

Assessment of sports training environments and safety conditions in university basketball facilities: Implications for athlete health and well-being in Mongolia

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Abstract- The Law of Mongolia on Physical Education and Sports and related legal frameworks establish essential guidelines for sports infrastructure. However, from a social and educational perspective, a sports facility is not merely a physical structure but a critical environment that influences student-athletes' overall well-being, training experiences, and institutional safety culture. This study evaluates the structural and environmental safety conditions of indoor university sports halls used for basketball training in Ulaanbaatar and discusses their broader social implications for sports education quality. Using empirical instruments—including lux meters, digital thermometers, hygrometers, and laser measuring devices—we assessed key parameters such as air quality, thermal comfort, lighting uniformity, fire safety preparedness, and emergency evacuation clearance across selected university halls. The findings indicate that several university facilities exhibit suboptimal lighting levels, inconsistent ventilation, and restricted safety clearance zones, which may compromise athletes' psychological comfort and heighten spatial anxiety. From a management perspective, deficiencies in designated emergency exits and smoke detection infrastructure highlight a pressing need to strengthen institutional safety cultures. We conclude that optimizing the physical sub-environments of university sports halls is a social determinant of health equity, vital for ensuring students' constitutional rights to safe learning, sustained athletic participation, and optimal well-being.

Keywords: Sports raining environment, Athlete well-being, Safety culture, Sports socialization, University basketball

1. INTRODUCTION

The physical environment of university sports facilities extends far beyond technical engineering parameters and architectural dimensions; it serves as a foundational space for student socialization, physical education quality, and overall psychosocial well-being. Within contemporary higher education, ensuring safe, healthy, and supportive sports environments aligns directly with the democratic and social mandates established by the Law of Mongolia on Physical Education and Sports [1], the Law on Hygiene [2], and the Law on Protecting Students' Health and Safety in the School Environment 2024 [3]. These comprehensive legislative frameworks explicitly emphasize that academic leadership and school administrators hold both an educational and legal responsibility to foster institutional spaces that support students' physical development without compromising their health status, dignity, or subjective sense of safety.

Under the conceptual frameworks of Sports Environment Theory and the Ecological Model of Health, a training facility does not function merely as a passive backdrop for

physical exertion. Instead, it constitutes a dynamic micro-system where physical and environmental stimuli directly interact with human behavior, intrinsic motivation, and mental health. This perspective aligns directly with contemporary academic discourse in the region, which argues that optimizing institutional environments and physical settings within higher education is a prerequisite for achieving broader student development and long-term educational equity [4]. While the World Health Organization[5] frames general hygiene as a set of baseline practices preserving life quality, in university settings, environmental hygiene represents a vital component of the student-athlete's institutional rights.

Suboptimal indoor conditions—such as inadequate illumination, fractured ventilation, or hazardous boundary spaces—do not merely hinder athletic performance; they fundamentally disrupt the quality of sports education, reduce physical activity satisfaction, and erode the proactive institutional safety culture that should protect student populations. Recent empirical findings in urban higher education settings across Ulaanbaatar further substantiate this, demonstrating that strategic structural remediation and sustainable resource allocation toward physical education facilities are foundational to ensuring health equity and safeguarding students' academic and physical well-being [6].

Basketball coaching and regular athletic training involve highly intensive, complex motor behaviors, including rapid tactical shifts, sudden accelerations, deceleration, and frequent high-impact physical contact. Consequently, structural elements like spatial lighting uniformity, thermal stability, and court clearance distances are not just arbitrary regulatory metrics—they are critical environmental determinants of an athlete's visual coordination, focus, and psychological comfort. Sociological and pedagogical research in sports education demonstrates that when students perceive their training environments as physically hazardous or uncomfortable, their sports socialization declines sharply. This environmental stress often manifests as heightened spatial anxiety, leading to higher dropout rates from varsity programs, lower physical activity engagement, and decreased subjective well-being.

Furthermore, the physiological response to high-intensity exercise modifies how human bodies interact with indoor spaces. According to exercise physiology within a social-ecological context, rigorous basketball training significantly intensifies respiratory demands, expanding pulmonary ventilation and minute volumes. For student-athletes training in poorly ventilated, overly humid, or neglected indoor arenas, this physiological shift dramatically increases their susceptibility to localized airborne discomfort, inducing premature physical fatigue and severe cognitive distraction. Therefore, evaluating the environmental integrity and safety compliance of university sports spaces in Ulaanbaatar provides essential social insights into how institutional infrastructure conditions directly affect student health rights, educational equity, and the sustainability of safe sports participation across Mongolia.

2. METHODS

2.1 Measurement Results of Physical Environmental Indicators in Sports Halls

The research evaluated physical parameters within the sports halls of the Mongolian University of Science and Technology (MUST), Mongolian National University of Education (MNUE), National University of Mongolia (NUM), University of Finance and Economics (UFE), Etugen University, Citi University, and M Bank Arena.

The following parameters were measured in detail:

- Lighting (lux meter)
- Temperature (digital thermometer)
- Humidity (hygrometer)
- Spatial dimensions (laser measuring device)

In addition, the following aspects were assessed through observation and evaluation:

- Availability of emergency exits
- Fire safety conditions
- Presence of ventilation systems
- Safety clearance distances

Air Pressure & Ventilation Quality: Air pressure was measured in each sports hall in the morning, afternoon, and evening, and compared with the normal atmospheric range (950–1050 hPa). The results showed that air pressure in all sports halls remained within the standard range (Figure 1), indicating that the overall indoor ventilation conditions were generally adequate. However, since pressure fluctuations are directly related to ventilation frequency and the training load of basketball athletes, continuous monitoring is required.

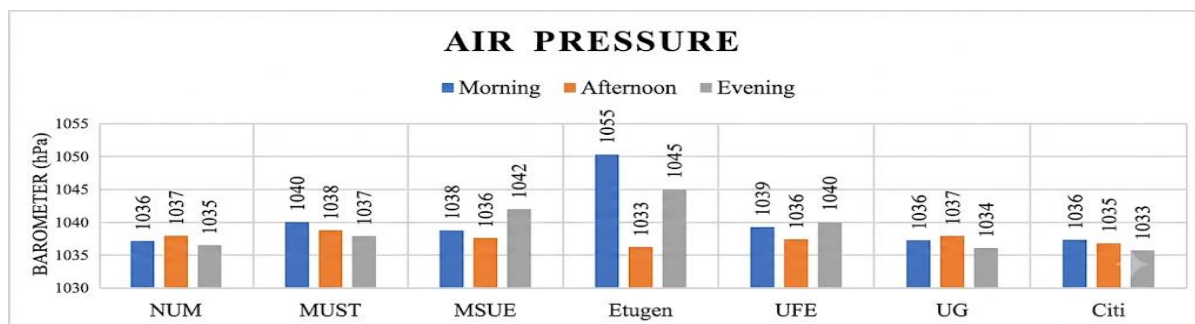


Figure 1. Air Pressure

Air pressure should be close to the atmospheric pressure of the outdoor environment. To ensure this, sports halls must be equipped with ventilation systems capable of exchanging air at least three times per hour, allowing users to receive approximately 40–60 m³ of fresh air. If ventilation is insufficient, after four hours of training the concentration of carbon dioxide in the air can rise to 3.5% (standard: 0.1%), and dust concentration may sharply increase beyond 0.15 g/m³ (standard: not exceeding 0.15 g/m³).

Lighting and Visual Performance. Measurements of sports hall lighting were compared with training standards (300 lux) and competition standards (750–1000 lux). A combination of natural and artificial lighting is permitted in sports halls; however, for HDTV live broadcasting, illumination should reach 1200–1500 lux, with low glare (UGR ≤ 22) and uniform distribution across the court.

The measurements showed the following results:

- National University of Mongolia: 151 lux (morning), 106 lux (afternoon), 151 lux (evening)
- Mongolian University of Science and Technology: 262 lux (morning), 103 lux (afternoon), 260 lux (evening)
- Mongolian National University of Education (Hall 10-106): 188 lux (morning), 173 lux (afternoon), 242 lux (evening)
- Etugen University: 151 lux (morning), 276 lux (afternoon), 192 lux (evening)
- University of Finance and Economics: 106 lux (morning), 162 lux (afternoon), 192 lux (evening)
- Citi University: 270 lux (morning), 316 lux (afternoon), 480 lux (evening)

In the sports halls of the National University of Mongolia, the Mongolian University of Science and Technology, and the Mongolian National University of Education, morning and evening lighting levels were relatively stable; however, reduced lighting during daytime may be associated with uneven distribution of artificial lighting. Only the Citi University sports hall met the training lighting standards, while the other university sports halls were below the required level and therefore require improvement.

In contrast, the M Bank Arena recorded 877 lux (morning), 702 lux (afternoon), and 934 lux (evening), fully meeting competition lighting standards.

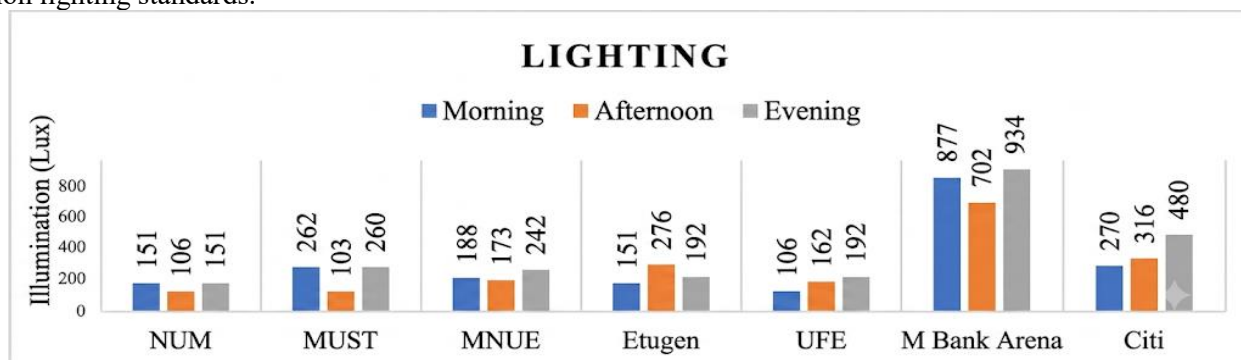


Figure 2. Lighting

Lighting standards must be maintained regardless of the time of day, ensuring the avoidance of glare and providing optimal visual performance for participants. Windows and light fixtures must be protected with nets or grilles to ensure participant safety.

Air Humidity and Spatial Safety: The relative humidity (RH) of the surveyed sports halls was evaluated against the standard range of 40–60%. Relative humidity (RH) is defined as the ratio of the amount of water vapor present in the air to the maximum amount of water vapor the air can hold at a given temperature. In simple terms, it indicates how “humid” or “dry” the air is.

The experimental results showed that most of the surveyed sports halls were within the acceptable range; however, in some measurements at the Mongolian University of Science and Technology, Mongolian National University of Education, and Etugen University, humidity levels exceeded 65%, indicating moisture accumulation and insufficient ventilation. Such conditions increase the risk of slipping in sports environments, mold growth, and accelerated wear of equipment. In the case of the Mongolian University of Science and Technology, these findings were confirmed in practice, as visible moisture-related damage was observed, including peeling paint on walls and corners and the presence of mold growth.

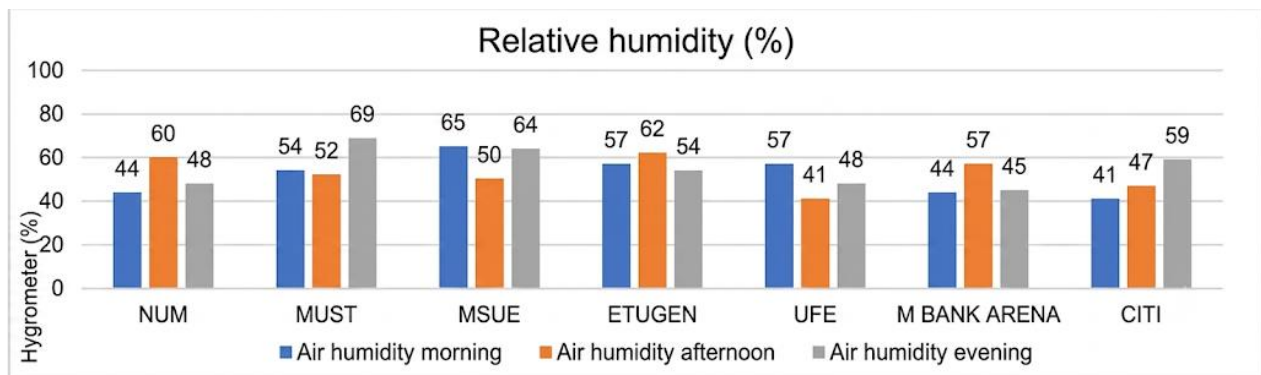


Figure 3. Air Humidity

Air humidity levels of 40–60% RH in sports halls provide comfortable conditions for athletes, ensure normal ball handling grip, and reduce slipping on the playing surface, while also having a positive effect on the lifespan of equipment. In contrast, excessively dry air (<30% RH) can negatively affect the skin and respiratory system and cause discomfort to the eyes, whereas excessively humid air (>65–70% RH) increases the risk of slipping, mold growth, and corrosion of equipment.

Thermal Conditions: The measured temperature values of the sports halls were compared against the standard range of 17–24°C. Sports hall temperature refers to the thermal condition of indoor air, determined by the kinetic energy of molecules within the environment. In simple terms, it represents the level of warmth or coldness suitable for physical exercise in a sports hall.

The measurement results indicate that most sports halls fluctuate within the acceptable standard range. Specifically, in some facilities, temperatures tend to drop below 16°C in the morning and evening, while during daytime hours the temperature increases and becomes more stable. This fluctuation may either reduce or increase the risk of muscle injury and fatigue during training sessions.

The classification of sports hall temperature is as follows:

- Above 28°C: excessively high temperature, associated with overheating, fatigue, and dehydration risk;
- Below 16°C: excessively low temperature, increasing the risk of muscle stiffness and injury;
- 17–24°C: standard temperature range, providing optimal muscle conditions, high training efficiency, and a comfortable environment [7].

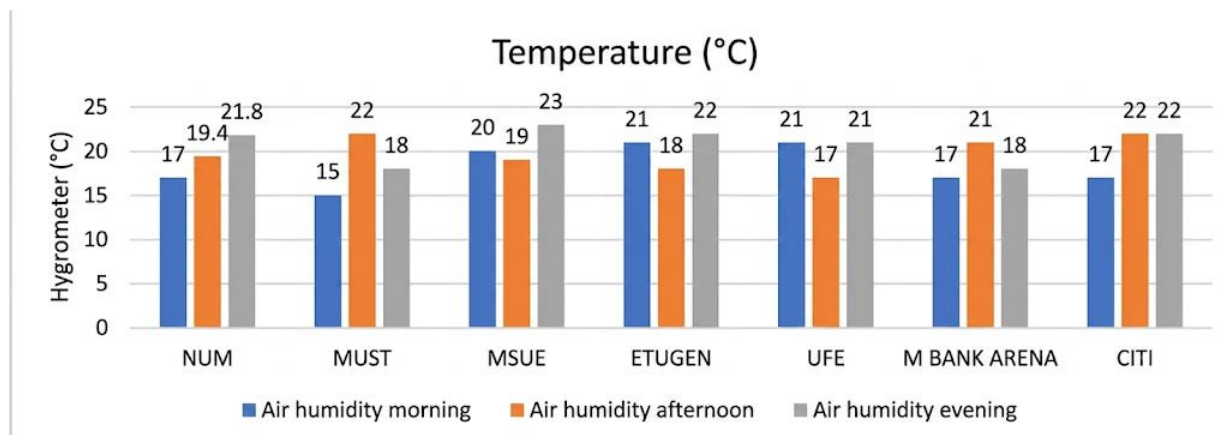


Figure 4. Temperature

2.2 Safety Assessment Indicators of Sports Halls

Sports hall safety encompasses the set of standards, regulations, and preventive measures designed to ensure the safety of athletes, coaches, staff, and spectators within indoor sports facilities. In basketball training environments, where high-intensity movements, rapid acceleration and deceleration, jumping, and frequent physical contact occur, the organization of safety measures is directly associated with training quality and injury prevention.

A. Emergency Exits

Emergency exits and evacuation signage must be clearly visible and designed to enable the rapid evacuation of a large number of occupants (Physical Education and Sports Law, 2024). Beyond architectural considerations, emergency egress represents a fundamental safety requirement for the rapid and secure evacuation of athletes, coaches, spectators, and staff during emergency situations. Given the dynamic and densely occupied nature of basketball training and competition environments, exit design plays a critical role in mitigating safety risks.

According to Mongolian building regulations and standards, the following requirements are specified for emergency exits in sports facilities:

- **Main entrance width:** The primary entrance must be no less than 4.0 meters wide to prevent congestion and ensure efficient evacuation during both training and competition settings.
- **Exit configuration:** Exits must provide direct access to corridors, changing rooms, rest areas, and other functional zones.
- **Number of exits:** The number of exits must be increased proportionally with the size of the facility and user capacity to ensure adequate evacuation flow. All exits must be clearly marked, properly illuminated, and equipped with outward-opening doors with minimal locking resistance[8].
- **Exit orientation:** Exit routes must be strategically oriented to facilitate the fastest and safest evacuation path during emergency conditions.

Among the surveyed facilities, the sports halls of M Bank Arena and the Mongolian University of Science and Technology are equipped with compliant emergency exit systems. In contrast, the sports halls of the National University of Mongolia, Mongolian National University of Education, Citi University, and Etugen University lack designated emergency exits, indicating non-compliance with essential safety requirements.

B. Fire Safety and Emergency Preparedness

In basketball training environments, fire safety must be integrated as a core component of risk management. International safety standards recommend that fire extinguishers be installed at intervals not exceeding 30 meters within sports halls to ensure immediate accessibility (Physical Education and Sports Law, 2024). In addition, fire alarm systems and smoke detectors are essential for early hazard detection and rapid emergency response, thereby reducing potential fire-related risks during training activities.

Furthermore, fire hose reels and pressurized water supply systems are required in sports facilities to ensure effective suppression capability in emergency situations (Physical Education and Sports Law, 2024).

Among the surveyed facilities, the sports halls of the Mongolian University of Science and Technology and Citi University were equipped with one fire safety information board, two fire extinguishers, and two fire hose systems, thereby meeting the minimum required standards. However, the National University of Mongolia, Mongolian National University of Education, Etugen University, and University of Finance and Economics demonstrated inadequate compliance, as fire extinguishers and water supply systems were not properly installed according to standards. Moreover, smoke detection systems were either absent or not fully implemented in most university sports halls, indicating insufficient fire safety compliance. In contrast, M Bank Arena fully complies with all fire safety requirements.

C. Safety Clearance Distance

Basketball is a high-intensity sport characterized by rapid directional changes, jumping, physical contact, collisions, and falls. Therefore, safety clearance around the playing court is a critical determinant of training quality and injury prevention. According to international and national building standards, a minimum unobstructed clearance of 2 meters around the playing area is required [9], significantly reducing the risk of athlete injuries.

During official competitions, spectator seating and barriers must be positioned at least 3 meters from the boundary lines of the court [10]. This requirement is also applicable to training environments, as it ensures unobstructed movement and allows coaches to provide tactical instruction without interference.

The measured safety clearance distances in the surveyed sports halls were as follows:

- National University of Mongolia: 1.45 m
- Etugen University: 1.20 m
- University of Finance and Economics: 0.78 m
- Citi University: 0.80 m

These values indicate that the surveyed facilities do not meet the minimum required safety clearance standards, thereby increasing the risk of player collision and injury.

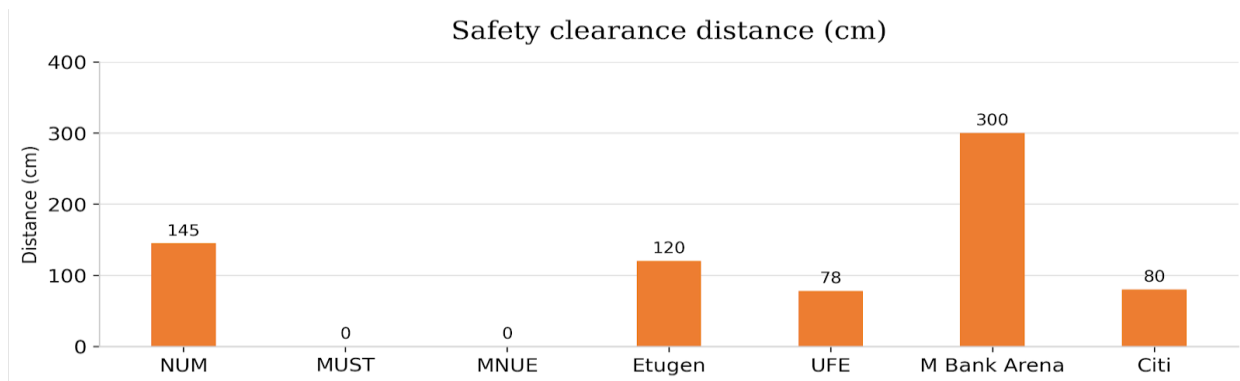


Figure 4. Safety Clearance Distance

In contrast, the sports halls of the Mongolian University of Science and Technology (MUST) and the Mongolian National University of Education (MNUE) demonstrate a safety clearance of 0 cm, as tables are placed directly adjacent to the boundary line of the playing court. This configuration presents a significant safety risk for athletes during training and competition.

In comparison, M Bank Arena meets the 3-meter safety clearance standard, providing a safe and well-optimized environment for both basketball training and competitive events.

3. DISCUSSION

The empirical evaluations gathered across Ulaanbaatar's university sports halls underscore a broader social reality: optimizing university sports infrastructure is fundamentally an issue of student health rights, social equity, and educational quality.

When university halls present suboptimal illumination, inadequate ventilation, or zero boundary clearance, the problem extends beyond technical facility non-compliance. These environments act as structural barriers that diminish the quality of sports education and limit healthy sports socialization. According to student well-being paradigms, safe physical environments foster positive psychological comfort, reduce spatial anxiety, and encourage continuous athletic participation. Conversely, resource-constrained environments can lead to uneven educational experiences and raise concerns regarding health equity among students attending different public and private institutions.

Therefore, enhancing university sports hall management is an essential step toward building a robust institutional safety culture. Upgrading lighting grids, maintaining thermal and humidity stability, and strictly preserving court clearance zones should be prioritized by university administrations. These actions do not simply fulfill architectural or hygiene regulations; they represent a necessary investment in protecting students' rights to a safe, healthy, and empowering learning environment.

4. CONCLUSION

This study systematically evaluated the implementation of health and safety standards within selected university sports halls in Ulaanbaatar, transitioning from a purely technical facility assessment to a holistic social science perspective. By analyzing critical indicators such as air quality, thermal stability, lighting uniformity, emergency egress, and courtside clearance, the research highlights how the physical infrastructure of higher education institutions directly intersects with student-athletes' psychosocial well-being, training experiences, and institutional safety culture.

The empirical findings reveal significant disparities between standard regulatory frameworks and the operational realities of university sports facilities. While baseline indoor air pressure and temperature fluctuations generally remain within acceptable ranges, critical micro-environmental sub-factors—specifically lighting stability and relative humidity control—vary dramatically. With the notable exception of modern reference facilities like M Bank Arena, the majority of university halls fail to meet the required 300 lux baseline for training lighting, which potentially elevates spatial anxiety, diminishes visual performance, and induces cognitive fatigue during high-intensity basketball coaching.

Furthermore, from a structural risk management perspective, the widespread deficiencies in designated emergency exits, automated smoke detection, and standardized fire suppression infrastructure reflect an underdeveloped institutional safety culture. This risk is heavily compounded by the critical lack of compliant safety clearance zones around basketball courts, with multiple major universities exhibiting clearances well below the 2-meter standard, or even 0 cm due to immediate physical obstructions. Within the framework of Sports Environment Theory and the Ecological Model of Health, these restricted physical boundaries do not merely present injury hazards; they function as environmental stressors that limit movement freedom, increase subjective vulnerability, and degrade the overall quality of sports education.

In conclusion, the socio-educational value of university sports cannot be maximized without fundamentally addressing these infrastructural deficits. Fulfilling and monitoring health and safety standards in sports halls must not be dismissed as a mere administrative or maintenance issue; rather, it should be recognized as a core determinant of student health rights and educational equity. Higher education administrators and policymakers in Mongolia must prioritize strategic investments in facility modernization—focusing on uniform illumination, proactive ventilation lifecycle management, and the strict elimination of courtside hazards. Fostering such supportive, highly compliant, and secure sports environments is essential to safeguard students' constitutional rights to safe learning, enhance long-term athletic participation, and cultivate a robust culture of well-being across the national sports socialization landscape.

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