









Exploring the Food Quality System (SQF) in Plastic Cap Manufacturing: A Scientific and Practical Approach

Exploración del Sistema de Calidad de Alimentos (SQF) en la fabricación de tapas plásticas: enfoque científico y práctico

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Abstract


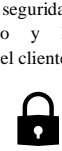





The Food Safety Quality System. (SQF) is a critical tool for ensuring the safety and quality of food products. However, its application goes beyond the food industry. The Food Quality System (SQF) is a necessary tool to ensure the safety and quality of food products. Therefore, this study focuses on the investigation of SQF in the specific context of plastic cap manufacturing. The unique challenges faced by this sector in terms of food safety, product quality, and regulatory compliance are examined, and a practical framework for implementing SQF in plastic cap manufacturing operations is proposed, with the goal of improving product safety and customer satisfaction. It is concluded that the Food Quality System (SQF) is essential to guarantee food safety and quality in the manufacture of plastic lids, helping to mitigate contamination risks, improve processes and meet consumer expectations. However, there is variability in SQF compliance among companies, with some showing high compliance and others requiring improvements, a clear correlation between SQF compliance and product quality indicates that rigorous standards result in higher quality products and customer satisfaction; The choice of rigorous, standardized criteria to assess compliance and quality is essential. Despite the good performance in implementing the SQF, there are always opportunities for continuous improvement through the identification of critical areas and the adoption of corrective actions.

Objectives	Methodology	Conclusions
To implement the SQF in plastic caps manufacturing operations, with the aim of improving product safety and customer satisfaction.  	Variables play a key role in understanding and evaluating the implementation of such a system.   	Companies that implement SQF standards more rigorously tend to produce higher quality plastic closures, which translates into higher customer satisfaction.  

Quality, Food, Application

Resumen

El Sistema de Calidad en seguridad de Alimentos con las siglas en ingles. (SQF) es una herramienta fundamental para garantizar la seguridad y la calidad de los productos alimenticios. Sin embargo, su aplicación va más allá de la industria alimenticia. El Sistema de Calidad de Alimentos (SQF) es una herramienta necesaria para garantizar la seguridad y la calidad de los productos alimenticios. Por lo que este estudio se centra en la investigación del SQF en el contexto específico de la fabricación de tapas plásticas. Se examinan los desafíos únicos que enfrenta este sector en términos de seguridad alimentaria, calidad del producto y cumplimiento normativo, por lo que se propone un marco práctico para implementar el SQF en las operaciones de fabricación de tapas plásticas, con el objetivo de mejorar la seguridad del producto y la satisfacción del cliente. Se concluye que el Sistema de Calidad de Alimentos (SQF) es imprescindible para garantizar la seguridad alimentaria y la calidad en la fabricación de tapas plásticas, ayudando a mitigar riesgos de contaminación, mejorar procesos y satisfacer las expectativas de los consumidores. Sin embargo, existe variabilidad en el cumplimiento del SQF entre las empresas, con algunas mostrando alto cumplimiento y otras requiriendo mejoras, una clara correlación entre el cumplimiento del SQF y la calidad del producto indica que estándares rigurosos resultan en productos de mayor calidad y satisfacción del cliente; la elección de criterios rigurosos y estandarizados para evaluar el cumplimiento y la calidad es esencial. A pesar del buen desempeño en la implementación del SQF, siempre hay oportunidades de mejora continua a través de la identificación de áreas críticas y la adopción de acciones correctivas.

Objetivos	Metodología	Conclusiones
Implementar el SQF en las operaciones de fabricación de tapas plásticas, con el mejoramiento de la seguridad del producto y la satisfacción del cliente.  	Las variables desempeñan un papel fundamental en la comprensión y evaluación de la implementación de dicho sistema.   	Las empresas que implementan de manera más rigurosa los estándares SQF tienden a producir tapas plásticas de mayor calidad, lo que se traduce en una mayor satisfacción del cliente.  

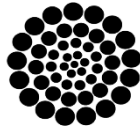
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Introduction

Food safety and product quality are paramount concerns at all stages of the food supply chain; that is why in this sense, the Food Quality System (SQF) is an internationally recognized standard to ensure the integrity and safety of food; but its application beyond the food industry, As is the case with the manufacture of plastic caps, it has received less attention.

This study seeks to address this gap by investigating how SQF adapts to and benefits the manufacture of plastic caps.

Challenges in Plastic Cap Manufacturing

The manufacture of plastic lids presents unique challenges in terms of food safety and product quality, with reference to cross-contamination, chemical migration and improper handling which are just some of the potential risks that need to be addressed; additionally, government regulations and consumer expectations demand a proactive approach to ensure regulatory compliance and customer satisfaction. (González Peña, 2023).



Figure 1
Plastic Cap Making Process

Source [Authors' own creation by Canva 2024]

Box 2

Table 1

Challenges in the production of plastic lids

Challenges in Plastic Cap Manufacturing	Preventive Measures
Cross-contamination	- Implementation of cleaning and disinfection protocols to prevent cross-contamination between materials.
Migration of chemicals	- Regular training of staff in hygiene practices and safe handling of materials and products. - Implementation of quality controls at every stage of the manufacturing process to detect and prevent improper handling.
Improper handling	- Regular training of staff in hygiene practices and safe handling of materials and products. - Implementation of quality controls at every stage of the manufacturing process to detect and prevent improper handling.
Government Regulations and Consumer Expectations	- Detailed record keeping demonstrating compliance with regulations and quality standards. - Constant monitoring of market trends and consumer demand to adapt and meet their expectations.

Source: [Authors' own creation]

During the process of producing, storing, or handling the materials used in the manufacture of the lids, there is a risk of cross-contamination with materials not suitable for food contact, because plastic materials contain additives and chemical compounds that have the potential to migrate into the food in contact with the plastic lids. which is accelerated by factors such as the temperature and acidity of food (González Peña, 2023). In addition, improper handling of plastic materials and caps can introduce physical, chemical, or biological contaminants into the final product, hence government regulations and meeting consumer expectations for product safety and quality is necessary to maintain consumer confidence and competitiveness in the industry. (Acuña Vélez, 2021)

The role of the Food Quality System (SQF)

The Food Quality System (SQF) plays an essential role in the manufacture of plastic lids by providing a comprehensive framework to ensure product safety and quality, in this context, the SQF is presented as an internationally recognized standard that addresses the specific challenges related to food safety in this area of production.

The implementation of SQF in the manufacture of plastic caps implies the adoption of its principles and best practices, which allows companies to establish quality management systems that cover all stages of the process, from the selection of raw materials to the delivery of the final product; in this sense, SQF acts as a precise approach that seeks to ensure safety, Quality, and compliance in all areas of production. (Acuña Vélez, 2021)

One of the key aspects of SQF is the implementation of strict hygiene controls, including the implementation of proper cleaning and disinfection procedures to prevent cross-contamination and ensure product safety. (Palacios Bautista, 2014).

In addition, SQF promotes the traceability of the materials used, which means that companies must be able to trace and document the origin of each component used in the manufacturing process.

Another critical aspect of SQF is the training of personnel in safe manufacturing practices. This ensures that the work team is well prepared to handle materials safely and prevent contamination hazards. (González Peña, 2023).

Ultimately, the implementation of SQF in the manufacture of plastic caps not only ensures compliance with regulations and consumer expectations, but also improves the competitiveness of companies in the global market by promoting consumer confidence and operational efficiency (Palacios Bautista, 2014).

Box 3

Table 2

Comparison between Plastic Cap Manufacturing Challenges and Food Quality System (SQF) Preventive Measures.

Challenges in Plastic Cap Manufacturing	Preventive Measures according to SQF
Cross-contamination	Implementation of cleaning and disinfection protocols.
Migration of chemicals	Implementation of cleaning and disinfection protocols.
Improper handling	Training staff in safe manufacturing practices.
Government Regulations and Consumer Expectations	Record keeping and adapting to market trends.

Source: [Authors' own creation]

Technical Aspects of SQF's Exploration in Plastic Cap Manufacturing

From the perspective of administrative engineering, the exploration of the Food Quality System (SQF) in the manufacture of plastic lids involves a combination of technical and practical aspects to ensure efficiency and effectiveness in the implementation of quality and food safety standards. (Palacios Bautista, 2014). Here are some key technical aspects:

- **Efficient process design:** A detailed analysis of plastic cap manufacturing processes is carried out to identify opportunities for improvement and optimization, which involves the application of process engineering methods to design and develop efficient workflows that minimize contamination risks and maximize the quality of the final product.
- **Implementation of advanced technologies:** It is necessary to consider the adoption of advanced technologies in the manufacture of plastic caps to improve the accuracy, consistency, and safety of the process, which brings with it the automation of certain tasks, the use of sensors to monitor production conditions, and the implementation of in-line quality control systems (Méndez-Barrón, 2018).

- **Resource optimization:** To do this, an analysis of the supply chain and the resources used in the manufacture of plastic lids must be carried out, with the aim of identifying areas of waste and opportunities for optimization, which includes the application of value engineering techniques to reduce costs, improve energy efficiency and minimize the use of raw materials. (Méndez-Barrón, 2018).
- **Quality Management and Regulatory Compliance:** The establishment of quality management systems based on the SQF to ensure compliance with food safety regulations and standards, including the implementation of quality control procedures, the conduct of internal and external audits, and the management of records and documentation, is a priority.
- **Risk Analysis and Decision Making:** Risk analysis techniques are not to be forgotten to identify, assess, and mitigate the risks associated with the manufacture of plastic caps, which involves conducting root cause analysis, risk analysis, and critical control points (HACCP), and implementing preventive and corrective measures based on scientific data and analysis.

That is why, from the perspective of administrative engineering, the exploration of SQF in the manufacture of plastic caps focuses on process optimization, the implementation of advanced technologies, efficient resource management, and quality assurance and regulatory compliance (González Peña, 2023).

This allows companies to improve their operational performance, reduce risks, and ensure the safety and quality of the final product (Méndez-Barrón, 2018).

Box 4

Table 3

Technical aspects of the exploration of the Food Quality System (SQF) in the manufacture of plastic lids.

Aspect	Strategies
Efficient Process Design	Process Analysis Workflow Design.
Implementation of Advanced Technologies	Task automation. Use of sensors for monitoring. Inline Quality Control Systems.
Resource optimization	Supply chain analysis. Reduced costs and waste. Improved energy efficiency.
Quality management and regulatory compliance	Implementation of quality control procedures. Conducting internal and external audits. Records and documentation management.
Risk Analysis and Decision Making	Risk Identification and Assessment Application of Risk Analysis Techniques. Implementation of preventive and corrective measures.

Source: [Authors' own creation]

The application of SQF in the context of plastic cap manufacturing

The principles and standards of the Food Quality System (SQF) and their specific adaptation to the context of the manufacture of plastic lids are elements that must be properly understood and harmonized, the SQF is a comprehensive quality management and food safety system internationally recognized that is based on the identification, evaluation, and control of risks to ensure the integrity of food products (Gambaudo, 2014). In the context of plastic cap manufacturing, the application of SQF involves the consideration of the following key elements:

1. **Quality Management and Food Safety:** The SQF provides a structured framework for establishing quality management systems spanning from raw material to final product in the manufacture of plastic lids, including the implementation of preventive controls to ensure food safety and product quality, as well as the training of personnel in safe manufacturing practices (Bravo, et al., 2021).

2. **Regulatory Compliance:** SQF helps companies comply with government regulations and food safety regulations applicable to plastic lid manufacturing, along with that comes accurate record keeping and adapting to ever-evolving market trends to ensure regulatory compliance and customer satisfaction (Gambaudo, 2014).
3. **Risk-based approach:** SQF is based on a risk management approach to identify, assess, and control the risks associated with the manufacture of plastic caps, considering the performance of comprehensive risk assessments at all stages of the manufacturing process and the implementation of preventive controls to mitigate the identified risks (Huerta-Dueñas, 2018).

Hence, the application of the Food Quality System (SQF) in the manufacture of plastic lids highlights the importance of ensuring food safety, product quality and regulatory compliance in this specific sector (Bravo, et al., 2021).

Box 5

Table 4

Application of SQF in the Manufacture of Plastic Caps

Aspect	Strategies
Quality Management & Food Safety	The SQF provides a structured framework for establishing quality management systems from raw material to final product in the manufacture of plastic caps, including the implementation of preventive controls to ensure food and product safety, as well as the training of the Personnel in Safe Manufacturing Practices.
Compliance	SQF helps companies meet the government regulations and Food Safety Applicable to Manufacturing of plastic caps, including maintenance accurate records and adaptation to the to ensure regulatory compliance and Customer Satisfaction.
Risk-based approach	SQF is based on a risk management approach. to identify, assess, and control the risks associated with the manufacture of plastic caps, in addition to conducting. Comprehensive risks at all stages of the process and the implementation of controls preventive measures to mitigate identified risks.

Specific SQF standard requirements for the plastic cap industry

The Food Quality System (SQF) is an internationally recognized standard designed to ensure food safety and product quality throughout the food supply chain. (Méndez-Barrón, 2018). Although originally developed for the food industry, its application has been extended to related sectors, such as the manufacture of plastic lids, which are in direct contact with food products. (Huerta-Dueñas, 2018).

Below are the specific requirements of the SQF standard applicable to the plastic cap industry, covering aspects such as food safety, product quality, hygiene, sanitation, and more.

Food safety

- **Risk Assessment and Hazard Analysis:** The implementation of SQF requires a comprehensive risk assessment and hazard analysis (HACCP) specific to the manufacture of plastic lids, which must identify all potential contamination points that may compromise food safety, such as chemical, physical, and biological contaminants; for which preventive measures and critical controls must be established to mitigate these risks. (Méndez-Barrón, 2018).
- **Raw material control:** Raw materials used in the manufacture of plastic lids, such as resins and additives, must meet food safety standards. It is essential that suppliers are evaluated and approved through audits that verify their compliance with SQF requirements. (Huerta-Dueñas, 2018). In addition, receiving and storage procedures must be implemented to ensure the integrity of raw materials.
- **Traceability:** Traceability is a necessary component of the SQF standard. Each batch of plastic caps must be traceable from the raw material to the final product, which entails a documentation and registration system that allows any batch of products to be traced in the event that a food safety issue is detected, facilitating quick and efficient recalls. (Bravo, et al., 2021).

Product Quality

- **Product Specifications:** Plastic lids must comply with detailed technical specifications that ensure their suitability for their intended use, especially when in contact with food, which must include precise dimensions, strength, tolerances, and compatibility with the food packaging that will use these lids.
- **Quality testing:** Quality testing should be performed on each production batch to ensure that plastic caps meet set specifications. These tests contain physical and chemical analyses, strength and durability tests, and compatibility tests with specific food products. (Huerta-Dueñas, 2018). The results of these tests should be documented and maintained as quality records.
- The SQF standard requires companies to conduct regular internal audits to assess the effectiveness of their quality management systems. (Bravo, et al., 2021). These audits should review all aspects of the manufacturing process, from the receipt of raw materials to the shipment of the final product, ensuring that quality requirements are met.

Hygiene and sanitation

1. **Cleaning and disinfecting programs:** Hygiene and sanitation are essential to the manufacture of food-safe plastic lids. Detailed cleaning and disinfection programs should be developed and maintained for all areas of production, storage, and handling; specifying the methods, frequencies and cleaning agents used. (Bravo, et al., 2021).
2. **Pest Control:** Pest control is a critical requirement for maintaining a hygienic production environment. Pest control programs should be implemented that include regular inspections, traps, and preventative measures to minimize the risk of infestations. (González Peña, 2023). In addition, all pest control-related activities need to be documented.

3. **Good Manufacturing Practices (GMP):** GMPs are essential to ensure hygiene and safety in the manufacture of plastic lids, which requires the use of appropriate equipment and utensils, the maintenance of clean and tidy facilities, and the continuous training of personnel in hygienic and food safety practices. (González Peña, 2023).

Quality System Management

1. **Documentation and Records:** The SQF standard requires extensive documentation of all procedures and activities related to food safety and product quality, including procedure manuals, production records, audit reports, and traceability documents. (González Peña, 2023). Proper management of this documentation is essential for the effective implementation and maintenance of the SQF system.
2. **Staff training:** Staff training is a key component of the SQF standard. All employees should receive ongoing training on food safety, product quality, hygiene, and sanitation issues, so training should be documented and updated regularly to reflect changes in procedures or regulatory requirements (Huerta-Dueñas, 2018).
3. **Communication and accountability:** Effective communication and clear assignment of responsibilities are critical to the management of the SQF system, all levels of the organization must be informed about food safety and quality objectives and procedures, clear communication channels must be established to report problems and take corrective actions. (Bravo, et al., 2021).

Continuous review and improvement

1. **Management Reviews:** Management reviews are a requirement of the SQF standard to evaluate the effectiveness of the food safety and quality system, which must be conducted by senior management and must include evaluation of audit results, food safety incidents, and the overall performance of the SQF system. (Huerta-Dueñas, 2018).

2. **Corrective and preventive actions:** Procedures must be established for the identification and correction of non-conformities, corrective actions must be implemented in a timely manner and properly documented. In addition, preventive measures must be taken to prevent the recurrence of problems. (González Peña, 2023).
3. **Innovation and technological improvements:** The plastic lid industry must be open to innovation and the adoption of new technologies that improve food safety and product quality, including the implementation of real-time monitoring technologies, process automation, and the use of advanced materials that reduce the risk of contamination. (González Peña, 2023).

Implementing the SQF standard in plastic lid manufacturing requires a comprehensive approach that encompasses food safety, product quality, hygiene and sanitation, quality system management, and continuous improvement, so meeting these requirements not only ensures compliance with international regulations, it also improves customer confidence and competitiveness in the market. (Bravo, et al., 2021).

Companies that adopt and maintain these rigorous standards are sure to succeed in producing plastic caps that meet the highest levels of safety and quality, thus ensuring consumer protection and long-term success in the industry. (Huerta-Dueñas, 2018).

Box 6

Table 5

SQF Standard Requirements for Plastic Caps

Criteria	Requirements
Food safety	<ul style="list-style-type: none">- Risk Assessment & Hazard Analysis- Raw material control- Traceability
Product Quality	<ul style="list-style-type: none">- Product Specifications- Quality Testing- Internal Audits
Hygiene and sanitation	<ul style="list-style-type: none">- Cleaning & Disinfection Programs- Pest Control- Good Manufacturing Practices (GMP)
Quality System Management	<ul style="list-style-type: none">- Product Specifications- Quality Testing- Internal Audits
Continuous Improvement Review	<ul style="list-style-type: none">- Management Reviews- Corrective and Preventive Actions- Innovation and technological improvements

Methodology

In the context of the research methodology of the SQF System in the manufacture of plastic lids, the variables are key in the understanding and evaluation of the implementation of this system.

Variables in SQF System Research

In this study, the variables are of different types and represent different aspects related to the implementation of the Food Quality System (SQF) in the manufacture of plastic lids, some of these variables are:

Independent variables:

1. Type of company: Medium
2. Geographic location: Cuautitlan Izcalli, Mexico.
3. Experience in implementing SQF: (New implementations versus companies with previous experience.)

Dependent Variables:

4. SQF Compliance Level: Measured through internal and external audits.
5. Product quality: Evaluated using specific quality and food safety criteria.
6. Customer satisfaction: Based on customers' perception and feedback on the quality and safety of plastic caps.

Importance of comparing the criteria used

Comparing the criteria used in this study is essential for several reasons:

1. **Validity of the conclusions:** Comparing the criteria used in different companies ensures that the conclusions of the study are valid and generalizable. If each company uses different criteria to assess SQF compliance or product quality, comparisons between them will be difficult and conclusions may be questionable.
2. **Reliability of measurements:** Using comparable criteria ensures the reliability of the measurements made. If the criteria used are consistent and standardized, the measurements are more likely to be accurate and reliable, increasing the credibility of the study results.

3. **Identification of best practices:**
Comparing the criteria used in different companies allows you to identify best practices in the implementation of SQF and the manufacture of plastic caps.

By knowing which criteria lead to better results in terms of SQF compliance and product quality, companies learn from each other and improve their own practices.

Research results of the SQF system in the manufacture of plastic caps for company Bericap Mexico

1. **SQF Compliance Level:**

The Bericap Mexico Company achieves an SQF compliance level of 96% internal audit, which indicates a solid commitment to the quality and food safety standards established by the SQF.

The level of compliance of the Food Quality System (SQF) of the Bericap Mexico Company is compared with the standards and requirements established by the SQF itself, as well as with the levels of compliance of other similar companies in the industry, in a recertification audit 99% was obtained in this area.

Box 7

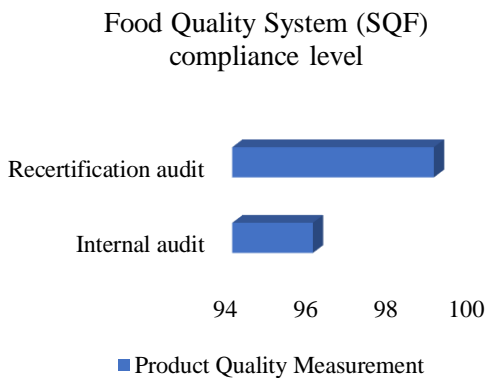


Figure 2
Food Quality System (SQF) compliance level

2. **Product Quality:**

95% of the plastic caps manufactured by Company Bericap Mexico meet the established quality standards, highlighting its focus on producing high-quality and safe products.

The percentage of plastic lids manufactured by Company Bericap Mexico that meet the established quality standards is compared with the quality criteria defined by the company and the customer's expectations.

Box 8

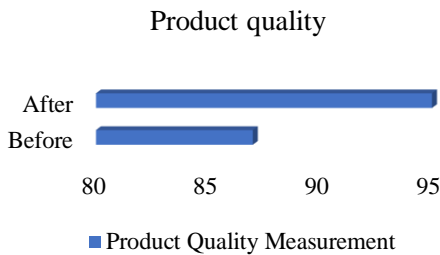


Figure 3
Product Quality

3. **Customer Satisfaction:**

1. 90% of Company Bericap Mexico 's customers are satisfied with the quality and safety of the plastic caps, reflecting the customer's trust and satisfaction in the company's products.
2. Company Bericap Mexico's level of customer satisfaction with the quality and safety of plastic caps is compared to customer expectations, as well as customer satisfaction levels of other companies in the same industry.

4. **Comparison of criteria used:**

1. Company Bericap Mexico uses rigorous and consistent criteria to assess SQF compliance and product quality, which correlates with its high levels of SQF compliance and customer satisfaction.

The rigor and consistency of the criteria used by Company Bericap Mexico to assess SQF compliance and product quality with the standards and guidelines set forth by the SQF and with the practices of other companies in the industry is compared.

Data collection

The data presented here were obtained from internal audits and pre-certification.

Conclusions

After the investigation of the Food Quality System (SQF) in the manufacture of plastic lids, the following conclusions have been obtained:

1. Importance of SQF in the Plastic Cap Industry:

SQF is instrumental in ensuring food safety and product quality in the manufacture of plastic lids. Its effective implementation helps mitigate contamination risks, improve processes, and meet consumer expectations.

2. Variety in SQF compliance:

Variability in the levels of compliance with the SQF is observed among the companies studied. While some companies show a high degree of compliance, others have areas for improvement that require immediate attention and action.

3. Relationship between SQF compliance and product quality:

There is a clear correlation between the level of SQF compliance and product quality. Companies that more rigorously implement SQF standards tend to produce higher-quality plastic caps, which translates to higher customer satisfaction.

4. Importance of the criteria used:

The choice and application of rigorous and consistent criteria to assess SQF compliance and product quality are critical. Companies that use clear and standardized criteria tend to achieve stronger and more consistent results in terms of food safety and product quality.

5. Opportunities for continuous improvement:

While good performance has been demonstrated in the implementation of SQF, there are always opportunities for improvement.

Identifying areas for improvement and implementing corrective actions are necessary to strengthen food safety and improve product quality.

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author contribution

Campos-Villegas, Cesar Antonio: Main idea of the research, design, development and implementation of the SQF.

Pecina-Rivas, Erika María: Monitoring, control and evaluation of the Quality system.

Availability of data and materials

The data was collected directly from sources provided by the company.

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Abbreviations

GMP	Good Manufacturing Practices
HACCP	Hazard Analysis and Critical Control Points.
SQF	The Food Safety Quality System
TECNM	Tecnológico Nacional de México
TESCI	Tecnológico de Estudios Superiores de Cuautitlán Izcalli

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