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Pipeline and Hazardous Materials Safety Administration (PHMSA)

Office of Hazardous Materials Safety (OHMS)

User Guide

Commodity Flow Survey:
Expanded HAZMAT Supplement

April 2025

Notice

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In particular, PHMSA's Office of Hazardous Materials Safety, Data, Risk & Analytics Branch, would like to acknowledge the U.S. Census Bureau, Economic Reimbursable Surveys Division. Their expertise and collaboration were indispensable to the success of this project.

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Acronyms

AAR	Association of American Railroads
CFR	Code of Federal Regulations
CFS	Commodity Flow Survey
CIPSEA	Confidential Information Protection and Statistical Efficiency Act
DOT	Department of Transportation
EHM	Expanded Hazardous Materials Supplement
EIA	Energy Information Administration
HAZMAT	Hazardous Materials
HMR	Hazardous Materials Regulations
HMT	Hazardous Materials Table
IBC	Intermediate Bulk Container
ID	Identification
MC	Motor Carrier
NA	North American
NAICS	North American Industry Classification System
NOAA	National Oceanic and Atmospheric Administration
OHMS	Office of Hazardous Materials Safety
PADD	Petroleum Administration for Defense District
PDF	Portable Document Format
PHMSA	Pipeline and Hazardous Materials Safety Administration
POP	Performance Oriented Packaging
SCT	Secretariat of Transport and Communications of Mexico
SP	Special Permit
TC	Transport Canada
UN	United Nations

1. Overview

The Expanded Hazardous Materials Supplement (EHM) is a survey sponsored by PHMSA's Office of Hazardous Materials Safety (OHMS) and conducted by the U.S. Census Bureau (Census) as part of the 2022 Commodity Flow Survey (CFS). PHMSA sponsored the survey to collect new data and generate new statistics about businesses that ship hazardous materials (HAZMAT) in the United States, focusing on DOT-regulated packaging. The new data and statistics are valuable to inform agency decision making about the safety of HAZMAT transportation.

[A PDF version of the 2022 Commodity Flow Survey](#), including the EHM, can be accessed through the Census website. Surveys were sent to approximately 165,000 potential respondents and among those, about 6,500 establishments responded in the affirmative to the EHM "screener question," indicating that they shipped at least one HAZMAT in DOT-regulated packaging. The data tabulated from these responses and approved for public release are available on the PHMSA and Census websites as two spreadsheet (.xlsx) files, one for each of the calendar years, 2021 and 2022, along with supporting documentation such as the CFS-EHM Experimental Data Product Methodology.

Click the link below:

[CFS-EHM Data and Supporting Documentation](#)

Please note, the "raw" EHM data is not publicly available. In accordance with the Confidential Information Protection and Statistical Efficiency Act (CIPSEA), Census is obligated to protect the confidentiality of survey respondents and their responses. Census aggregated the responses to the EHM survey and reviewed the data to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data (Disclosure Review Board approval number: CBDRB-FY23-100). The EHM dataset available on the PHMSA and Census websites was specifically prepared and approved for public release.

The primary objective of the EHM is to survey the HAZMAT shipper population in the United States and produce estimates of the total number of establishments that ship HAZMAT in DOT-regulated packaging, along with sub-total estimates reflecting several variables that are important to HAZMAT transportation and the Hazardous Materials Regulations (HMR). Key HAZMAT variables in the EHM include Hazard Class/Division, United Nations (UN)/North American (NA) Identification (ID) number, packaging type and specification, annual shipment quantity, average net weight per package, and primary mode of transportation. In addition, EHM features other variables that are helpful to group and describe HAZMAT shippers in relation to the broader economy, such as North American Industry Classification System (NAICS) codes, and geography (i.e., Petroleum Administration Defense Districts or PADDs).

To illustrate how the EHM estimates vary in dimension and granularity, the following table provides a variety of example estimates:

Table A. Example EHM Estimates Varying in Dimension and Granularity

Query	Number of Establishments Using DOT-regulated Packaging to Ship HAZMAT
Any Hazard Class; Any Packaging Type; Any Specification; Any UN/NA ID; Any Quantity; Any Mode; Any Average Net Package Weight	20,460
HAZMAT shippers that shipped <i>any Class 3 flammable liquid</i>	9,480
HAZMAT shippers that shipped any Class 3 flammable liquid in <i>any drum</i>	2,078
HAZMAT shippers that shipped any Class 3 flammable liquid in a <i>“steel drum, with a removable head”</i>	530
HAZMAT shippers that shipped <i>NA1993, fuel oil</i> (a specific Class 3 flammable liquid) in any drum	517
HAZMAT shippers that shipped, for example, <i>between 2,500 and 4,999 drums</i> containing NA1993	382
HAZMAT shippers that shipped NA1993 in any drum in a <i>company-owned truck</i>	137
HAZMAT shippers who shipped a drum with an average net weight of NA1993 <i>between 50 and 99 pounds</i>	18

As these examples illustrate, the EHM assists with high-level questions about HAZMAT shipping in the U.S. The EHM also assists in answering technical and detailed questions that are unique to the HAZMAT industry and the specialized knowledge that Federal, state, and local regulators, businesses in the regulated community, safety advocates, emergency response technicians, and other HAZMAT specialists require to conduct proper organizational planning, market research, and cost/benefit analysis. PHMSA expects that these users have technical knowledge about HAZMAT and would like guidance about which EHM data tables to review for specific research topics, as well as other background about the scope, organization, and presentation of the EHM survey and data.

In addition, this User Guide should also be useful for Economists, Data Scientists, Statisticians, and other specialists who routinely “work with data” and would like to gain knowledge about the HAZMAT domain. For general questions about HAZMAT and the HMR, users can contact the Hazardous Materials Information Center by calling 1-800-HMR-4922 (Monday-Friday, 9am-5pm Eastern Time) or e-mailing infocntr@dot.gov.

Much like the field of HAZMAT transportation, the EHM can be complicated, and misunderstanding its scope or methodology carries risks. Please exercise care in using, citing, and interpreting the data. Users of the EHM data are strongly encouraged to review all the supporting documentation, including this User Guide and the Census technical documentation, *[EHM Experimental Data Product Methodology](#)*.

Users may reach out to the Research, Development & Technology team within PHMSA's Office of Hazardous Materials Safety to provide feedback, ask questions, and make data requests; please e-mail your feedback, questions, and requests to HAZMATRESEARCH@dot.gov.

In addition, please cite the source in any publication for attribution. Data users who create their own estimates using EHM data should cite the Census as the source of the original data only.

Source: U.S. Census Bureau. 2022 Commodity Flow Survey, Expanded Hazardous Materials Supplemental Survey. April 5, 2024. <https://www.census.gov/data/experimental-data-products/cfs-expanded-hazardous-materials-estimates.html>

2. Scope

The scope of the survey was limited to **commercial shipping establishments** that used **DOT-regulated packaging** to ship at least one **HAZMAT** from any of the 50 U.S. states or the District of Columbia in 2021 or 2022.

“Establishments”

First, respondents to the EHM were commercial shipping establishments. An “establishment” is a single physical location where business is conducted or where services or industrial operations are performed. As such, each response to the EHM represents the HAZMAT shipping activity of one establishment, that is, one business with one physical location.

Shippers, Not Carriers

Next, it is important to emphasize that *shippers* were surveyed, not *carriers*. In 49 CFR § 171.8, the HMR defines “an offeror,” which for purposes of the survey, is synonymous with “shipper.” Shippers prepare the HAZMAT package for transportation, performing “pre-transportation functions,” such as filling, securing, marking, or labelling the package, preparing shipping papers that properly identify the HAZMAT by UN/NA ID and Hazard Class/Division, and certifying that the package meets the requirements of the HMR. Once the HAZMAT package is prepared for transportation, the shipper tenders the HAZMAT to the carrier, who is responsible for transporting the HAZMAT by highway, water, rail, or air from its origin to destination. As such, carriers are the trucking companies, seafaring vessel operators, railroads, and airlines that transport the HAZMAT, whereas shippers are the companies that contract with these carriers to transport or move the HAZMAT from origin to destination. In addition, a business can be both a shipper and a carrier. For example, a shipper that transports its own products with company-owned trucks is also a carrier, and a carrier that performs pre-transportation functions is also a shipper. To be eligible for the EHM survey, the business needed to be a shipper.

Must Ship HAZMAT

In addition, the regulatory definition of a “hazardous material” was critical to the survey scope because the shipper must also be a HAZMAT shipper. According to 49 CFR § 171.8, “hazardous material” means a substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and has designated as hazardous under Federal hazardous materials transportation law (49 U.S.C. 5103). The term includes materials that meet the defining criteria for hazard classes and divisions in Part 173 of the HMR, and materials designated as hazardous in the Hazardous Materials Table (HMT; 49 CFR § 172.101). Specifically, hazardous materials must be identifiable by a UN/NA ID number from the HMT, such as “UN1267” for petroleum crude oil or “UN3481” for lithium-ion batteries contained in, or packed with, equipment. To be eligible for the EHM survey, the business needed to identify at least one hazardous material that they shipped by UN/NA ID number.

Must Use DOT-Regulated Packaging

Further, the survey scope was limited to HAZMAT shippers that use DOT-regulated packaging. The HMR prescribes the authorized packaging for each hazardous material; “packaging” refers to the authorized containers and receptacles that can be used to safely transport the hazardous material. As such, “packaging” is a general term for all the various HAZMAT containers described in the HMR, including cylinders, cargo tanks, tank cars, portable tanks, intermediate bulk containers (IBCs), boxes, bags, drums, jerricans, and other packaging. The term, “package,” is related but carries a distinction; “package” is generally reserved to refer to the packaging plus the HAZMAT contents. See 49 CFR § 171.8.

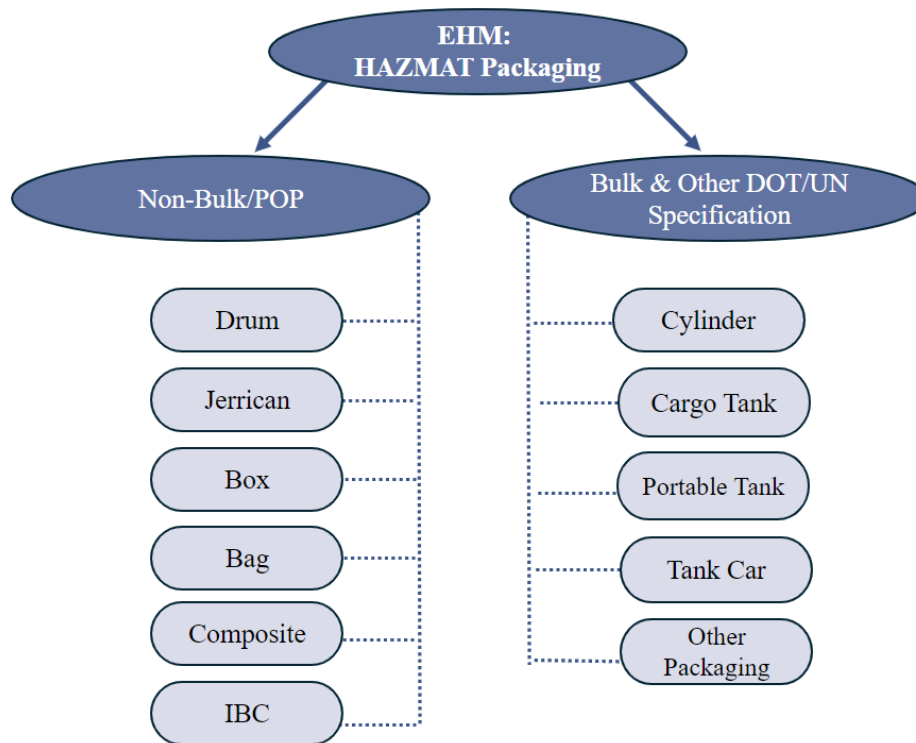
In most cases, the authorized packaging for the HAZMAT must conform to a packaging *specification* or, alternatively, to *performance-oriented packaging (POP) standards*. Both are packaging standards, but POP standards are known to be more flexible and less prescriptive, emphasizing that the packaging design, construction, and configuration can vary so long as the packaging passes initial and periodic performance tests. Conversely, specification packaging must also pass performance tests, but it is known as less flexible and more prescriptive, accommodating little, if any, variation from the specification. To be eligible for the EHM, a business needed to identify at least one HAZMAT that required DOT-regulated packaging in the form of a performance-oriented packaging or specification packaging.

This categorization of HAZMAT packaging into two broad categories – POP or specification – is reflected in the EHM survey and data. In general, POP comprises the packaging types for “non-bulk,” smaller quantities of HAZMAT and derives from UN international standards. POP includes boxes, drums, bags, jerricans, composite packaging, and IBCs. Conversely, specification packaging includes the packaging types for “bulk,” relatively larger quantities of HAZMAT (cargo tanks, tank cars, and portable tanks), as well as cylinders.

PHMSA acknowledges that this categorization may not be perfect, but it assisted with survey design and serves as a general way to differentiate HAZMAT packaging. While IBCs derive from UN standards like other performance-oriented packaging, IBCs are commonly larger than non-bulk packagings and smaller than bulk packagings, as implied by the word, “intermediate.” Similarly, cylinders can be non-bulk or bulk in capacity, but they are not covered in the UN POP standards, so statistics for cylinders are tabulated alongside the DOT and UN bulk packaging specifications. Further, the survey included a category for “Other Packaging,” for respondents who use HAZMAT packaging that does not easily fall into conventional POP and specification packaging categories.

The following graphic illustrates EHM’s packaging categorization.

Figure A. Outer Packaging Types in EHM



Data users must decide which of the two, broad categories of DOT-regulated packaging they are interested in to find the most appropriate EHM table and relevant statistics for their research. EHM Tables 4-7 deal with the first category (Non-Bulk/POP) and EHM Tables 8-11 deal with the second (Bulk or Other DOT/UN specification packaging). EHM Tables 1 and 2 do not deal with packaging directly; there is no tabulation of packaging data in EHM Tables 1 or 2. EHM Table 3 deals with all outer packaging types, whether POP or specification.

PHMSA and Census provided survey respondents with visual aids to understand the different HAZMAT packaging types and their appearance. In addition, using online image search tools can be helpful to understand the different HAZMAT packaging types and their appearance; however, please be mindful that random images may misidentify packaging types and appearance. Here are some helpful resources for understanding packaging types, although resources not created by PHMSA cannot be endorsed.

- [PHMSA Guide to Performance-Oriented Packaging](#)
- [PHMSA Unpacking Packaging Codes](#)
- [PHMSA Emergency Response Guidebook](#) (e.g., pages 10-12 for tank cars (rail), pages 13-14 for cargo tanks (highway))
- [Association of American Railroads \(AAR\) Field Guide for Tank Cars](#)

Shippers Using Exceptions Not Included

Packaging specifications and POP standards ensure that the packaging will safely contain the HAZMAT during normal transportation conditions. In some cases, however, the HMR provides an exception from the requirement to use POP or specification packaging, such as when the shipper qualifies for “limited quantity,” “de minimis,” or other exceptions in the HMR. To be eligible for the EHM survey, businesses needed to identify that they use DOT-regulated packaging – i.e., at least one type of DOT or UN specification packaging or one type of POP – to ship HAZMAT. As a result, HAZMAT shippers claiming they are entirely excepted from the packaging requirements in the HMR, and thus do not use DOT-regulated packaging, were not surveyed in the EHM. It is possible a shipper claimed they are excepted from the HMR when the shipper is not.

DOT-SP Packaging Not Included

In addition to POP standards and specification packaging, PHMSA is responsible for issuing DOT special permits (DOT-SPs), which set forth alternative requirements to the HMR and are sometimes used to authorize a packaging that does not conform to the packaging standards required under the HMR. Notably, questions about packaging authorized by DOT-SPs were not specifically included in EHM due to uncertainty surrounding categorization. Future versions of the EHM should consider how to best incorporate DOT-SP packaging, which might be categorized in a variety of ways. For example, some DOT special permits authorize entirely novel packaging types, whereas other special permits allow just a small deviation from specification, but otherwise align closely with a specification prescribed in the HMR. Users will not find data or information specifically about DOT-SP shippers or packaging in the EHM.

Screener Question

The EHM survey used a “screener question” to clarify the scope for respondents in practical terms and ensure that responses were from commercial HAZMAT shippers using DOT-regulated packaging. The respondent was asked, “At any time during 2021 (or 2022), did this location ship any hazardous materials (HAZMAT)?” The respondent could answer “Yes,” “Yes, but all shipments were excepted from Department of Transportation (DOT) packaging regulations,” or “No.” Only respondents choosing “Yes” were considered in-scope.

Top Ten & Top Three HAZMATs

After the screener question, respondents who reported shipping HAZMAT in DOT-regulated packaging at any time during 2021 or 2022 were asked to provide a list of the top ten HAZMATs that they ship most frequently. Then, for the top three HAZMATs, additional detailed questions were asked to solicit information regarding the HAZMAT packaging, including packaging type and specification, average net weight per package, the annual quantity shipped, and primary mode of transportation. The EHM survey instructed HAZMAT shippers to “[c]onsider the

packaging that was used the greatest number of times in YYYY [2021 or 2022] as the most frequently used.”

PHMSA and Census pursued a limited roster of hazardous materials for the survey (i.e., “top ten,” “top three”) in acknowledgement of the potential burden of the survey on U.S. businesses. In accordance with the Paperwork Reduction Act, Federal agencies are expected to be good stewards of the public’s time, and not overwhelm businesses with unnecessary or burdensome requests for information. PHMSA and Census also recognized that an overly burdensome survey does not encourage high-quality responses and may negatively affect the response rate and overall data quality. The topic of HAZMAT packaging can be complex and confusing given the wide variety of regulations, terminology, and practices within the industry. PHMSA felt that focusing most of the survey on shippers’ top three HAZMATs would enhance the accuracy and detail provided about HAZMAT packaging.

Data Limitations Due to Scope

Ultimately, the focus on the top three (or top ten) reported HAZMATs results in underestimation of the total number of establishments that ship a given HAZMAT or use a specific packaging type or mode of transportation. In this light, the HAZMAT shipper counts in the EHM dataset should be likened to a count of “common” or “frequent” shippers of the HAZMAT or packaging in question. Towards the bottom of each tab within the EHM spreadsheets, footnotes identify how estimates are affected by this “top-HAZMATs” approach. Specifically, EHM Tables 3 through 11 depend on the top three reported HAZMATs, whereas EHM Table 2 depends on the top ten reported HAZMATs. Please note, EHM Table 1 does not depend on the top three or top ten HAZMATs; instead, it is based on a stand-alone question that asked shippers how many distinct HAZMATs they ship. See section 3.8 in this User Guide for more information about the footnotes used in EHM.

The impact of the scope on the count of establishments is readily observable. For example, based on the top ten reported HAZMATs, the number of HAZMAT shippers that shipped NA1993 in DOT-regulated packaging in 2022 is 1,891 (see Table 2 in the EHM spreadsheet file for 2022). This is a more inclusive count that is closer to the idealized count for all shippers shipping NA1993, but it is still an undercount. In contrast, based on the top three reported HAZMATs, the number of HAZMAT shippers that shipped NA1993 in DOT-regulated packaging in 2022 is 1,570 (see Table 3 in the EHM spreadsheet file for 2022). This is a more selective count that is further reduced from the idealized count. However, the top-three count may be preferable in some cases because it captures the “core regulated community” of HAZMAT shippers that would be most impacted by regulatory changes pertaining to NA1993; that is, shippers most likely to incur costs or accrue savings when regulatory changes are implemented.

Sum of Parts Greater Than the Total

There is another important facet of the data created by the survey methodology and scope. In the EHM data, totals are not always equal to the sum of their parts. Because many establishments ship more than one type of hazardous material, disaggregated counts of establishments may not add up to the total, or aggregated, count.

For example, the disaggregated count of establishments for each of the nine hazard classes sums up to more than the aggregated count of establishments for all hazard classes. Specifically, in EHM Table 2 (2022 spreadsheet file), the count of establishments shipping any hazardous material is 20,460, but the sum of all the counts for each of the individual hazard classes is 33,000. This is not inaccurate. Put another way, “double counting” is allowed; a shipper can be counted as shipping HAZMAT from multiple Hazard Classes/Divisions. In EHM Table 2, one shipper could, in theory, be counted in ten different hazard classes or divisions if their top ten reported HAZMATs, in fact, belong to ten distinct hazard classes or divisions. Similarly, summing the percentage of establishments within a particular grouping of shippers may not add up to 100%.

Table B. Excerpt of EHM Table 2, Number of Establishments that Ship Selected Hazardous Materials (2022)

Hazard Class or Division	Count of Establishments	Percentage of Establishments
All Hazardous Material	20,460	100.0
Class 3, Flammable and combustible liquid	10,320	50.4
Class 8, Corrosive material	5,588	27.3
Class 9, Miscellaneous hazardous material	4,799	23.5
Division 2.2, Nonflammable, nonpoisonous compressed gas	3,899	19.1
Division 2.1, Flammable gas	3,424	16.7
Division 6.1, Toxic (poisonous) materials	1,354	6.6
Division 5.1, Oxidizer	1,080	5.3
Division 4.1, Flammable solid	806	3.9
Division 1.4, Explosives with no significant blast hazard	539	2.6
Class 7, Radioactive material	325	1.6
Division 5.2, Organic peroxide	281	1.4
Division 2.3, Gas poisonous by inhalation	184	0.9
Division 4.3, Dangerous when wet material	133	0.7
Division 1.1, Explosives with a mass explosion hazard	77	0.4
Division 4.2, Spontaneously combustible material	68	0.3
Division 6.2, Infectious substances	49	0.2
Division 1.5, Very insensitive explosives, blasting agent	38	0.2
Division 1.3, Explosives with predominantly a fire hazard	36	0.2

3. Key Variables & Dataset Contents

The EHM dataset includes 11 different data tables that have the same structure for both survey years (2021 and 2022). Further, many variables in the EHM data are uniform across all, or most, of the data tables. This section discusses these key variables that are used consistently across the EHM data; they are attributes of the EHM data *as a dataset*. These variables differentiate (or break down) the HAZMAT shipper estimates according to different dimensions, such as industry classification, geographical region, commodity type and classification, packaging type and specification, annual shipment quantity, average net weight per package, and primary mode of transportation. The following table summarizes these variables that are shared across multiple tables in the EHM dataset.

Table C. Dimensions and Variables Used Across the EHM Dataset

Dimension	Variable(s)	Applicable EHM Tables	Source
Industry Classification	2017 North American Industry Classification System (NAICS)	All EHM Tables (1 through 11)	Census NAICS web page
Geographical Region	Petroleum Administration Defense Districts (PADDs)	All EHM Tables (1 through 11)	EIA Glossary entry for "PADD"
Commodity	<ul style="list-style-type: none"> Hazard Class UN/NA ID 	EHM Tables 2 through 11	<ul style="list-style-type: none"> 49 CFR § 173.2 (Hazardous Material Classes) 49 CFR § 172.101 (Hazardous Materials Table)
Packaging	<ul style="list-style-type: none"> Outer Packaging Types Performance Oriented Packaging (POP) Types (Generally Non-Bulk) DOT or UN Specifications (Generally Bulk) 	EHM Tables 3 through 11	<ul style="list-style-type: none"> See 49 CFR Part 178 (Cylinders, Portable Tanks, Cargo Tanks, POP) See 49 CFR Part 179 (Tank Cars) Guide to Performance Packaging Codes (POP)
Quantity	Annual Quantity Shipped (Number of Packages)	EHM Tables 4 and 9	No external data source. EHM data are unique.
Weight	Average Net Weight Per Package (pounds)	EHM Tables 5 and 10	No external data source. EHM data are unique.
Modes of Transportation	Primary Mode of Transportation	EHM Tables 6 and 11	See 2017 Commodity Flow Survey Methodology (July 2020), Table 24

The following sections (3.1-3.7) describe each of these 7 dimensions further. For additional technical details, please refer to the [EHM Experimental Data Product Methodology](#).

3.1 Industry Classification

The dimension of industry classification is characterized by the respondent's 2017 NAICS Code. The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. NAICS codes are standardized between the U.S., Mexico, and Canada. The EHM covers establishments in selected mining, manufacturing, wholesale trade, retail industries, transportation and warehouse industries, publishers, and auxiliary establishments (e.g., warehouses) of in-scope multiunit companies.

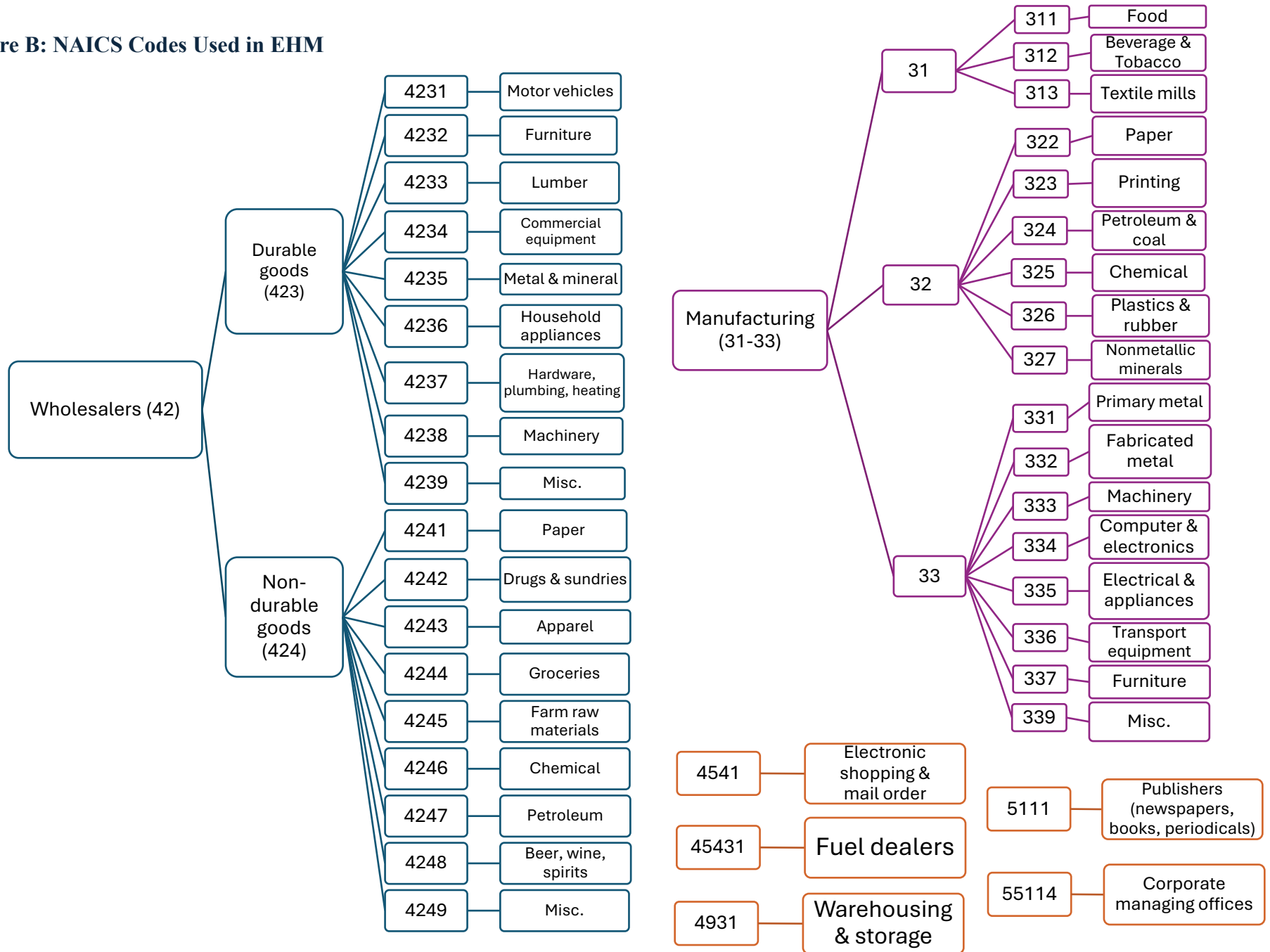
NAICS is a hierarchical system. A hierarchy is the relationship of one item to a particular category. The meaning of NAICS codes varies depending on the digits that are shared with other NAICS codes and the number of digits in the code; i.e., the fewer the number of digits, the more general the classification. Two-digit codes comprise the highest-level or most general classification. Specifically, "00" is used to denote the "Total for all NAICS codes" in the EHM data, whereas "31-33" and "42" are the two-digit NAICS codes corresponding to "Manufacturing" and "Wholesale trade" sectors, respectively. Most HAZMAT shippers fall under these two, two-digit NAICS codes.

Three-digit NAICS codes are more specific and branch off from the two-digit codes, showing a parent-child relationship in the hierarchy. For example, "311" and "312" both fall under "31" for "Manufacturing" and are the three-digit NAICS codes for "Food manufacturing" and "Beverage and tobacco manufacturing," respectively. As another example, "423" and "424" fall under "42" for "Wholesale trade" and are the three-digit NAICS codes for merchant wholesalers of "durable" and "non-durable" goods, respectively. Further, four-digit NAICS codes branch off from the three-digit codes. For example, "4231" is the four-digit NAICS code for wholesalers of "Motor vehicles and motor vehicle parts," which are durable goods, and "4241" is the NAICS code for "Paper and paper products," which are non-durable goods.

There are some stand-alone NAICS codes in the EHM data: "4541," "45431," "4931," and "551114." In these NAICS codes, HAZMAT shippers are counted only once in the specified codes. In other words, the HAZMAT shipper counts for these NAICS codes do not "roll up" or "drill down" (aggregate or disaggregate) into higher- or lower-level categories. This contrasts with the majority of NAICS codes in the EHM data, which aggregate into either "31-33" or "42" or disaggregate into three- or four-digit NAICS codes stemming from "31-33" or "42," such as "339," "327," "313," "4239," or "424."

The following figure shows all the 2017 NAICS codes in the EHM data and indicates the industries they represent.

Figure B: NAICS Codes Used in EHM

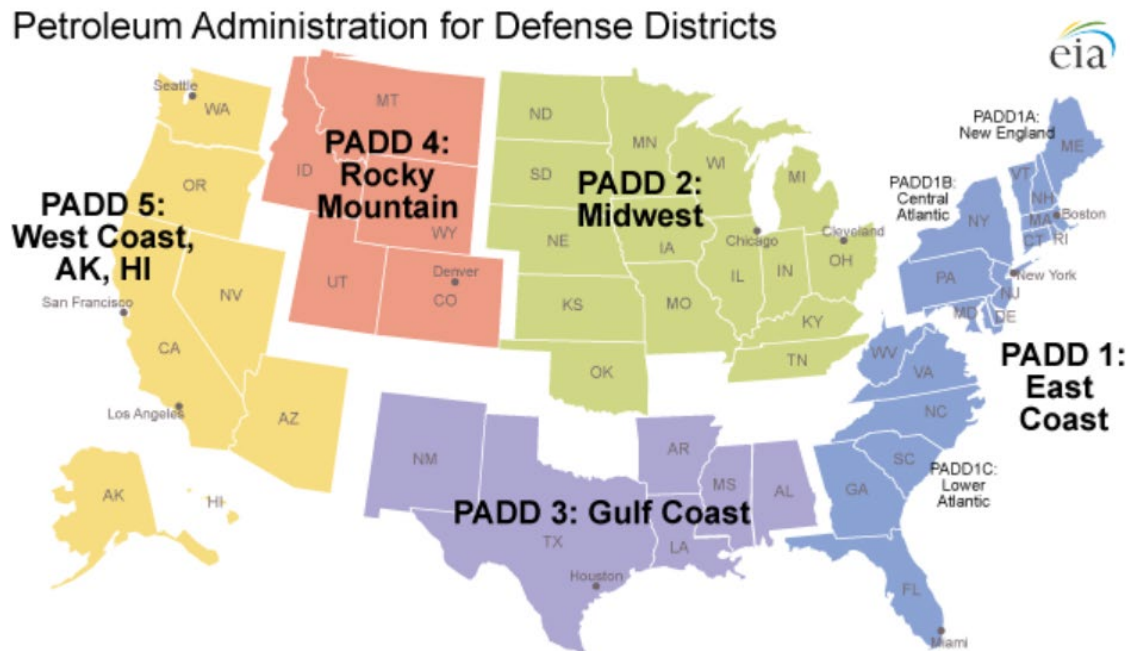


3.2 Geographical Region

The EHM data are categorized geographically using Petroleum Administration for Defense Districts (PADDs), which are categories created by the U.S. Energy Information Administration (EIA). PADDs are geographic aggregations of the 50 states and District of Columbia into five distinct districts. For purposes of the EHM, Roman numerals and Western Arabic numerals are equivalent, for example, PADD_I and PADD_1 are the same. The following PADD levels are found in every table of the EHM dataset:

- A – United States (all PADDs combined)
- PADD_1 – East Coast
- PADD_2 – Midwest
- PADD_3 – Gulf Coast
- PADD_4_5 – Rocky Mountain and West Coast Combined

Figure C. PADDs Representing Geographical Regions in EHM



All tables in the EHM dataset include differentiation by PADD. This geographic variable can be found in the first column of every data table. Initial rows of all data tables cover PADD level “A,” providing the national estimates for all of the United States. Subsequent rows cover the other PADD levels, PADD_1, PADD_2, PADD_3, and PADD_4_5, providing sub-national or regional estimates. For purposes of ensuring appropriate protection of confidential source data and producing a publicly available dataset for the EHM, PADDs 4 and 5 are consolidated (Rocky Mountain & West Coast Combined). If the data user only wishes to see regional estimates, they can filter the first column for their region(s) of interest.

In designing the EHM survey and publishing the EHM dataset, Census and PHMSA needed to consider trade-offs related to disclosure avoidance and the specificity or granularity of the data published. For example, a trade-off existed between geographic granularity and packaging detail. If there are only a couple shippers in a specific state that ship a relatively uncommon HAZMAT in an uncommon packaging type, the data about that HAZMAT activity becomes sparse and the identity of these respondents might become deducible. Given this trade-off, possibly the EHM could have published *more specific* data about where HAZMAT is shipped from (e.g., state or county of shipment origin) if *less specific* data were published about HAZMAT packaging types or specifications.

Should there be future iterations of the EHM survey, PHMSA will need to consider whether and how best to increase the geographical granularity of the public release data while satisfying Federal standards for disclosure avoidance and data quality.

3.3 Commodity

For HAZMAT shippers, each type of HAZMAT shipped is a different chemical commodity. In the EHM, HAZMATs are differentiated by Hazard Class/Division and UN/NA ID. Hazard classes and divisions are specified in 49 CFR § 173.2 and summarized in the following table.

Table D. Hazard Classes/Divisions in the HMR (49 CFR § 173.2)

Class	Division	Name of Class/Division	49 CFR Reference for Definition
1	1.1	Explosives (with a mass explosion hazard)	173.50
1	1.2	Explosives (with a projection hazard)	173.50
1	1.3	Explosives (with predominately a fire hazard)	173.50
1	1.4	Explosives (with no significant blast hazard)	173.50
1	1.5	Very insensitive explosives; blasting agents	173.50
1	1.6	Extremely insensitive detonating substances	173.50
2	2.1	Flammable gas	173.115
2	2.2	Non-flammable compressed gas	173.115
2	2.3	Poisonous gas	173.115
3		Flammable and combustible liquid	173.120
4	4.1	Flammable solid	173.124
4	4.2	Spontaneously combustible material	173.124
4	4.3	Dangerous when wet material	173.124
5	5.1	Oxidizer	173.127
5	5.2	Organic peroxide	173.128
6	6.1	Poisonous materials	173.132
6	6.2	Infectious substance (etiologic agent)	173.134
7		Radioactive material	173.403
8		Corrosive material	173.136
9		Miscellaneous hazardous material	173.140

In addition to Hazard Class/Division, the chemical commodity data from EHM are also differentiated by UN/NA ID. The Hazardous Materials Table (HMT; 49 CFR § 172.101) provides the list of all the possible UN/NA IDs that can be used to classify HAZMAT.

For disclosure avoidance and data quality purposes, estimates about HAZMAT shipped by fewer than 500 establishments nationally are not published. The following table shows the UN/NA IDs that are present in the EHM data given this threshold. In future iterations of the EHM survey, PHMSA should consider ways to minimize this threshold and increase the amount of data that is publishable, while satisfying Federal standards for disclosure avoidance and data quality.

Table E. UN/NA IDs Estimated to be Shipped by More Than 500 Establishments

UN/NA ID	Hazard Class/Division	Chemical Commodity Name (Abbreviated)
NA1993	3	Combustible liquid, n.o.s. or Diesel fuel
UN1001	2.1	Acetylene, dissolved
UN1005	2.2	Ammonia, anhydrous
UN1006	2.2	Argon, compressed
UN1013	2.2	Carbon dioxide
UN1046	2.2	Helium, compressed
UN1066	2.2	Nitrogen, compressed
UN1072	2.2	Oxygen, compressed
UN1075	2.1	Liquefied petroleum gas
UN1090	3	Acetone
UN1133	3	Adhesives, containing a flammable liquid
UN1170	3	Ethanol or Ethyl alcohol
UN1202	3	Gas oil, diesel fuel, or heating oil, light
UN1203	3	Gasoline including mixed with ethanol, not more than 10% alcohol
UN1219	3	Isopropyl alcohol
UN1263	3	Paint or paint related material
UN1268	3	Petroleum distillates, n.o.s.
UN1760	8	Corrosive liquids, n.o.s
UN1789	8	Hydrochloric acid
UN1791	8	Hypochlorite solutions
UN1824	8	Sodium hydroxide
UN1866	3	Resin Solution, flammable
UN1950	2.1	Aerosols
UN1956	2.2	Compressed gas, n.o.s
UN1977	2.2	Nitrogen, refrigerated liquid cryogenic liquid
UN1993	3	Flammable liquids, n.o.s.
UN2922	8	Corrosive liquids, toxic, n.o.s
UN3077	9	Environmentally hazardous substance, solid, n.o.s

UN3082	9	Environmentally hazardous substance, liquid, n.o.s.
UN3264	8	Corrosive liquid, acidic, inorganic, n.o.s
UN3265	8	Corrosive liquid, acidic, organic, n.o.s
UN3266	8	Corrosive liquid, basic, inorganic, n.o.s
UN3480	9	Lithium-ion batteries
UN3481	9	Lithium-ion batteries contained in, or packed with, equipment

Relying on the top ten most frequently shipped HAZMATs reported by shippers, EHM Table 2 breaks out the count of HAZMAT shippers by Hazard Class/Division and UN/NA ID. EHM Tables 3 through 11 also break out HAZMAT shipper counts by Hazard Class/Division and UN/NA ID, but these tables rely only on shippers' top three most frequently shipped HAZMATs. EHM Table 1 has no such differentiation because it is based on a stand-alone survey question (Item H4), quantifying the total number of HAZMATs shipped per shipper during 2021 or 2022.

3.4 Packaging

In general, 49 CFR Part 178 details the different DOT specifications for cylinders and cargo tanks, as well as performance-oriented packaging (e.g., drums, boxes, bags, jerricans, IBCs). 49 CFR Part 178 also includes portable tank specifications, many of which are incorporated by reference from the United Nations Recommendations on the Transport of Dangerous Goods—Model Regulations (e.g., T1 portable tank, T22, T50). In addition, 49 CFR Part 179 contains tank car specifications (e.g., DOT-105, DOT-111), along with standards incorporated by reference from the Association of American Railroads Manual of Standards and Recommended Practices, Section C-III, Specifications for Tank Cars. For the most part, the specifications and packaging standards categories used in the EHM originate from Parts 178 and 179 in the HMR.

For their top three most frequently shipped HAZMATs, respondents to the EHM survey were asked to describe the packaging they used. The dimension of packaging is characterized by a few different variables in the EHM data, namely, outer packaging type, POP sub-type, and DOT/UN specification. Section 2 of this User Guide describes the distinction between performance-oriented packaging and DOT/UN specification packaging. In review, the outer packaging types in EHM include:

- **POP** – drum; jerrican; box; bag; composite packaging; and intermediate bulk container
- **DOT/UN Specification** – cylinder; cargo tank; portable tank; tank car; and other packaging

These outer packaging types break down into more granular, lower-level categories. Specifically, each outer packaging type can be disaggregated further into performance-oriented packaging types (“POP sub-types”) or DOT/UN specifications. The following table shows this hierarchy for categorizing HAZMAT packaging.

Please note, some POP sub-types and DOT/UN specifications were ultimately not used by respondents. The following table only presents the POP sub-types and DOT or UN specifications that respondents used, and for which estimates met Census standards for disclosure avoidance

and publication. See EHM Tables 7 and 8 for the count of HAZMAT shippers differentiated by POP sub-type and DOT/UN specification, respectively.

Table F. POP Sub-Types and DOT/UN Specifications in the EHM Dataset

DOT-Regulated Packaging Group	Outer Packaging Type	POP Sub-Type or DOT/UN Specification
POP	Drum	Steel drum, non-removable head
		Steel drum, removable head
		Aluminum drum, non-removable head
		Aluminum drum, removable head
		Fiber drum
		Plastic drum, non-removable head
		Plastic drum, removable head
		Metal drum, non-removable head
		Metal drum, removable head
	Jerrican	Steel jerrican, non-removable head
		Steel jerrican, removable head
		Aluminum jerrican, removable head
		Plastic jerrican, non-removable head
		Plastic jerrican, removable head
	Box	Steel box
		Aluminum box
		Fiberboard box
		Wood box, ordinary
		Plywood box
		Reconstituted wood box
		Plastic box, expanded
		Plastic box, solid
		Metal Box
	Bag	Woven plastic bag, water-resistant
		Plastic film bag
		Paper bag, multi-wall
		Paper bag, multi-wall water-resistant
	Composite Packaging	Plastic receptacle within a protective steel drum
		Plastic receptacle within a protective fiberboard box
		Plastic receptacle within a protective plastic drum
Plastic receptacle within a protective plastic box		
Glass, porcelain, or stoneware receptacles within a protective fiberboard box		
Glass, porcelain, or stoneware receptacles within a protective solid plastic packaging		

	Intermediate Bulk Container	Metal Intermediate Bulk Container
		Rigid plastic Intermediate Bulk Container
		Composite Intermediate Bulk Container
		Fiberboard Intermediate Bulk Container
		Flexible Intermediate Bulk Container
DOT/UN Specification	Cylinder	Specification 39 cylinder
		DOT 3A cylinder
		DOT 3AA cylinder
		DOT 3AL cylinder
		DOT 4BA cylinder
		DOT 4BW cylinder
		DOT 4L cylinder
		Other DOT 4-series cylinder
		Other DOT 8-series cylinder
		Other DOT/UN/ISO cylinder
	Cargo Tank	MC/TC/SCT 306 cargo tank
		MC/TC/SCT 307 cargo tank
		MC/TC/SCT 312 cargo tank
		MC/TC/SCT 331 cargo tank
		MC/TC/SCT 338 cargo tank
		DOT/TC 406 cargo tank
		DOT/TC 407 cargo tank
		DOT/TC 412 cargo tank
	Other cargo tank	
	Portable Tank	Specification 60 portable tank
		T1 - T22 portable tank
		T50 portable tank
		Other UN portable tank
	Tank Car	DOT/TC 105 tank car
		DOT/TC 111 tank car
		DOT/TC 112 tank car
		DOT/TC 117 tank car
		Other DOT/TC/AAR tank car

3.5 Weight

For each of their top three HAZMATs, respondents were asked to provide the average net weight of the HAZMAT, in pounds, per package. The net weight is the total weight of the HAZMAT package minus the weight of the packaging. In other words, net weight is the weight of the HAZMAT package minus the tare weight.

Moreover, the EHM survey asked for the “average net weight” because HAZMAT shippers fulfill many different orders and different packagings have different capacities. Using an average

captures the potentially wide variation in the amount of HAZMAT shipped per package. This is true for most, if not all, HAZMAT packages, but especially so for bulk packagings such as cargo tanks, portable tanks, and tank cars that can be filled to different levels below their full capacity.

In the EHM data, responses for the average net weight are aggregated and presented as bins or ranges of pounds (lbs.) for the average net weight per package. In the EHM data, Tables 5 (POP) and 10 (specification packaging) show the count of HAZMAT shippers differentiated by the bins for average net weight. Please note, certain average net weight bins may not be displayed in the EHM data if the number of shippers shipping within that weight range was zero.

The following table shows the bins used to differentiate HAZMAT shippers according to outer packaging type and the average net weight per package. The bins are very similar between the POP and specification packaging groups; however, specification packaging has a few larger bins, which reflects the fact that cargo tanks, tank cars, and portable tanks are bulk packagings that have a larger capacity than POP, which is generally non-bulk.

Table G. Bins for Average Net Weight by Outer Packaging Type

DOT-Regulated Packaging Group	Outer Packaging Types	Bins (Average Net Weight)	Unit of Measure
POP	Drum, Jerrican, Box, Bag, Composite Packaging, Intermediate Bulk Container	<ul style="list-style-type: none"> • Any Average Net Weight • Less than 5 • 5 to 9 • 10 to 24 • 25 to 49 • 50 to 99 • 100 to 249 • 250 to 499 • 500 to 999 • 1,000 to 4,999 • 5,000 to 24,999 • 25,000 to 49,999 • No package weight reported 	Pounds
DOT/UN Specification	Cylinder, Cargo Tank, Portable Tank, Tank Car, Other Packaging	<ul style="list-style-type: none"> • Any Average Net Weight • Less than 5 • 5 to 9 • 10 to 24 • 25 to 49 • 50 to 99 • 100 to 249 • 250 to 499 • 500 to 999 • 1,000 to 4,999 	Pounds

		<ul style="list-style-type: none"> • 5,000 to 24,999 • 25,000 to 49,999 • 50,000 to 99,999 • 100,000 to 249,999 • 250,000 or more • No package weight reported 	
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The EHM survey requested that all weights be reported in pounds, for consistency with CFS shipments’ unit of measurement, but allowed respondents to provide alternative units of measure. When respondents used an alternative unit of measure for average net weight, Census analysts reviewed the data collected and performed conversions based on the unit of measurement reported. Online calculators were used for mass conversions (e.g., kg to lbs.). Volume to mass conversions (e.g., gallons to lbs.) required additional research based on the HAZMAT being converted. In addition to using Safety Data Sheets for specific HAZMAT, other resources such as the [National Oceanic and Atmospheric Administration \(NOAA\) Computer-Aided Management Emergency Operations \(CAMEO\) Chemicals Database of Hazardous Materials](#) were consulted when performing volume to mass conversions.

3.6 Quantity

For each of their top three most frequently shipped HAZMATs, respondents were asked to describe the how many packagings they shipped in 2021 and 2022.

Specifically, for respondents using POP types, the EHM survey asked, “How many packagings of this hazardous material were shipped in YYYY [2021 or 2022]?” In other words, HAZMAT shippers using POP were asked how many individual boxes, drums, IBCs, etc. they shipped in the survey year.

For respondents using DOT or UN specification packaging, the EHM survey asked, “What was the total amount of this hazardous material shipped in YYYY [2021 or 2022] via this packaging type?” This total amount was divided by the average net weight per package to determine the number of DOT or UN specification packages shipped. For example, if a HAZMAT shipper shipped approximately one million pounds of gasoline in a year, and the average net weight per cargo tank was 3,600 pounds, the annual shipment quantity for that shipper was about 278 packages (cargo tanks). As described in the previous section (3.5 Weight), the EHM survey requested that weight be reported in pounds but allowed respondents to report an alternative unit of measure. When respondents used an alternative unit of measure, Census analysts reviewed the data collected and performed conversions based on the specific properties of the HAZMAT shipped and the unit of measure reported.

In the EHM dataset, data about annual shipment quantity are aggregated in EHM Tables 4 (POP) and 9 (specification) and presented as bins or ranges for the number of packages shipped. The bins for annual shipment quantity are standardized across packaging types. However, certain

shipment quantity ranges may not be shown in the EHM data if zero respondents reported shipping within that quantity range. This bullet-point list shows the bins used to differentiate HAZMAT shippers according to the number of packages they shipped annually:

- Any Shipment Quantity
- Less than 10 packages
- 10 to 49 ...
- 50 to 99 ...
- 100 to 249 ...
- 250 to 499 ...
- 500 to 999 ...
- 1,000 to 2,499 ...
- 2,500 to 4,999 ...
- 5,000 to 9,999 ...
- 10,000 to 49,999 ...
- 50,000 to 99,999 ...
- Greater than 100,000 ...
- No Shipment Quantity Reported

3.7 Primary Mode of Transportation

For each of their top three most frequently shipped HAZMATs, respondents were asked for the primary mode of transportation used to ship each HAZMAT. While shipments of HAZMAT are commonly intermodal – i.e., they use multiple modes of transportation to ship the HAZMAT from origin to destination – the EHM survey only requested the primary mode. Should there be future iterations of the EHM survey, PHMSA will need to consider how to capture more accurately the multimodal or “intermodal” nature of hazardous materials transportation.

In the EHM survey, the categories for modes of transportation were the same as the long-standing, traditional CFS. These were the modal categories in the 2022 CFS and EHM:

- For-hire truck
- Company-owned truck
- Rail
- Air
- Inland water
- Deep sea
- Pipeline
- Parcel, U.S. Postal Service, or courier
- Customer pick-up
- Other mode
- Unknown

Notably, “Inland water” and “Pipeline” do not appear in the public EHM data, meaning respondents did not choose either mode as the primary mode of transportation for any of their top

three HAZMATs. See EHM Tables 6 (POP) and 10 (specification) for estimates showing the primary modes of transportation used to ship shippers' top three HAZMATs.

3.8 Footnotes

Each of the 11 EHM Tables has footnotes. In the spreadsheet data files, the user will find the footnotes applicable to a particular EHM Table by scrolling down below the data contents within each tab. The footnotes are generally the same across all EHM Tables; however, footnote 2 varies slightly depending on the EHM Table being used.

For instance, footnote 2 in Table 4 clarifies that the data refers only to performance-oriented packaging types. Conversely, footnote 2 in Table 8 clarifies that the data only pertains to specification packaging types.

Please see the following table for an index of all the footnotes used in the EHM dataset.

Table H. Footnote Index

Footnote	Description
1	Among establishment's reported top ten most frequently shipped materials.
2	Establishment reports a single outer packaging most frequently used for a given material... <ul style="list-style-type: none"> • Only performance-oriented packaging types are reflected on this table. <i>(EHM Tables 4-7)</i> • Only specification packaging types are reflected on this table. <i>(EHM Tables 8-11)</i>
3	Among establishment's reported top three most frequently shipped materials.
4	Wholesale establishments exclude manufacturers' sales offices and own brand importers.
5	Includes only captive warehouses that provide storage and shipping support to a single company. Warehouses offering their services to the general public and other businesses are excluded. For tabulation and publication purposes, NAICS 484 (Truck transportation) is grouped with NAICS 4931.
6	Includes NAICS 51223 (Music publishers).
S	Estimate does not meet publication standards because of high sampling variability, poor response quality, or other concerns about the estimate quality. Unpublished estimates derived from this table by subtraction are subject to these same limitations and should not be attributed to the U.S. Census Bureau.
X	Not applicable.
Z	Estimate rounds to zero.

4. EHM Table-by-Table Guide

Although the 11 tables in the dataset share several key variables, each data table is unique and serves a distinctive purpose.

Please see below for the EHM Table-by-Table Guide. This guide provides a summary of each data table in the EHM dataset and should help users with navigating the dataset.

Table I. EHM Table-by-Table Guide, Applicable to Both Survey Years (2021 & 2022)

Packaging Type	EHM Table Number	Example Research Questions	Key Attributes	Categories & Values
All Packaging Types	1	How many HAZMATs do shippers report shipping?	Number of different HAZMATs shipped <i>(Number of Distinct UN/NA IDs)</i>	Bins- as ranges of distinct HAZMATs <i>(1-4 HAZMATs, 5-9, 10-14, ..., 55 or more)</i>
	2	How many businesses ship Class 3 flammable liquids? How many businesses ship a given hazardous material, such as UN1075 or UN3480?	Hazard Class & UN/NA ID	Hazard Classes <i>(D1.1, D1.3, D2.1, ...)</i> UN ID <i>(NA1993, UN1001, ...)</i>
	3	What types of outer packaging do HAZMAT shippers typically use? How many HAZMAT shippers use each type?	Outer Packaging Types	Outer Packaging Types <i>(Tank Car, Cylinder, Drum, ...)</i>
Non-Bulk/POP	4	How many non-bulk HAZMAT packages does a business typically ship in a year?	Annual Shipment Quantity <i>Non-Bulk/POP Only</i>	Bins- as ranges of shipment quantities <i>(less than 10 packages, 10-49, ...)</i>
	5	How much do non-bulk HAZMAT packages weigh on average?	Average Net Weight per Package (lbs.) <i>Non-Bulk/POP Only</i>	Bins- as ranges of weight <i>(less than 5 pounds, 5-9 pounds, ...)</i>

	6	What modes of transportation are typically used to ship non-bulk HAZMAT?	Mode of Transportation <i>Non-Bulk/POP Only</i>	Modes <i>(air, deep sea, railroad, ...)</i>
	7	What specific types of non-bulk packaging do shippers typically use? How many businesses use each specific type?	POP/Non-Bulk Packaging Types and Characteristics	POP Types and Sub-Types <i>(Steel drum, non-removable head, metal IBC, ...)</i>
Bulk & DOT/UN	8	What DOT and UN specification packaging do shippers typically use? How many HAZMAT shippers use each specification?	Bulk and DOT/UN Specifications	DOT/UN Specifications <i>(DOT 3A cylinder, DOT 406 cargo tank, T1-T22 portable tank, ...)</i>
	9	How many DOT/UN specification packages does a business typically ship in a year?	Annual Shipment Quantity <i>Bulk and DOT/UN Specifications Only</i>	Bins- as ranges of shipment quantities <i>(less than 10 packages, 10-49, ...)</i>
	10	How much do DOT/UN specification packages weigh on average?	Average Net Weight Per Package (lbs.) <i>Bulk and DOT/UN Specifications Only</i>	Bins- as ranges of weight <i>(less than 5 pounds, 5-9 pounds, ...)</i>
	11	What modes of transportation are typically used to ship HAZMAT in DOT/UN specification packaging?	Mode of Transportation <i>Bulk and DOT/UN Specifications Only</i>	Modes <i>(air, deep sea, railroad, ...)</i>