IDENTIFICATION OF OZONE-DEPLETING SUBSTANCES AND THEIR ALTERNATIVES BASED ON IDENTIFICATION MARKINGS

Khasanov Otabek Allaberdiyevich
Head of the Department of Currency Control and Non-Tariff Regulation, Customs Committee of the Republic of Uzbekistan
e-mail: xasanovo81@gmail.com

Okhunjonov Mukhammadqodir Ashurali ugli
Inspector of the Department of Currency Control and Non-Tariff Regulation, Customs Committee of the Republic of Uzbekistan
e-mail:oxunjonovmuxammad02@gmail.com

DOI:https://doi.org/10.5281/zenodo.23505985

Abstract. This thesis addresses the identification of ozone-depleting substances and their alternatives at the initial stage of customs control. The practical significance of an integrated approach to identifying refrigerants based on container color codes, ASHRAE refrigerant (R) numbers, chemical names and formulas, Chemical Abstracts Service (CAS) registry numbers, and United Nations (UN) numbers is substantiated. The development of a methodological guide consolidating identification data into a unified system is proposed.

Keywords: ozone-depleting substances (ODS), refrigerant, preliminary identification, labeling, ASHRAE refrigerant (R) number, CAS registry number, United Nations (UN) number, customs control, non-tariff regulation.

INTRODUCTION

The depletion of the ozone layer is one of the major environmental challenges affecting global ecological security. The stratospheric ozone layer protects the Earth's surface from harmful ultraviolet radiation emitted by the Sun. The release of certain chemical compounds containing chlorine and bromine into the atmosphere leads to the destruction of ozone molecules and the disruption of the natural balance of the ozone layer.

The gradual phase-out of the production and consumption of ozone-depleting substances (ODS), as well as the control of their international trade, is regulated under the Vienna Convention and the Montreal Protocol [1, 2]. The implementation of these international obligations strengthens the role of customs authorities in controlling the transboundary movement of ODS and their alternatives.

In customs practice, the similarity in the physical appearance of refrigerants, their distribution under various trade names, and their occurrence as pure substances or mixtures complicate their preliminary identification. Therefore, during customs inspections, it is essential not to rely solely on product names or information provided in accompanying documents, but also to comprehensively assess labeling and other identification characteristics.

The aim of this study is to systematize the criteria for the preliminary identification of ODS and their alternatives during customs inspections and to develop a methodological approach that facilitates the rapid determination of regulatory measures applicable to these substances.

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MAIN BODY

The refrigerants currently in circulation are subject to different regulatory requirements. The circulation of certain substances is prohibited, some are controlled under established quotas, while other alternative substances may be placed on the market in accordance with applicable regulations [3, 4]. Therefore, the rapid and accurate identification of substances at the initial stage of customs control is of particular importance.

Customs officers conducting inspections do not always have the opportunity to determine the chemical composition of substances directly through laboratory analysis. However, the color markings on refrigerant cylinders or containers, ASHRAE refrigerant (R) numbers, Chemical Abstracts Service (CAS) Registry Numbers, chemical names and formulas, United Nations (UN) numbers, and manufacturer's markings provide essential information for preliminary identification [8, 9].

Container color codes enable the preliminary visual differentiation of refrigerants. Since color markings do not serve as definitive confirmation of a substance's chemical composition, they should be assessed in conjunction with other identification indicators [7].

ASHRAE refrigerant (R) numbers are used for the standardized designation of refrigerants [5]. For certain single-component refrigerants, the R-number is derived from their molecular composition. For example, the chemical formula of refrigerant R-22 is CHF_2Cl. Subtracting one from the number of carbon atoms, adding one to the number of hydrogen atoms, and taking the number of fluorine atoms yields the values 0-2-2. By omitting the leading zero, the designation R-22 is obtained [5, 6].

The CAS Registry Number is a unique numerical identifier assigned to chemical substances, allowing them to be accurately distinguished regardless of their various chemical or commercial names. For example, the CAS Registry Number of R-12 (dichlorodifluoromethane) is 75-71-8. The United Nations (UN) number is a four-digit international identification system used to identify substances or groups of substances during the transportation of dangerous goods. For R-12, the corresponding UN number is UN 1028 [10].

It is essential to apply these identification indicators comprehensively rather than individually. While container color markings provide preliminary visual information, the ASHRAE R-number indicates the standardized refrigerant designation, the CAS Registry Number serves as an individual identifier of a specific chemical substance, and the UN number provides identification for dangerous goods transportation purposes. The chemical name and molecular formula enable cross-verification of these data.

One of the major practical challenges is that identification information is distributed across various sources. During customs inspections involving large quantities of goods within limited timeframes, it is practically difficult for officers to search multiple sources for each refrigerant's R-number, CAS Registry Number, UN number, chemical composition, and regulatory status.

In this regard, the development of a methodological guide consolidating information on ODS and their alternatives into a unified system is proposed. Such a guide should present interconnected information on each refrigerant, including its name, chemical formula, ASHRAE R-number, CAS Registry Number, UN number, container color markings, and other relevant identification characteristics.

The practical significance of the proposed approach lies in linking identification data not only to the determination of a substance's identity but also to the regulatory regime applicable under customs control. Consequently, by using an identified R-number or another identification indicator, customs officers would be able to obtain preliminary information on whether the import or export of a particular substance is prohibited, subject to quota restrictions, or not subject to such restrictions.

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Thus, the establishment of a unified methodological reference would enable customs officers to simultaneously compare the principal identification characteristics of a substance and obtain preliminary information regarding its regulatory status. The practical value of this approach is reflected in reducing the time required to search for information during inspections, consolidating data from different sources, and ensuring consistency in customs control procedures.

The proposed methodological approach should not be regarded as an alternative to laboratory examination but rather as a preliminary control tool preceding such examination. If labeling information is inconsistent, suspicious markings are detected on containers, or reasonable uncertainty arises regarding the identity of a substance, grounds are established for further inspection and, where necessary, instrumental laboratory analysis. This approach ensures logical continuity between customs inspection and expert examination procedures.

From the perspective of customs control, the subsequent stage of identification involves assessing the regulatory status of the identified substance. Certain ODS and their alternatives are prohibited, some are controlled under quota systems, while others may not be subject to such restrictions. Therefore, incorporating the relevant regulatory status of substances alongside their identification characteristics in the methodological guide would accelerate decision-making during customs inspections [3, 4].

The practical value of identification indicators lies in their complementary nature. For example, container color markings provide customs officers with an immediate visual indication of the refrigerant, while the R-number helps verify this information through standardized designation. The CAS Registry Number enables verification of the chemical identity of the substance, whereas the UN number facilitates comparison with information related to the transportation of dangerous goods. Accordingly, cross-verification using multiple identification indicators helps reduce the likelihood of incorrect identification.

The systematization of the identification characteristics examined in this study is also important for establishing a standardized approach to customs control. The application of uniform criteria by customs officers contributes to the consistency of preliminary conclusions regarding refrigerants, reduces the risk of misinterpretation, and improves the efficiency of control procedures. Consequently, the methodological guide could serve not only as a reference resource but also as a supporting tool for practical decision-making.

At the same time, information obtained from the methodological guide should not be interpreted as a definitive expert conclusion in cases where doubts exist regarding the actual chemical composition of a substance. The results of preliminary identification serve an informational function, assisting customs officers in detecting risk indicators, verifying additional documentation, or deciding whether to submit samples for expert examination when necessary. In this respect, the proposed guide strengthens the practical connection between customs inspections and laboratory examinations.

One of the principal practical aspects of the proposal is the integration of identification characteristics and regulatory status within a single reference source. During customs inspections, determining the name of a substance alone is insufficient; it is also necessary to promptly establish which control measures apply to the identified substance. Therefore, clearly distinguishing prohibited substances, substances subject to quota controls, and alternatives not subject to such restrictions within the guide would provide practical assistance to customs officers in determining subsequent control measures [3, 4].

The structure of the methodological guide should also be developed in accordance with the practical needs of customs officers. Presenting information on each refrigerant in a standardized sequence—including the substance name, R-number, chemical formula, CAS Registry Number, UN number,

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container color markings, and regulatory status—would facilitate rapid information retrieval. This would allow officers to locate a particular substance using any available identification indicator and cross-check the remaining characteristics. Such an approach would reduce the need to search for information separately across multiple sources.

To ensure a systematic identification process during customs inspections, it is advisable to verify the relevant information in a sequential manner. Initially, the external labeling and color markings of the container or cylinder should be examined, followed by a comparison of the indicated R-number, chemical name, and molecular formula. At the next stage, the chemical identity of the substance should be verified using its CAS Registry Number. Where a UN number is available, it should be compared with the relevant dangerous goods transportation information. This sequence prevents conclusions based solely on a single external characteristic and enhances the reliability and justification of preliminary identification.

CONCLUSION

Accurate identification of ozone-depleting substances (ODS) and their alternatives at the initial stage of customs control is essential for ensuring effective control over their transboundary movement. The comprehensive application of container color codes, ASHRAE refrigerant (R) numbers, chemical names and molecular formulas, CAS Registry Numbers, and United Nations (UN) numbers enables the preliminary identification of substances and assessment of the regulatory measures applicable to them.

Consolidating identification data into a unified methodological reference contributes to improving the efficiency of customs control, reducing the risk of misidentification, and preventing the illegal transboundary movement of prohibited refrigerants or those subject to quota restrictions. Such a guide is not intended to replace laboratory examination but rather to serve as a preliminary practical and methodological tool for customs officers conducting inspections.

REFERENCES

1. Vienna Convention for the Protection of the Ozone Layer. – Vienna, 1985.
2. Montreal Protocol on Substances that Deplete the Ozone Layer. – Montreal, 1987.
3. Resolution No. 17 of the Cabinet of Ministers of the Republic of Uzbekistan dated January 9, 2018, “On Approval of the National Programme for the Phase-Out of Ozone-Depleting Substances in the Republic of Uzbekistan.”
4. Resolution No. 126 of the Cabinet of Ministers of the Republic of Uzbekistan dated March 9, 2021, “On Measures to Further Improve the Regulation of the Import into and Export from the Republic of Uzbekistan of Ozone-Depleting Substances and Products Containing Such Substances.”
5. ASHRAE. ANSI/ASHRAE Standard 34: Designation and Safety Classification of Refrigerants. – Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers.
6. ASHRAE. ASHRAE Handbook — Fundamentals. – Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers.
7. Air-Conditioning, Heating, and Refrigeration Institute (AHRI). Guideline N: Assignment of Refrigerant Container Colors. – Arlington, VA: AHRI.
8. United Nations Environment Programme (UNEP). Training Manual for Customs Officers: Saving the Ozone Layer — Phasing Out Ozone-Depleting Substances in Developing Countries. – Nairobi: UNEP.
9. United Nations Environment Programme (UNEP). OzonAction: Refrigerant Identification and Safe Handling of Refrigerants. – Paris: UNEP OzonAction.
10. United Nations. Recommendations on the Transport of Dangerous Goods: Model Regulations. – New York; Geneva: United Nations.

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