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Design and Experimental Evaluation of a Modified 1.5-Ton Window Air Conditioner for Water-Free Cooling

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Research Article

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Abstract

This work presents the design concept of a modified 1.5-ton LG window air conditioner configured to deliver cooled air through a revised housing and front air-outlet arrangement without using water as the cooling medium. The original vapour-compression refrigeration system is retained, while modifications are made to the external body, air-discharge arrangement, and fan configuration. The objective is to document the modification and establish an experimental method for evaluating air-delivery behaviour, temperature reduction, and electrical power consumption. The prototype has been switched on for preliminary functional observation; however, a complete set of controlled measurements has not yet been recorded. The paper therefore defines the proposed test procedure and performance indicators rather than claiming quantified improvements. Inlet and outlet air temperatures, ambient conditions, relative humidity, electrical input power, and airflow rate should be measured under documented operating conditions. The results will be used to determine whether the modified arrangement provides measurable benefits compared with the original unit. This study distinguishes water-free refrigeration-based cooling from evaporative cooling, which relies on water evaporation.

Important Draft Note

This is a revised preliminary research-paper draft based on the project information and three sets of measured values supplied by the author. The prototype is described as a modified 1.5-ton LG window air conditioner that retains its original refrigeration system and uses modified housing, air-outlet, and fan arrangements. The supplied readings have been entered in the experimental table and basic averages calculated. Before submission, the author must verify and document the measurement locations, instruments and accuracy, test settings, stabilization time, date and conditions of testing, and exact AC model. No comparison with the unmodified unit, cooling-capacity result, COP, or energy-saving claim is made because the required data are not yet available.

1. Introduction

Air-cooling equipment is commonly used to improve thermal comfort in residential, educational, commercial, and industrial environments. Evaporative air coolers use water evaporation to cool air, whereas conventional air conditioners use a refrigeration cycle to remove heat from indoor air. A refrigeration-based system can therefore provide cooling without requiring water to be evaporated as part of the cooling process, although condensate may still form depending on operating conditions.

This project investigates the modification of an existing 1.5-ton LG window air conditioner. The original refrigeration system is retained, while the external housing, front air outlet, and fan arrangement are modified. The work is intended to document the design and establish a repeatable method for assessing the modified unit. The engineering value of the modification must be demonstrated through measurements rather than inferred from the appearance or initial operation of the prototype.

2. Problem Statement

The project requires a systematic assessment of whether changing the housing, outlet geometry, and fan arrangement of an existing window air conditioner affects its air-delivery characteristics and cooling performance. At present, the prototype has been operated for an initial functional check, but complete measured data are unavailable. Consequently, a controlled experimental procedure is needed before drawing conclusions about performance or energy use.

3. Objectives

- To document the construction and modification of a 1.5-ton LG window air conditioner.
- To retain and describe the original refrigeration system while recording changes to the housing, outlet, and fan arrangement.
- To measure inlet and outlet air temperatures under defined operating conditions.
- To measure electrical input power and, where equipment is available, airflow rate.
- To compare the modified configuration with the original configuration under comparable conditions, if a safe and practical baseline test can be performed.
- To idntify the limitations and possible future improvements based on experimental evidence.
- *Figure 1. AI-generated conceptual illustration of possible front, internal, side, outlet, and fan views. These are illustrative views only, not photographs of the author's actual prototype; replace them with actual labeled photographs before journal submission.*

4. Prototype Description

The prototype is based on a used LG window air conditioner in the 1.5-ton capacity class, obtained from a second-hand market in non-operational condition and subsequently modified. The exact model number is unavailable. According to the project description, the original refrigeration system is retained and the external body, front air outlet, and fan arrangement are modified. The cooling process remains refrigeration-based; water is not used as the cooling medium. The model number, nameplate ratings, refrigerant type, compressor rating, fan specifications, outlet dimensions, and detailed fabrication steps should be recorded if they can be recovered from the unit or established by inspection.

5. Materials and Methods

5.1 Equipment and instruments

- Modified 1.5-ton LG window air conditioner.
- Calibrated digital thermometers or temperature probes for inlet, outlet, and ambient air.
- Suitable true-power meter or power analyser rated for the unit's electrical supply.
- Anemometer or airflow-measuring arrangement, if available.

- Relative-humidity meter, if available.
- Timer and a data-recording sheet.

5.2 Test procedure

1. Record the AC model number, rated voltage, rated current, rated input power, refrigerant information if available, and all physical modifications.
2. Inspect the prototype and ensure that electrical connections, guards, mounting, drainage, and airflow paths are safe. Testing and internal electrical work should be carried out by a qualified person.
3. The prototype was tested in a room measuring 20 ft × 15 ft, with the thermostat set to 18°C, and operated for approximately 8 hours. Record the room height, door/window condition, fan setting, ambient temperature, and relative humidity if available. Clarify whether the 8-hour period was continuous and whether the three readings were taken at different times during that period.
4. Operate the unit until readings are reasonably stable. Record the stabilization period and do not assume a fixed period without observing the system.
5. Measure inlet-air temperature and outlet-air temperature at documented locations. Avoid placing the sensor where it touches a coil or is directly affected by an unintended heat source.
6. Measure electrical input power with an appropriately rated instrument. Do not open or touch energized electrical parts.
7. Measure airflow at a documented outlet plane if an appropriate instrument is available. Record the instrument and measurement method.
8. Repeat each test at least three times where practical, under comparable conditions, and report individual readings as well as the mean and variation.
9. If comparing with the original AC arrangement, keep ambient conditions, thermostat setting, operating mode, and measurement locations as similar as possible.

5.3 Data to be recorded

Table 1
Experimental readings recorded for the modified prototype.

Run	Ambient temp. (°C)	Inlet temp. (°C)	Outlet temp. (°C)	Input power (W)
1	30	30	18	1210
2	31	30	18	1195
3	31	29	17	1190

Additional observations: relative humidity (%), airflow rate (m³/h), thermostat setting, fan setting, time after start, room dimensions, outdoor/indoor test conditions, and any abnormal noise, vibration, frost, or condensate.

5.5 Recorded test conditions

The author reports that testing was carried out in a room measuring 20 ft × 15 ft, the prototype was operated for 8 hours, the AC thermostat setting was 18°C, electrical power was measured with a wattmeter, and the cumulative energy-meter reading after the test was 9.6 kWh. The exact AC model number is unavailable. Before submission, specify the room height, door/window condition, wattmeter/energy meter make and model and accuracy, temperature-sensor details and locations, fan setting, whether the 8-hour operation was continuous, and when the three temperature/power readings were taken.

5.4 Data analysis

The measured air-temperature difference is calculated as $\Delta T = T_{inlet} - T_{outlet}$. For the three recorded runs, ΔT = 12°C, 12°C, and 12°C; the arithmetic mean is 12.00°C. The mean electrical input power is (1210 + 1195 + 1190)/3 = 1198.33 W. The mean ambient temperature is 30.67°C, mean inlet temperature is 29.67°C, and mean outlet temperature is 17.67°C. The author reports a cumulative energy-meter reading of 9.6 kWh over 8 hours, which corresponds to an average power of 9.6 kWh ÷ 8 h = 1.20 kW (1200 W). This is close to the mean of the three power readings (1198.33 W), but meter accuracy and the timing of the readings should be documented. These calculations assume the supplied readings were taken with appropriate instruments and consistent measurement locations. The air-temperature difference alone is not a measure of total cooling capacity or COP.

6. Results and Discussion

Table 2
summarizes the arithmetic means calculated from the three supplied readings. The mean inlet-to-outlet air-temperature difference was 12.00°C. These averages are descriptive of the recorded runs only; the test conditions and instrument details should be reported alongside them.

Parameter	Mean value
Ambient temperature	30.67°C
Inlet air temperature	29.67°C
Outlet air temperature	17.67°C
Input power	1198.33 W
Inlet-to-outlet temperature difference	12.00°C
Cumulative energy over 8 hours (reported meter reading)	9.6 kWh
Average power from 8-hour energy reading	1.20 kW (1200 W)

Table 2. *Mean values calculated from the three recorded runs.*

The prototype was tested in a room measuring 20 ft × 15 ft, with the AC thermostat set to 18°C, and was operated for approximately 8 hours. Electrical input power was measured using a wattmeter, and the

author reports a cumulative energy-meter reading of 9.6 kWh after the 8-hour test. The three recorded runs are presented in Table 1. The ambient temperatures were 30, 31, and 31°C; inlet-air temperatures were 30, 30, and 29°C; outlet-air temperatures were 18, 18, and 17°C; and measured input powers were 1210, 1195, and 1190 W. For the three recorded runs, the mean ambient temperature was 30.67°C, mean inlet-air temperature was 29.67°C, mean outlet-air temperature was 17.67°C, and mean input power was 1198.33 W. The inlet-to-outlet air-temperature differences ($T_{inlet} - T_{outlet}$) were 12°C in all three runs, giving a mean measured temperature difference of 12°C. The reported cumulative energy reading of 9.6 kWh over 8 hours corresponds to an average energy-use rate of 1.20 kW. This is broadly consistent with the mean power reading of 1198.33 W, subject to meter accuracy and whether the recorded values cover the same operating period. These data alone do not establish improved performance, energy savings, or a coefficient of performance. Measurement locations, instrument make/model and accuracy, operating settings, stabilization time, and test conditions should be documented to make the experiment reproducible.

Do not insert estimated or illustrative numbers as if they were experimental results. If a measurement cannot be taken, state the limitation explicitly.

7. Limitations

- The exact AC model number and full component specifications are unavailable because the used unit was obtained from a second-hand market in non-operational condition.
- The prototype has undergone only an initial functional check; controlled performance measurements are pending.
- The precise geometry and dimensions of the modified housing, outlet, and fan arrangement must be documented.
- A reliable comparison with the original configuration requires comparable test conditions and appropriate instruments.
- Safety, refrigerant handling, and electrical compliance must be considered before extended testing.

8. Conclusion

A modified 1.5-ton-class LG window air conditioner configured for water-free, refrigeration-based cooling was evaluated in a room measuring 20 ft × 15 ft, with the thermostat set to 18°C, over an approximately 8-hour operating period. Electrical input power was measured using a wattmeter, and the author reports a cumulative energy-meter reading of 9.6 kWh after the test. Across three recorded runs, the mean inlet-to-outlet air-temperature difference was 12°C and mean measured input power was 1198.33 W. The reported 9.6 kWh over 8 hours corresponds to an average power of 1.20 kW, broadly consistent with the mean power readings. The exact model number was unavailable because the used unit was obtained from a second-hand market in non-operational condition. These values are limited to the reported test conditions and do not, by themselves, demonstrate an improvement over the original configuration or quantify cooling capacity, energy efficiency, or energy savings. Further work should document the

instrument specifications and measurement locations, repeat the tests under controlled conditions, measure airflow if possible, and compare the modified prototype with the original unit under comparable conditions.

Declarations

Ethics, Consent to Participate, and Consent to Publish

Ethics, Consent to Participate, and Consent to Publish declarations: not applicable.

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Author Contribution

Author Contributions StatementP. S. Thakare conceptualized the research, developed and modified the prototype, conducted the experimental testing, collected and analyzed the experimental data, and prepared the original manuscript. The author reviewed and approved the final version of the manuscript and takes responsibility for the integrity of the work.

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Data Availability

The experimental data supporting the findings of this study were generated during testing of the modified 1.5-ton window air conditioner prototype. The recorded data include ambient temperature, inlet and outlet air temperatures, electrical input power, and energy consumption. The data are included in the manuscript. Additional details may be requested from the corresponding author, subject to availability.

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Figures

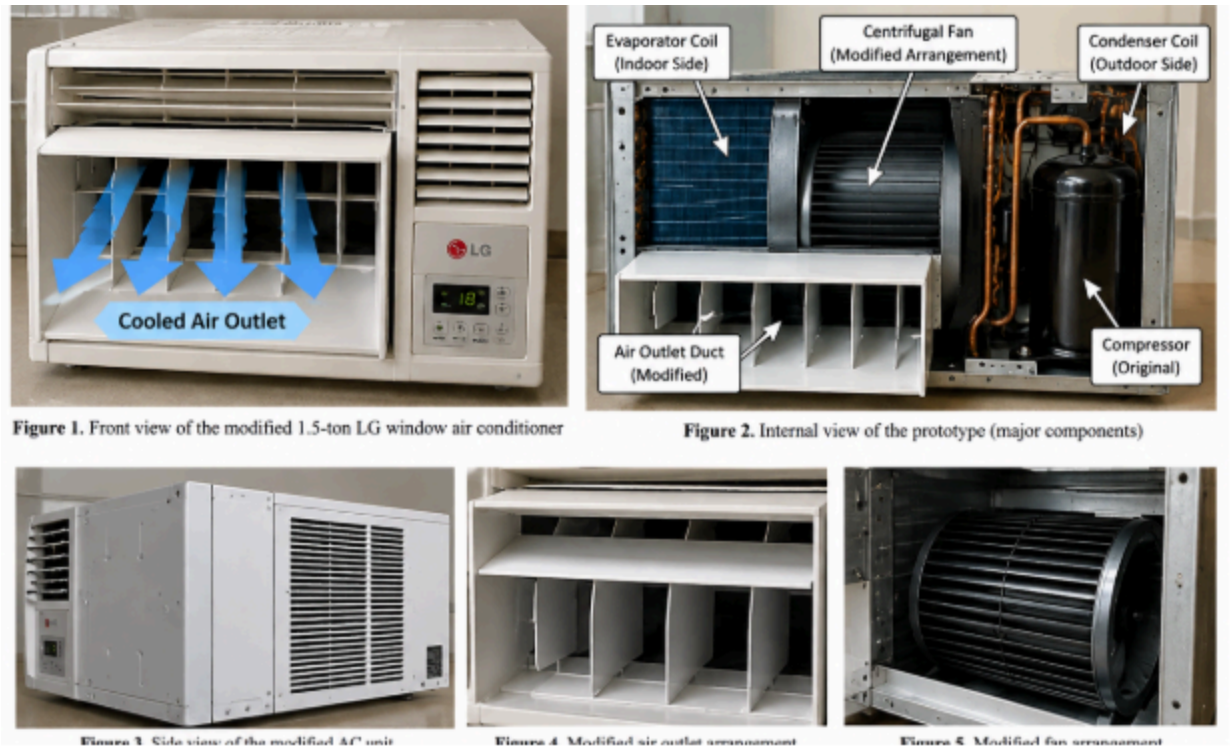


Figure 1. Front view of the modified 1.5-ton LG window air conditioner

Figure 2. Internal view of the prototype (major components)

Figure 1

AI-generated conceptual illustration of possible front, internal, side, outlet, and fan views. These are illustrative views only, not photographs of the author's actual prototype; replace them with actual labeled photographs before journal submission.