

Evaluation of The Appropriate Selection of Fire Extinguisher Types, Placement, and Maintenance in Buildings in Sumacab Este, Cabanatuan City, Nueva Ecija, Philippines

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ABSTRACT: This study evaluated the selection, placement, and maintenance of portable fire extinguishers in selected buildings in Sumacab Este, Cabanatuan City. It focused on determining compliance with Republic Act No. 9514, also known as the Fire Code of the Philippines of 2008. The researchers used a descriptive-evaluative research design and an observational checklist based on RA 9514. Twenty selected residential, commercial, and institutional buildings were assessed. The data were analyzed using frequency, percentage, and compliance scoring. The findings showed that the selected buildings were generally Mostly Compliant. Most fire extinguishers were accessible, visible, and physically in good condition. However, some issues were found in proper fire extinguisher selection, signage, inspection records, and maintenance documentation. The study recommends regular inspection, proper signage, updated maintenance records, and correct extinguisher selection based on fire hazards

KEYWORDS: Fire Extinguisher, Building Safety, Fire Protection, Maintenance Inspection

I. INTRODUCTION

Fire incidents remain a serious threat to life, property, and infrastructure, particularly in urban and developing communities where buildings continue to increase in number, use, and complexity. In areas such as Sumacab Este, Cabanatuan City, Nueva Ecija. The presence of residential, commercial, and institutional buildings makes fire safety preparedness an important concern. Among the basic and essential tools used in fire protection is the portable fire extinguisher, which serves as a first-response device during the early stage of a fire. According to Sani S.A. (2023), fire extinguishers can help prevent severe property damage and fatalities in homes and businesses when used appropriately. Portable fire extinguishers are designed for different fire classifications, including ordinary combustibles, flammable liquids, electrical equipment, and cooking oils. Proper selection is important because the extinguisher must match the fire hazards present in the building to ensure an effective response during emergencies (Sani S.A., 2023). Proper placement is also necessary, as fire extinguishers should be visible, accessible, and located along normal paths of travel for immediate access during fire incidents (Turk, 2023). In addition, regular inspection and maintenance are essential to ensure that fire extinguishers remain functional and reliable, since lack of servicing may lead to pressure loss, physical damage, or expired units that may fail during actual fire incidents (Novanandini et al., 2021). This study is guided by Republic Act No. 9514, also known as the Fire Code of the Philippines, particularly Section 10.2.6.9 on Portable Fire Extinguishers. This provision establishes standards for the proper selection, installation, inspection, and maintenance of portable fire extinguishers in various occupancies. In this study, RA 9514 serves as the basis for evaluating fire safety compliance in selected buildings in Sumacab Este, Cabanatuan City, focusing on extinguisher type, suitability to

fire hazards, visibility, accessibility, location, and maintenance condition.

This study aims to evaluate the appropriateness of fire extinguisher types, placement, and maintenance in selected residential, commercial, and institutional buildings in Cabanatuan City in accordance with the provisions of Republic Act No. 9514 (Philippine Fire Code of 2008), particularly Section 10.2.6.9 on Portable Fire Extinguishers. It specifically assesses whether fire extinguishers are suitable for the hazards and occupancy of each building, properly placed for accessibility and visibility, and maintained in good condition for effective emergency use, and seeks to answer the corresponding research questions.

1. What are the types of fire extinguishers present in the selected buildings in terms of Fire extinguisher classification.
2. What is the level of compliance of fire extinguisher types with the provisions of Republic Act No. 9514 in relation to the fire hazards present in the building?
3. What is the level of compliance of fire extinguisher placement with the provisions of Republic Act No. 9514 in terms of visibility, accessibility, and location along normal paths of travel and exits?
4. What is the maintenance condition of the fire extinguishers as assessed based on RA 9514 standards in terms of the compliance rate per building classification?
5. Based on the findings, to what extent do the selected buildings comply with RA 9514 regarding the selection, placement, and maintenance of portable fire extinguishers?

The scope is limited to portable fire extinguishers and excludes other fire protection systems and actual fire testing. The findings of this study may benefit building owners, administrators, occupants, the Bureau of Fire Protection, local government units, engineering students, educators, and future researchers. By identifying possible gaps in compliance, the

study may help improve fire safety practices, strengthen awareness, and support better inspection and maintenance of fire extinguishers in the community.

II. METHODS

This study employed a descriptive-evaluative research design to assess the appropriateness of fire extinguisher type, placement, and maintenance in selected buildings in Sumacab Este, Cabanatuan City. The design was used because the researchers did not manipulate variables but only observed, described, and evaluated existing conditions of portable fire extinguishers based on Republic Act No. 9514, also known as the Fire Code of the Philippines, particularly Section 10.2.6.9 on Portable Fire Extinguishers.

The study involved twenty (20) selected residential, commercial, and institutional buildings. These were selected through purposive sampling based on accessibility, availability of installed fire extinguishers, and permission from building owners or administrators. The main research instrument used was an observational checklist adapted from RA 9514, covering fire extinguisher type and selection, placement compliance, and maintenance condition.

Data were gathered through direct observation using the checklist. Prior to inspection, permission was obtained from building owners or administrators. Each building was visited on-site to determine whether fire extinguishers were appropriate for the fire hazards present, properly placed along normal paths of travel or near exits, visible and accessible, and in good working condition. Responses were recorded using a “Yes” or “No” format indicating compliance or non-compliance.

The data were analyzed using frequency count and percentage distribution to determine the level of compliance for each indicator.

% = (f / n) × 100

Where:

% = level of compliance

f = frequency of compliant or non-compliant responses

n = total number of observed buildings

Compliance scoring was used to determine the overall compliance level of each building. Each compliant item was given a score of 1, while each non-compliant item was given a score of 0. Items marked not applicable were excluded from the computation. The total score was converted into a percentage and interpreted using the following scale:

Table I. Compliance Score Interpretation Scale Interpretation

Compliance Rate	Interpretation
90% – 100%	Fully Compliant
75% – 89%	Mostly Compliant
50% – 74%	Partially Compliant
Below 50%	Non-Compliant

This method allowed the researchers to determine the level of compliance of the selected buildings in terms of fire extinguisher selection, placement, and maintenance.

III. RESULTS AND DISCUSSION

Part I- Fire Extinguisher Type and Selection

Table II presents the data on fire extinguisher type and selection. This includes whether the fire extinguishers installed in the buildings match the appropriate type based on the fire hazards present and comply with the required standards.

TABLE II. Fire Extinguisher Type and Selection Data

NO	INDICATOR	YES	NO	N/A	COMPLIANCE RATE (%)
1	The fire extinguisher present is classified as Class A (for ordinary combustibles such as wood, paper, cloth).	20	0	0	100%
2	The fire extinguisher present is classified as Class B (for flammable liquids, gases, and petroleum products).	20	0	0	100%
3	The fire extinguisher present is classified as Class C (for energized electrical equipment).	20	0	0	100%
4	The fire extinguisher present is classified as Class K (for cooking appliances involving animal or vegetable oils).	0	10	10	0%
5	The type and classification of fire extinguisher is appropriate for the specific fire hazard present in the building.	14	6	0	70%
6	The agent type (dry chemical, CO ₂ , water mist, wet chemical) is suitable for the class of fire hazard present.	13	7	0	65%
7	The building's hazard level (light, ordinary, or extra hazard) has been considered in the selection of fire extinguisher type.	16	4	0	80%
8	The fire extinguisher rating is appropriate and matches the type of fire hazard as designated by the authority having jurisdiction.	15	5	0	75%

Table II shows the compliance of selected buildings in terms of fire extinguisher type and selection under Republic Act No. 9514. The results show full compliance for Statements 1, 2, and 3, with all 20 buildings obtaining 100%. This indicates that the buildings provided fire extinguishers suitable for Class A, Class B, and Class C fire hazards, which are commonly present in residential, commercial, and institutional establishments. However, Statement 4 obtained 0% compliance, with some responses marked “No” and others “N/A.” This suggests that Class K fire extinguishers

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were either not provided or not applicable, since this type is mainly required in areas involving cooking oils and fats, such as food service establishments. Statements 5 to 8 received compliance rates ranging from 65% to 80%, showing that most buildings provided extinguishers appropriate to their hazards, although some still had issues with extinguisher type, extinguishing agent, hazard classification, and proper rating.

Overall, the findings indicate that the selected buildings generally complied with the basic requirements for fire extinguisher type and selection. However, improvements are still needed in ensuring that extinguishers fully match the specific fire hazards and required ratings of each building.

Part Ii-Placement Compliance

Table III presents the compliance scores for fire extinguisher placement. This includes whether fire extinguishers are installed in accessible, visible, and proper locations within the building.

Table Iii. Placement and Compliance

N O	INDICATOR	YE S	NO	N/ A	COMPLIANC E RATE (%)
1	The fire extinguisher is installed along normal walking paths within the building.	16	4	0	80%
2	The fire extinguisher is located near exits or escape routes for easy access during emergencies.	16	4	0	80%
3	The fire extinguisher is clearly visible and unobstructed from the normal viewpoint of building occupants.	18	2	0	90%
4	The fire extinguisher is mounted on a wall bracket, hook, or cabinet at the prescribed height (handle not exceeding 1.5 m from the floor).	6	0	14	100%
5	The fire extinguisher is placed in proximity to the most likely area of fire	19	1	0	95%

	origin or hazard within the building.				
6	The travel distance from any point in the building to the nearest fire extinguisher does not exceed the maximum allowable distance for the hazard class.	20	0	0	100%
7	The location of the fire extinguisher is marked with a visible sign or label indicating its presence.	1	19	0	5%
8	The number of fire extinguishers installed is adequate for the size and occupancy type of the building.	20	0	0	100%

Table III shows the compliance of selected buildings in terms of fire extinguisher placement and accessibility under Republic Act No. 9514. The results indicate that most establishments were generally compliant, particularly in placing fire extinguishers along normal paths of travel, near exits, visible areas, and likely fire hazard locations. Statements 4, 6, and 8 obtained 100% compliance, showing that the extinguishers were properly mounted, located within allowable travel distance, and adequate in number based on building size and occupancy. However, Statement 7 received only 5% compliance, indicating that most establishments failed to provide visible signs or labels for fire extinguisher locations. Although the extinguishers were generally accessible and properly installed, the lack of signage may make them harder to locate during emergencies, especially in crowded or smoke-filled areas.

Overall, the findings show that the selected buildings were mostly compliant in terms of fire extinguisher placement and accessibility, but improvement is needed in providing proper signs or labels to help occupants easily identify extinguisher locations during fire emergencies.

Part Iii- Maintenance Condition

Table IV presents the compliance scores for the maintenance condition of fire extinguishers. This includes pressure level, physical condition, safety pin, labels, nozzle or hose condition, and inspection or servicing records.

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Table Iv. Maintenance Condition

N O	INDICATOR	YE S	N O	N/ A	COMPLIANC E RATE (%)
1	The pressure gauge of the fire extinguisher is in the operable/green zone, indicating adequate pressure.	19	1	0	95%
2	The fire extinguisher does not show visible signs of physical damage such as dents, rust, cracks, or corrosion on the body.	20	0	0	100%
3	The nozzle, hose, or discharge horn is free from blockage, damage, or deterioration.	20	0	0	100%
4	The pull pin (safety pin) is intact, properly positioned, and secured with a tamper indicator or seal.	20	0	0	100%
5	The operating instructions/lab el on the fire extinguisher are legible and clearly visible.	20	0	0	100%
6	A valid inspection tag or maintenance record is attached to the fire extinguisher, indicating it has been serviced within the past twelve (12) months.	14	6	0	70%
7	The date of last inspection/rech arging is recorded and within the	2	18	0	10%

	required maintenance interval.				
8	The fire extinguisher has not exceeded its recommended service life or hydrostatic test date.	14	6	0	70%
9	The fire extinguisher is free from any condition that would prevent its immediate and safe operation during a fire emergency	20	0	0	100%

Table IV shows the compliance of selected establishments in terms of fire extinguisher maintenance conditions under Republic Act No. 9514. The results indicate generally high compliance in the physical and operational condition of the extinguishers. Most units had pressure gauges in the operable range, no visible damage, functional nozzles and hoses, intact safety pins and seals, readable operating instructions, and no defects that could prevent safe use during emergencies. However, lower compliance was observed in maintenance records and servicing schedules. Some establishments lacked updated inspection tags or maintenance records, while regular inspection and recharging were not consistently followed. There were also cases where extinguishers had exceeded their service life or hydrostatic test date, which may be due to delayed replacement, limited awareness, or lack of regular monitoring.

Overall, the findings show that although most fire extinguishers were physically usable and ready for immediate operation, improvements are still needed in documentation, scheduled servicing, and long-term maintenance compliance to ensure their reliability during fire emergencies.

Overall Compliance Scores of Selected Buildings

Table V presents the overall compliance scores of the twenty selected buildings across the three variables: fire extinguisher type selection, placement, and maintenance condition.

Table V. Overall Compliance Scores of Selected Buildings

BLDG.	Type	Part 1	Part 2	Part 3	Overall
1	Commercial	77.34%	74.33%	83.25%	78.31%
2	Institutional	93.75%	87.50%	82.64%	87.96%
3	Residential	93.75%	86.61%	88.89%	89.75%

The overall findings show that the selected buildings complied with the fire extinguisher requirements under Republic Act No. 9514 based on the three variables: Part I (fire extinguisher type selection), Part II (placement), and Part III (maintenance condition).

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The average compliance scores showed that residential buildings obtained the highest overall compliance rate at 89.75%, followed by institutional buildings at 87.96%, while commercial buildings recorded the lowest overall compliance rate at 78.31%. Despite the differences in scores, all categories were interpreted as Mostly Compliant.

For Part I, both institutional and residential buildings obtained the highest score at 93.75%, while commercial buildings recorded 77.34%. In Part II, institutional buildings achieved the highest compliance rate at 87.50%, followed closely by residential buildings at 86.61%, whereas commercial buildings obtained 74.33%. In Part III, residential buildings recorded the highest score at 88.89%, followed by commercial buildings at 83.25%, while institutional buildings obtained 82.64%.

Overall, the findings indicate that residential and institutional buildings demonstrated higher levels of compliance in terms of fire extinguisher selection, placement, and maintenance conditions. Commercial buildings, although still interpreted as Mostly Compliant, showed the lowest average scores and may require greater attention to improve compliance and ensure effective fire safety preparedness.

V. CONCLUSIONS AND RECOMMENDATIONS

The study evaluated twenty selected buildings in Sumacab Este, Cabanatuan City in terms of fire extinguisher type and selection, placement compliance, and maintenance condition. Results showed that most buildings used Class A, B, and C fire extinguishers with full compliance, while Class K extinguishers were limited in areas with cooking-related fire hazards. Compliance on the appropriateness of extinguisher type and agent type to fire hazards was lower, indicating that some extinguishers may not fully match the hazards present. In terms of placement, most extinguishers were properly located along normal paths of travel, near exits, and within allowable travel distance, but compliance on signage and labels was very low. For maintenance, most extinguishers were physically in good condition and operationally ready; however, inspection tags, maintenance records, and servicing documentation showed lower compliance. Overall, residential buildings obtained the highest average compliance rate (89.75%), followed by institutional (87.96%) and commercial buildings (78.31%), with all categories interpreted as Mostly Compliant. Commercial buildings recorded the lowest compliance rate, indicating the need for improved fire extinguisher selection, placement, and maintenance practices.

Conclusions

Based on the findings, the selected buildings in Sumacab Este, Cabanatuan City are generally Mostly Compliant with Republic Act No. 9514 regarding the selection, placement, and maintenance of portable fire extinguishers.

1. The selected buildings commonly contain Class A, B, and C fire extinguishers, indicating compliance with the basic fire safety requirements of RA 9514.
2. The appropriateness of extinguisher and agent types requires further improvement to ensure compatibility with the specific fire hazards and occupancy classifications of the buildings.
3. The placement of fire extinguishers is generally compliant, as most units are accessible and located near exits and along normal paths of travel. However, inadequate signage and labels remain a concern.

4. The maintenance condition of the fire extinguishers is generally satisfactory, with most units appearing functional and ready for use. Further improvements were observed in inspection records, servicing documentation, and updated recharging dates.
5. Overall, the selected buildings demonstrate a fair level of compliance with RA 9514 regarding the selection, placement, and maintenance of portable fire extinguishers, but improvements are still needed in extinguisher selection, signage, inspection records, and maintenance documentation.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. Building owners should regularly assess fire extinguishers to ensure they are appropriate for the fire hazards present, including providing Class K extinguishers in areas with cooking appliances when necessary.
2. Fire extinguishers should be installed in visible and accessible locations with proper signage for easy identification during emergencies.
3. Regular inspection and maintenance should be strictly observed, with updated inspection tags and servicing records for each fire extinguisher.
4. Commercial buildings should strengthen compliance monitoring since they recorded the lowest compliance rate among building categories.
5. The Bureau of Fire Protection should conduct more frequent inspections and fire safety information campaigns on the proper selection, placement, and maintenance of fire extinguishers.
6. Building occupants should be educated on the location and proper use of fire extinguishers to improve emergency response during fire incidents.
7. Future studies may include more buildings and other fire protection systems, such as fire alarms, sprinkler systems, emergency exits, and evacuation plans, for a more comprehensive fire safety assessment.

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REFERENCES

1. Brushlinsky, N.N. Ahrens, M. Sokolov, S.V. and Wagner, P. (2017), "World fire statistics" https://www.ctif.org/sites/default/files/ctif_report22_world_fire_statistics_2017.pdf
2. *Care and Maintenance of your Fire Extinguisher*. (n.d.). [Www.fire-Extinguisher101.com. https://www.fire-extinguisher101.com/careandmaintenance.html](https://www.fire-extinguisher101.com/careandmaintenance.html)
3. Ciotto GR, Biddinger PD, Darling RG, Fares S, Keim ME, Molloy MS, et al. "Ciotto's Disaster Medicine" 2nd ed. Philadelphia: Elsevier; 2016. https://books.google.com.ph/books?hl=en&lr=&id=GBzmCgAAQBAJ&oi=fnd&pg=PP1&ots=N-fkuhEBaP&sig=SCiGWDI7OtakEq1eNjZIOC4NLiE&redir_esc=y#v=onepage&q&f=false

4. de Bekker-Grob et al., (2015) Sample Size Requirements for Discrete-Choice Experiments in Healthcare: a Practical Guide
<https://pubmed.ncbi.nlm.nih.gov/25726010/>
5. Fic, S. (2024, July 26). *How to Maintain Fire Extinguisher | 10 Easy Methods* (2024). Safetyfic.
<https://safetyfic.com/how-to-maintain-fire-extinguisher/>
6. Garcia-Martin, R., González-Briones, A., & Corchado, J. M. (2019). SmartFire: Intelligent Platform for Monitoring Fire Extinguishers and Their Building Environment. *Sensors*, 19(10), 2390.
<https://www.mdpi.com/1424-8220/19/10/2390>
7. Novanandini, E. R., Dewi, O. C. and Nugroho, Y. S. (2021) "Evaluation of fire safety maintenance of an educational laboratory facility"
<https://iopscience.iop.org/article/10.1088/1755-1315/933/1/012029/meta>
<https://doi.org/10.1177/1744987120927206>
9. Medved, Sašo (2021) "Buildings Fires and Fire Safety"
https://link.springer.com/chapter/10.1007/978-3-030-74390-1_6
10. O'Connor, B. (2023, October 5). Fire extinguisher types. National Fire Protection Association.
<https://www.nfpa.org/news-blogs-and-articles/blogs/2023/08/01/fire-extinguisher-types>
- Philip, M. (2024). Questionnaire, Rating Scale and Checklist – how do they differ? *Methods in Psychology*, 10, 100145–100145.
<https://www.sciencedirect.com/science/article/pii/S2590260124000110>
11. Sani, S. A. (2023) "FIRE EXTINGUISHER TYPES AND APPLICATIONS" TMP Universal Journal of Research and Review Archives, 2(3).
<https://doi.org/10.69557/ujrra.v2i3.56>
- Satapathy, S. (2023, June 11). *Observation as a Tool for Collecting Data*. ResearchGate; unknown.
https://www.researchgate.net/publication/371475537_Observation_as_a_tool_for_collecting_data
12. Siedlecki, Sandra L. PhD, RN, APRN-CNS, FAAN (2020) "Understanding Descriptive Research Designs and Methods"
https://journals.lww.com/cns-journal/citation/2020/01000/understanding_descriptive_research_designs_and.4.aspx
13. Tongthong, T., Nyimin, T., & Peansupap, V. (2023). A System for Developing and Evaluating Fire Extinguisher Plans of Construction Projects in Virtual Environments. *Journal of Information Technology in Construction*, 28.
<https://itcon.org/paper/2023/10>
14. Turk, Žiga (2021) "A System for Developing and Evaluating Fire Extinguisher Plans of Construction Projects in Virtual Environments"
https://itcon.org/papers/2023_10-ITcon-Tongthong.pdf