability is assessed in this work using the failure rate listed in table 1. Figure 4 and figure 5, gives the graphical representation for comparison of reliability for different time periods. From the figure it is clear that, as the time increases the reliability of the fire extinguisher decreases.

REFERENCES

- [1] Anwan, F., Aulia, T. B. and Afifuddin, M., "The reliability of fire protection system case study of Aceh Besar district regency office", IOP Conf. Series: Material Science and Engineering 933 (2020) 012018, DOI: 10.1088/1757-899X/933/1/012018.
- [2] Bordakov, V. N., "The study of fire extinguishing process of modeled fire seats", Occupational Safety in Industry, pp. 57-62, 2021, DOI: 10.24000/0409-2961-9-57-62.
- [3] Kim, H. and Song, Y., Korean Society of Hazard Mitigation, "A study on the durability of fire hoses of fire hydrants", 21(6), (2021), 97-102.
- [4] Kuprin, D. S. and Polyakov, A. S., "The accuracy and reliability of comparative efficiency assessment of portable fire extinguishers used in the process of fire extinguishing of structural components of motor vehicles and automotive finishing", DOI: 10.22227/pvb.2021.30.02.88-97, 30(2), (2021), 88-97.
- [5] Meshalkin, E. A., Bordakov, V. N. and Kazakov, A. V., "On physical modeling of the current measurements in a jet of fire extinguishing agent", Occupational Safety in Industry, DOI: 10.24000/0409-2961-2021-6-21-27, (2021), 21-27.
- [6] Permana, H. and Susilowati, H., vol 2018, "Evaluation of Reliability Values of the Building Safety System against Fire Hazards in the X Government Office Building in Jakarta", International Conference of Occupational Health and Safety (ICOHS-2017).
- [7] Tiwary, A., et al., "Reliability evaluation of fire extinguisher-An innovation safety approach", International Journal of Innovative Science and Research Technology, 6(5), (2021), 244-247.
- [8] Ulu, M. and Sahin, H., "An integrated approach for fire extinguishers section with DEMATEL and TODIM methoda", Business and Management Studies an International Journal, 9(4), (2021), 1696-1707.

