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Risk assessment for the 2024 In-Service Verification (ISV) of CO_2 emissions of Light-Duty Vehicles

Risk Assessment ISV 2024 according to Commission Implementing Regulation (EU) 2023/2866

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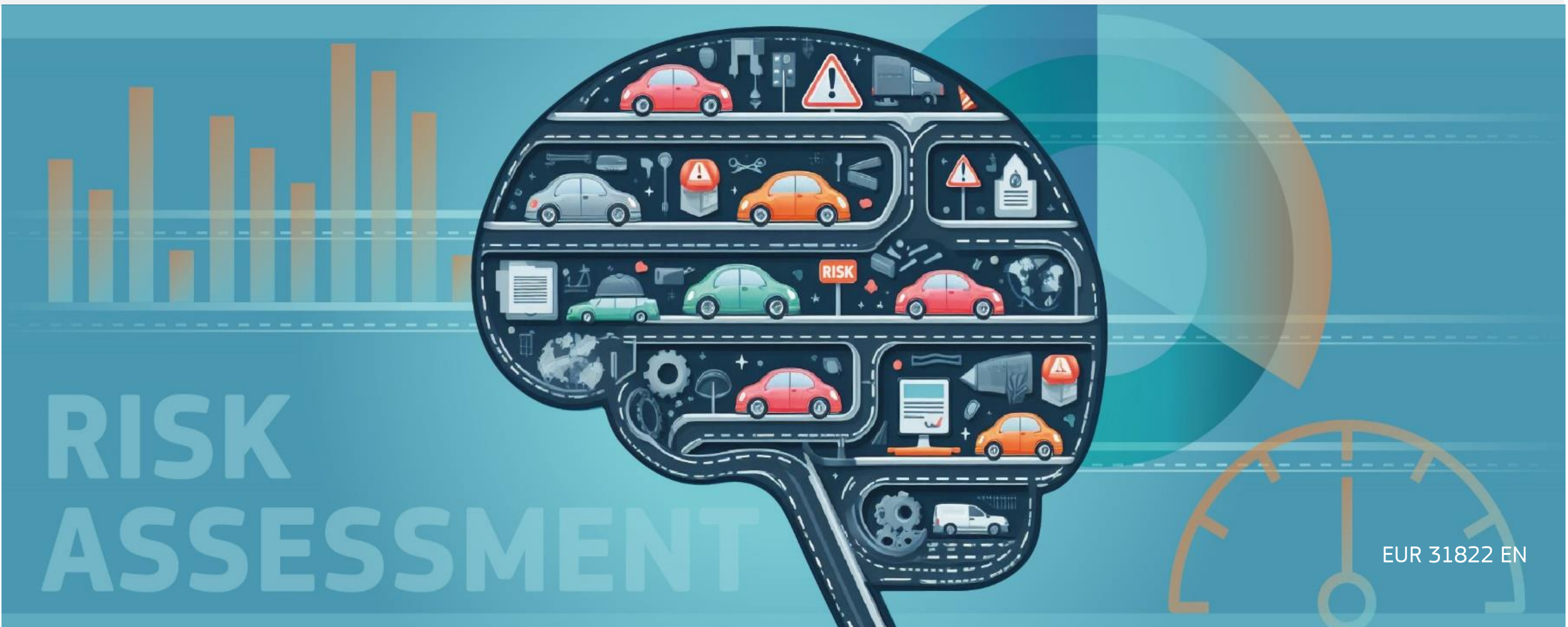
2024



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Contents

Abstract

Article 13 of Regulation (EU) 2019/631 requires the type-approval authorities to verify the CO_2 emission and fuel consumption values of light-duty vehicles in-service. Commission Delegated Regulation (EU) 2023/2867 sets out the guiding principles and criteria for defining the procedures for that verification, while Commission Implementing Regulation (EU) 2023/2866 determines the actual verification procedures.

Article 3(4) of that Implementing Regulation requires the Commission to set out a methodology for assessing the risk that in-service verification (ISV) families may include vehicles with a deviation in the CO_2 emission values and to publish each year a report describing that methodology and listing those families with the highest risk of including such vehicles. JRC has been tasked to perform the risk assessment on behalf of the Commission. When assessing the risk, at least the elements mentioned in Article 3(3) of the Implementing Regulation need to be taken into account, when available. The type-approval authorities must use the Commission's risk assessment as a basis for selecting the families for their in-service verification.

This is the first annual report describing the methodology for the assessment, and the main findings. The risk assessment methodology described is based on a Composite Risk Index (CRI), which combines the probability and severity of a specific occurrence. Probability levels are determined based on the total number of new vehicles from the in-service verification family that have been placed on the Union market. For the severity determination, the data collected pursuant to Article 14 of Implementing Regulation (EU) 2021/392 and through the Commission's market surveillance test campaigns have been utilized. The real-world data, as referred to in Article 3(3)(e) of Implementing Regulation (EU) 2023/2866, has not yet been used for this risk assessment due to the limited number of such data submitted so far.

This report also identifies the ISV families with the highest risk of including vehicles with a deviation in CO_2 emissions values. These families are labelled as ISV families with the first testing priority in 2024. Based on the risk assessment, a total of 131 interpolation families, representing 106 ISV families, have been identified as having such high risk. Additionally, a significant number of interpolation families were reported as part of the annual CO_2 monitoring for light-duty vehicles, but could not be found amongst those reported to the Commission under Article 14 of Implementing Regulation (EU) 2021/392. Therefore, a number (66) of those missing interpolation families with the highest vehicle registration numbers in the last three years has been selected as high risk, and labelled as ISV families with the first testing priority for the 2024 in-service verification.

To further support the vehicle selection for the 2024 in-service verification, this report also presents a random selection of additional IP families both registered and not registered in Database of In-service verification of CO_2 Emissions (DICE). Finally, all remaining families that are not registered in DICE are also presented.

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Authors

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Executive summary

Policy context

Building on the guiding principles and criteria set out in Commission Delegated Regulation (EU) 2023/2867, the procedures for the In-Service Verification (ISV) of Light-Duty Vehicle (LDV) CO_2 emissions by granting type-approval authorities (GTAAs), which will start from 2024 onwards, are set out in Commission Implementing Regulation (EU) 2023/2866. The Implementing Regulation establishes the rules for the selection of vehicle families and individual vehicles for ISV, the type and number of ISV tests, the pass/fail criteria, the vehicle and test conditions, the reporting format and, in case of failure, the procedure for correcting the average specific emissions of CO_2 of a manufacturer. In this context, the Commission has to develop a risk assessment methodology for the ISV family selection and annually publish a list of ISV families with the highest risk of having vehicles with a deviation in the CO_2 values. The JRC has taken up this task.

Methodology

To support the risk assessment and selection of ISV families, the elements from Article 3(3) of the Implementing Regulation have been considered, when available. In this context, the datasets employed were: (1) the official CO_2 emission type-approval data of each interpolation (IP) family entering the EU market reported to JRC pursuant to Article 14 of Implementing Regulation (EU) 2021/392, (2) the data from each individual new vehicle registered in the EU and reported to the European Environmental Agency, and (3) the data collected through Commission market surveillance test campaigns. As regards the other elements listed in Article 3(3) of Implementing Regulation (EU) 2023/2866, the results of previous in-service verifications could not be included since this is the first time the exercise takes place. Additionally, the usage of real-world data (Article 3(3)(e)) was omitted in this year's report due to the limited number of vehicles (7.2% of the new car fleet and less than 1% of the van fleet) for which data was submitted in the first year of reporting. Nevertheless, the methodology for the future use in risk assessment has been developed and presented in this report.

The risk assessment methodology described in this report is based on a Composite Risk Index (CRI) that combines the probability and severity of a specific occurrence. Probability levels are determined based on the number of new vehicles belonging to the same IP family, which were registered in the Union (from 2020 to 2022). Probability is categorized into three levels: low (1), medium (2), and high (3). Severity levels are determined based on different criteria depending on the source of data utilized and the type of issue identified. The severity considered elements such as implementation of the various steps of the Type 1 test procedure, identification of IP families with similar technical characteristics but lower CO_2 emissions or cycle energy demand (CED), and laboratory (WLTP) and on-road (RDE) test results from in-service conformity (ISC) and market surveillance tests performed in previous years. Severity is also categorized into three levels: low (1), medium (2), and high (3). The final CRI scores are calculated by multiplying the probability and severity levels and thus have values of 1, 2, 3, 4, 6, or 9. Depending on the CRI score, the final risk level for a family will be Low (CRI = 1 or 2), Medium (CRI = 3 and 4) or High (CRI = 6 or 9) Risk.

The last element under consideration in this report is a random selection approach. This concerns IP families that were not part of the previous analysis in order to cover potential issues that may not be addressed by the systematic approach.

Main findings

The risk assessment has identified 131 unique interpolation (IP) families as high risk, indicating the potential presence of vehicles with deviations in CO_2 emissions and fuel consumption values. These families have been aggregated into 106 In-Service Verification (ISV) families and these families are selected for inclusion in the 2024 in-service verification with the first testing priority. For each selected family, the most relevant type(s) of ISV test (chassis-dynamometer, road load, or artificial strategy test) has been identified based on the type of issue that triggered the interpolation family to be flagged as high risk.

A significant number of IP families, recently reported in the EU as part of the annual CO_2 monitoring exercise, could not be found amongst the families reported to DICE. Further investigation is needed to understand the reasons for this. This report includes a list of all missing families with at least 100 registered vehicles. In order to cover the missing IP families as part of the ISV procedures, a number of them (66) have been selected for inclusion in the 2024 in-service verification with the first testing priority: it concerns those missing families that had the highest number of vehicles registered in the last three years.

To further support the ISV family and vehicle selection by GTAAs for the 2024 in-service verification, the report also presents a random selection of IP families, both registered and not registered in DICE. These families are labeled as ISV families with the second testing priority in 2024. Furthermore, all remaining families that are not registered in DICE are labelled as third testing priority.

1 **Introduction**

1.1 Scope of the report

This report is intended to support the implementation of Implementing Regulation (EU) 2023/2866 ([1]) on the in-service verification of CO_2 emissions and fuel consumption of light duty vehicles. The report addresses the requirement of Article 3 of the Regulation, which stipulates that:

> "*Each year, by 31 December, the Commission shall publish a report describing the **methodology used for the assessment** referred to in paragraph 2, point (b), and **the main findings of its assessment** undertaken in that year. The report shall also contain **a list of in-service verification families with the highest risk** of including vehicles with a deviation in the CO_2 emission values*".

This report provides the first annual risk assessment for the In-service Verification (ISV) of CO_2 emissions for passenger cars and light commercial vehicles to start in 2024 and guides the Member States' Granting Type Approval Authorities (GTAAs) in selecting the ISV families that should undergo testing.

1.2 Regulatory background

The official fuel consumption and CO_2 emission values for new light-duty vehicles (LDV) registered in the EU are determined based on Regulation (EU) 2017/1151 ([2]) following the Worldwide harmonized Light vehicles Test Procedure (WLTP).

The WLTP foresees vehicle CO_2 emission testing on a chassis dynamometer, with the chassis dynamometer load settings based on the results of road-load testing. To limit the test burden, the WLTP allows for the grouping of vehicles into interpolation families. The WLTP defines specific test boundaries, which represent a set of predefined 'reference' conditions, as the test protocol cannot cover all potential operating situations.

Regulation (EU) 2019/631 ([3])(Article 13) requires manufacturers to ensure that the CO_2 emission and fuel consumption values recorded in the certificates of conformity of their vehicles correspond to the values determined for vehicles in-service in accordance with the procedures set out in Regulation (EU) 2017/1151. This correspondence, as well as the presence of any strategies artificially improving the WLTP performance of the vehicles, has to be verified by the type-approval authorities concerned by testing an appropriate sample of selected vehicles. Delegated Regulation (EU) 2023/2867 ([4]) sets out the guiding principles and criteria for the in-service verification (ISV) procedures. Implementing Regulation (EU) 2023/2866 ([1]) sets out the actual procedures.

To ensure the accuracy of CO_2 emission values recorded in certificates of conformity and their correspondence with in-service vehicle CO_2 emissions, Delegated Regulation (EU) 2023/2867 stipulates that a sample of vehicles from the ISV families selected has to undergo road-load and chassis dynamometer tests according to the procedures set out in Regulation (EU) 2017/1151 ([1]). The ISV families are composed of IP families that share the same Type 1 test results and have emission type-approvals granted by the same GTAA.

Moreover, to verify whether strategies are present that could artificially improve a vehicle's performance in the tests performed for the purpose of type-approval, additional dedicated tests are to be performed.

Implementing Regulation (EU) 2023/2866 specifies how to select ISV families, including based on a risk assessment to be performed by the Commission, the type and number of ISV tests, the pass and fail criteria, the vehicle and test conditions, the reporting format and, in case of failure, how the average specific emissions of CO_2 of a manufacturer should be corrected.

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[1] EC. 2023a. Regulation (EU) No 2023/2866. Off. J. Eur. Union OJ (IMPLEMENTING)
[2] EC. 2017. Regulation (EU) No 2017/1151. Off. J. Eur. Union OJ L 175, 1–643
[3] EU. 2019. Regulation (EU) No 2019/631. OJ L 111, 25.4.2019, p. 13–53
[4] EC. 2023b. Regulation (EU) No 2023/2867. Off. J. Eur. Union OJ L (DELEGATED).

When selecting ISV families for testing, the GTAA has to[5]:

- include all ISV families for which in the preceding 12 months it has received evidence from the Commission, a type-approval authority, a market surveillance authority or a third party complying with the requirements of Commission Implementing Regulation (EU) 2022/163[6], indicating the presence of a deviation in the CO_2 emission values;
- select further ISV families on the basis of the assessment by the Commission of the risk that those families may include vehicles with a deviation in the CO_2 emission values.

In this regard, the Commission has to publish each year by 31 December, a report describing the methodology used for the risk assessment referred to in the second bullet above, and the main findings of its assessment undertaken in that year. The report also needs to contain a list of ISV families with the highest risk of including vehicles with a deviation in the CO_2 emission values.

1.3 Risk assessment objectives

In accordance with Article 3 of Implementing Regulation (EU) 2023/2866, the risk assessment has to consider, when available, at least the following elements:

a) the total **number of new vehicles** from the ISV family that have been placed on the Union market;

b) ISV families with **similar technical characteristics but with lower CO_2 emission or fuel consumption values**, identified using the data collected pursuant to Article 14 of Implementing Regulation (EU) 2021/392 ([7]);

c) the results of **previous in-service verifications**, and in particular the findings related to the presence of artificial strategies;

d) relevant information from **in-service conformity tests** pursuant to Regulation (EU) 2017/1151;

e) **real-world data** as defined in Article 2(c) of Implementing Regulation (EU) 2021/392.

The risk assessment presented in this report is built on these elements. In addition to the above mentioned elements, the risk assessment also integrated the evaluation of other factors, which, supported by available evidence, could effectively help to identify families with a high risk of a deviation in CO_2 emissions and fuel consumption values.

Element b) concerns the analysis of type-approval data collected in accordance with Article 14 of Implementing Regulation (EU) 2021/392. The quality control checks were conducted on this data to validate the accurate implementation of various steps outlined in Regulation (EU) 2017/1151, including gearshift calculation, the difference between theoretical vehicle speed and the speed driven in the Type 1 test, corrections of measured CO_2 emissions, and CO_2 declaration.

That analysis allowed detecting outliers or ISV families with similar technical characteristics but lower CO_2 emissions or cycle energy demand (CED). Additionally, test data collected through the Commission's market surveillance test campaigns have been utilized in the risk assessment. This comprehensive approach ensures a robust identification of ISV families at the highest risk of deviation in their CO_2 emission and fuel consumption values.

This year's risk assessment, however, could not yet consider point (c) as no ISV tests have been performed so far. Also, data under point (e) were not used as the real-world data available were based solely on information collected and reported by vehicle manufacturers. In addition, not all manufacturers have reported real-world data so far, and the first dataset covered only around 7.2% of the EU new car fleet and less than 1% of the van fleet registered in 2021.

5 Article 3 of Implementing Regulation (EU) 2023/2866

6 EC. 2022a. Regulation (EU) 2022/163. OJ L 27, 8.2.2022, p. 1.

7 EC. 2021. Regulation (EU) No 2021/392. Off. J. Eur. Union OJ L 77, 5.3.2021, 8–25.

Furthermore, through a detailed analysis of the CO_2 monitoring data reported for the new vehicles registered in the Union, a substantial number of IP families were identified, for which the type-approval data had not been reported to the Commission under Article 14 of Implementing Regulation (EU) 2021/392.

In order to ensure consideration of these families in the risk assessment, a number of missing interpolation families were selected and flagged with the first testing priority in the 2024 in-service verification, based on the highest vehicle registration numbers in the last three years.

Various types of tests are required for ISV (laboratory chassis-dynamometer emission tests, road load tests, and tests to identify the presence of artificial strategies). Therefore, the assessment also links potential risks associated with ISV families flagged as high risk to chassis-dynamometer testing, road load tests, or the implementation of artificial strategies. Consequently, each of the listed ISV families will be marked for specific types of tests based on the outcomes of this assessment.

Furthermore, to address potential issues that may not be captured by the systematic checks undertaken as part of the risk assessment, a number of other IP families – covering families registered in DICE as well as families missing from DICE - were randomly selected from the type-approval dataset. These randomly selected families are labeled as the second testing priority in 2024.

In addition, all remaining families that are not registered in DICE are labelled as the third testing priority in 2024.

1.4 Structure of the report

The report is structured as follows:

Chapter 1 introduces the scope of the report, and the regulatory background. In addition, this chapter outlines the most important objectives of the risk assessment and the structure of this report.

Chapter 2 describes the different sources of data used in the risk assessment.

Chapter 3 details the risk assessment methodology explaining the probability and severity definitions, methodologies for establishing probability and severity levels and the composite risk index. Additionally, it details the random selection approach applied along with the risk assessment.

Chapter 4 presents the main findings of the risk assessment analyses and random selection approach. In addition, it details which interpolation families were not reported to DICE along with the methodology developed for prioritizing the highest-risk interpolation families among them.

Chapter 5 presents the results and the list of families with first, second, and third testing priority in the 2024 in-service verification. In addition, it highlights the types of test proposed for each selected ISV family based on the severity analysis.

Chapter 6 summarizes the conclusions of this report.

2 Sources of data

To support the risk assessment, four datasets have been employed, in line with the elements listed in Article 3(3) of Implementing Regulation (EU) 2023/2866:

- the total number of new vehicles from the in-service verification family that that have been registered in the Union in the period from 2020-2022, based on the data reported to the European Environment Agency (EEA) for CO_2 emissions monitoring according to Regulation (EU) 2021/392, hereafter referred to as the **EEA dataset;**
- in-service verification families with similar technical characteristics but with lower CO_2 emission or fuel consumption values, identified using the data collected pursuant to Article 14 of Implementing Regulation (EU) 2021/392. The data regarding vehicle certification tests reported to the European Commission according to (EU) 2021/392, hereafter referred to as **DICE dataset**, and is split into two subsets the DICE COMPLETE and the DICE RA dataset;
- the results of previous in-service verifications, and in particular the findings related to the presence of artificial strategies: these are not available yet as this is the first year of ISV.
- relevant information from in-service conformity tests pursuant to Regulation (EU) 2017/1151, based on data from In-Service Conformity (ISC) and market surveillance (MASU) tests received through the Commission's Electronic Platform, or collected through Commission's market surveillance test campaigns, hereafter referred to as **ISC dataset**
- real-world data as defined in Article 2(c) of Implementing Regulation (EU) 2021/392, that is the data communicated by vehicle manufacturers to the EEA and the Commission regarding vehicle on board fuel consumption monitoring, hereafter **OBFCM dataset**;

Specifics regarding each dataset can be found in the subsequent sections.

2.1 EEA dataset

Each year, EU Member States (and Norway and Iceland) have to submit to the European Environment Agency (EEA) information related to their new vehicle registrations, for both cars (vehicle category M1) and vans (vehicle category N1). In this report the CO_2 monitoring data from vehicles (M1 and N1) registered in the EU in 2020, 2021, and 2022 have been analysed. In total 28.1 million M1 and 3.6 million N1 vehicles (other than pure electric vehicles)[8] were registered in the period of 2020-2022.

The **EEA dataset** provides valuable information about the total number of new vehicles, corresponding to the IP families that have been registered in the EU market in the last three years. It is used to define the probability level of the families in the risk assessment, as described in section 3.1.

2.2 DICE dataset

For each interpolation family (IP) for which new vehicles are registered in the EU since September 2017, the CO_2 emission type-approval data has to be reported to the Commission (JRC). Until the end of 2020 these data were collected through CO_2MPAS under the framework of the correlation process ([9]). From 2021 onwards, these data have been collected pursuant to Article 14 of Implementing Regulation (EU) 2021/392. In both cases, the collection platform is referred to as DICE ([10]). The DICE dataset is composed of IP families of Pure Internal Combustion Engine (Pure ICE) vehicles, Not-Off-Vehicle Charging Hybrid Electric Vehicles (NOVC-HEVs) and Off-Vehicle Charging Hybrid Electric Vehicles (OVC-HEVs).

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8 Pure electric vehicles do not fall within the scope of the in-service verification obligations, as they have zero tailpipe emissions.

9 Fontaras et al., 2018, 'The development and validation of a vehicle simulator for the introduction of Worldwide Harmonized test protocol in the European light duty vehicle CO_2 certification process', doi.org/10.1016/j.apenergy.2018.06.009

10 JRC DICE, https://dice.jrc.ec.europa.eu/

From September 2017 until October 2023 type-approval data for 9,101 different interpolation families have been received in DICE (**Table 1**). IP families are always defined by a vehicle that exhibits the highest cycle energy demand (CED) over the WLTP (vehicle high or VH) and, where applicable, a vehicle with the lowest CED (vehicle low or VL). As the VL is optional, more results are available in DICE for VH than for VL.

This report introduces two distinct DICE datasets:

- Complete DICE dataset (**DICE COMPLETE** dataset)
- Risk Assessment dataset (**DICE RA** dataset)

The **DICE COMPLETE** dataset contains all submissions from September 2017 until 11 October 2023. This dataset was utilized for the analysis of outliers (section 4.2.), and to identify the interpolation families found in the EEA dataset, but not reported in DICE, as described in the section 4.6 of this report.

The **DICE RA** dataset is a subset of DICE COMPLETE and contains only IP families for which data was received pursuant to Article 14 of Implementing Regulation (EU) 2021/392 from its entry into force in 2021 until the end of 2022. In that period, DICE submissions for 1,491 unique IP families have been received, with the distribution across fuel types and powertrains as presented in **Table 1** ("other" fuel types refers to LPG, NG, and ethanol). The **DICE RA** dataset was used in the risk assessment for DICE quality checks (QC) described in section 4.1 since only the data collected under the framework of the Implementing Regulation (EU) 2021/392 contained the information necessary for conducting this risk assessment. It is important to note that data received in 2023 are not part of this year's DICE QC risk assessment. This decision stems from the fact that these vehicles are not yet part of the EEA dataset (reporting deadline for Member States is end February 2024). This is not considered a major issue as vehicles type-approved in 2023 are expected to have a low probability of being registered and accumulating the ISV required mileage by 2024. The evaluation of the 2023 submissions will be the focus of the next year's risk assessment.

Table 1. Distribution of IP families in DICE RA and DICE COMPLETE datasets by fuel type and powertrain.

		FUEL			POWERTRAIN		
	TOTAL	GASOLINE	DIESEL	OTHER	PURE ICE	NOVC-HEV	OVC-HEV
DICE RA	1,491	688	749	54	1,044	277	170
DICE COMPLETE	9,101	4,285	4,675	141	7,643	114	444

Source: JRC, 2023.

2.3 ISC dataset

According to Article 3 of Regulation (EU) 2023/2866, when performing the ISV risk assessment, the Commission has to take into account information from in-service conformity (ISC) tests pursuant to Regulation (EU) 2017/1151. The granting type approval authorities, accredited laboratories, or technical services shall include all results of the ISC testing performed in the Electronic Platform for in-service conformity([11]) described in point 5.9 (Annex II to (EU) 2017/1151). Although the platform is operational, as of the report's writing, only results from 2 ISC families have been reported. Therefore, the ISC tests for this year's ISV risk assessment could not be incorporated and the **ISC dataset** contains only data from the Commission's market surveillance tests.

[11] EC Electronic Platform, https://dice.jrc.ec.europa.eu/

Based on Regulation (EU) 2018/858 ([12]) on the approval and market surveillance of motor vehicles, in the period from 2018 to 2020 the JRC carried out vehicle emissions testing (both WLTP and real-driving emissions (RDE) tests) on a number of vehicles as a pilot activity ([13,14]). Following the entry into force of Regulation 2018/858 in September 2020, the JRC has actively continued its involvement in market surveillance testing ([15]).

Between 2018 and 2022, emission tests were carried out on 73 vehicles. The compliance for tailpipe emissions is verified for both the type 1 (WLTP) and type 1a (RDE) tests in accordance with the requirements of respectively Annex XXI and Annex IIIa of Regulation 2017/1151 and its amendments. The results of these tests have been utilized in the risk assessment. Further details about the methodology are provided in section 4.3.

2.4 OBFCM dataset

Article 12 of Regulation (EU) 2019/631 requires the Commission to assess the WLTP's real-world representativeness using 'real-world data' recorded by on-board fuel and energy consumption monitoring (OBFCM) devices. Such devices must be type-approved and installed in new light-duty vehicles registered as of 1 January 2021.

The OBFCM data, collected throughout 2021, were reported by manufacturers to the EEA in the course of 2022. OBFCM data was received for 916,216 M1 vehicles (cars) and 12,301 N1 vehicles (vans) that could be correlated with their respective WLTP type-approval values ([7]). Following the elimination of outliers, inconsistencies, and vehicles with very low mileage (less than 500 km), the final dataset included only 617,194 M1 vehicles (7.2% of the 2021 EU fleet) and 6,667 N1 vehicles (0.6% of the 2021 EU fleet).

For this first year's evaluation, the **OBFCM dataset** has not been used in view of the aforementioned limitations. Nevertheless, an outline of a methodology for future assessments is elaborated in section 3.2.3.

[12] EC. 2018. Regulation (EU) No 2018/858. OJ L 151, 14.6.2018, p. 1–218

[13] JRC,2018, 'Joint Research Centre 2018 light-duty vehicles emissions testing', doi:10.2760/155802, JRC117625.https://dice.jrc.ec.europa.eu/

[14] JRC, 2019, 'Joint Research Centre 2019 light-duty vehicles emissions testing', doi:10.2760/783111, JRC122035.

[15] JRC, 2022, 'European market surveillance of motor vehicles', doi:10.2760/734643, JRC128360.https://dice.jrc.ec.europa.eu/

3 Risk assessment methodology and random selection

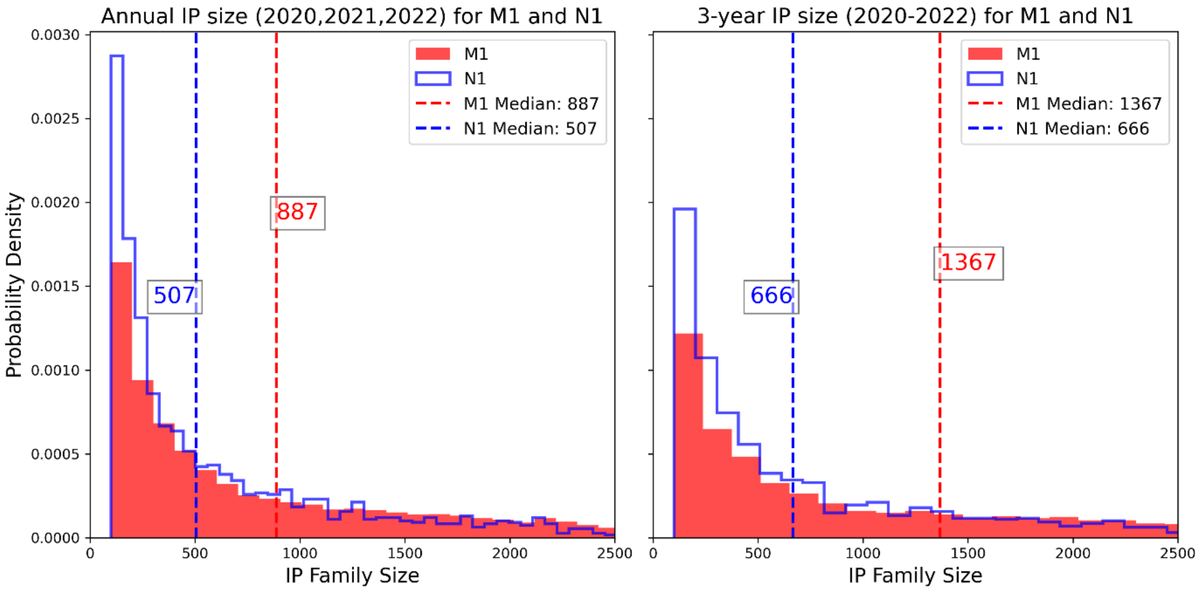
The risk assessment methodology employed in this report is based on the concept of Composite Risk Index (CRI). This index combines the probability and severity of a specific occurrence. In the context of this study, severity is a measure of the impact of a risk, particularly concerning CO_2 emissions. Probability, on the other hand, indicates the frequency with which the harm associated with a risk may occur, specifically in terms of the number of vehicles in the Union market affected by the risk. Further details regarding severity, probability, and the determination of overall risk levels can be found in the subsequent sections. In addition, section 3.4 describes the random selection method, which complements the vehicle selection for the 2024 in-service verification.

3.1 Probability

Probability levels in this report are determined based on the number of new vehicles registered in the Union belonging to the Interpolation Family (IP) both annually and in the 3-year period considered. For this, EEA data for vehicles (M1 and N1) registered in 2020, 2021, and 2022 have been analysed.

Figure 1 presents the frequency distribution of IP family sizes, i.e. the number of registered new M1 and N1 vehicles per IP family, as reported to EEA over the past three years (2020, 2021, and 2022). Given that vehicles from the same IP family can be registered in more than one year, the presentation includes both annual and cumulative figures for the three-year period.

Figure 1. Histograms of the size of the IP family for new M1 and N1 vehicles registered in EU in 2020-2022 (left: annual; right: sum over 3 year period).



Source: JRC, 2023.

As evident from the figure, there is a clear distinction in the size of IP families between the different vehicle categories, with M1 families being generally larger compared to N1 families. The median annual sizes of the IP families were 887 vehicles for M1 and 507 vehicles for N1. Over the three-year period, the median IP sizes were 1367 and 666 for M1 and N1, respectively.

The same vehicle registration data are analysed in more detail and presented in **Table 2** (for M1 category) and **Table 3** (for N1 category). On the left side of these tables, the results of the statistical analysis are shown, considering all interpolation families regardless of their size (number of vehicle registrations).

Median values indicate that half of the families considered, both annually and over the three-year period, had very small sizes, with vehicle registrations below 100 vehicles for M1 (except in 2020) and even below 10 vehicles for N1. It is important to note that the EEA 2022 dataset is still provisional and, therefore, not cleaned and checked for all typos and errors. This may explain the larger number of identified IP families in 2022 (IP count) and the smaller mean and median values compared to the 2020 and 2021 datasets.

Table 2. Statistics of the size (number of registrations) of M1 IP families in the years 2020 to 2022 (annual 2020, 2021, 2022 and sum over period 2020-2022) including all IP families (left) and only IP families with more than 100 registrations (right)

REGISTRATIONS DATA M1									
		ALL DATA				IPs < 100 REGISTRATIONS EXCLUDED			
		2020	2021	2022	2020-2022	2020	2021	2022	2020-2022
IP COUNT		6,173	5,872	8,173	12,972	3,408	2,841	2,369	5,347
SIZE OF IP FAMILY	MEAN	1,771	1,512	928	2,112	3,188	3,104	3,178	5,105
	STD	5,752	5,266	4,316	8,650	7,447	7,239	7,560	12,895
	MIN	1	1	1	1	100	100	100	100
	25%	18	7	1	1	273	277	335	365
	50%	148	86	4	31	**819**	**837**	**1,051**	**1,367**
	75%	1,057	780	195	741	**2,859**	**2,793**	**3,219**	**4,690**
	MAX	124,407	115,244	201,978	275,142	124,407	115,244	201,978	275,142

Source: JRC, 2023.

Table 3. Statistics of the size of N1 IP families in the years 2022 to 2022 (annual 2020, 2021, 2022 and period 2020-2022) including all IP families (left) and only IP families with more than 100 registrations (right)

REGISTRATIONS DATA N1									
		ALL DATA				IPs < 100 REGISTRATIONS EXCLUDED			
		2020	2021	2022	2020-2022	2020	2021	2022	2020-2022
IP COUNT		2,167	2,549	3,138	5,244	572	701	612	1,249
SIZE OF IP FAMILY	MEAN	578	477	285	641	2,158	1,696	1,412	2,655
	STD	2,465	1,947	1,334	3,139	4,433	3,427	2,748	6,006
	MIN	1	1	1	1	100	100	100	100
	25%	2	2	1	1	218	203	183	244
	50%	7	11	6	7	**673**	**507**	**444**	**666**
	75%	118	133	51	83	**2,057**	**1,471**	**1,293**	**2,412**
	MAX	57,505	43,968	32,413	102,214	57,505	43,968	32,413	102,214

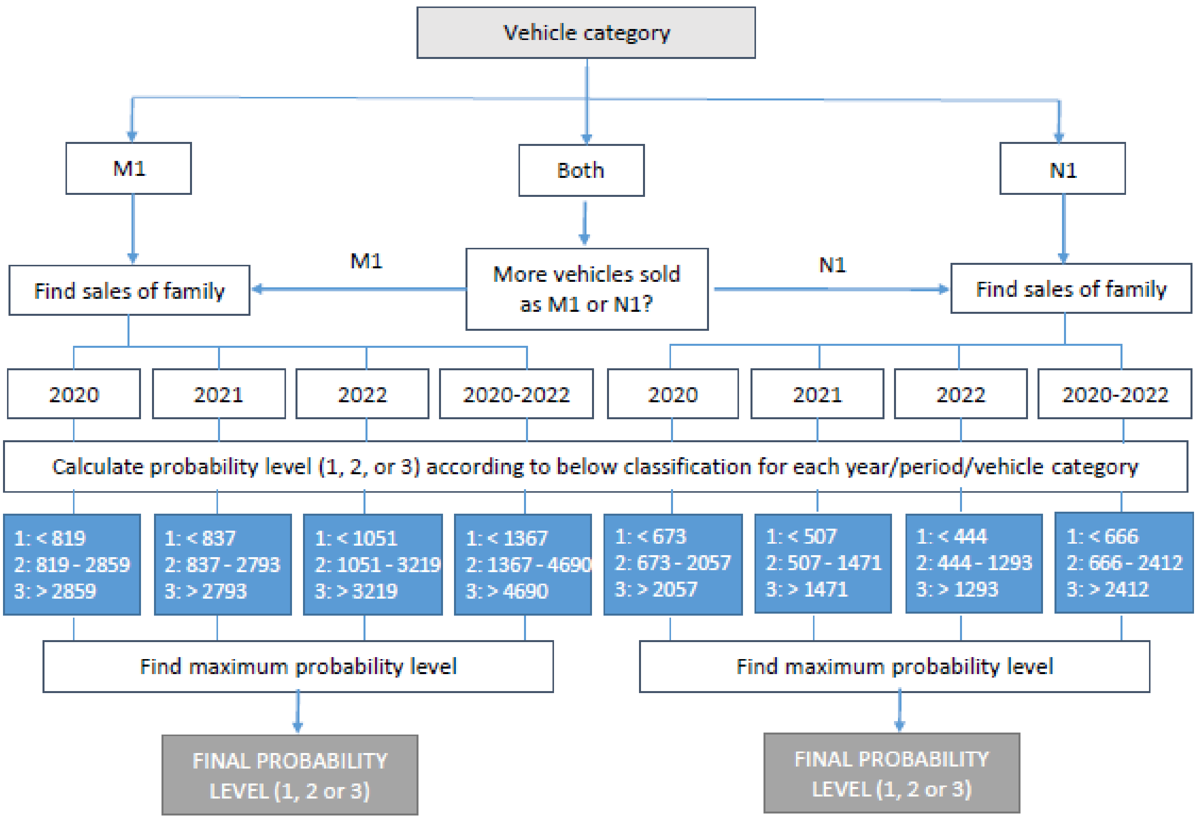
Source: JRC, 2023.

To eliminate errors in the datasets, mainly due to typos in IP family identifiers, the scope of the risk assessment has been limited to those IP families that have at least 100 vehicles registered over the 3-year period. In addition, IP families with fewer than 100 vehicles will be very difficult to source for testing and their probability levels would be anyway very low. The results of the statistical analysis, excluding IP families with fewer than 100 vehicles, are presented on the right sides of the above tables.

As expected, the number of IP families (count) dropped significantly, and the mean, as well as all percentile values, increased and remained more constant over the years. Additionally, cumulative values for the 3-year period are higher compared to the annual ones, confirming that IP families can have a lifetime longer than 1 year. This is particularly important to highlight because some IP families analysed in this risk assessment from DICE RA and DICE COMPLETE datasets (explained in section 2.1), which are type-approved in the course of 2020 and before, were found in all three EEA datasets (2020, 2021, and 2022), and their cumulative vehicle count for the period 2020-2022 was high. On the other hand, families that are type-approved in 2021 and 2022 can be found only in 2021 and/or 2022 EEA datasets, and their cumulative vehicle count for the period 2020-2022 is expected to be lower.

To address this, it has been decided to calculate the probability level of each IP family individually for each year and separately for the period 2020-2022 and to consider the final probability level as the maximum of these four values. The steps are depicted in **Figure 2** for better clarity.

Figure 2. Flowchart of steps carried out to define probability level of one interpolation family.



Source: JRC, 2023.

When determining probability levels (1, 2, or 3), it has been established to use median values as the thresholds for medium probability (probability = 2) and 75th percentiles as the thresholds for high probability (probability = 3). In practical terms, it means that if the IP family count for the analysed year or 3-year period is:

1. Below median value, for that year or period, the probability level for that family is low (1);
2. Between median and 75th percentile, for that year or period, the probability level for that family is medium (2);
3. Above the 75th percentile, for that year or period, the probability level for that family is high (3).

With this approach half (50%) of the IP families (with at least 100 annual registrations) will result in low probability, 25% in medium, and 25% in high. The thresholds for M1 category vehicles are highlighted (bold) in **Table 2** and **Table 3**. The advantage of this dynamic assessment of probability, as opposed to fixed pre-set values, is that the threshold numbers will be adjusted in the future to reflect the current situation. This is particularly important if the size of IP family changes with the introduction of more pure electric vehicles and lower sales of vehicles that emit CO_2, ensuring that the probability levels remain relevant and adaptable to evolving market trends.

As outlined in **Figure 2**, the main steps in defining probability level of one IP family are the following:

- Validate if the vehicle category is M1 or N1 by checking if the vehicle registrations can be found in EEA M1 or N1 datasets. In special cases where the same IP family has been registered in both M1 and N1 categories, an additional check is performed to determine if the family has more M1 or N1 registrations. This decision will guide whether the family follows the M1 or N1 route depicted in Figure 2.
- Find the number of registrations for that family in each separate year (2020, 2021, and 2022) and cumulative registrations for the period 2020-2022.
- Calculate the probability level (1, 2, or 3) for each year and 3-year period using median and 75th percentile thresholds, as outlined in the tables and **Figure 2**.
- Find the maximum probability level from the four values calculated in Step 3 and use that value as the final probability level for the IP family.

3.2 Severity

The report employs two distinct methodologies for establishing severity levels: one involves setting thresholds for deviations, while the other focuses on detecting outliers. The choice between these approaches depends on the source of data and the specific type of analysis performed, as outlined in **Table 4**. In the context of analysing the DICE RA database and WLTP emission tests undertaken for market surveillance and in-service conformity, specific thresholds are set to distinguish between different severity levels. These thresholds are tailored to the nature of the analysis performed.

Table 4. Severity methodologies used in risk assessment for different sources of data and different types of analysis.

SOURCE OF DATA	TYPE OF ANALYSIS	SEVERITY METHOD APPLIED	SEVERITY LEVELS		
			S=1	S=2	S=3
DICE RA	GEARSHIFT	Thresholds	70-100% matching	50-70% matching	<50% matching
	VEHICLE SPEED	Thresholds	1.00-1.02 ratio	1.02-1.05 ratio	> 1.05 ratio
	CO_2 CORRECTIONS	Thresholds	1.00-1.02 ratio	1.02-1.05 ratio	> 1.05 ratio
	DECLARED/MEASURED RATIO	Thresholds	1.02-1.04 ratio	1.01-1.02 ratio	< 1.01 ratio
DICE COMPLETE	ANALYSIS OF OUTLIERS	Outliers	k=1.0	k=1.1	k=1.3
ISC DATASET	WLTP TEST RESULTS	Thresholds	1.00-1.02 ratio	1.02-1.05 ratio	> 1.00 ratio
	RDE TEST RESULTS	Outliers	k=0.5	k=0.75	k=1

OBFCM DATASET	OBFCM GAP	Outliers	TBD	TBD	TBD

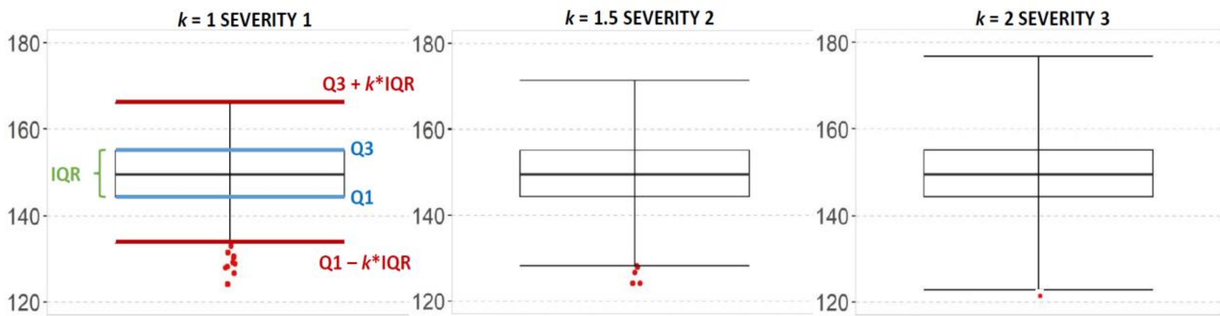
Source: JRC, 2023.

The outlier detection method was employed in the analysis of both the DICE COMPLETE database and emissions from Real Driving Emissions (RDE) tests within the scope of market surveillance and in-service conformity. It is crucial to note that, in this context, outliers are not indicative of measurement errors but are instead considered statistical outliers. These outliers represent ISV families that significantly deviate from the broader population with similar characteristics. The outlier detection method will be applied in subsequent years for analysing real-world data recorded by OBFCM devices.

This study adopts Tukey's approach ([16]) to identify outliers, in this case families substantially different from the others, and evaluate the severity of these deviations. For grouping families with similar characteristics, an iterative k-means clustering algorithm is utilized, partitioning the dataset into 'k' clusters ([17]). Each cluster represents families with shared features, and the method minimizes variance within clusters, assigning families based on their proximity to the cluster's centroid.

The IQR, calculated as the difference between the third quartile (Q3) and the first quartile (Q1) of a dataset (IQR = Q3 – Q1), is fundamental to this method. Outliers are identified using Tukey's 'k * IQR rule' where data points below Q1 - k * IQR or above Q3 + k * IQR are flagged as potential outliers. Notably, the 'k' factor is pivotal in determining severity; a higher 'k' results in fewer but more severe outliers. **Figure 3** visually illustrates this process, highlighting how Tukey's method and increase of 'k' factors effectively identifies outliers.

Figure 3. Illustration of the IQR outlier detection for definition of severity



Source: JRC, 2023.

The choice of 'k' factor can vary based on specific analysis requirements and data characteristics. Additionally, depending on the issue analysed, solely the lower side (below the threshold of Q1 - k * IQR) or the higher side (above Q3 + k * IQR) outliers might be selected in a risk assessment. In the example shown in **Figure 3**, k-factors of 1, 1.5, and 2 have been used, and only outliers on the lower side are selected. In practical terms, the example depicted in Figure 3 can be interpreted as follows:

1. All data points below Q1 - 2 * IQR are marked with the highest severity: 3;
2. All data points below Q1 – 1.5 * IQR, and not identified in the previous step, are marked with medium severity: 2;
3. All data points below Q1 – 1 * IQR, and not identified in the previous two steps, are marked with low severity: 1.

[16] Tukey, JW. Exploratory data analysis. Addison-Wesley, 1977
[17] MacQueen, J. Some methods for classification and analysis of multivariate observations, 1967

In the next sections more in-depth discussions and details are given about practical implementation of these two methodologies (thresholds and outliers) for various types of datasets and issues.

3.2.1 DICE dataset analysis

For this analysis the DICE data collected pursuant to Article 14 of Implementing Regulation (EU) 2021/392 (DICE RA) and under the framework of the correlation process from September 2017 (DICE COMPLETE) have been used. The DICE analysis comprises both quality control (QC) analysis with setting thresholds for deviations and the identification of outliers.

The quality control analysis utilized the DICE RA dataset, consisting of total of 1,491 interpolation families as outlined in **Table 1**. The objective of these QC checks was to validate the correct implementation of various steps outlined in Regulation (EU) 2017/1151 ([1]) and to identify interpolation families at the highest risk of deviating from the declared CO_2 emission values. These systematic checks included:

- validation of theoretical and driven gearshift profile (section 3.2.1.1);
- evaluation of the difference between theoretical vehicle speed and the one driven in the Type 1 test (section 3.2.1.2);
- validation of corrections applied on the measured CO_2 emissions (section 3.2.1.3); and
- degree of CO_2 over-declaration (section 3.2.1.4).

All these steps can have significant impact directly on either measured CO_2 emissions, or the final CO_2 declared emissions and values recorded on the vehicle's Certificate of Conformity (CoC).

The DICE COMPLETE dataset has been used in the second part of DICE analysis for the identification of outliers (section 3.2.1.5). Outliers are determined through four independent analyses:

- analysis of the outliers in the slope of the CO_2-CED interpolation line for interpolation families with VH and VL;
- analysis of the outliers in the CO_2-to-CED ratio for interpolation families with VH only;
- identification of CO_2 emission outliers from the population sharing the same technologies and characteristics; and
- identification of CED outliers from the population sharing the same technologies and characteristics.

More details about each of these analyses will be provided in the section 3.2.1.5.

3.2.1.1 Gearshift analysis

The objective of gearshift analysis was to validate the theoretical gearshift profile calculated for the purpose of type-approval by comparing it with the gearshift profile actually employed during the emission test, as gear selection may have an important impact on the resulting CO_2 emissions.

Annex B2 of Regulation (EU) 2022/2124 ([18]) outlines the procedures concerning theoretical gear selection and shift point determination for vehicles equipped with a manual transmission. The gearshift point should be calculated for each second of the WLTP speed profile, considering the balance between the power needed to overcome driving resistance and acceleration, and the power supplied by the engine in all possible gears at a specific second of the cycle.

For the purpose of type-approval, manufacturers and testing authorities may use their in-house calculation tools or one of the gearshift calculation tools that are officially validated and approved by the United Nations Economic Commission for Europe (UNECE). JRC has developed one such official UNECE tool, the JRC Python Gearshift Calculation Tool (JR-Shift), implemented in the Python programming language ([19]).

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18 EC. 2022b. Regulation (EU) No 2022/2124. OJ L 290, 10.11.2022, p. 1–625.

19 JRC Python Gearshift Calculation Tool (JR-Shift), https://code.europa.eu/jrc-ldv/jrshift https://dice.jrc.ec.europa.eu/

In addition, for the purpose of gearshift QC check, the driven gearshift profile obtained from the actual type-approval test was calculated and analysed. The driven profile was calculated using the type-approval measurement data, including the driven vehicle speed, engine rpm, gearshift ratios, and tire size.

Two main goals of gearshift analysis were:

- To assess the conformity of the user-calculated theoretical gearshift profile with the profile generated by the official UNECE tool (JR-Shift). The degree of deviation from the JR-Shift theoretical gearshift profile was quantified as a percentage of matching;
- To perform a comparative analysis between the driven gearshift profile and the JR-Shift theoretical one. The deviation in this case was also expressed as a percentage of matching.

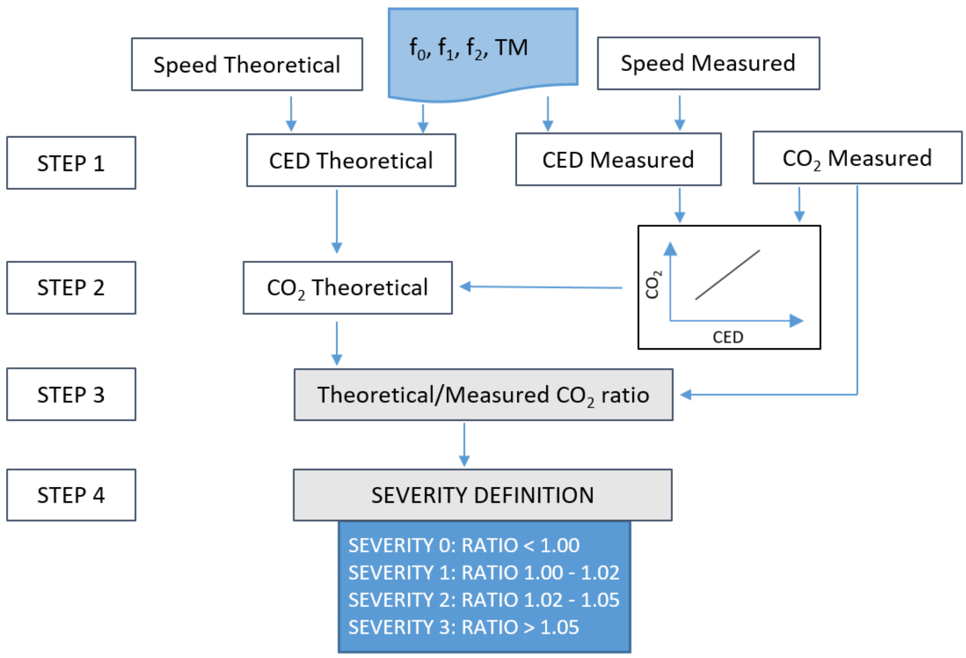
In the subsequent stage, severity levels were assigned based on the percentage of matching in either the theoretical or driven gearshift profile. As presented in **Table 4**, families with matching percentages ranging from 0 to 50% were given severity score 3, those with matching percentages from 50 to 70% severity score 2, and those with matching percentages from 70% to 100% severity score 1.

3.2.1.2 Vehicle speed analysis

Annex B2 of Regulation (EU) 2022/2124 describes the cycles to be driven during the test (cycle classes) that will depend on vehicle's power-to-mass-in-running-order ratio. Regulation also foresees some special procedures for vehicles that have power-to-mass-in-running-order ratios close to the borderlines between classes, or for vehicles with limited maximum speed (capped). To avoid drivability problems for these vehicles the special downscaling procedure and/or speed capping procedure shall be applied to improve drivability and is explained in all details in the same Annex of the Regulation.

JR-Shift tool considers all these factors when calculating theoretical speed profile for each individual interpolation family in DICE RA dataset. On the other side driven or measured speed profile is provided in DICE RA. The difference between these two speed profiles (theoretical and driven), when expressed as cycle energy demand (CED), shall be low. The objective of this analysis was to quantify the impact on CO_2 emissions in cases where the difference is significant.

Figure 4. Flowchart for steps carried out to calculate severity in vehicle speed analysis



Source: JRC, 2023.

As presented in **Figure 4**, the cycle energy demand (CED) is computed separately for the theoretical and driven/measured speed profiles. CED is derived from vehicle speed, road load coefficients (f_0, f_1, f_2) and vehicle's test mass, applying the formulas specified in Regulation (EU) 2022/2124. While the CO_2 corresponding to the driven/measured CED is directly measured in type-approval test and reported in DICE RA, the CO_2 associated with the theoretical CED needs to be calculated. To compute the theoretical CO_2, CO_2-CED interpolation lines created between VH and VL for each IP family have been utilized. For families consisting solely of VH, default slopes defined in the Implementing Regulation (EU) 2023/2866 have been applied. For OVC-HEV powertrains, the vehicle speed driven in cold start test with charge-sustaining mode has been evaluated.

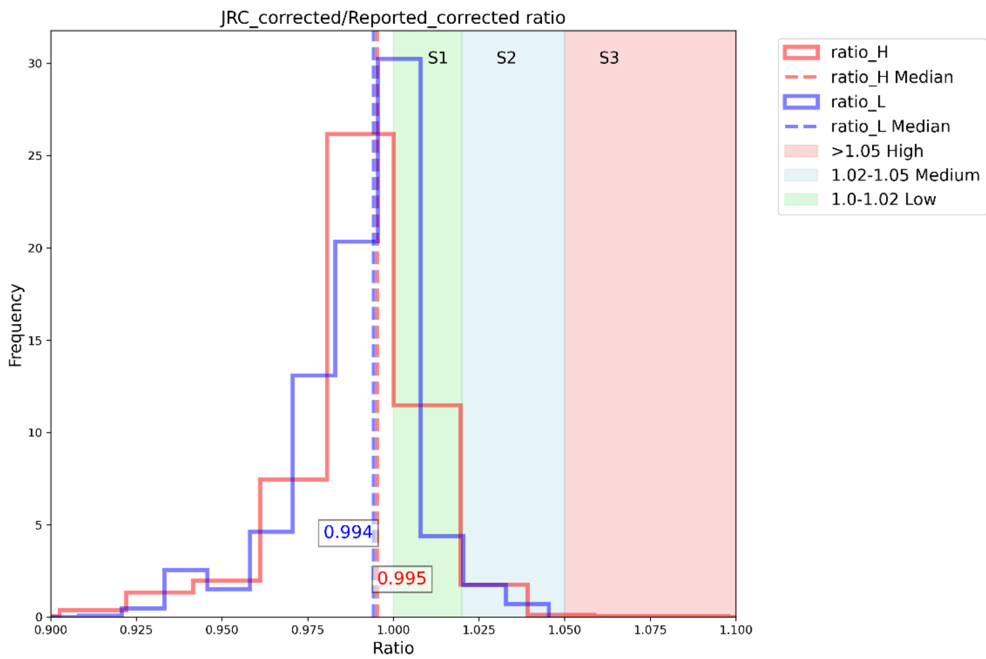
After determining both CO_2 values (theoretical and measured), the ratio of theoretical to measured CO_2 emissions has been calculated. In the subsequent stage, severity levels were assigned based on that ratio. As presented in **Table 4** families with the ratio above 1.05 were categorized as severity 3, those with ratio between 1.02 and 1.05 as severity 2, and those with ratio between 1 and 1.02 as severity 1.

3.2.1.3 Correction of measured CO_2 values

The primary objective of this analysis was to autonomously execute all correction steps to the CO_2 emission values measured during the Type 1 test (see Annex B7), in line with the Regulation (EU) 2022/2124. These corrections include battery, speed and distance, ambient temperature, and Ki regeneration corrections as foreseen in the Regulation. The aim was to compare the final measured and corrected value independently calculated by JRC with the reported measured and corrected value in the DICE RA dataset during the vehicle certification.

For each interpolation family in DICE RA dataset the JRC measured and corrected over reported measured and corrected CO_2 ratio is computed. For OVC-HEV powertrains the corrections have been applied to the cold start test in charge-sustaining mode and compared with reported measured and corrected CO_2 values for the same mode. As depicted in **Figure 5**, the median CO_2 ratio (JRC measured corrected/reported corrected) for all interpolation families in the DICE RA dataset was 0.99 (both for VH and VL). A ratio below 1 suggests that the corrected values independently calculated by JRC were lower compared to the values reported in type-approval. Conversely, a ratio above 1 indicates that the values reported in type-approval are lower compared to the ones calculated by JRC. That factor is considered a risk in the ISV.

Figure 5. Histogram of the ratio (JRC corrected/reported corrected CO_2 emissions) for VH and VL with shaded severity areas (>1.05 for severity High, 1.02-1.04 for severity Medium, and 1.00-1.02 for severity Low)



Source: JRC, 2023.

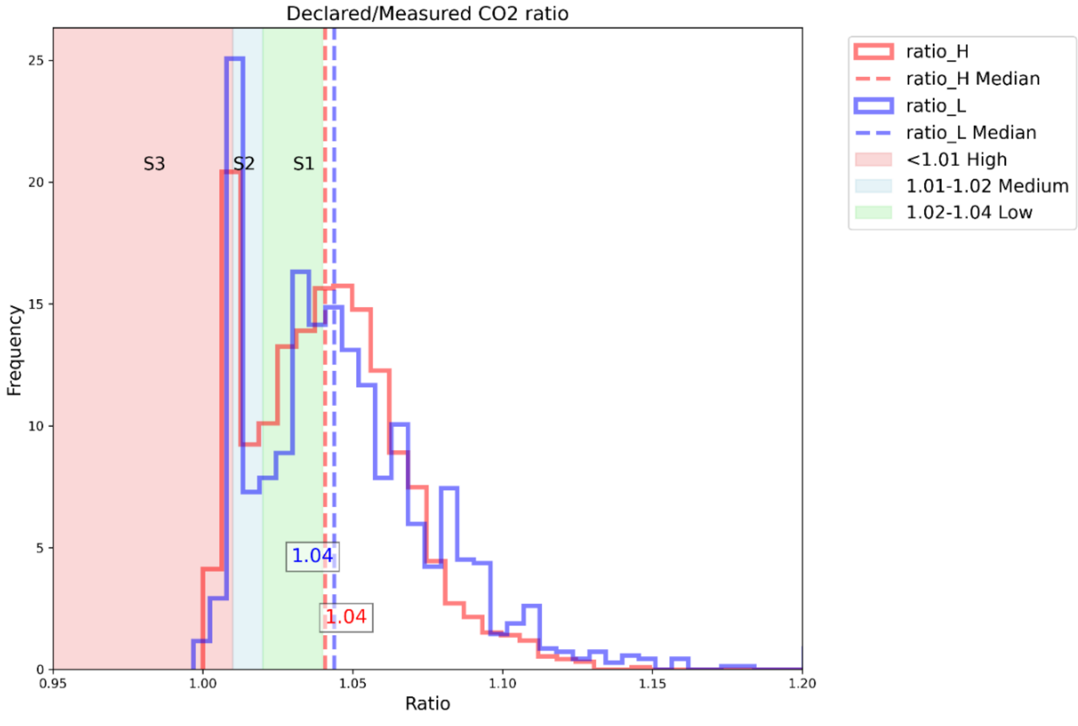
Consequently, severity levels were assigned based on this ratio. For families with both configurations (VH and VL), the ratio is calculated as the average of these two. As presented in **Table 4**, families with a ratio above 1.05 were categorized as severity 3, those with a ratio between 1.02 and 1.05 as severity 2, and those with a ratio between 1.00 and 1.02 as severity 1.

3.2.1.4 CO_2 declaration

Prior to conducting each WLTP test for both VH and (when applicable) VL configurations, the vehicle manufacturer declares the expected CO_2 value. In cases where the measured and corrected CO_2 value from the Type 1 test is lower than the declared value, the declared value becomes the official value for that specific vehicle configuration. The measured value referred to in this context is the value obtained after taking into account the battery, speed and distance, ambient temperature, and Ki regeneration corrections as foreseen in the regulation.

In this analysis, the measured and corrected CO_2 emission value is compared with the manufacturer's declared value for each interpolation family in the DICE RA dataset. The declared over measured and corrected CO_2 ratio is computed as part of this assessment. For OVC-HEV powertrains the measured and corrected CO_2 emission value in charge-sustaining mode was compared with declared CO_2 values for the same mode. As presented in **Figure 6**, the median CO_2 ratio (declared/measured) for all interpolation families in DICE RA dataset was 1.04 (both for VH and VL).

Figure 6. Histogram of the declared/measured CO_2 ratio for VH and VL with shaded severity areas (<1.01 for severity High, 1.01-1.02 for severity Medium, and 1.02-1.04 for severity Low)



Source: JRC, 2023.

The level of over-declaration can be seen as one of the risk factors in ISV that has direct impact on CO_2 declared emissions and values recorded on the vehicle's certificate of conformity. Interpolation families with a lower ratio (declared/measured) will face greater challenges in meeting ISV requirements compared to those with a higher ratio. Therefore, the severity levels were assigned based on that ratio. For the families having both configurations VH and VL the ratio is calculated as the average of these two. As presented in **Table 4**, families with ratio below 1.01 were categorized as severity 3, those with ratio between 1.01 and 1.02 as severity 2, and those with ratio between 1.02 and 1.04 as severity 1.

3.2.1.5 DICE analysis of outliers

The DICE COMPLETE dataset has been used for the identification of outliers. The outliers are determined based on the following four independent analyses:

1. **Slope analysis:** This analysis identifies outliers in the slope of the CO_2-CED interpolation line between the VL and VH of the interpolation families. The analysis employs the driven CED and the measured and corrected CO_2 emissions from the Type 1 test. While measured and corrected CO_2 emissions are directly available in the DICE dataset, the driven CED was derived from the driven vehicle speed, road load coefficients (f_0, f_1, f_2) and vehicle's test mass, using the formulas specified in Regulation (EU) 2022/2124.

   The slope is determined through the formula: $(CO_{2\_VH} – CO_{2\_VL}) / (CED_{VH} – CED_{VL})$.

   IP families are grouped based on powertrain (ICE, NOVC-HEV, and OVC-HEV) and fuel type (diesel, gasoline, and other fuels), creating eight distinct subgroups. This approach is founded on the premise that vehicles sharing the same technologies and characteristics should demonstrate similar slopes.

2. **Ratio analysis:** Due to the unavailability of VL data for certain IP families, which renders the slope analysis unfeasible, an alternative methodology was used for these cases; the CO_2-to-CED ratio (CO_{2_VH} / $CED_{\_VH}$). The CED driven was again determined from the driven speed profile as described in the slope analysis. Grouping was carried out based on the powertrain and fuel type, but additionally introducing a third variable through the k-means method. This variable aimed to cluster vehicles with similar CO2-to-CED ratios and power-to-mass ratios, resulting in four optimal cluster groups. Combined with powertrain and fuel groups, this approach led to the formation of 16 distinct subgroups where outliers are scrutinized.

3. **CO_2 emission outliers**: Outliers in CO_2 emissions were identified independently for VH and VL. The grouping was executed based on powertrain, fuel type, and five k-means clusters, representing vehicles with similar maximum engine power, CED, and CO_2 emissions. It is essential to note that the clusters differ between VH and VL. This grouping strategy led to the formation of 25 sub-groups for VH and 27 sub-groups for VL. The underlying principle of this analysis is that vehicles sharing the same technologies and characteristics (sub-groups) should exhibit comparable CO_2 emissions.

4. **CED outliers**: This analysis mirrors the preceding one, with the sole difference being that outliers were identified in respect to the CED and not the CO_2 emissions. The same number of sub-groups (25 for VH and 27 for VL) has been defined.

As presented in **Table 4**, the 'k factors' used for these four analysis are: k = 1.3 for high severity 3, k = 1.1 for medium 2, and k = 1 for low severity 1. In addition, only the lower side (below Q1 - k * IQR) outliers are selected in this risk assessment.

3.2.2 ISC dataset analysis

The compliance for tailpipe emissions is verified for both the type 1 (WLTP) and type 1a (RDE) tests in accordance with the requirements of respectively Annex XXI and Annex IIIa of Regulation (EU) 2017/1151 and its amendments.

In the context of analysing the WLTP emission tests results, specific thresholds are set to distinguish between different severity levels. For each vehicle tested, the ratio of the CO_2 emissions measured at JRC to the CO_2 declared on the vehicle's certificate of conformity (CoC) has been calculated. Vehicles with a ratio above 1 are categorized as follows. Vehicles with a ratio above 1.05 were categorized as severity 3, those with a ratio between 1.02 and 1.05 as severity 2, and those with a ratio between 1.00 and 1.02 as severity 1.

As part of the examination of the RDE emission test results the ratio of RDE CO_2 emissions measured from RDE compliant trips to the CO_2 emissions measured from WLTP tests has been computed. In the subsequent stage, the severity assessment involves the identification of outliers for vehicles grouped based on the powertrain (3 sub-groups). The 'k factors' used in this assessment were k = 1 for severity 3, k = 0.75 for severity 2, and k =

0.5 for severity 1. In addition, only the higher side (above Q3 + k * IQR) outliers are selected in this risk assessment.

3.2.3 OBFCM dataset analysis

Since 2022, the European Commission collects information on the real-world fuel consumption of passenger cars and vans from the on-board fuel and energy consumption monitors (OBFCM) installed in the new vehicles registered in the EU.

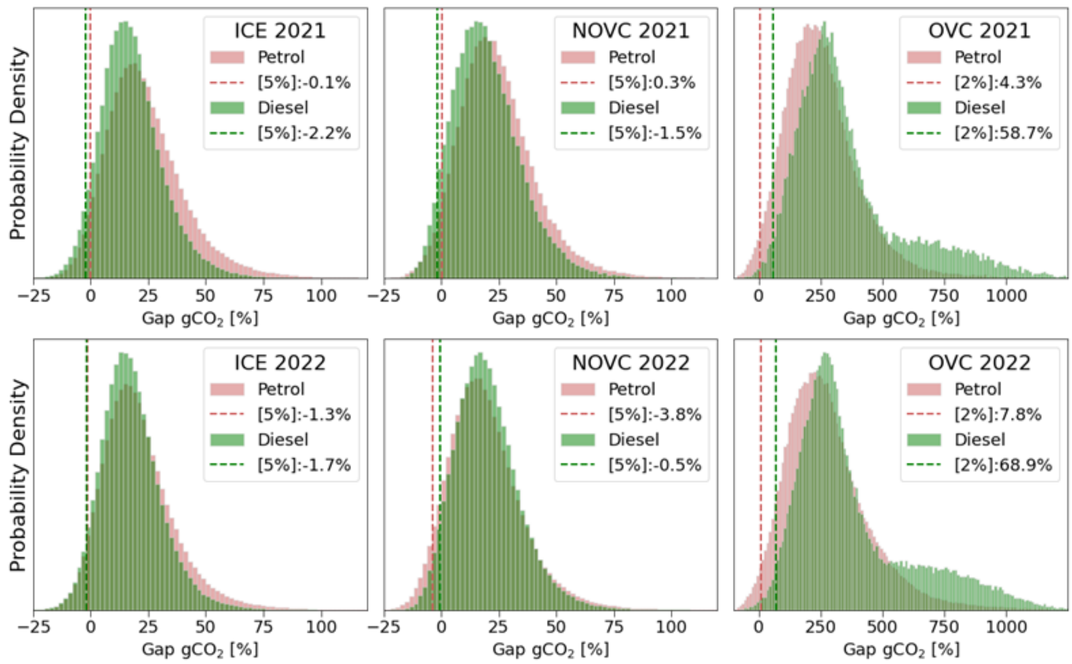
In contrast to the pre-established conditions during laboratory tests, real-world driving implies a combination of variable driving conditions that lead to a broad distribution of real-world emission values even at vehicle model-specific level. Most of these factors increasing the real-world emissions are vehicle (and driver) specific. The main scope of this risk assessment element is to detect potential cases which would lead to lower official emission values for the entire family.

Based on this approach, this element of risk assessment aims to detect those families where the most optimally driven vehicles, or vehicles in the best possible condition, still have real world emissions significantly above the official values. This assumes that the differences for these particular cases cannot be unquestionably attributed to on-road factors increasing real-world values, but might point as well to deviations in the type-approval values.

The gap between real-world and official CO_2 emission values for 2021 and 2022 is illustrated in **Figure 7** for the OBFCM-reporting vehicles of a certain technology. In all cases, the quasi-normal distributions are shifted towards positive gap values, with notably higher deviation in the case of OVC-HEVs due to the low share of electric driving (utility factor). At the same time, the figure reveals that the gap value reached at specifically selected percentiles (5%-percentile for ICE and NOVC distributions, 2% for OVC) is almost negligible, or moderately higher for the case of gasoline OVCs. The case of diesel OVCs should be taken cautiously as the statistical sample is much smaller.

In conclusion, it is reasonable to consider the low-percentile region of the gap as representative of the official value, and deviations of such percentiles towards higher gap values can be linked to high- or moderate- severity levels.

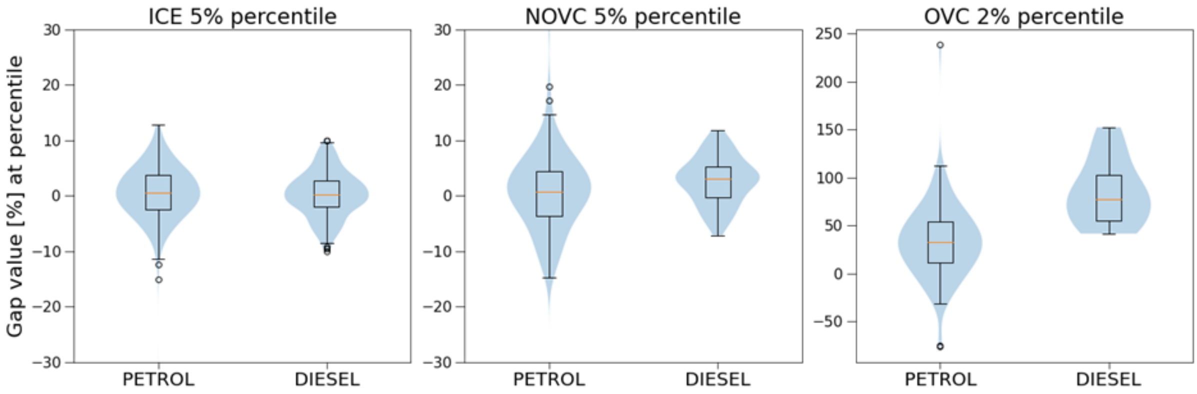
Figure 7. Relative gap distribution of the EU-fleet for 2021 (upper panels) and 2022 (lower panels) OBFCM data. Each distribution corresponds to a combination of powertrain (ICE, NOVC-HEV and OVC-HEV) and fuel-type vehicle technology. Vertical broken lines display the nth-percentile for each distribution.



Source: JRC, 2023.

The severity will be determined using the Tukey's approach for outlier detection, where the variable to analyse is the gap value at a certain (to be determined) *n*th-percentile. **Figure 8** shows an example for the M1 database of OBFCM data. The families are grouped in different clusters based on the vehicle technology: ICE, NOVC-HEV and OVC-HEV, and on the fuel type: gasoline and diesel. To avoid further clustering, the analysis considers a relative gap (in %) instead of absolute gap (in gCO_2), as the first one has only minimal dependency on the magnitude of the emissions.

Figure 8. Illustration of the distribution of gap relative values for the nth-percentile of each interpolation family for several combinations of vehicle technology and fuel type. A different nth-percentile value is established in each case.



Source: JRC, 2023.

In summary, the proposed procedure is the following, subject to revision as more data becomes available:

1. OBFCM data are processed (cleaned) and grouped by family;
2. Only interpolation families with a statistically relevant sample (more than 100 vehicles) are considered;
3. For each of these families, calculate the value of the relative-gap at a pre-defined specific percentile (specific percentiles assigned to each vehicle technology);
4. Collect all the relative-gap values from step 3, one per family, and screen outliers for each category (combination of vehicle technology and fuel type) using specific 'k factors';
5. Determine the severity degree and combine with registrations per family to obtain the Composite Risk Index (CRI)

The OBFCM data constitutes an optimal tool for selecting candidate families for the three types of tests, namely, chassis-dyno, road-load determination and artificial strategies, with special relevancy for the latter. However, the only available consolidated data correspond to 2021, where the data was submitted only by manufacturers and, being the first year of the campaign, the reporting share from the manufacturers is quite poor and irregular. On the other hand, the 2022 data are still provisional at the time of the elaboration of this report, and therefore could not be used either.

3.3 Composite Risk Index (CRI)

The Composite Risk Index (CRI) is used in this risk assessment to evaluate and quantify the overall risk level of each interpolation family by combining probability and severity defined as described in sections 3.1 and 3.2. The CRI considers both, the likelihood of an event (the number of vehicles registered in the last three years in the EU) and the potential severity of its consequences (the impact on CO_2 emissions).

The CRI is calculated by multiplying the probability and severity scores, both being either 1, 2 or 3. The combination of these 2 components is used for defining the final risk level of an interpolation family as illustrated in **Figure 9**.

As shown in **Figure 9**, the CRI can yield results with values of 1, 2, 3, 4, 6, and 9. Depending on the outcome the final risk level an IP family can be labelled as:

1. **Low Risk (CRI 1 or 2)**

   a. CRI 1: Occurs when both probability and severity are low (both equal to 1).

   b. CRI 2: Can occur when either probability or severity is medium (equal to 2), and the other is low (equal to 1).

2. **Medium Risk (CRI 3 or 4)**

   c. CRI 3: When either probability or severity is high (equal to 3), and the other is low (equal to 1).

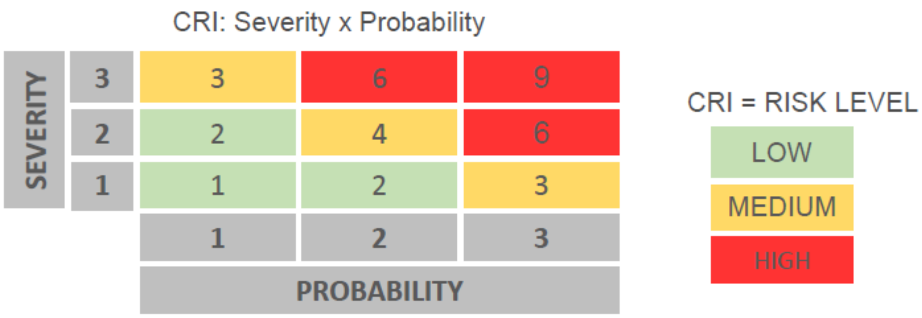
   d. CRI 4: Occurs when both probability and severity are medium (equal to 2)

3. **High Risk (CRI 6 or 9)**

   e. CRI 6: Occurs when either probability or severity is high (equal to 3), and the other is medium (equal to 2).

   f. CRI 9: Occurs when both probability and severity are high (both equal to 3).

Figure 9. Calculation of CRI and the final risk levels



Source: JRC, 2023.

3.4 Random selection

The risk assessment analysis described in sections 3.1 through 3.3 has led to the classification of interpolation families into low, medium, or high-risk levels. This categorization was based on specific deviations and practices observed during the implementation of the WLTP test procedure, or the identification of a family as an outlier based on CO_2 emission, CED, OBFCM real-world data, or the RDE test results. The DICE dataset analysis involved validating various aspects of the test procedure to identify interpolation families at the highest risk of deviating from the declared CO_2 emission values.

However, acknowledging the inherent limitations of predefined checks, the incorporation of randomness and random selection into the overall approach for selecting ISV families could help in uncovering potential issues not addressed or revealed by systematic checks.

Therefore, to support GTAAs, a random selection approach was applied to identify additional interpolation families that could be selected for ISV. The procedure for random selection is based on a random number that is automatically generated during the submission of the type-approval test data from the Type Approval Authority to the Commission server (DICE).

4 Main findings ISV 2024

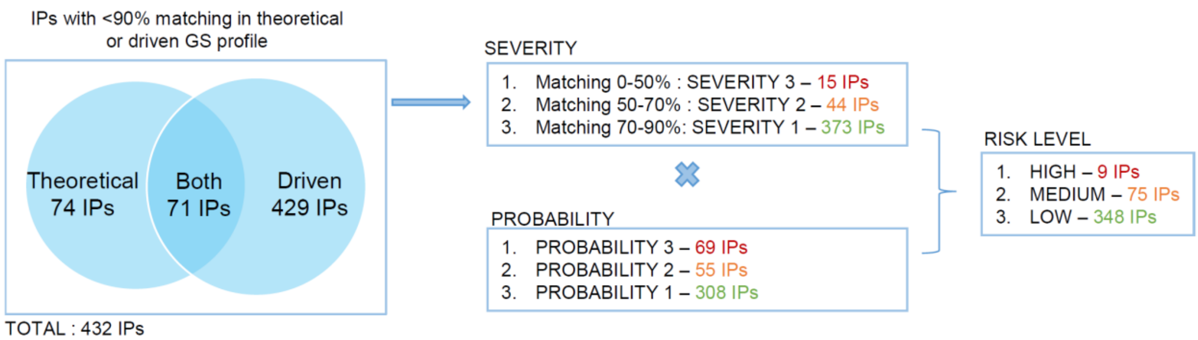
4.1 DICE dataset analysis: QC checks results

The results of risk assessment based on quality control (QC) analysis of the DICE RA dataset are presented in the subsequent sections.

4.1.1 Gearshift

In total, 74 families showed matching below 90% in the theoretical gearshift profile (for either VH or VL test), and 429 families exhibited matching below 90% in the driven gearshift profile (for either VH or VL test). Additionally, 71 IP families had below 90% percentage of matching in both gearshift profiles (the theoretical and driven). In total, 432 interpolation families were identified with discrepancies in either the theoretical or driven gearshift profile, as illustrated in **Figure 10**.

Figure 10. Probability, severity and final risk levels for IP families identified with gearshift issues



Source: JRC, 2023.

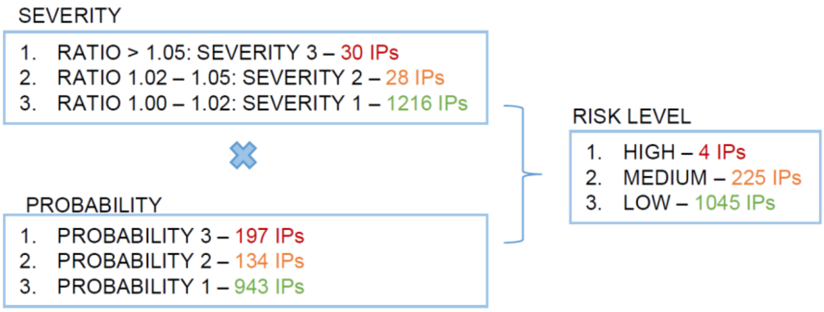
In the subsequent stage, severity levels were assigned based on the percentage of matching. Families with matching percentages ranging from 0 to 50% were given severity score 3 (15 families), those with matching percentages from 50 to 70% severity score 2 (44 families), and those with matching percentages between 70% and 90% severity score 1 (373 families). Following the combination with probability levels calculated for these families, as per the procedure described in section 3.1, the Composite Risk Index (CRI) was computed, and final risk levels were determined. A total of 9 interpolation families were identified with high risk, 75 with medium risk, and 348 with low risk, as depicted in **Figure 10**.

4.1.2 Vehicle speed profile

As described in section 3.2.1.2, the ratio of theoretical to measured CO_2 emissions, corresponding to the deviation of driven from the theoretical speed profile foreseen by the regulation has been calculated for each interpolation family in the DICE RA dataset. In the subsequent stage, severity levels were assigned based on that ratio. As shown in **Figure 11**, 30 families with ratio above 1.05 were categorized as severity 3, 28 families with ratio between 1.02 and 1.05 as severity 2, and 1,216 families with ratio between 1 and 1.02 as severity 1.

Following the combination with probability levels calculated for these families, the Composite Risk Index (CRI) was computed, and final risk levels were determined. A total of 4 interpolation families were identified with high risk, 225 with medium risk, and 1,045 with low risk.

Figure 11. Probability, severity and final risk levels for IP families identified with vehicle speed deviations



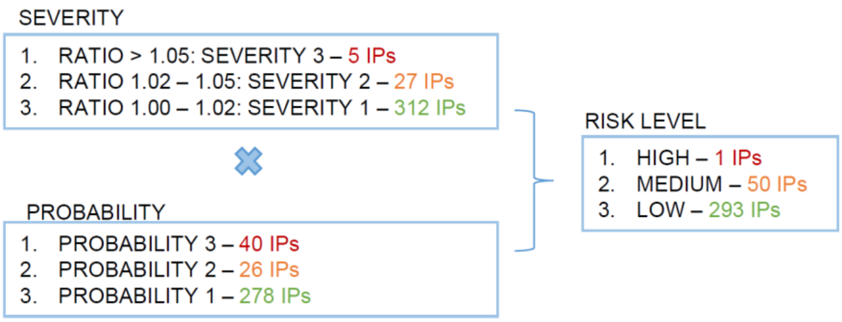
Source: JRC, 2023.

4.1.3 Correction of measured CO_2 values

For each interpolation family in the DICE RA dataset the ratio between measured CO_2 emission values independently corrected by JRC and CO_2 measured and corrected values reported during vehicle certification has been calculated. As shown in **Figure 12**, 5 families with ratio above 1.05 were categorized as severity 3, 27 families with ratio between 1.02 and 1.05 as severity 2, and 312 families with ratio between 1 and 1.02 as severity 1.

Subsequently, in combination with probability levels calculated for these families, the Composite Risk Index (CRI) was computed, and final risk levels were determined. Only one interpolation family was identified with high risk, 50 with medium risk, and 293 with low risk. All other interpolation families analysed had a ratio below 1 (878) and were labelled as 'no risk' families.

Figure 12. Probability, severity and final risk levels for IP families identified with deviations in correction of measured CO_2 emission values



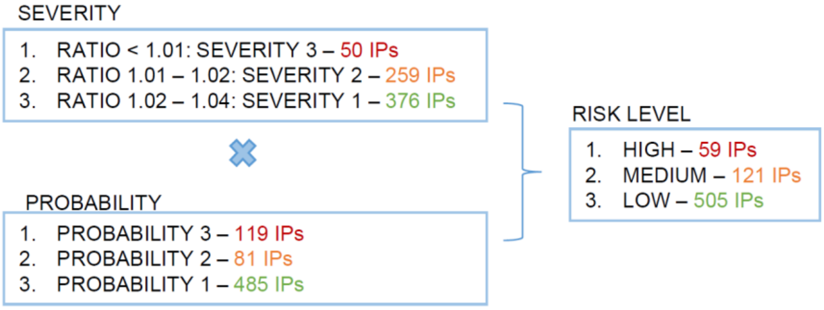
Source: JRC, 2023.

4.1.4 CO_2 declaration

For each interpolation family in the DICE RA dataset, the ratio between the manufacturer's declared value and the measured and corrected CO_2 emission value, both reported during vehicle certification, has been calculated. As presented in **Figure 13**, 50 families with ratio below 1.01 were categorized as severity 3, 259 families with ratio between 1.01 and 1.02 as severity 2, and 376 families with ratio between 1.02 and 1.04 as severity 1.

Following the combination with probability levels calculated for these families, the Composite Risk Index (CRI) was computed, and final risk levels were determined. A total of 59 interpolation families were identified with high risk, 121 with medium risk, and 505 with low risk. All other interpolation families analysed had ratio above 1.04 (796) and were labelled as 'no risk' families.

Figure 13. Probability, severity and final risk levels for IP families identified with CO_2 declaration below the thresholds defined for this analysis



Source: JRC, 2023.

4.2 DICE dataset analysis: Outlier detection results

As described in section 3.2.1.5, interpolation families present in DICE COMPLETE dataset were screened for outliers based on four independent analyses. The results of these analysis are the following:

1. **Slope analysis:** The slope analysis identifies outliers in the slope of the interpolation line between the VL and VH of the IP families. The analysis identified 62 outlier IP families (48 with high, 12 with medium, and 2 with low severity). Combining with the probability levels of these families, 10 interpolation families were identified as high risk families.
2. **Ratio analysis:** The ratio analysis is the method alternative to slope analysis that identifies outliers for interpolation families having only VH configuration. This analysis identified 38 outlier IP families (10 with high, 11 with medium, and 17 with low severity). Combining with the probability levels of these families, 9 interpolation families were identified as high risk families.
3. **CO_2 emission outliers**: This analysis identifies outliers in CO_2 emissions for interpolation families sharing the same technologies and characteristics (sub-groups). The analysis identified 73 outlier IP families (22 with high, 22 with medium, and 29 with low severity). Combining with the probability levels of these families, 23 interpolation families were identified as high risk families.
4. **CED outliers**: This analysis mirrors the preceding one and identifies outliers in cycle energy demand (CED) for interpolation families sharing the same technologies and characteristics (sub-groups). The analysis identified 123 outlier IP families (39 with high, 34 with medium, and 50 with low severity). Combining with the probability levels of these families, 23 interpolation families were identified as high risk families.

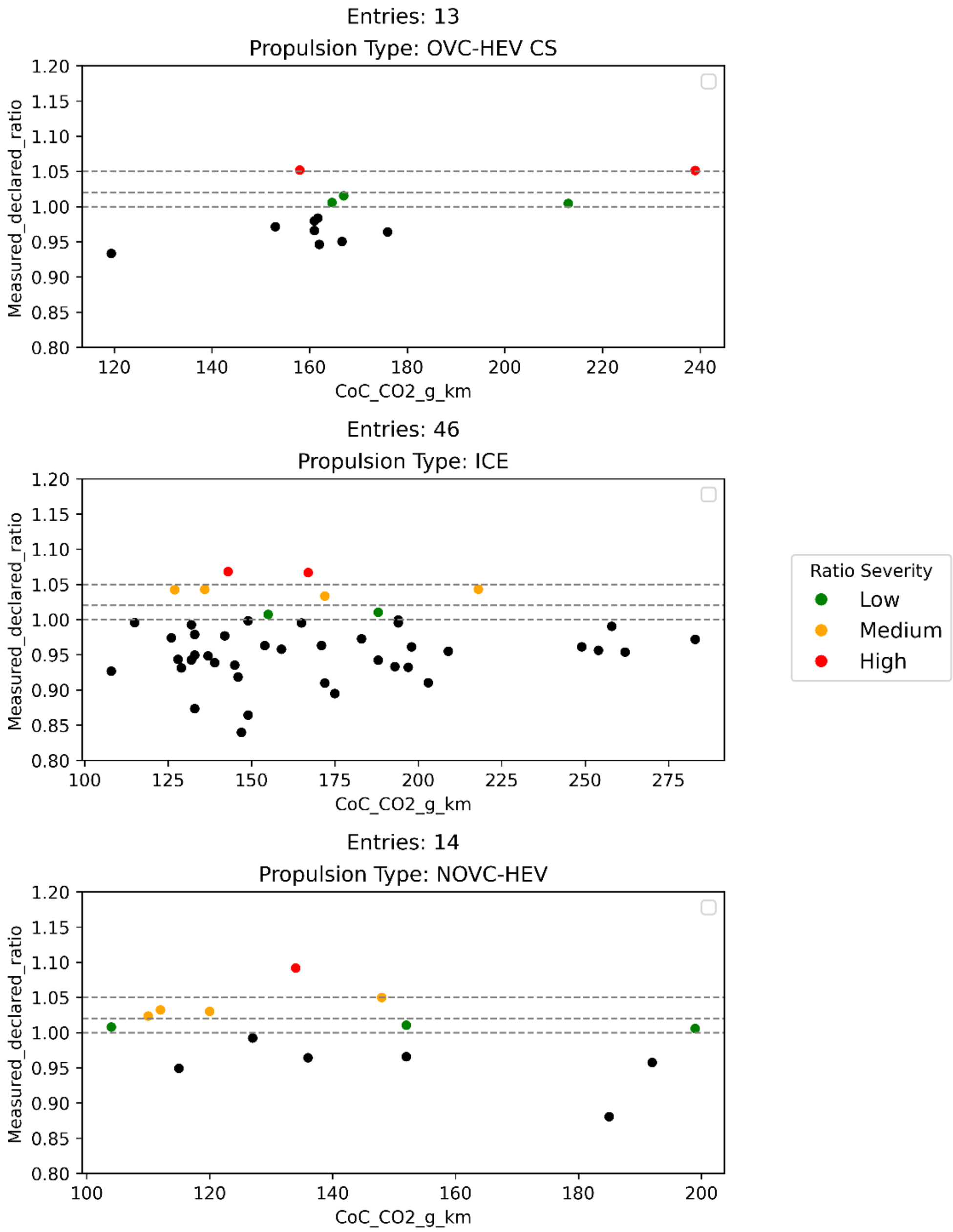
4.3 ISC dataset analysis results

As mentioned earlier in this report, in the period from 2018 to 2022 JRC performed pilot studies on the market surveillance and in-service conformity and emission tests on 73 vehicles (46 ICE vehicles, 14 NOVC-HEVs and 13 OVC-HEVs). The compliance for tailpipe emissions was verified for both the type 1 (WLTP) and type 1a (RDE) tests in accordance with the requirements of respectively Annex XXI and Annex IIIa of Regulation (EU) 2017/1151.

For OVC-HEVs only charge-sustaining CO_2 emissions have been evaluated. The average WLTP test results for the different vehicle powertrains are shown in **Figure 14** as the ratio of CO_2 emissions measured at JRC and CO_2 values declared on the vehicle's certificate of conformity (CoC). For the majority of vehicles that ratio was below 1 as indicated by the black dots in the Figure. These vehicles were labelled as 'no risk' vehicles.

Vehicles with ratio above 1 are categorized as follows. Vehicles with a ratio above 1.05 were categorized as severity 3 (5 vehicles), those with a ratio between 1.02 and 1.05 as severity 2 (8 vehicles), and those with a ratio between 1.00 and 1.02 as severity 1 (8 vehicles). Subsequently, in combination with probability levels calculated for these vehicles, the Composite Risk Index (CRI) was computed, and final risk levels were determined. Nine vehicles were identified with high risk, 7 with medium risk, and 5 with low risk.

Figure 14. Results of WLTP tests performed at JRC for different vehicle powertrains with coloured severity areas (red for severity high, orange for severity medium, and green for severity low)



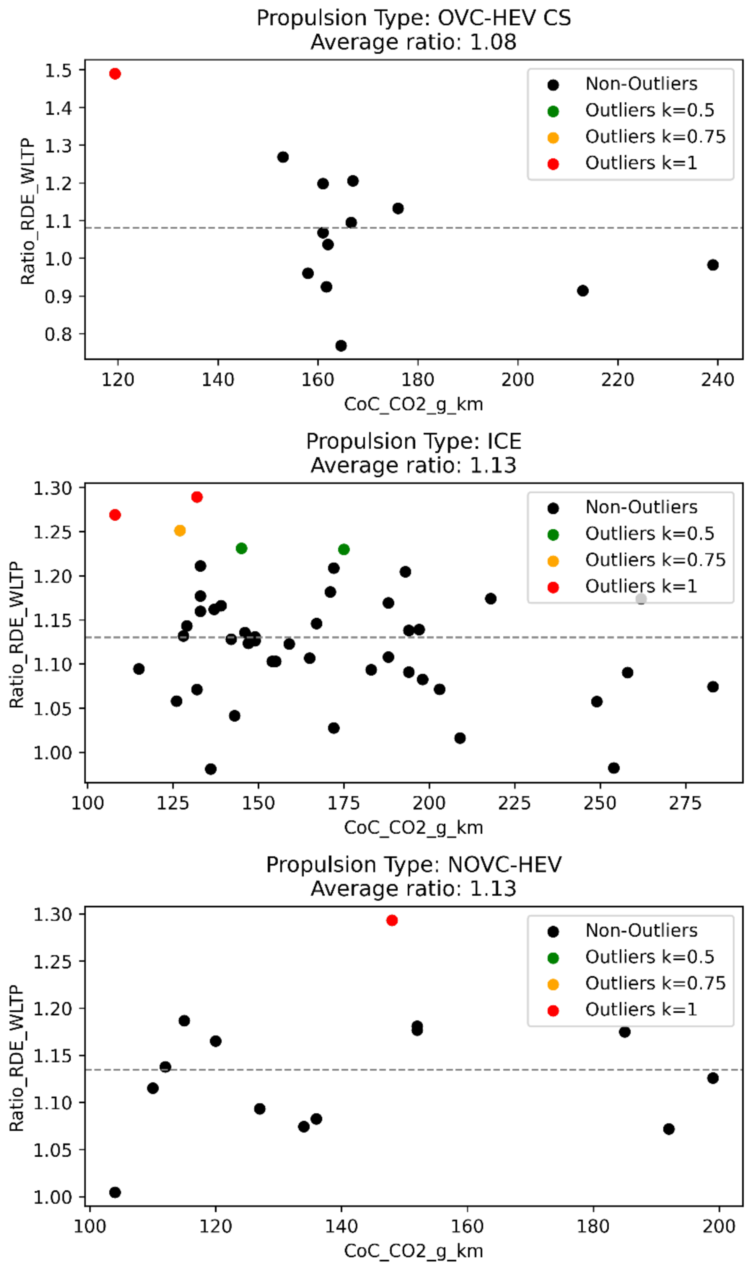
Source: JRC, 2023.

The average RDE (compliant) test results for these different vehicle powertrains are shown in **Figure 15** as the ratio of RDE CO_2 measured at JRC and the CO_2 measured from WLTP tests. The average ratio for ICE vehicles and NOVC-HEVs is 1.13 and for OVC-HEVs is 1.08. The calculated average ratio indicates that, on average, RDE compliant tests result in 13% higher CO_2 emissions for ICE vehicles and NOVC-HEVs, and 8% higher for OVC-HEVs, in comparison to WLTP laboratory testing.

In the subsequent stage, the severity assessment involves the identification of outliers. The 'k factors' used in this assessment were k = 1 for severity 3 (4 vehicles), k = 0.75 for severity 2 (1 vehicle) and k = 0.5 for severity 1 (2 vehicles). In addition, only the higher side (above Q3 + k * IQR) outliers are selected in this risk assessment. Subsequently, in combination with probability levels calculated for these vehicles, the Composite Risk Index

(CRI) was computed, and final risk levels were determined. Five vehicles were identified with high risk, 1 with medium risk, and 1 with low risk.

Figure 15. Results of RDE tests performed for different vehicle powertrains coloured severity areas (red for severity high, orange for severity medium, and green for severity low)



Source: JRC, 2023.

4.4 Risk assessment summary

The combined results of the risk assessment described in sections 4.1, 4.2, and 4.3 are summarized in **Table 5**, indicating the number of interpolation families flagged as high risk for each type of analysis performed. A total of 152 IP families have been identified with one or more "high risk" flags, corresponding to 131 unique IP families.

As a result of DICE quality control (QC) analysis, 73 interpolation families (63 unique) were identified with a high-risk level, with the majority (59) exhibiting CO_2 over-declaration ratios below 1.01. Nine interpolation families were selected due to low matching between driven or user-calculated gearshift profiles and the theoretical gearshift calculated by the JRC Python Gearshift Calculation Tool (JR-Shift). Furthermore, four interpolation families showed significant differences between theoretical and driven cycle energy demand and corresponding CO_2 emissions. Only one interpolation family was flagged because the values reported in the type-approval were notably lower compared to those calculated by JRC after all corrections mandated by the regulation.

Tukey's method for detection of outliers identified 65 interpolation families (58 unique) with high risk following four independent analyses (slope, ratio, CO_2 and CED outliers) described in section 4.2. The list is completed with 14 interpolation families selected after the analysis of their type 1 (WLTP) and type 1a (RDE) physical test results.

Table 5. Number of IP families (and estimated number of ISV families) identified with high risk level by type of the issue

HIGH RISK LEVEL FAMILIES			
SOURCE	**TYPE OF ANALYSIS**	**IP FAMILIES**	**ISV FAMILIES**
DICE RA dataset QC analysis	GEARSHIFT	9	4
	VEHICLE SPEED	4	4
	CO_2 CORRECTIONS	1	1
	DECLARED/MEASURED RATIO	59	37
DICE COMPLETE dataset OUTLIERS analysis	SLOPE OUTLIERS	10	7
	RATIO OUTLIERS	9	9
	CO_2 OUTLIERS	23	23
	CED OUTLIERS	23	23
ISC dataset analysis	WLTP and RDE TESTS	14	12
	TOTAL	152	120
	TOTAL UNIQUE	**131**	**106**

Source: JRC, 2023.

For certain IP families, the emission type-approval has been granted based on the Type 1 test of another (similar) IP family. This "parent-child" concept is recognized in ISV by defining ISV families as groups of IP families for which the same Type 1 test was used (meaning the same reported values for 'measured value' 'speed and distance corrected value' and 'RCB correction coefficient') and for which the emission type-approval was granted by the same GTAA. The DICE database links parent and child families, enabling the identification of ISV families and counting their numbers. However, it is important to underline that these ISV families could contain additional IP families, as many families have not been reported to DICE (see Section 4.5). Based on the available information, 120 ISV families (106 unique) have been identified with the high risk.

Table 6 provides a breakdown of the unique interpolation families with high risk, categorized by powertrain and fuel type. Among these families, 59 IP families are fuelled with gasoline, 71 IP families with diesel, and 1 IP family with other fuel. The distribution by powertrain reveals that 89 IP families are ICE vehicles, 26 are conventional hybrids (NOVC-HEV), and 48 are plug-in hybrid vehicles (OVC-HEV).

In addition, each of these IP families is marked for specific types of ISV tests based on the outcomes of risk assessment. As summarized in **Table 6**, 110 interpolation families have been selected for chassis-dynamometer tests (CDM), 40 interpolation families for road load tests (RL), and 5 interpolation families for dedicated tests to identify the presence of artificial strategies (AS).

Table 6. Number of IP families identified with high risk level with the number of tests (CDM, RL, AS) separated by powertrain and fuel type

	TOTAL	FUEL			POWERTRAIN		
		GASOLINE	DIESEL	OTHER	ICE	NOVC-HEV	OVC-HEV
HIGH RISK FAMILIES	131	59	71	1	89	26	16
CDM TEST	110	48	61	1	75	24	11
RL TEST	40	20	20	0	26	3	11
AS TEST	5	1	4	0	3	1	1

Source: JRC, 2023.

4.5 Families not reported to DICE

The risk assessment conducted in this study with results presented in section 4.4 was only feasible for the families reported to DICE and included in the assessment.

However, upon inspection of the 2020, 2021, and 2022 EEA CO_2 monitoring datasets, a significant number of families could not be found in the DICE database. These missing families were either not reported or their identifier is misspelled in the EEA monitoring datasets. There are two legally justifiable reasons for a family not being reported to DICE. The first one pertains to hybrid vehicles approved before 2020, as they were out of scope of the NEDC-WLTP correlation and reporting. The second case refers to vehicles approved in the period from January 2021 to July 2021, when the correlation phase had ended, but the monitoring regulation (EU) 2021/392 was not in force yet. The authorities were then not obliged to report type-approved families to DICE, although they could do so on a voluntary basis.

As shown in **Figure 16**, after exclusion of pure electric vehicles, the total number of IP families with new M1 or N1 vehicles registered in the EU during the period 2020-2022 was 15,309. A detailed analysis revealed issues on the IP family names reported (spaces, underscores/dashes, special characters, etc.), resulting in 11,510 unique IP families. Among these, 6,339 IP families have been reported to DICE and 5,171 were missing.

On the families not reported, 74 IP families of hybrid electric vehicles (both OVC-HEV and NOVC-HEV) registered from 2020 onwards were approved before 2020, and thus had valid reasons for not being found in DICE.

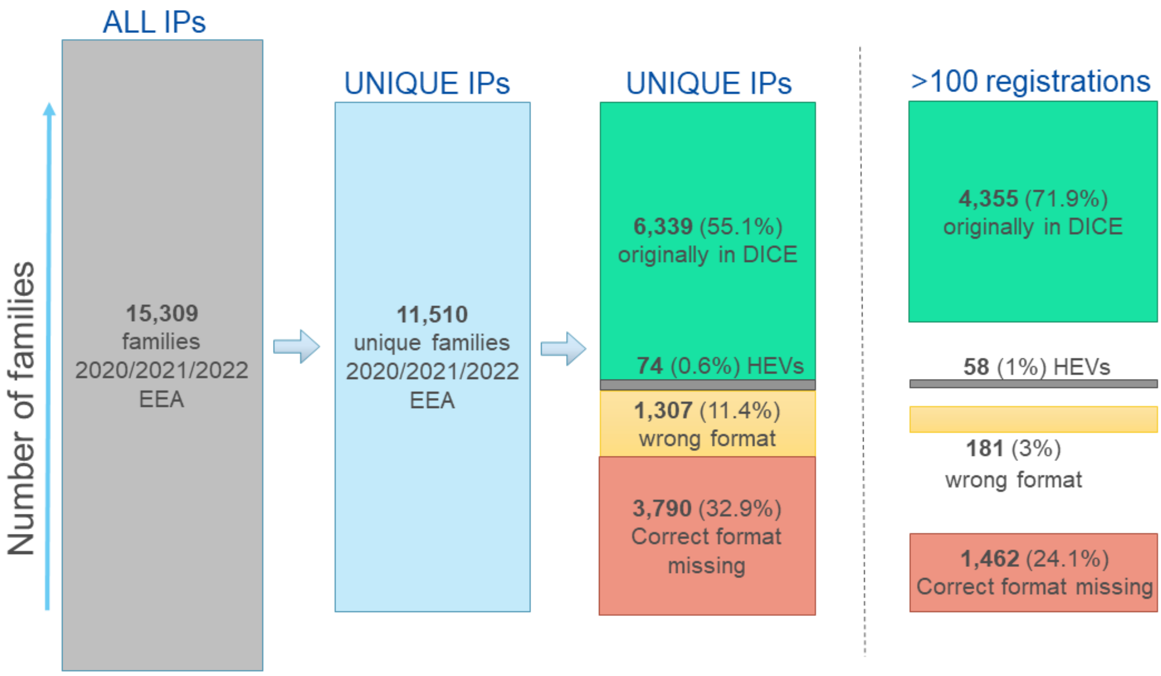
Furthermore, until the end of 2022 Regulation (EU) 2017/1151 allowed the use of two different formats as IP family identifiers, the first one running until the end of 2018 and the second one for the remaining period. On this basis, 1,307 IP families were identified with the wrong format. These families cannot be associated with any type-approved interpolation family, presumably due to misspelled reporting to the EEA. Further investigation is necessary to identify these families and correct their reporting identifiers.

Finally, a total number of 3,790 IP families with the correct IP format according to the regulation were identified as missing in DICE. That corresponds to 33% of the total number of unique IP families identified in the 3-year monitoring period (2020-2022).

While the majority of misspelled identifier cases have been resolved with the steps described above, there might be cases not addressed by the applied corrections. Further investigation and clarification, involving the type-approval authorities concerned, will be necessary to ensure a comprehensive understanding of the reasons behind the 3,790 IP families missing in DICE, but these high numbers raise serious doubts that this could be justified solely based on the two mentioned reasons.

Following the analysis methodology consistent with the rest of this report, and considering the ISV's eligibility criterion of a minimum of 100 registered vehicles per family, the total count of families missing in DICE without apparently a valid reason is 1,462 (**Figure 16**).

Figure 16. Flowchart of the methodology applied to identify the missing IP families from 2020-2022 EEA datasets



Source: JRC, 2023.

In order to provide a fair ISV selection across all interpolation families, whether or not reported in DICE, a specific approach was developed for selecting interpolation families not (yet) reported to DICE. The starting point for this was to achieve a number of first priority non-DICE families, which is equivalent with the number of high risk DICE families identified on the basis of the risk assessment. In order to reflect such equivalence, a ratio of 2:1, between DICE and non-DICE IP families, has been applied.

For each vehicle manufacturer, the number of first priority non-DICE IP families was determined based on a weighting that combines the percentage of missing vehicle registrations in DICE with the percentage of missing interpolation families in DICE. Manufacturers with higher combined weights were allocated a higher number of non-DICE interpolation families for ISV 2024 testing, and vice versa. For these calculations only vehicles and IP families with sales above 100 units have been considered.

An example of the calculation for manufacturer (OEM1) is shown below.

Step 1. The weighting factor for OEM1 ($OEM1_{WF}$) is calculated following the formula:

$$OEM1_{WF} = \frac{OEM1_{miss\_veh}}{OEM_{all\_veh}} \times \frac{OEM1_{miss\_IP}}{OEM1_{tot\_IP}}$$

where:

$OEM1_{miss\_veh}$ is the number of vehicles registered in the period 2020-2022, but missing in DICE for OEM1;

OEM_{all_veh} is the number of all vehicles registered in the period 2020-2022 for all manufacturers;

$OEM1_{miss\_IP}$ is the number of IP families missing in DICE for OEM1 for the period 2020-2022;

$OEM1_{tot\_IP}$ is the total number of all IP families reported for the period 2020-2022 for OEM1.

Step 2. The total weighting factor (OEM_{WF_TOT}) is calculated as the sum of weighting factors for each individual manufacturer (OEM) calculated using the above mentioned formula.

Step 3. The number of interpolation families allocated to each OEM is done following the formula:

$$OEM1_{IP\_allocated} = \frac{OEM1_{WF} \times IP_{RA}}{OEM_{WF\_TOT}}$$

where IP_{RA} is half of the total number of interpolation families flagged with high risk in the risk assessment (50% of 131 interpolation families as shown in Table 5), to reflect the above mentioned equivalence ratio of 2:1, between DICE and non-DICE IP families.

Step 4. Select the first priority interpolation families allocated to each manufacturer ($OEM1_{IP\_allocated}$) based on the highest registration numbers in the last three years.

4.6 Random selection results

The random selection methodology described in section 3.4 resulted in the identification of 30 interpolation families from the DICE RA dataset with at least 100 vehicles registered during the period 2020-2022.

In addition, to provide a fair ISV selection also for families not reported in DICE, a ratio of 2:1, between DICE and non-DICE IP families, has been applied to randomly select 15 families not reported to DICE with at least 100 vehicles registered.

5 Selected families for ISV 2024

5.1 ISV families with the first testing priority in the year 2024

ISV families with the first testing priority in 2024 comprise:

- the families selected as a result of risk assessment summarized in **Table 5**
- the families not reported to DICE and selected based on the methodology described in section 4.5

5.1.1 DICE ISV families

The comprehensive list of all unique 131 IP families identified with high risk in risk assessment is presented in the table in **Annex 1** under the column labelled 'IP FAMILY' (families numbered 1 to 131). The second column 'ISV FAMILY' includes the list of all IP families that share the same Type 1 test results, based on the information gathered in DICE and are therefore part of the same ISV family.

The last three columns labelled 'CDM' (short for laboratory or chassis-dynamometer test), 'RL' (short for road load test), and 'AS' (short for artificial strategies test), indicate the type of ISV test prioritized for each selected IP family. The selection is based on the analysis type that flagged the interpolation family with high risk.

- A total of 110 interpolation families have been chosen for chassis-dynamometer tests (CDM).
- 40 interpolation families are allocated for road load tests (RL).
- 5 interpolation families are designated for dedicated tests to identify artificial strategies (AS).

These allocations correspond to 84%, 10%, and 4% (for CDM, RL, and AS tests respectively) of the total number of interpolation families selected with high risk. According to the implementing regulation (Article 4(1)), at least 75% of the in-service verification families should undergo chassis-dynamometer tests, 50% road load tests, and 25% artificial strategies tests. It is noteworthy that the resulting test distribution in this report serves as guidance for the GTAAs.

5.1.2 ISV families missing in DICE

The families numbered 132 to 197 in the table in **Annex 1** correspond to the list of families not reported to DICE and flagged with the highest risk based on the methodology described in section 4.5. They correspond to 66 families selected and allocated based on the highest registration numbers in the last three years.

As these families are not reported to DICE and cannot be associated with any other interpolation family that potentially could share the same Type 1 test, the second column 'ISV FAMILY' in the table in Annex 1 is empty. In addition, there is no specific recommendation regarding the type of ISV tests (CDM, RL, or AS) for each selected IP family. The minimum requirement is one test.

5.2 ISV families with the second testing priority in the year 2024

The ISV families with the second testing priority in 2024 encompass both families randomly selected from DICE and families chosen randomly from the database of interpolation families not reported to DICE, as described in section 4.6. The complete list of these families is presented in the table in **Annex 2**.

The families randomly selected from DICE RA dataset, detailed in section 4.6 are numbered 1 to 30 in the table in **Annex 2**. As these families are reported to DICE, the second column 'ISV FAMILY' includes the list of all IP families that share the same Type 1 test results, based on the information gathered in DICE.

The families randomly selected from the database of interpolation families not reported to DICE based on the methodology described in section 4.6 are numbered 31 to 45 in the table in **Annex 2**. Again, for these families, the second column 'ISV FAMILY' in the table in Annex 2 is empty.

Furthermore, due to the random selection, which is not tied to specific risks, there is no explicit recommendation regarding the type of ISV tests (CDM, RL, or AS) for the selected IP family.

5.3 ISV families with the third testing priority in the year 2024

As detailed in section 4.5, the number of interpolation families not reported to DICE with a minimum of 100 registered vehicles is equal to 1,462. Some of these families have been included in the first (66) and second (15) testing priority lists for ISV 2024 testing, as described in the previous sections.

The rest of interpolation families missing in DICE is presented in the table in **Annex 3**. That list serves as the third testing priority for ISV in 2024.

5.4 Distribution of selected families for ISV 2024 by GTAAs

The additional analysis focused on identifying the type-approval authorities that issued emission type-approvals (GTAAs) for interpolation families selected with the first and second priority. GTAA identification was made possible through the ETAES platform, which is a platform operated by KBA (German Federal Motor Transport Authority) ([20]) gathering vehicle type-approval documents from different EU type-approval authorities.

The GTAA identification, conducted via the ETAES platform, successfully identified the type-approval authorities (GTAAs), except for three interpolation families not reported to DICE, one with the first and 2 with the second priority.

As shown in **Table 8**, the highest number of first priority families is assigned to Sweden (37), followed by France (36), Spain (28), Belgium (23), Netherlands (18), Luxembourg (16), and Germany (15). The rest of GTAAs (Italy, Ireland, Czech Republic, and Romania) have less than 10 families selected with the first priority. The highest number of second priority families is assigned to France (15), followed by Luxembourg (7), and Germany (6). Other GTAAs have less than five families selected with the second priority.

Table 7. Distribution of ISV families selected for 2024 testing by GTAAs and priority (first and second priority)

	FIRST PRIORITY	SECOND PRIORITY	TOTAL

20 ETAES platform, https://www.etaes.eu/

COUNTRY	DICE	Non DICE	ALL	DICE	Non DICE	ALL	1st + 2nd
France	23	13	36	9	6	15	51
Sweden	34	3	37	3	1	4	41
Spain	22	6	28	3	1	4	32
Luxembourg	10	6	16	6	1	7	23
Belgium	8	15	23	0	0	0	23
Germany	9	6	15	3	3	6	21
Netherlands	10	8	18	1	0	1	19
Ireland	4	2	6	4	1	5	11
Italy	2	6	8	0	0	0	8
Czech Republic	6	0	6	1	0	1	7
Romania	3	0	3	0	0	0	3
Not Identified	0	1	1	0	2	2	3

Source: JRC, 2023.

6 Conclusions

This report supports the implementation of In-Service Verification (ISV) Regulation (EU) 2023/2866 on the verification of CO_2 emissions and fuel consumption of light duty vehicles. The report identifies ISV families at high risk of incorporating vehicles with deviations in their CO_2 emission values and provides a detailed explanation of the risk assessment methodology employed and datasets used.

The risk assessment methodology employed in this report is based on the concept of Composite Risk Index (CRI) that combines the probability (number of vehicles registered in the EU) and severity (impact of a risk) of a specific occurrence. The severity considered elements such as conformity in the implementation of the various steps of Type 1 test procedure, detection of outlier families with similar technical characteristics but lower CO_2 emissions or CED, and findings from previous in-service conformity tests and market surveillance tests.

In addition, a detailed analysis of new vehicles introduced to the Union market revealed a substantial number of interpolation families lacking corresponding type-approval data reported to the Commission under Article 14 of Implementing Regulation (EU) 2021/392. For these families a methodology was developed for selecting a fair share of them for 2024 ISV testing, prioritizing the highest-risk interpolation families among them.

To address potential issues that may not be captured by systematic checks in the risk assessment, a number of additional IP families were randomly selected both from the database of interpolation families reported and not reported to DICE.

The risk assessment analysis has identified 131 interpolation families with high-risk, corresponding to 106 unique ISV families. In addition, 66 interpolation families missing from DICE were identified as high risk based on the highest registration numbers in the last three years. Together with the 131 high-risk families selected from the risk assessment, a total of 197 families are labeled with the first testing priority for the 2024 in-service verification.

To complement the vehicle selection by GTAAs for the 2024 in-service verification, a total of 45 interpolation families have been selected using the random selection method, both from families found (30) and not found (15) in DICE. These families are labeled as ISV families with the second testing priority in 2024.

This report details the risk assessment methodology for ISV, offering guidance to Member States' Granting Type Approval Authorities (GTAAs) in selecting the ISV families that should undergo the in-service verification testing planned for 2024 and beyond.

References

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List of abbreviations and definitions

AS	Artificial Strategies tests
CDM	Chassis Dynamometer Measurement tests
CED	Cycle Energy Demand
CoC	Certificate of Conformity
CRI	Composite Risk Index
DICE	Database for In-Service verification of CO_2 Emissions
EEA	European Environment Agency
EU	European Union
GTAA	Granting Type-Approval Authority
ICE	Internal Combustion Engine
ISC	In-Service Conformity
ISV	In-Service Verification
IP	Interpolation (Family)
IQR	Interquartile Range
JRC	Joint Research Centre
LDV	Light-Duty Vehicles
LPG	Liquefied Petroleum Gas
NEDC	New European Driving Cycle
NG	Natural Gas
NOVC-HEV	Not-Off-Vehicle Charging Hybrid Electric Vehicle
OBFCM	On-Board Fuel and energy Consumption Monitoring
OVC-HEV	Off-Vehicle Charging Hybrid Electric Vehicle
QC	Quality Control
RDE	Real Driving Emissions
RL	Road Load tests
UNECE	United Nations Economic Commission for Europe
VH	Vehicle High
VL	Vehicle Low
WLTP	Worldwide harmonized Light vehicles Test Procedure

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Annexes

Annex 1. List of families with the first testing priority in the year 2024

NR	IP FAMILY	ISV FAMILY	TYPE OF TEST		
			CDM	RL	AS
1	IP-0000457-WBA-1	IP-0000457-WBA-1	✓		✓
2	IP-0000483-WBA-1	IP-0000483-WBA-1		✓	
3	IP-0000905-WBA-1	IP-0000905-WBA-1		✓	
4	IP-0000922-WBA-1	IP-0000922-WBA-1	✓	✓	
5	IP-0110-JT1-1	IP-0110-JT1-1	✓		
6	IP-0118-JT1-1	IP-0118-JT1-1	✓		
7	IP-0168-JT1-1	IP-0168-JT1-1	✓		
8	IP-03_312_0208-ZFA-1	IP-03_312_0208-ZFA-1	✓		
9	IP-03_940_0152-ZAR-1	IP-03_940_0152-ZAR-1	✓		
10	IP-04-KNA-2018-1068	IP-04-KNA-2018-1068			✓
11	IP-0401361-U5Y-1	IP-0401361-U5Y-1	✓	✓	
12	IP-0401368-U5Y-1	IP-0401368-U5Y-1	✓		
13	IP-0401408-U5Y-1	IP-0401408-U5Y-1	✓		
14	IP-0401410-U5Y-1	IP-0401410-U5Y-1	✓		
15	IP-0500972-TMA-1	IP-0500972-TMA-1	✓		
16	IP-0600464-KMH-1	['IP-0600472-KMH-1', 'IP-0600464-KMH-1']	✓	✓	
17	IP-0600467-KNA-1	['IP-0600467-KNA-1', 'IP-0600479-KNA-1']	✓	✓	

18	IP-0600472-KMH-1	['IP-0600472-KMH-1', 'IP-0600464-KMH-1']	✓	✓	
19	IP-0600479-KNA-1	['IP-0600467-KNA-1', 'IP-0600479-KNA-1']	✓	✓	
20	IP-0931274-KNA-1	IP-0931274-KNA-1	✓	✓	
21	IP-11-NLH-2018-0010	IP-11-NLH-2018-0010	✓		
22	IP-2021_246H5D-YV1-1	IP-2021_246H5D-YV1-1	✓	✓	
23	IP-21u20p297PAA_01-SAL-1	IP-21u20p297PAA_01-SAL-1	✓		
24	IP-4_1227-JSA-1	IP-4_1227-JSA-1	✓		
25	IP-4_1246-JSA-1	IP-4_1246-JSA-1		✓	
26	IP-4_1247-JSA-1	IP-4_1247-JSA-1		✓	
27	IP-4_13072-TSM-1	IP-4_13072-TSM-1	✓		
28	IP-4_13082-TSM-1	IP-4_13082-TSM-1	✓		
29	IP-62A3M7DPF6A_000-VF1-0	['IP-62A3M7DPF6A_000-VF1-0', 'IP-62A3M7DPF6A_000-VF6-0', 'IP-62A3M7DPF6A_000-VNV-0']	✓		
30	IP-62A3M7DPF6A_000-VF6-0	['IP-62A3M7DPF6A_000-VF1-0', 'IP-62A3M7DPF6A_000-VF6-0', 'IP-62A3M7DPF6A_000-VNV-0']	✓		
31	IP-62A3M7DPF6A_000-VNV-0	['IP-62A3M7DPF6A_000-VF1-0', 'IP-62A3M7DPF6A_000-VF6-0', 'IP-62A3M7DPF6A_000-VNV-0']	✓		
32	IP-6_00459-TSM-1	IP-6_00459-TSM-1	✓		
33	IP-A03A5MT_2_14_01-MMC-1	IP-A03A5MT_2_14_01-MMC-1	✓		
34	IP-A05_5MT_2_14_00-MMC-1	IP-A05_5MT_2_14_00-MMC-1		✓	
35	IP-BX72_2019_00007-WF0-1	IP-BX72_2019_00007-WF0-1	✓		
36	IP-C519_2019_00019-WF0-1	IP-C519_2019_00019-WF0-1	✓		✓
37	IP-C519_2022_00003-WF0-1	IP-C519_2022_00003-WF0-1	✓		

38	IP-C519_2022_00007-WF0-1	['IP-C519_2022_00007-WF0-1', 'IP-C519_2022_00005-WF0-1']	✓		
39	IP-EFB1MEPDW5A_002-VFA-1	IP-EFB1MEPDW5A_002-VFA-1		✓	
40	IP-EFB1MFPDW5A_000-VFA-1	IP-EFB1MFPDW5A_000-VFA-1		✓	
41	IP-F16A1DTP6DAX_00-JN1-1	IP-F16A1DTP6DAX_00-JN1-1	✓		
42	IP-HNA1MJPUK0A_000-VF1-1	IP-HNA1MJPUK0A_000-VF1-1	✓		
43	IP-HNK____ATN8544D-VR3-0	IP-HNK____ATN8544D-VR3-0	✓		
44	IP-HNS____ATN85447-VR3-0	IP-HNS____ATN85447-VR3-0	✓		
45	IP-HNS____ATN8544G-VR3-0	IP-HNS____ATN8544G-VR3-0	✓		
46	IP-HNS____MB6_5426-VR3-0	IP-HNS____MB6_5426-VR3-0	✓		
47	IP-JAA1ACDTL4A_001-VF1-1	IP-JAA1ACDTL4A_001-VF1-1	✓		
48	IP-JAA1MUP0010_001-VF1-1	IP-JAA1MUP0010_001-VF1-1	✓		
49	IP-JBA1MMP010A_001-VF1-1	IP-JBA1MMP010A_001-VF1-1	✓	✓	
50	IP-JBA1MUP001A_001-VF1-1	IP-JBA1MUP001A_001-VF1-1	✓		
51	IP-JDA1ADDTL4B_001-VF1-1	['IP-JDA1ADDTL4B_001-VF1', 'IP-JDA1ADDTL4B_001-VF1-1']	✓	✓	
52	IP-JDA1ADDTL8B_001-VF1-1	IP-JDA1ADDTL8B_001-VF1-1	✓	✓	
53	IP-JDA1M3PDC4A_000-VF1-1	IP-JDA1M3PDC4A_000-VF1-1	✓		
54	IP-JDA1M6PJT4B_000-VF1-1	IP-JDA1M6PJT4B_000-VF1-1	✓		
55	IP-JDA1MFPTL4B_000-VF1-1	IP-JDA1MFPTL4B_000-VF1-1	✓		
56	IP-JDA1MTGJT4B_000-VF1-1	IP-JDA1MTGJT4B_000-VF1-1	✓		
57	IP-JFA1M6PJH3B_000-UU1-0	['IP-JFA1M6PJH3B_000-UU1-0']	✓		

58	IP-JFB1M6PJT4A_000-UU1-0	['IP-JFB1M6PJT4A_000-UU1-0']	✓	✓	
59	IP-JFD1MDPJT4B_000-UU1-0	['IP-JFD1MDPJT4B_000-UU1-0']	✓		
60	IP-JLA1MUP001A_000-VF1-1	IP-JLA1MUP001A_000-VF1-1	✓		
61	IP-JLA1MUP001A_001-VF1-1	IP-JLA1MUP001A_001-VF1-1	✓		
62	IP-MQB27SZ_A1_0537-VSS-1	['IP-MQB27SZ_A3_0537-WVW-1', 'IP-MQB27SZ_A1_0537-VSS-1', 'IP-MQB27SZ_A0_0537-TMB-1', 'IP-MQB27SZ_A2_0537-WAU-1']	✓		
63	IP-MQB27SZ_A1_0539-VSS-1	['IP-MQB27SZ_A1_0539-VSS-1', 'IP-MQB27SZ_A2_0539-WAU-1', 'IP-MQB27SZ_A0_0539-TMB-1', 'IP-MQB27SZ_A3_0539-WVW-1']	✓		
64	IP-MQB27SZ_A1_0549-VSS-1	['IP-MQB27SZ_A3_0549-WVW-1', 'IP-MQB27SZ_A1_0549-VSS-1', 'IP-MQB27SZ_A2_0549-WAU-1', 'IP-MQB27SZ_A0_0549-TMB-1']	✓		
65	IP-MQB27SZ_B1_0539-VSS-1	['IP-MQB27SZ_B3_0539-WVW-1', 'IP-MQB27SZ_B1_0539-VSS-1', 'IP-MQB27SZ_B2_0539-WAU-1', 'IP-MQB27SZ_B0_0539-TMB-1']	✓		
66	IP-MQB27ZZ_A1_0529-WAU-1	['IP-MQB27ZZ_A1_0529-WAU-1', 'IP-MQB27ZZ_A2_0529-WVW-1', 'IP-MQB27ZZ_A0_0529-VSS-1']	✓		
67	IP-MQB27ZZ_A2_0529-WVW-1	['IP-MQB27ZZ_A1_0529-WAU-1', 'IP-MQB27ZZ_A2_0529-WVW-1', 'IP-MQB27ZZ_A0_0529-VSS-1']	✓		
68	IP-MQB37AS_A2_1033-WVW-1	IP-MQB37AS_A2_1033-WVW-1	✓	✓	
69	IP-MQB37AZ_A2_0115-WVN-1	IP-MQB37AZ_A2_0115-WVN-1	✓	✓	
70	IP-MQB37AZ_B0_0919-WVW-1	['IP-MQB37AZ_B0_0919-WVW-1', 'IP-MQB37AZ_B1_0919-VSS-1']	✓	✓	
71	IP-MQB37AZ_B1_0919-VSS-1	['IP-MQB37AZ_B0_0919-WVW-1', 'IP-MQB37AZ_B1_0919-VSS-1']	✓	✓	
72	IP-MQB37WZ_A0_0498-VSS-1	IP-MQB37WZ_A0_0498-VSS-1	✓		
73	IP-MQB37WZ_A0_0512-WAU-1	IP-MQB37WZ_A0_0512-WAU-1	✓		
74	IP-MQB37WZ_A0_0515-TMB-1	IP-MQB37WZ_A0_0515-TMB-1	✓	✓	
75	IP-MQB37WZ_A0_0582-TMB-1	IP-MQB37WZ_A0_0582-TMB-1	✓		
76	IP-MQB37WZ_A0_0583-VSS-1	IP-MQB37WZ_A0_0583-VSS-1	✓		
77	IP-MQB37WZ_A0_0591-TMB-1	IP-MQB37WZ_A0_0591-TMB-1	✓		

78	IP-MQB37WZ_A0_0901-WVW-1	IP-MQB37WZ_A0_0901-WVW-1		✓	
79	IP-MQB37WZ_A0_1011-WVW-1	IP-MQB37WZ_A0_1011-WVW-1	✓		
80	IP-MQB37WZ_A0_1012-TMB-1	IP-MQB37WZ_A0_1012-TMB-1	✓		
81	IP-MQB37WZ_A0_1018-VSS-1	IP-MQB37WZ_A0_1018-VSS-1	✓		
82	IP-MQB37WZ_A1_0267-WVW-1	IP-MQB37WZ_A1_0267-WVW-1	✓		
83	IP-MQB37WZ_A1_0476-VSS-1	['IP-MQB37WZ_A1_0476-VSS-1', 'IP-MQB37WZ_A3_0476-WVW-1', 'IP-MQB37WZ_A2_0476-WAU-1', 'IP-MQB37WZ_A0_0476-TMB-1']	✓		
84	IP-MQB37WZ_A1_0512-VSS-1	IP-MQB37WZ_A1_0512-VSS-1	✓		
85	IP-MQB37WZ_A1_0583-WAU-1	IP-MQB37WZ_A1_0583-WAU-1	✓		
86	IP-MQB37WZ_A1_0901-TMB-1	IP-MQB37WZ_A1_0901-TMB-1		✓	
87	IP-MQB37WZ_A1_1018-WAU-1	IP-MQB37WZ_A1_1018-WAU-1	✓		
88	IP-MQB37WZ_A2_0440-WVW-1	IP-MQB37WZ_A2_0440-WVW-1	✓		
89	IP-MQB37WZ_A2_0512-WVW-1	IP-MQB37WZ_A2_0512-WVW-1	✓	✓	
90	IP-MQB37WZ_A2_0583-WVW-1	IP-MQB37WZ_A2_0583-WVW-1	✓		
91	IP-MQB37ZZ_A0_0258-WVW-1	IP-MQB37ZZ_A0_0258-WVW-1		✓	
92	IP-MQB37ZZ_A1_0258-TMB-1	IP-MQB37ZZ_A1_0258-TMB-1		✓	
93	IP-MQB37ZZ_A2_0258-VSS-1	IP-MQB37ZZ_A2_0258-VSS-1		✓	
94	IP-MQB48ZZ_B1_0843-WVW-1	IP-MQB48ZZ_B1_0843-WVW-1			✓
95	IP-P375_2021_00011-6FP-1	IP-P375_2021_00011-6FP-1	✓		
96	IP-P375_2021_00012-6FP-1	IP-P375_2021_00012-6FP-1	✓		
97	IP-P703_2022_00008-6FP-1	IP-P703_2022_00008-6FP-1		✓	

98	IP-V362_2021_00045-WF0-1	['IP-V362_2021_00047-WF0-1', 'IP-V362_2021_00046-WF0-1', 'IP-V362_2021_00045-WF0-1']	✓		
99	IP-V362_2021_00046-WF0-1	['IP-V362_2021_00047-WF0-1', 'IP-V362_2021_00046-WF0-1', 'IP-V362_2021_00045-WF0-1']	✓		
100	IP-V362_2021_00047-WF0-1	['IP-V362_2021_00047-WF0-1', 'IP-V362_2021_00046-WF0-1', 'IP-V362_2021_00045-WF0-1']	✓		
101	IP-V363_2021_00012-WF0-1	['IP-V363_2021_00013-WF0-1', 'IP-V363_2021_00016-WF0-1', 'IP-V363_2021_00012-WF0-1', 'IP-V363_2021_00014-WF0-1', 'IP-V363_2021_00015-WF0-1']	✓		
102	IP-V363_2021_00013-WF0-1	['IP-V363_2021_00013-WF0-1', 'IP-V363_2021_00016-WF0-1', 'IP-V363_2021_00012-WF0-1', 'IP-V363_2021_00014-WF0-1', 'IP-V363_2021_00015-WF0-1']	✓		
103	IP-V363_2021_00014-WF0-1	['IP-V363_2021_00013-WF0-1', 'IP-V363_2021_00016-WF0-1', 'IP-V363_2021_00012-WF0-1', 'IP-V363_2021_00014-WF0-1', 'IP-V363_2021_00015-WF0-1']	✓		
104	IP-V363_2021_00015-WF0-1	['IP-V363_2021_00013-WF0-1', 'IP-V363_2021_00016-WF0-1', 'IP-V363_2021_00012-WF0-1', 'IP-V363_2021_00014-WF0-1', 'IP-V363_2021_00015-WF0-1']	✓		
105	IP-V363_2021_00016-WF0-1	['IP-V363_2021_00013-WF0-1', 'IP-V363_2021_00016-WF0-1', 'IP-V363_2021_00012-WF0-1', 'IP-V363_2021_00014-WF0-1', 'IP-V363_2021_00015-WF0-1']	✓		
106	IP-V363_2021_00022-WF0-1	['IP-V363_2021_00022-WF0-1', 'IP-V363_2021_00023-WF0-1', 'IP-V363_2021_00024-WF0-1', 'IP-V363_2021_00025-WF0-1']	✓		
107	IP-V363_2021_00023-WF0-1	['IP-V363_2021_00022-WF0-1', 'IP-V363_2021_00023-WF0-1', 'IP-V363_2021_00024-WF0-1', 'IP-V363_2021_00025-WF0-1']	✓		
108	IP-V363_2021_00024-WF0-1	['IP-V363_2021_00022-WF0-1', 'IP-V363_2021_00023-WF0-1', 'IP-V363_2021_00024-WF0-1', 'IP-V363_2021_00025-WF0-1']	✓		
109	IP-V363_2021_00025-WF0-1	['IP-V363_2021_00022-WF0-1', 'IP-V363_2021_00023-WF0-1', 'IP-V363_2021_00024-WF0-1', 'IP-V363_2021_00025-WF0-1']	✓		
110	IP-V363_2021_00026-WF0-1	['IP-V363_2021_00026-WF0-1', 'IP-V363_2021_00030-WF0-1', 'IP-V363_2021_00027-WF0-1', 'IP-V363_2021_00029-WF0-1', 'IP-V363_2021_00028-WF0-1']	✓		
111	IP-V363_2021_00027-WF0-1	['IP-V363_2021_00026-WF0-1', 'IP-V363_2021_00030-WF0-1', 'IP-V363_2021_00027-WF0-1', 'IP-V363_2021_00029-WF0-1', 'IP-V363_2021_00028-WF0-1']	✓		
112	IP-V363_2021_00028-WF0-1	['IP-V363_2021_00026-WF0-1', 'IP-V363_2021_00030-WF0-1', 'IP-V363_2021_00027-WF0-1', 'IP-V363_2021_00029-WF0-1', 'IP-V363_2021_00028-WF0-1']	✓		
113	IP-V363_2021_00029-WF0-1	['IP-V363_2021_00026-WF0-1', 'IP-V363_2021_00030-WF0-1', 'IP-V363_2021_00027-WF0-1', 'IP-V363_2021_00029-WF0-1', 'IP-V363_2021_00028-WF0-1']	✓		
114	IP-V363_2021_00030-WF0-1	['IP-V363_2021_00026-WF0-1', 'IP-V363_2021_00030-WF0-1', 'IP-V363_2021_00027-WF0-1', 'IP-V363_2021_00029-WF0-1', 'IP-V363_2021_00028-WF0-1']	✓		
115	IP-V363_2021_00031-WF0-1	['IP-V363_2021_00034-WF0-1', 'IP-V363_2021_00031-WF0-1', 'IP-V363_2021_00033-WF0-1', 'IP-V363_2021_00032-WF0-1']	✓		
116	IP-V363_2021_00032-WF0-1	['IP-V363_2021_00034-WF0-1', 'IP-V363_2021_00031-WF0-1', 'IP-V363_2021_00033-WF0-1', 'IP-V363_2021_00032-WF0-1']	✓		
117	IP-V363_2021_00033-WF0-1	['IP-V363_2021_00034-WF0-1', 'IP-V363_2021_00031-WF0-1', 'IP-V363_2021_00033-WF0-1', 'IP-V363_2021_00032-WF0-1']	✓		

118	IP-V363_2021_00034-WF0-1	['IP-V363_2021_00034-WF0-1', 'IP-V363_2021_00031-WF0-1', 'IP-V363_2021_00033-WF0-1', 'IP-V363_2021_00032-WF0-1']	✓		
119	IP-V363_2021_00035-WF0-1	['IP-V363_2021_00035-WF0-1', 'IP-V363_2021_00063-WF0-1', 'IP-V363_2021_00062-WF0-1', 'IP-V363_2021_00036-WF0-1']	✓		
120	IP-V363_2021_00036-WF0-1	['IP-V363_2021_00035-WF0-1', 'IP-V363_2021_00063-WF0-1', 'IP-V363_2021_00062-WF0-1', 'IP-V363_2021_00036-WF0-1']	✓		
121	IP-V363_2021_00062-WF0-1	['IP-V363_2021_00035-WF0-1', 'IP-V363_2021_00063-WF0-1', 'IP-V363_2021_00062-WF0-1', 'IP-V363_2021_00036-WF0-1']	✓		
122	IP-V363_2021_00063-WF0-1	['IP-V363_2021_00035-WF0-1', 'IP-V363_2021_00063-WF0-1', 'IP-V363_2021_00062-WF0-1', 'IP-V363_2021_00036-WF0-1']	✓		
123	IP-VN41TZZ_A4_0474-WVN-1	IP-VN41TZZ_A4_0474-WVN-1	✓	✓	
124	IP-YHT____MB6_112B-VF3-0	IP-YHT____MB6_112B-VF3-0		✓	
125	IP-YHT____MB6_112B-VF7-0	IP-YHT____MB6_112B-VF7-0		✓	
126	IP-YHT____MB6_112E-VF7-0	IP-YHT____MB6_112E-VF7-0		✓	
127	IP-YHT____MB6_112F-VF7-0	IP-YHT____MB6_112F-VF7-0		✓	
128	IP-YHT____MB6_5123-VR3-0	IP-YHT____MB6_5123-VR3-0	✓	✓	
129	IP-YHY____BE__1118-VF7-0	IP-YHY____BE__1118-VF7-0		✓	
130	IP-YHY____MB6_1125-VR3-0	IP-YHY____MB6_1125-VR3-0	✓	✓	✓
131	IP-YHZ____ATN85145-VR3-0	IP-YHZ____ATN85145-VR3-0		✓	
132	IP-0000293-WBA-1				
133	IP-0000337-WBA-1				
134	IP-0003-JT1-1				
135	IP-0017-JT1-1				
136	IP-0018-JT1-1				
137	IP-0022-VF3-0				

138	IP-0022-VF7-0				
139	IP-0058-JT1-1				
140	IP-0061-JT1-1				
141	IP-0063-JT1-1				
142	IP-0069-JT1-1				
143	IP-0074-JT1-1				
144	IP-0076-JT1-1				
145	IP-0097-JT1-1				
146	IP-0098-JT1-1				
147	IP-0165-JT1-1				
148	IP-02_10_2020_2201-W1V-1				
149	IP-03_225_0287-ZFA-1				
150	IP-03_312_0208-ZFA-1				
151	IP-03_312_0273-ZFA-1				
152	IP-03_312_0282-ZFA-1				
153	IP-03_312_0290-ZFA-1				
154	IP-03_312_0300-ZFA-1				
155	IP-0401353-U5Y-1				
156	IP-0401363-U5Y-1				
157	IP-041202-U5Y-1				

158	IP-041226-U5Y-1				
159	IP-04-KNA-2018-1056				
160	IP-0500769-TMA-1				
161	IP-091893-U5Y-1				
162	IP-11-NLH-2018-0016				
163	IP-13_2019_521-JMZ-1				
164	IP-13_2019_526-JMZ-1				
165	IP-20_GR6_0023-JHM-1				
166	IP-2019_0401-W1K-1				
167	IP-2019_0409-W1K-1				
168	IP-2021_0416-W1K-1				
169	IP-2021_0421-W1K-1				
170	IP-2021_3410-W1K-1				
171	IP-20820D132MAA_01-SAL-1				
172	IP-4_1215-TSM-1				
173	IP-4_1227-JSA-1				
174	IP-4_1307-TSM-1				
175	IP-4HA____ML6_8223-VF7-0				
176	IP-82A3MNDPF6A_001-ZFA-0				
177	IP-AS23P_2020_01-LSJ-1				

178	IP-BX72_2019_00003-WF0-1				
179	IP-BX72_2020_00005-WF0-1				
180	IP-C482_2019_00007-WF0-1				
181	IP-C482_2020_00010-WF0-1				
182	IP-DGZ____EAT84552-VF3-0				
183	IP-DGZ____EAT84552-VR3-0				
184	IP-DGZ____EAT84552-W0V-0				
185	IP-DR_T39M_002-ZPY-1				
186	IP-EHZ____AMN87243-VF3-0				
187	IP-HNP____MB6_1424-VF3-0				
188	IP-J11B1DZP6TAY_00-JN1-1				
189	IP-J12B1DZP6DAY_00-JN1-1				
190	IP-JAA1AGDTL4A_000-VF1-1				
191	IP-JBA1MMP010A_000-VF1-1				
192	IP-JLA1MUP001A_000-VF1-1				
193	IP-MLB49ZZ_A0_4032-WAU-1				
194	IP-MQB27SZ_A0_1021-WVW-1				
195	IP-MQB37SZ_A1_1022-WVW-1				
196	IP-MQB37SZ_B1_1022-WVW-1				
197	IP-YHV____ML6_7124-VF3-0				

Source: JRC, 2023.

Annex 2. List of families with the second testing priority in the year 2024

NR	IP FAMILY	ISV FAMILY	TYPE OF TEST		
			CDM	RL	AS
1	IP-EHT____ML6_722G-VF3-0	['IP-EHT____ML6_722G-VF3-0', 'IP-EHT____ML6_722G-VF3']			
2	IP-EHZ____AMN8724G-YAR-0	['IP-EHZ____AMN8724G-YAR-0', 'IP-EHZ____AMN8724G-VF7', 'IP-EHZ____AMN8724G-VF7-0', 'IP-EHZ____AMN8724G-VF3-0']			
3	IP-DGX____EAT82556-VR3-0	['IP-DGX____EAT82556-VR3', 'IP-DGX____EAT82556-VR3-0']			
4	IP-4HA____ML6_822L-VF7-0	['IP-4HA____ML6_822L-VF7-0', 'IP-4HA____ML6_822L-VF3-0', 'IP-4HA____ML6_822L-ZAC-0']			
5	IP-0000865-WBA-1				
6	IP-FBD1A6DDW5B_000-VF1-1				
7	IP-5GB____EAT8455C-VF3-0	['IP-5GB____EAT8455C-VF3-0', 'IP-5GB____EAT8455C-VR3-0', 'IP-5GB____EAT8455C-W0V-0', 'IP-5GB____EAT8455C-VF3']			
8	IP-0000856-WBA-1	['IP-0000856_U-WBA', 'IP-0000856-WBA-1']			
9	IP-MQB37SZ_B1_1035-VSS-1	['IP-MQB37SZ_B2_1035-WAU-1', 'IP-MQB37SZ_B1_1035-VSS-1', 'IP-MQB37SZ_B3_1035-WVW-1', 'IP-MQB37SZ_B0_1035-TMB-1']			
10	IP-VN54TZZ_A3_0935-WVN-1				
11	IP-0000876-WBA-1	['IP-0000876-WBA-1', 'IP-0000876_U-WBA']			
12	IP-HNS____ATN82443-VR3-0				
13	IP-HMR____MA5_1316-VF7-0				
14	IP-FKB1MBPDW5B_000-VF1-0	['IP-FKB1MBPDW5B_000-W1V-0', 'IP-FKB1MBPDW5B_000-VF1-0']			
15	IP-62A3M0DPF6A_001-VF6-0	['IP-62A3M0DPF6A_001-VF1-0', 'IP-62A3M0DPF6A_001-VF6-0', 'IP-62A3M0DPF6A_001-VNV-0']			
16	IP-VN41TZZ_A3_0473-WVN-1				
17	IP-V363_2021_00039-WF0-1	['IP-V363_2021_00039-WF0-1', 'IP-V363_2021_00042-WF0-1', 'IP-V363_2021_00040-WF0-1', 'IP-V363_2021_00041-WF0-1']			
18	IP-MQB27ZZ_B0_0534-VSS-1	['IP-MQB27ZZ_B1_0534-WAU-1', 'IP-MQB27ZZ_B2_0534-WVW-1', 'IP-MQB27ZZ_B0_0534-VSS-1']			

19	IP-0401411-U5Y-1				
20	IP-MQB37SZ_A0_1009-TMB-1				
21	IP-MQB37WZ_A2_0579-WAU-1	['IP-MQB37WZ_A3_0579-WVW-1', 'IP-MQB37WZ_A1_0579-VSS-1', 'IP-MQB37WZ_A2_0579-WAU-1', 'IP-MQB37WZ_A0_0579-TMB-1']			
22	IP-MQB37WZ_A0_0585-WAU-1	['IP-MQB37WZ_A0_0585-WAU-1', 'IP-MQB37WZ_A1_0585-WVW-1']			
23	IP-MQB37WZ_A2_0476-WAU-1	['IP-MQB37WZ_A1_0476-VSS-1', 'IP-MQB37WZ_A0_0476-TMB-1', 'IP-MQB37WZ_A2_0476-WAU-1', 'IP-MQB37WZ_A3_0476-WVW-1']			
24	IP-MQB37WZ_A0_0916-WAU-1				
25	IP-V362_2021_00040-WF0-1	['IP-V362_2021_00041-WF0-1', 'IP-V362_2021_00059-WF0-1', 'IP-V362_2021_00040-WF0-1']			
26	IP-0000686-WBA-1				
27	IP-02_09_2021_3265-W1V-1				
28	IP-MQB37SZ_A2_1009-WAU-1	['IP-MQB37SZ_A2_1009-WAU-1', 'IP-MQB37SZ_A1_1009-VSS-1']			
29	IP-MQB37AS_B0_1024-WAU-1				
30	IP-0000799-WBA-1				
31	IP-13_2019_526-JMZ-1				
32	IP-9-WF0-2018-0025				
33	IP-J11A1TND6TNZ_00-JN1-1				
34	IP-FAA1NBPTL4A_000-VF1-1				
35	IP-2019_6418-WDB-1				
36	IP-AHK____AMN87244-VF7-0				
37	IP-HNP____MB6_2424-VF3-0				
38	IP-0010056-WBA-1				
39	IP-YHX____AT6_1132-VF7-0				

40	IP-2019_6441-WDB-1				
41	IP-C519_2020_00025-WF0-1				
42	IP-02-VF3-2017-3121				
43	IP-2017_1821-WDB-1				
44	IP-491180-ZKV-1				
45	IP-0004-ZHW-1				

Source: JRC, 2023.

Annex 3. List of families with the third testing priority in the year 2024

IP FAMILY	IP FAMILY	IP FAMILY	IP FAMILY	IP FAMILY	IP FAMILY	IP FAMILY
IP-J11A1DZP6TA7_00-JN1-1	IP-YHV____ML6_7124-YAR-0	IP-82A1MLDPF6A_000-ZFA-0	IP-MQB37WZ_A1_0247-VSS-1	IP-13_2017_014-JMZ-1	IP-041204-U5Y-1	IP-03_952_0278-ZAR-1
IP-JFD1MTGJT4C_000-UU1-0	IP-AHK____AMN87247-VF7-0	IP-02_05_2021_2305-W1V-1	IP-0080-JT1-1	IP-MLB58ZZ_C0_0630-WAU-1	IP-2018_1611-WDB-1	IP-V363_2018_00070-WF0-1
IP-FBA1A6DTL6A_000-VF1-1	IP-MQB27ZZ_A1_1005-VSS-1	IP-20820D177MAA_01-SAL-1	IP-62A3A1DZF4B_000-VF6-0	IP-13-WAU-2018-5053	IP-13_2017_021-JMZ-1	IP-0010324-WBA-1
IP-JDA1ADDTL8B_000-VF1-1	IP-82A3MNDPF6A_000-VNV-0	IP-E4JLPHEVSAH-1C4-1	IP-13_2019_523-JMZ-1	IP-491897-ZKV-1	IP-0010320-WBA-1	IP-03_AV1_0337-ZAR-1
IP-BX72_2021_00006-WF0-1	IP-2020_8425-W1K-1	IP-2018_6408-WDB-1	IP-13_2018_037-JMZ-1	IP-DR_T35M_002-ZPY-1	IP-EHZ____AMN83240-VR3-0	IP-13_2019_522-JM4-1
IP-K14A1RTP6TAF_00-JN1-1	IP-FBA1A2DTL6A_000-VF1-1	IP-2018_6406-WDB-1	IP-2019_6438-WDB-1	IP-FAA1NCPTL4A_000-VF1-1	IP-0016-WAP-1	IP-02-VF3-2018-7124
IP-JDA1ADDTL4B_000-VF1-1	IP-MQB37WZ_A0_0247-WAU-1	IP-03_BU_0306-1C4-1	IP-61A1A7DTL4A_000-W1V-0	IP-AHKAMN87244-YAR-0	IP-0010295-WBA-1	IP-2021_6434-W1K-1
IP-MQB37WZ_A2_0247-WVW-1	IP-13_2018_025-JMZ-1	IP-03_356_0301-ZFA-1	IP-9-WF0-2018-0014	IP-0016-JF1-1	IP-1-WP0-2018-0016	IP-CANTER_2020_05-TYB-0
IP-4_1308-TSM-1	IP-FBA1A6DDW5B_000-VF1-1	IP-BX72_2021_00008-WF0-1	IP-0000724-WBA-1	IP-FAA1N9PTL4A_000-VF1-1	IP-0000775-WBA-1	IP-03_250_0337M-ZFA-1
IP-0000174-WBA-1	IP-0010358-WBS-1	IP-02_10_2020_2304-W1V-1	IP-13-WAU-2017-0002	IP-FFA1A6DTL6A_000-VF1-1	IP-13-WAU-2018-5062	IP-13_2019_524-JM4-1
IP-4_1216-TSM-1	IP-2021_0422-W1K-1	IP-MLB42AS_A0_0607-WAU-1	IP-YHZ____ML6_612D-W0V-0	IP-04-KMH-2018-0924	IP-6-JHM-2018-0029	IP-14R-SBM-1

IP-MQB27ZZ_A0_1019-TMB-1	IP-0150-JT1-1	IP-0010257-WBA-1	IP-VN54TZZ_A2_0830-WVN-1	IP-MQB48ZZ_A2_0167-WVW-1	IP-2019_6431-WDB-1	IP-2021_536K7F-YV1-1
IP-091894-U5Y-1	IP-02_01_2021_2203-W1V-1	IP-J12A1DZP6DAY_00-JN1-1	IP-2019_1419-WDB-1	IP-MLB53AS_B0_0624-WAU-1	IP-02-W0V-2018-3440	IP-YHZ____ML6_612D-YAR-0
IP-FEA1A6DDW5A_000-VF1-1	IP-13-WAU-2018-5038	IP-61A2A7DTL4A_000-W1V-0	IP-EHZ____AMN8724C-VF7-0	IP-FKB1AADTL4A_000-VF1-0	IP-13_2019_516-JMZ-1	IP-E3_2021_0001-ZN6-1
IP-4_1229-JSA-1	IP-9-WF0-2018-0032	IP-0012-JT1-1	IP-0010402-WBA-1	IP-13-WAU-2018-5041	IP-13_2018_0504-JMZ-1	IP-0159-JT1-1
IP-4_1228-JSA-1	IP-9-WF0-2018-0004	IP-MQB48ZZ_B1_2181-WVW-1	IP-13-WAU-2018-4063	IP-0010232-WBA-1	IP-06-JT1-2017-0020	IP-11-VF7-2018-0000
IP-091907-U5Y-1	IP-02-W0V-2018-6119	IP-EHZ____AMN8724C-VF3-0	IP-EHT____ML6_722A-VF7-0	IP-1-WP1-2018-0006	IP-2020_6416-W1K-1	IP-FKB1ACDTL6A_000-W1V-0
IP-MQB27ZZ_A1_0178-WVW-1	IP-FAA1A8DDW6A_000-VF1-1	IP-YHV____ML6_7128-YAR-0	IP-BX72_2021_00001-WF0-1	IP-2020_6440-W1K-1	IP-0010160-WBA-1	IP-DR_S2M_001-ZPY-1
IP-JBA1MUP001A_000-VF1-1	IP-B460_2021_00001-WF0-1	IP-PQMIXZZ_A0_0124-WVW-1	IP-05-WF0-2018-0008	IP-20U30D258MAA_01-SAL-1	IP-EHZ____AMN83240-VF3-0	IP-2021_6416-W1K-1
IP-0000121-WBA-1	IP-0000774-WBA-1	IP-13-WAU-2018-5010	IP-F16A1RNP6DAL_01-JN1-1	IP-0010322-WBA-1	IP-06-JT1-2018-0049	IP-0010265-WBA-1
IP-0000034-WBA-1	IP-03_334_0303-ZFA-1	IP-AHX____ML6_7222-VF7-0	IP-2020_2603-W1K-1	IP-02-ZFA-2018-0001	IP-YHR____ML6_7125-VF7-0	IP-B479_2020_00006-WF0-1
IP-YHZ____ATN82141-VF3-0	IP-0000245-WBA-1	IP-FKB2AADTL4A_000-W1V-0	IP-V362_2019_00001-WF0-1	IP-1-WP1-2018-0004	IP-01-JMB-2018-0011	IP-0048-JT1-1
IP-BX72_2020_00003-WF0-1	IP-62A3A1DPF6A_000-VF1-0	IP-2021_0419-W1K-1	IP-BX72_2020_00007-WF0-1	IP-82A1MNDPF6A_000-VNV-0	IP-2018_6403-WDB-1	IP-2021_1409-W1K-1
IP-4_1301-TSM-1	IP-2019_6402-WDB-1	IP-FKB1ABDTL4A_000-W1V-0	IP-2019_6805-WDB-1	IP-20U30D183MAA_01-SAL-1	IP-NP6_013-ZAP-1	IP-2019_2603-WDB-1
IP-MQB37AS_B2_2118-WVW-1	IP-02_05_2021_2304-W1V-1	IP-1-WP0-2018-0011	IP-AP992002G3TAT00-WP0-1	IP-EHT____ML6_722A-YAR-0	IP-VN34SZZ_A3_0109-WVN-1	IP-CANTER_2020_01-TYB-0
IP-BX72_2021_00007-WF0-1	IP-MQB37ZZ_A1_0165-WVW-1	IP-0000295-WBA-1	IP-2019_1416-WDB-1	IP-03_250_0316M-ZFA-1	IP-2018_2602-WDB-1	IP-2019_6425-WDB-1
IP-4_1300-TSM-1	IP-2019_1431-WDB-1	IP-0014-JT1-1	IP-0500825-TMA-1	IP-67A2NBPJR5A_000-UU1-1	IP-03-ZFF-2018-0001	IP-02-W0V-2018-6420
IP-MQB37AS_A2_0118-WVW-1	IP-13-WAU-2017-0001	IP-2019_6802-WDB-1	IP-13_2018_0505-JMZ-1	IP-11-JT1-2018-0041	IP-2020_1803-WMX-1	IP-02-VR3-2018-5440
IP-091889-U5Y-1	IP-2020_6434-W1K-1	IP-0000753-WBA-1	IP-MQB48ZZ_A1_0167-WVW-1	IP-0044-JT1-1	IP-MQB37WZ_A1_0806-VSS-1	IP-VN46TZZ_B1_2210-WVN-1

IP-B479_2021_00004-WF0-1	IP-03_250_0302M-ZFA-1	IP-01-JMB-2018-0012	IP-02-VR3-2017-3141	IP-AHX____ML6_7223-YAR-0	IP-VN54TZZ_A1_0812-WVN-1	IP-0010336-WBA-1
IP-091897-U5Y-1	IP-091900-U5Y-1	IP-MLB49_Z_A0_0722-WAU-1	IP-03_MP_0327-ZFA-1	IP-0010269-WBA-1	IP-VN46T1Z_A1_0516-WVN-1	IP-04-JSA-2018-1047
IP-20820D110MAA_01-SAL-1	IP-J12A1DZP6DNW_00-JN1-1	IP-03_263_0285B-ZFA-1	IP-AP992002G30AT00-WP0-1	IP-2019_6406-WDB-1	IP-13_2017_013-JMZ-1	IP-0000031-WBS-1
IP-JAA1ADDTL4A_000-VF1-1	IP-PQMIXZZ_A0_0106-WVW-1	IP-23_FL4_0044-JHM-1	IP-491898-ZKV-1	IP-MLB58ZZ_A0_4058-WAU-1	IP-02-W0V-2017-1431	IP-0500782-NLH-1
IP-MQB37ZZ_A0_0115-WVW-1	IP-0500791-NLH-1	IP-MLB58ZZ_A0_4083-WAU-1	IP-2018_1606-WDB-1	IP-FBA1M8PDW6A_000-VF1-1	IP-0000700-WBA-1	IP-2020_6461-W1K-1
IP-YHY____BE__1118-VF3-0	IP-2021_6427-W1K-1	IP-13-WAU-2018-5036	IP-1009-ZCF-1	IP-MLB53AS_C0_0626-WAU-1	IP-1-WP1-2018-0001	IP-0010356-WBA-1
IP-4_1217-TSM-1	IP-VN46T1Z_A1_0504-WVN-1	IP-MQB37ZZ_B0_2097-WVW-1	IP-5-WF0-2018-0007	IP-2020_6620-W1K-1	IP-2018_2622-WDB-1	IP-09-VSS-2018-2159
IP-0079-JT1-1	IP-MLB58ZZ_B0_0632-WUA-1	IP-02_05_2019_2203-WDF-1	IP-F142CDE-ZFF-1	IP-13-WAU-2018-5057	IP-11-TMA-2018-0012	IP-02-W0V-2018-3540
IP-0000292-WBA-1	IP-0000226-WBA-1	IP-MQB48ZZ_A2_0181-WVW-1	IP-5GG____ATN84544-VR3-0	IP-BX72_2021_00003-WF0-1	IP-0000711-WBA-1	IP-VN46TZZ_B1_2209-WVN-1
IP-0015-JF1-1	IP-C519_2020_00023-WF0-1	IP-02-VR3-2018-6117	IP-2019_1412-WDB-1	IP-4HC____ML6_822B-VF7-0	IP-1071-ZCF-1	IP-0003-SCF-1
IP-0005-JT1-1	IP-2019_2621-WDB-1	IP-2021_536K8F-YV1-1	IP-EHY____AMN84242-VR3-0	IP-0010299-WBA-1	IP-2021_8401-W1K-1	IP-E3_2021_0297-ZN6-1
IP-MQB27ZZ_A2_1005-WVW-1	IP-JDA1MFPTL4A_000-VF1-1	IP-0060-JT1-1	IP-VN34SZZ_A5_0106-WVN-1	IP-F152GPF-ZFF-1	IP-YHZ____ATN86142-W0V-0	IP-0010409-WBA-1
IP-MQB27SZ_B0_1021-WVW-1	IP-MQB27SZ_A0_0232-WVW-1	IP-2021_1405-W1K-1	IP-13_2018_0501-JMZ-1	IP-82A1MVDDW6A_000-VF1-0	IP-9-WF0-2018-0034	IP-FFA1A2DTL6A_000-VF1-1
IP-041203-U5Y-1	IP-BX72_2020_00004-WF0-1	IP-2021_536K8M-YV1-1	IP-HNS____MB6_2425-VF3-0	IP-0401331-KMH-1	IP-0010398-WBA-1	IP-03_250_0322M-ZFA-1
IP-0000289-WBA-1	IP-04-JSA-2018-0876	IP-13_2021_003-JMZ-1	IP-V363_2021_00004-WF0-1	IP-11-TMA-2018-0011	IP-4_1211-JSA-1	IP-VN46TZZ_A1_1203-WVN-1
IP-J12A1DZP6DAW_00-JN1-1	IP-5-WF0-2018-0003	IP-2019_6401-WDB-1	IP-MQB37AS_A0_0823-TMB-1	IP-13-SJA-2018-0000	IP-09-VSS-2018-0097	IP-13_2019_514-JMZ-1
IP-C519_2020_00024-WF0-1	IP-0000162-WBA-1	IP-0500793-U5Y-1	IP-03_330_0162-ZFA-1	IP-1040-ZCF-1	IP-0000196-WBA-1	IP-YHX____AT6_1133-VF3-0
IP-2018_2402-WDB-1	IP-02-VR3-2018-6171	IP-01-JMB-2018-0016	IP-0039-JT1-1	IP-VN46TZZ_A1_1210-WVN-1	IP-13_2018_002-JMZ-1	IP-2021_6622-W1K-1
IP-YHR____ML6_7122-VF7-0	IP-0035-JT1-1	IP-FKB2ACDTL6A_000-VF1-0	IP-13_2019_508-JM4-1	IP-2019_6429-WDB-1	IP-0082-JT1-1	IP-13_2017_012-JMZ-1

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IP-0167-JT1-1	IP-0000312-WBA-1	IP-0000751-WBA-1	IP-4HB_____ML6_822F-VF3-0	IP-03_AV1_0316-ZAR-1	IP-13_2019_505-JMZ-1	IP-2019_6422-WDB-1
IP-091898-U5Y-1	IP-1-WP1-2018-0000	IP-2020_6442-W1K-1	IP-82A3MNDPF6A_001-VNV-0	IP-FKB1ACDTL6A_000-VF1-0	IP-9-WF0-2018-0028	IP-MQB37AS_A1_0132-WVW-1
IP-2019_246K5C-YV1-1	IP-0043-JT1-1	IP-MLB53AZ_B0_5046-WVW-1	IP-YHZ_____ATN83141-VR3-0	IP-2019_1401-WDB-1	IP-MQB37AS_A2_0180-WVW-1	IP-3S_2021_W12_01-SCB-1
IP-MQB27ZZ_A3_0534-TMB-1	IP-0055-JT1-1	IP-C519_2020_00027-WF0-1	IP-VN46T1Z_A1_0513-WVN-1	IP-6-JHM-2018-0027	IP-2020_1825-WMX-1	IP-04-KMH-2018-0016
IP-MQB37ZZ_A0_0097-WVW-1	IP-13_2018_046-JMZ-1	IP-MQB37WZ_A0_0899-VSS-1	IP-2019_1602-WDB-1	IP-9-WF0-2018-0021	IP-62A3A1DZF4A_000-VF6-0	IP-MQB37WZ_B0_1008-WVW-1
IP-MQB27ZZ_A0_1005-TMB-1	IP-5GF_____ATN83540-VF3-0	IP-1-WDF-2018-4001	IP-20U30D221MAA_01-SAL-1	IP-49T35M_001-ZPY-1	IP-6-JHM-2018-0014	IP-02-VF1-2018-0038
IP-0500785-NLH-1	IP-VN54TZZ_A1_0815-WVN-1	IP-ZS11_2020_01-LSJ-1	IP-0000767-WBA-1	IP-VN46TZZ_A3_1206-WVN-1	IP-SMG180_EDP_M1N1-WAK-1	IP-13_2018_004-JMZ-1
IP-BX72_2019_00004-WF0-1	IP-FBA1A6DDW5B_001-VF1-1	IP-18_FK7_0017-JHM-1	IP-62A3A1DPF6A_000-VF6-0	IP-22H30P294PAA_01-SAL-1	IP-MQB37AS_A2_0132-VSS-1	IP-21815P221PAA_01-SAL-1
IP-0000021-WBA-1	IP-2021_0417-W1K-1	IP-KUV100-MA1-1	IP-F152BDE-ZFF-1	IP-6-JHM-2018-0012	IP-0010025-WBA-1	IP-13_2019_514-JM4-1
IP-091899-U5Y-1	IP-13-WAU-2018-4057	IP-AHX_____ML6_7220-VF7-0	IP-MQB37AS_B1_2164-WVW-1	IP-2018_6404-WDB-1	IP-02-VR3-2018-6119	IP-13_2019_0519-JM4-1
IP-BX72_2021_00005-WF0-1	IP-03_263_0285C-ZFA-1	IP-FEA1NCPTL4A_000-VF1-1	IP-2021_8403-W1K-1	IP-04-TMA-2018-0001	IP-1067-ZCF-1	IP-2017_1834-WDB-1
IP-C482_2021_00004-WF0-1	IP-MQB37WZ_A0_0860-VSS-1	IP-03_MP_0307-ZFA-1	IP-13_2017_027-JMZ-1	IP-3S_2020_V8_03-SCB-0	IP-3S_2019_V8_01-SCB-1	IP-02-UU1-2017-0003
IP-MQB27ZZ_A3_0530-TMB-1	IP-MLB58ZZ_B0_5058-WAU-1	IP-2018_2432-WDB-1	IP-9-WF0-2018-0027	IP-13_2017_026-JMZ-1	IP-MQB37WZ_B1_0390-VSS-1	IP-04-KMH-2018-0001
IP-HNS_____MB6_3420-VR3-0	IP-MQB48ZZ_B2_2181-WVW-1	IP-4900722-ZKV-1	IP-EHY_____AMN83241-VF7-0	IP-11-TMA-2018-0038	IP-491179-ZKV-1	IP-VN54TZZ_A1_0817-WVN-1
IP-MQB37AS_B3_2148-WVW-1	IP-FAA1A7DDW6A_001-VF1-1	IP-52C1JLDJR5A_000-UU1-1	IP-V362_2021_00033-WF0-1	IP-FBA1NCPTL4A_000-VF1-1	IP-0005-SCF-1	IP-2021_536K9C-YV1-1
IP-11-TMA-2018-0034	IP-13-WAU-2018-4061	IP-03_356_0305-ZFA-1	IP-FKB2ABDTL4A_000-VF1-0	IP-F164BCB-ZFF-1	IP-B479_2020_00005-WF0-1	IP-11-1FA-2017-0001

IP-AHK____ML6_7226-VF7-0	IP-5-WF0-2018-0002	IP-0931078-KMH-1	IP-02_05_2019_2303-WDF-1	IP-P375_2021_00005-6FP-1	IP-2021_6436-W1K-1	IP-2021_0605-W1K-1
IP-MQB37WZ_B0_0247-WAU-1	IP-EHZAMN87241-YAR-0	IP-MLB53AS_B0_0628-WUA-1	IP-2019_6405-WDB-1	IP-2019_6421-WDB-1	IP-02-VF7-2017-1310	IP-2019_1807-WDB-1
IP-YHV____ML6_7124-VF7-0	IP-5GF____ATN83540-W0V-0	IP-AHX____ML6_7223-VF7-0	IP-0081-JT1-1	IP-2019_6413-WDB-1	IP-2019_6412-WDB-1	IP-0401312-KMT-1
IP-19_RT6_0010-JHM-1	IP-11-TMA-2018-0001	IP-0000030-WBS-1	IP-08_ZAV_0089_01-W0V-1	IP-EHZ____AMN84241-VR3-0	IP-2017_1836-WDB-1	IP-87A1JSPTL4A_000-VF1-1
IP-0500781-NLH-1	IP-4HA____ML6_822G-VF7-0	IP-0010362-WBS-1	IP-4HC____ML6_822B-VF3-0	IP-DR_T39M_001-ZPY-1	IP-HMR____MA5_1310-VF3-0	IP-0014-ZHW-1
IP-U625_2019_00001-WF0-1	IP-MQB27ZZ_B1_0531-WVW-1	IP-0152-JT1-1	IP-E3_2019_0006-ZAR-1	IP-MQB37WZ_A2_0425-WVW-1	IP-49T7A_001-ZPY-1	IP-2018_0403-WDB-1
IP-MQB37WZ_B1_0247-VSS-1	IP-MQB37ZZ_A2_0189-VSS-1	IP-62A3A1DZF4A_000-VF1-0	IP-49T35C_001-ZPY-1	IP-2021_0405-W1K-1	IP-MLB58ZZ_A0_0632-WUA-1	IP-CX001-202-1
IP-MQB37SZ_A2_0171-VSS-1	IP-JDA1ADDTL4A_000-VF1-1	IP-VN34SZZ_A3_1101-WVN-1	IP-13_2017_022-JMZ-1	IP-MLB58ZZ_B0_0631-WAU-1	IP-0000328-WBA-1	IP-V363_2021_00049-WF0-1
IP-MQB37AS_A1_1024-WVW-1	IP-MQB37SZ_A2_0098-VSS-1	IP-YHX____AT6_1133-VF7-0	IP-DGX____EAT82550-VR3-0	IP-MLB53AS_A0_0623-WAU-1	IP-MLB65ZZ_A0_0633-WAU-1	IP-11-1FA-2017-0004
IP-C482_2019_00002-WF0-1	IP-13_2019_524-JMZ-1	IP-NP6_003-ZAP-1	IP-XKY6DA2I6-KPT-1	IP-FFB1MDPJT4A_000-VF1-1	IP-JDA1AFDTL4A_000-VF1-1	IP-2021_6432-W1K-1
IP-02-VR3-2018-6118	IP-MQB37AS_B2_2159-WVW-1	IP-18_FK7_0018-JHM-1	IP-MLB53AS_B0_0626-WAU-1	IP-DR_T8_001-ZPY-1	IP-82A3MWDPF6A_000-VF1-0	IP-2018_1607-WDB-1
IP-03_312_0326-ZFA-1	IP-B479_2022_00001-WF0-1	IP-MQB37ZZ_A1_0168-WVW-1	IP-2017_1402-WDB-1	IP-MLB53AZ_A0_4045-WVW-1	IP-03_250_0322AM-ZFA-1	IP-13_2018_007-JMZ-1
IP-0059-JT1-1	IP-13_2018_0502-JMZ-1	IP-2018_2407-WDB-1	IP-MQB37WZ_A1_0390-VSS-1	IP-0024-JF1-0	IP-MQB37SZ_A2_0197-VSS-1	IP-0003-ZHW-1
IP-03_250_0301M-ZFA-1	IP-MQB37SZ_A2_0130-VSS-1	IP-2019_6409-WDB-1	IP-0000736-WBA-1	IP-MQB37AS_B2_2132-VSS-1	IP-2017_1609-WDB-1	IP-62A3A1DZF4B_000-VNV-0
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IP-0166-JT1-1	IP-02_05_2019_2208-WDF-1	IP-K14A1RNP6TAY_00-JN1-1	IP-03_250_0305M-ZFA-1	IP-13_2019_504-JMZ-1	IP-2020_1813-W1K-1	IP-2020_6415-W1K-1
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IP-0001-JT1-1	IP-V362_2018_00062-WF0-1	IP-JDA1ADDTL8A_000-VF1-1	IP-03_250_0306AM-ZFA-1	IP-11-NLH-2018-0018	IP-13_2018_008-JMZ-1	IP-04-TMA-2018-0002
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IP-BX72_2020_00009-WF0-1	IP-AHK____ML6_7226-YAR-0	IP-V408_2020_00017-WF0-1	IP-0500794-U5Y-1	IP-EHZ____AMN87242-VF7-0	IP-VN54TZZ_A1_0803-WVN-1	IP-2021_6621-W1K-1
IP-2019_3401-WDB-1	IP-2019_246K2C-YV1-1	IP-MQB37ZZ_A3_0137-WVW-1	IP-2018_1803-WDB-1	IP-2021_6433-W1K-1	IP-0010333-WBA-1	IP-0401330-KMH-1
IP-0014-JF1-1	IP-03_334_0308-ZFA-1	IP-0000701-WBA-1	IP-FCA1AMDDW6A_000-VF1-1	IP-13_2019_512-JMZ-1	IP-82A1MVDDW6A_000-VNV-0	IP-04-KMH-2018-1040
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IP-2021_0423-W1K-1	IP-YHX____AT6_1132-W0V-0	IP-13_2021_001-JMZ-1	IP-11-TMA-2018-0002	IP-1042-ZCF-1	IP-0010325-WBA-1	IP-09-VSS-2018-0030
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IP-2020_6436-W1K-1	IP-041201-U5Y-1	IP-2020_246BFD-LYV-1	IP-MQB48ZZ_A1_0181-WVW-1	IP-04-U5Y-2018-0009	IP-03_263_0286-ZFA-1	IP-02-W0V-2018-6113
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IP-2020_8410-W1K-1	IP-0000708-WBA-1	IP-091892-U5Y-1	IP-MQB37WZ_A0_1008-WVW-1	IP-62A1A1DPF6A_000-VF1-0	IP-09-SAL-2018-0026	IP-23U30D147MAA_02-SAL-1
IP-2019_256K2C-YV1-1	IP-5GF____ATN83540-VR3-0	IP-62A3A2DZF4B_000-VF6-0	IP-13-WAU-2018-5063	IP-1-WP0-2018-0003	IP-0021-WAP-1	IP-0010390-WBA-1
IP-11-TMA-2018-0019	IP-EHT____ML6_722C-VF3-0	IP-050605-ZKV-1	IP-0000771-WBA-1	IP-04-KMH-2018-0002	IP-13_2019_509-JM4-1	IP-1106-ZCF-1
IP-2020_6439-W1K-1	IP-13-WAU-2018-4009	IP-0000296-WBA-1	IP-03_250_0303M-ZFA-1	IP-02-W0V-2018-1423	IP-3S_2021_W12_00-SCB-1	IP-2020_6410-W1K-1
IP-0401354-U5Y-1	IP-MQB37ZZ_A2_0172-WVW-1	IP-0010410-WBA-1	IP-2018_2628-WDB-1	IP-2020_6460-W1K-1	IP-13_2018_0504-JM4-1	IP-C482_2022_00001-WF0-1

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IP-0155-JT1-1	IP-2019_1218-WDB-1	IP-61A2A5DTL4A_000-W1V-0	IP-9-WF0-2018-0011	IP-2019_6439-WDB-1	IP-2021_536K9D-YV1-1	IP-YHZ____AT6_3130-VR3-0
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IP-YHZ____ATN8214A-VR3-0	IP-03_263_218_77-ZFA-1	IP-MQB37AS_B0_2183-WVW-1	IP-11-TMA-2018-0008	IP-61A1A6DTL4A_000-W1V-0	IP-2020_6614-W1K-1	IP-23U30D183MAA_04-SAL-1
IP-03_330_0276-ZFA-1	IP-FCA1ALDDW6A_000-VF1-1	IP-08_BAV_0077_01-W0V-1	IP-B479_2020_00007-WF0-1	IP-01-MMC-2018-0018	IP-E3_2021_0004-ZN6-1	IP-03_250_0325M-ZFA-1
IP-2018_2433-WDB-1	IP-5GF____ATN8454C-VR3-0	IP-FBC1MDPJT4A_000-VF1-1	IP-VN54TZZ_A2_0827-WVN-1	IP-2019_6414-WDB-1	IP-13_2017_017-JMZ-1	IP-0010186-WBA-1
IP-AHK____ML6_7227-YAR-0	IP-03_MP_0298-ZFA-1	IP-PQMIXZZ_A0_0135-WVW-1	IP-1084-ZCF-1	IP-2017_2446-WDB-1	IP-00000015-LSH-1	IP-13_2018_003-JMZ-1
IP-YHZ____ML6_212D-VR3-0	IP-MLB53AS_B0_0609-WAU-1	IP-C519_2020_00026-WF0-1	IP-2021_6429-W1K-1	IP-2018_1613-WDB-1	IP-0000743-WBA-1	IP-0010287-WBA-1

IP-2021_3409-W1K-1	IP-1-WP1-2018-0002	IP-87A1NEPTL4A_000-VF1-1	IP-MQB37AZ_A0_0117-WVW-1	IP-20U30D221MAA_02-SAL-1	IP-HNS____MB6_4420-VR3-0	IP-VN46T1Z_B1_0504-WVN-1
IP-J11A1DZP6TAY_00-JN1-1	IP-0041-JT1-1	IP-87A1JSPDC4A_000-VF1-1	IP-13_2018_006-JMZ-1	IP-BX72_2020_00008-WF0-1	IP-0010224-WBA-1	IP-11-JT1-2017-0013
IP-MLB53AS_B0_0623-WAU-1	IP-5-WF0-2018-0006	IP-0010329-WBA-1	IP-AP9YA004G00AT00-WP1-1	IP-4_1153-JSA-1	IP-2019_1403-WDB-1	IP-2021_1201-W1K-1
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IP-MQB37SZ_A2_0179-VSS-1	IP-2021_1403-W1K-1	IP-MLB53AS_B0_0627-WAU-1	IP-0010297-WBA-1	IP-E3_2019_0001-ZN6-1	IP-PQMIXZZ_A0_0136-WVW-1	IP-0010326-WBA-1
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IP-13-WAU-2018-4040	IP-V363_2018_00012-WF0-1	IP-YHZ____ATN86142-VR3-0	IP-050049-ZKV-1	IP-49-ZKV-2018-0002	IP-6-JHM-2018-0013	IP-0010351-SCA-1
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IP-P375_2021_00003-6FP-1	IP-2021_1410-W1K-1	IP-MLB53AZ_A0_4046-WVW-1	IP-03_952_0261-ZAR-1	IP-MLB58ZZ_B0_5085-WAU-1	IP-2019_2601-WDB-1	IP-YHRML67125-YAR-0
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Information about the European Union in all the official languages of the EU is available on the Europa website (european-union.europa.eu).

EU publications

You can view or order EU publications at op.europa.eu/en/publications. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (european-union.europa.eu/contact-eu/meet-us_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

Open data from the EU

The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets

Science for policy

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