**Word Supplemental File Systematic Evidence Map for 150+ Per- and Polyfluoroalkyl Substances (PFAS)**

DeDuper

DeDuper is a tool developed by ICF, freely available to clients by request, that incorporates machine learning to identify and reconcile duplicate references in multiple database search results. The DeDuper tool uses a two-phase approach to identify duplicates: 1) locates duplicates using automated logic, and 2) employs machine learning to predict likely duplicates which are then verified manually.

ICF automated the deduplication process by applying a novel pipeline of deduplication algorithms. Deduplication is performed in two phases and can be evaluated for precision (proportion of true positives within all records predicted to be duplicates) and recall (i.e., sensitivity, the proportion of true positives within all records that were actual duplicates). Phase 1 prioritizes precision, by defining a set of exact match rules that operate on a limited set of fields in standard bibliographic citation files (lower-case title, publication year, first author, and starting page). The second phase of the pipeline uses machine learning to flag predicted matches as duplicates for removal and entity resolution on Research Information Systems (RIS) files; this phase is designed to maximize recall by applying algorithms to more comprehensively detect the remaining duplicates. The algorithms (i) intelligently limit the number of record comparisons to ensure speedy performances, and (ii) apply machine learning and fuzzy comparisons to learn and apply user tolerance for differences in select fields that are not exact matches (e.g., title, author names, and publication year).

This tool utilizes the Python Dedupe package to compare references field by field to identify pairs that have the highest likelihood of being a duplicate record. During training, the program:

* Groups records based on editing distance across specific fields (i.e., affine gap distance).
* Proposes grouped records as duplicates to the user for verification and changes the relative weights of various features of each entry based on the user’s response.
* Identifies the probability of duplication based on the distance between each record cluster after sufficient testing and allows for a more conservative or a more aggressive deduplication process based on threshold probabilities.

For rapid processing, ICF created a large training dataset from deduplication efforts on previous projects that save the user the need for training the model for each new run.

The algorithms underlying DeDuper - and its application in a case study involving a literature search related to diisononyl phthalate (DINP) - were presented at the 2019 Society of Toxicology (SOT) meeting (Magnuson, 2019}. In this case study, ICF applied DeDuper to a set of 30,000 references in which duplicates had been previously identified manually. Phase 1 achieved a precision of 100%, although recall was limited at 76%. Phase 2 achieved a recall of 99% with a 48% precision. After accounting for manual review to remove false positives from the machine-identified duplicates pile, the combined pipeline realized an 82% efficiency gain. ICF normalized these results based on maximum possible efficiency gains (which depends on the proportion of duplicate groups in the original dataset) to estimate a specificity of 85%.

Distiller Literature Inventory SOP for PFAS 150 (abbreviated)

**Part 1: Data Extraction**

**Step 1: View list of studies.** To view the list of studies, go to Review -> Level 3 -> Health Literature Inventory Extraction form. Alternatively, you can access the list from the assessment home page. Under Level 3, click on “Unreviewed” to access the list of studies that have not been extracted yet.



**Step 2: Select a study for extraction.**  Select a study by clicking on it, and a new tab will open.



Once the new tab opens, search the RefID at <https://heronet.epa.gov/heronet/index.cfm/search> and download the PDF.

**Step 3: Data extraction – Part 1**

**Step 3a: Enter Author information.** Use the format specified in the Distiller form.



**Step 3b: Select all supplemental tags that apply**

**Step 3c: Select other PFAS chemicals that were evaluated but not included in our screening**

**Step 3d: Select “No” for the QC question if you are doing the primary extraction**

Select “No” to indicate that you are doing the initial data extraction. *If you find during your review that the study does not meet PECO criteria, it should not be extracted. Select “study is not PECO-relevant: update full-text screening tags” to indicate that the study needs to be retagged at the full text review level.*

**Step 4: Data extraction – Part 2**

**Step 4a: Add a subform**

To begin extracting data, click on ‘Add’ and a subform will appear. You are now ready to enter information into the form.



**Step 4b: Enter evidence type.** This is a dropdown menu – human, animal, or PBPK



Note: For this project, select “human (abbreviated extraction)” for human.

**Step 4c: Select chemical form.** This is a dropdown menu of the preferred names of each chemical.

Refer to the [**Master List**](https://teams.microsoft.com/l/file/FF30C05A-5D22-42F6-9CB1-01D57B03FFF9?tenantId=cf90b97b-be46-4a00-9700-81ce4ff1b7f6&fileType=xlsx&objectUrl=https%3A%2F%2Ficfonline.sharepoint.com%2Fteams%2FNCEATO-15IRISsupport%2FShared%20Documents%2FTD-015%20(PFAS%20150)%2FPFAS%20Master%20List.xlsx&baseUrl=https%3A%2F%2Ficfonline.sharepoint.com%2Fteams%2FNCEATO-15IRISsupport&serviceName=teams&threadId=19:fd99c08fbd60496da12ca65f51b61cb1@thread.skype&groupId=b39678e7-873d-4c28-96f7-0baf9c8654bb) in Teams for their synonyms.

 

**The next questions about study design will differ depending on whether the study is in humans or animals.**

**Human studies (abbreviated form):**

**Step 4d (Human): Enter sex, population, and study design.** Select sex, population, and study design from dropdown menus. **Please refer to Appendix 1 for guidance in selectng the study design.**



**Step 4e (Human): Exposure measurement.** Enter information on the exposure measurement as prompted in the Distiller form.



**Step 4f (Human): Select health outcome.** See **Appendix 2** for what kind of endpoints are grouped under which health outcomes. Please create a separate form for each outcome. See Step 6 on how to clone a form.



**Animal studies (abbreviated):**

**Step 4d (Animal): Enter study design.** This is a drop-down menu.

Note: If a study presents multiple experiments with different exposure durations, e.g. subchronic and chronic, these experiments need to be entered in separate forms. Please indicate which experiment you are referring to in the comment box. Also, see instructions below to clone the form.



“Developmental” includes F0 and F1 data fro°m one generation repro/developmental study designs.

“Multigenerational” includes repro/developmental studies that span two generations and beyond.

Both developmental and multigenerational study designs will have a free text box where you will indicate the generation (F0, F1, etc).

**Step 4e: Enter the route, species, sex, and health outcomes**



Note: See **Appendix 2** for what kind of endpoints are grouped under which health outcomes.

**Step 5: Click ‘Submit’** when you have completed the form. This will save the subform. Note: If you are done with all your subforms, you must also click ‘Submit’ at the top of the page (see Step 8).

**Step 6: Cloning the form.** If you have more than one study design or health outcome, you can ‘clone’ the form to avoid having to reenter the study design information (although all outcome information will need to be deleted and reentered in the cloned form). To do this, select the form you want to clone and click “Clone” near the top of the page. Alternatively, you can start a new blank form by clicking “Add”.



**Step 7: Editing the form:** If you need to change information or edit a form you have completed, you can click on the arrow within a form to edit.



**Step 8: At the top of the page, click ‘Submit’.** Note: If you don’t do this, the study will remain as ‘reviewed, but unsubmitted’, which means it is still incomplete.



Table S1: Categorization for grouping endpoints under health outcomes

| **Health Effect Category** | **Examples of Relevant Endpoints** | **Notes** |
| --- | --- | --- |
| **Systemic Effects** | * Body weight (not reproductive/developmental)
* Mortality, survival, or LD50s
* Growth curve
* Clinical observations (e.g. lethargy; oral discharge)
 | * Clinical chemistry endpoints are under Hepatic or Hematologic
* Maternal body weights are under Reproductive
* Pup body weight endpoints are under Developmental
* Pathology (including gross lesions) is organ-specific
 |
| **Carcinogenicity** | * Tumors
* Precancerous lesions (e.g., dysplasia)
 |  |
| **Cardiovascular Effects** | * Heart weight
* Heart, artery, and vein histopathology
* Blood pressure
* Serum cholesterols and lipids
 | * Other blood measures are under Hepatic, Immune, or Hematologic
 |
| **Dermal Effects** | * Skin sensitivity
* Skin histopathology
 |  |
| **Developmental Effects** | * Pup viability/survival, or other birth parameters
* Pup weight or growth (into adulthood if developmental exposure)
* Developmental landmarks (e.g. eye opening) not including markers for other organ/system-specific toxicities
* Skeletal, visceral, or gross abnormalities in fetuses/pups
 | * Histopathology and markers of development specific to other systems are organ/system-specific (e.g., vaginal opening is under Female Reproductive; tests of sensory maturation are under Nervous System)
 |
| **Endocrine Effects** | * Thyroid/adrenal weight
* Thyroid/adrenal histopathology
* Hormonal measures in any tissue or blood (non-reproductive)
* Stress-related factors in blood (e.g., glucocorticoids or other adrenal markers)
 | * Reproductive hormones are under Reproductive
 |
| **Gastrointestinal Effects** | * Stomach and intestine weight
* Stomach and intestine histopathology
 |  |
| **Hematologic Effects** | * Corpuscular volume
* Red blood cells
* Serum hematocrit or hemoglobin
* Serum platelets or reticulocytes
* Serum biochemical measures (sodium, calcium, phosphorus)
* Blood coagulation markers
 | * White blood cell counts and globulin are under Immune
* Serum lipids are under Cardiovascular
* Serum liver markers are under Hepatic
 |
| **Hepatic Effects** | * Liver weight
* Liver histopathology
* Liver tissue enzyme activity (e.g., catalase) or protein/DNA content
* Liver enzymes (ALT; AST)
* Liver biochemical markers (albumin; glycogen)
* Liver tissue lipids (triglycerides, cholesterol)
 | * Serum lipids are under Cardiovascular
* Biochemical markers such as albumin or glucose are under Hematological
* Liver tissue cytokines are under immune
* Serum glucose is under Metabolic
 |
| **Immune Effects** | * Host resistance
* Allergic, autoimmune or infectious disease
* Hypersensitivity
* Lymphocyte phenotyping or proliferation
* Lymphoid tissue weight, histopathology, cell counts
* Immune functional assays (e.g. antibody production, natural killer cell function, delayed-type hypersensitivity [DTH], mixed leukocyte reaction [MLR], cytotoxic T lymphocyte [CTL], phagocytosis or bacterial killing by monocytes)
* Immune responses in the respiratory system (includes asthma)
* White blood cell counts
* Serum immunological factors or cytokines
* Immune cell counts or immune-specific cytokines in non-lymphoid tissues
* Bone marrow histopathology and cell counts
 | * Red blood cells are under Hematological
* Non-immune measures of pulmonary function are under Respiratory
 |
| **Metabolic Effects** | * Pancreatic effects relevant to diabetes
* Induced-obesity or BMI
* Free fatty acids
* Serum glucose or insulin, or other measures related to diabetes
 |  |
| **Musculoskeletal/Connective Tissue** | * Bone weight and histopathology
* Muscular histopathology
 |  |
| **Neurological Effects** | * Brain weight
* Brain histopathology
* Nervous system histopathology
* Behavioral measures (including FOB and cage-side observations)
 |  |
| **Ocular Effects** | * Eye histopathology
* Vison changes
* Eye irritation
 |  |
| **Renal Effects** | * Kidney weight
* Kidney histopathology
* nary tract histopathology
* Bladder weight and histopathology
* Urinary measures (e.g., protein; volume; pH; specific gravity)
 |  |
| **Reproductive Effects** | * Dam health, body weight, food consumption
* Reproductive organ weight
* Reproductive organ histopathology
* Markers of sexual differentiation or maturation (e.g., preputial separation in males; vaginal opening or estrous cycling in females)
* Mating parameters (e.g., success; mount latency)
* Sperm parameters (e.g., counts; motility)
* Reproductive hormones
 | * Birth parameters (e.g., litter size; resorptions; implantations; viability) are under Developmental

[NOTE: if data indicate altered birth parameters are likely attributable to female fertility, these data may be discussed under Female Reproductive] |
| **Respiratory Effects** | * Lung weight and histopathology
* Nasal cavity histopathology
 |  |

Table S2: Types of study designs (human)

|  |  |
| --- | --- |
| **Study Design** | **Description** |
| Cross-sectional | Exposure and outcome are examined at the same point in time in a defined study population. Cannot determine if exposure came before or after outcome. |
| Cohort | A group of people is examined over time to observe a health outcome. Everyone belongs to the same population (e.g., general U.S. population; an occupational group; cancer survivors). All cohort studies (prospective or retrospective) consider exposure data from before the occurrence of the health outcome. |
| Case-control | Cases (people with the health outcome) and controls (people without the health outcome) are selected at the start of a study. Exposure is determined and compared between the two groups. A case-control study can be nested within a cohort. |
| Ecological | The unit of observation is at the group level (e.g., zip code; census tract), rather than the individual level. Ecological studies are often used to measure prevalence and incidence of disease. Cannot make inferences about an individual’s risk based on an ecological study. |
| Controlled Trial | Exposure is assigned to subject and then outcome is measured. |

Table S3. Inventory of HAWC data pivot visuals by chemical in this SEM.

|  |  |  |
| --- | --- | --- |
| **PFAS**DTXSID | **Health Category** | **HAWC URL** |
| **6:2 Fluorotelomer Alcohol**DTXSID5044572 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-62-fluorotelomer-alcohol-dtxsid5044572/> |
|  | Cardiovascular and Hematologic (Reproductive/Developmental Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-6-62-fluorotelomer-alcohol-and-cardio-repro/> |
|  | Cardiovascular and Hematologic (Subchronic Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-5-62-fluorotelomer-alcohol-and-cardio-sc/> |
|  | Developmental(Offspring) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-2-62-fluorotelomer-alcohol-and-development/> |
|  | Developmental*a* (Offspring; Multiple Chemicals) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Main-Report_Offspring-Abnorm_Oral/> |
|  | Developmental (Pregnancy Outcomes) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-1-62-fluorotelomer-alcohol-and-development/> |
|  | Endocrine and Gastrointestinal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-8-62-fluorotelomer-alcohol-and-endocrine-an/> |
|  | Hematologic *a* (Oral Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Main-Report_62_FA_Hematologic_Oral/> |
|  | Hepatic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-7-62-fluorotelomer-alcohol-and-hepatic-effe/> |
|  | Hepatic *a*(Weight; Multiple Chemicals) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Main-Report_Hepatic_Weight_Oral/> |
|  | Immune | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure9_62-fluorotelomer-alcohol-and-immune/> |
|  | Multi-system, Musculoskeletal, and Ocular | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/fig13_62-fluorotelomer-alcohol-and-other-health/> |
|  | Nervous, Respiratory, and Urinary | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure10_62-fluorotelomer-alcohol-and-nerv-resp/>  |
|  | Reproductive(Female or Combined) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-4-62-fluorotelomer-alcohol-and-female-repro/> |
|  | Reproductive(Male) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-3-62-fluorotelomer-alcohol-and-male-repro/> |
|  | Whole Body (Reproductive/Developmental Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-12-62-fluorotelomer-alcohol-and-whole-body/> |
|  | Whole Body(Subchronic Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-11-62-fluorotelomer-alcohol-and-whole-body/> |
| **6:2 Fluorotelomer Methacrylate**DTXSID3047558 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-62-fluorotelomer-methacrylate-dtxsid30475/> |
|  | Developmental *a* (Offspring; Multiple Chemicals) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Main-Report_Offspring-Abnorm_Oral/> |
|  | Developmental, Gastrointestinal, Reproductive, Urinary, and Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure14_fluorotelomer-methacrylate-and-health/> |
|  | Hepatic *a*(Weight; Multiple Chemicals) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Main-Report_Hepatic_Weight_Oral/> |
| **6:2 Fluorotelomer Sulfonic Acid**DTXSID6067331 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-62-fluorotelomer-sulfonic-acid-dtxsid6067/> |
|  | Cardiovascular and Hematologic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-17-62-fluorotelomer-sulfonic-acid-and-cardi/> |
|  | Developmental | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-15-62-fluorotelomer-sulfonic-acid-and-devel/> |
|  | Endocrine, Hepatic, Immune, Nervous, and Urinary | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-18-62-fluorotelomer-sulfonic-acid-and-other/> |
|  | Multi-system and Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-19-62-fluorotelomer-sulfonic-acid-and-whole/> |
|  | Reproductive | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-16-62-fluorotelomer-sulfonic-acid-and-repro/> |
| **8:2 Fluorotelomer Alcohol**DTXSID7029904 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-82-fluorotelomer-alcohol-dtxsid7029904/> |
|  | Cardiovascular, Dermal, Musculoskeletal, and Ocular | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-26-82-fluorotelomer-alcohol-and-cardiovascu/> |
|  | Developmental | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-20-82-fluorotelomer-alcohol-and-development/> |
|  | Endocrine and Gastrointestinal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-25-82-fluorotelomer-alcohol-and-endocrine-a/> |
|  | Hematologic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-22-82-fluorotelomer-alcohol-and-hematologic/> |
|  | Hepatic and Immune | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-24-82-fluorotelomer-alcohol-and-hepatic-and/> |
|  | Multi-system and Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-27-82-fluorotelomer-alcohol-and-multi-syste/> |
|  | Nervous, Respiratory, and Urinary | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-23-82-fluorotelomer-alcohol-and-nervous-res/> |
|  | Reproductive | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-21-82-fluorotelomer-alcohol-and-reproductiv/> |
| **1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, salt with sulfonium, dimethylphenyl**DTXSID90881840 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-1-butanesulfonic-acid-112233444-nonafluor/> |
| **1-Hexene, 3,3,4,4,5,5,6,6,6-nonafluoro-, polymer with ethene and 1,1,2,2-tetrafluoroethene**DTXSID50880596 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-1-hexene-334455666-nonafluoro-polymer-eth/> |
| **1H,1H,2H-Perfluorocyclopentane**DTXSID50880218 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-1h1h2h-perfluorocyclopentane-dtxsid508802/> |
| **1H,1H,5H-Perfluoropentanol**DTXSID0059879 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-1h1h5h-perfluoropentanol-dtxsid0059879/> |
| **2-Chloro-1,1,1,2-Tetrafluoroethane**DTXSID7029245 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-2-chloro-1112-tetrafluoroethane-dtxsid702/> |
|  | Cardiovascular, Dermal, Musculoskeletal, and Ocular | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-36-2-chloro-1112-tetrafluoroethane-and-card/> |
|  | Developmental | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-28-2-chloro-1112-tetrafluoroethane-and-deve/> |
|  | Endocrine and Gastrointestinal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-35-2-chloro-1112-tetrafluoroethane-and-endo/> |
|  | Hematologic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-30-2-chloro-1112-tetrafluoroethane-and-hema/> |
|  | Hepatic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-33-2-chloro-1112-tetrafluoroethane-and-hepa/> |
|  | Immune | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-34-2-chloro-1112-tetrafluoroethane-and-immu/> |
|  | Multi-system | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-37-2-chloro-1112-tetrafluoroethane-and-mult/> |
|  | Nervous and Respiratory | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-31-2-chloro-1112-tetrafluoroethane-and-nerv/> |
|  | Reproductive | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-29-2-chloro-1112-tetrafluoroethane-and-deve/> |
|  | Urinary | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-32-2-chloro-1112-tetrafluoroethane-and-urin/> |
|  | Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-38-2-chloro-1112-tetrafluoroethane-and-whol/> |
| **3,3,4,4,5,5,6,6,6-Nonafluorohexene**DTXSID6047575 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-334455666-nonafluorohexene-dtxsid6047575/> |
|  | Developmental, Hepatic, Reproductive, and Whole Body(Reproductive/Developmental Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-69-334455666-nonafluorohexene-and-health-ef/> |
|  | Endocrine, Hematologic, Hepatic, Immune, Ocular, Urinary, Multi-system, and Whole Body(Subchronic Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-68-334455666-nonafluorohexene-and-health/> |
| **3-Methoxyperfluoro(2-methylpentane)**DTXSID20881338 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-3-methoxyperfluoro2-methylpentane-dtxsid2/> |
| **Bis(2-hydroxyethyl)ammonium perfluorobutanesulfonate**DTXSID1072052 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-bis2-hydroxyethylammonium-perfluorobutane/> |
| **Dodecafluoroheptanol**DTXSID9059832 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-dodecafluoroheptanol-dtxsid9059832/> |
| **Methyl perfluoro(3-(1-ethenyloxypropan-2-yloxy)propanoate)**DTXSID8044969 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-methyl-perfluoro3-1-ethenyloxypropan-2-yl/> |
| **N-Ethyl-N-(2-hydroxyethyl)perfluorooctanesulfonamide**DTXSID6027426 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-n-ethyl-n-2-hydroxyethylperfluorooctanesu/> |
|  | Developmental, Reproductive, and Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/fig66_n-etfoseetfosemefose-oral-and-health-effects/> |
| **N-Ethylperfluorooctanesulfonamide**DTXSID1032646 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-n-ethylperfluorooctanesulfonamide-dtxsid1/> |
|  | Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/fig67_n-ethylperfluorooctanesulfonamide-and-health/> |
| **N-Methyl-N-(2-hydroxyethyl)perfluorooctanesulfonamide**DTXSID7027831 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-n-methyl-n-2-hydroxyethylperfluorooctanes/> |
|  | Cardiovascular and Hematologic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-71-n-methyl-n-2-hydroxyethylperfluorooctane/> |
|  | Dermal, Multi-system, Musculoskeletal, Ocular, and Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-76-n-methyl-n-2-hydroxyethylperfluorooctane/> |
|  | Endocrine and Gastrointestinal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-72-n-methyl-n-2-hydroxyethylperfluorooctane/> |
|  | Hepatic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-73-n-methyl-n-2-hydroxyethylperfluorooctane/> |
|  | Immune | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-74-n-methyl-n-2-hydroxyethylperfluorooctane/> |
|  | Nervous, Respiratory, and Urinary | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-75-n-methyl-n-2-hydroxyethylperfluorooctane/> |
|  | Reproductive | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-70-n-methyl-n-2-hydroxyethylperfluorooctane/> |
| **Perfluamine**DTXSID9059834 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluamine-dtxsid9059834/> |
| **Perfluoro(N-methylmorpholine)**DTXSID7059933 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoron-methylmorpholine-dtxsid7059933/> |
|  | Hematologic, Ocular, Multi-system, and Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure54_perfluoron-methylmorpholine-and-health/> |
| **Perfluoro(propyl vinyl ether)**DTXSID0061826 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoropropyl-vinyl-ether-dtxsid0061826/> |
|  | Cardiovascular and Hematologic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-56-perfluoropropyl-vinyl-ether-and-health/> |
|  | Dermal, Ocular, and Musculoskeletal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-59-perfluoropropyl-vinyl-ether-and-dermal-o/> |
|  | Developmental and Reproductive | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-55-perfluoropropyl-vinyl-ether-and-reproduc/> |
|  | Endocrine and Gastrointestinal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-57-perfluoropropyl-vinyl-ether-and-endocrin/> |
|  | Hepatic, Immune, Nervous, Respiratory, and Urinary | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-58-perfluoropropyl-vinyl-ether-and-health-e/> |
| **Perfluoro-1,3-dimethylcyclohexane**DTXSID0036926 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoro-13-dimethylcyclohexane-dtxsid00/> |
| **Perfluoro-1-iodohexane**DTXSID7047566 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoro-1-iodohexane-dtxsid7047566/> |
| **Perfluoro-2,5-dimethyl-3,6-dioxanonanoic acid**DTXSID00892442 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoro-25-dimethyl-36-dioxanonanoic-ac/> |
| **Perfluoro-3-(1H-perfluoroethoxy)propane**DTXSID8052017 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoro-3-1h-perfluoroethoxypropane-dtx/> |
| **Perfluorobutanesulfonyl fluoride**DTXSID20861913 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluorobutanesulfonyl-fluoride-dtxsid20/> |
| **Perfluorocyclohexanecarbonyl fluoride**DTXSID80379781 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluorocyclohexanecarbonyl-fluoride-dtx/> |
| **Perfluoroheptanesulfonate**DTXSID20892505 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoroheptanesulfonate-dtxsid20892505/> |
| **Perfluoroheptanesulfonic acid**DTXSID8059920 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoroheptanesulfonic-acid-dtxsid80599/> |
| **Perfluoroheptanoic acid**DTXSID1037303 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoroheptanoic-acid-dtxsid1037303/> |
| **Perfluoro-3-methoxypropanoic acid** DTXSID70191136 | Literature Tag Tree | https://hawcprd.epa.gov/summary/visual/assessment/100500085/PFAS-150-Perfluoro-3-methoxypropa-DTXSID70191136/ |
|  | Immune | https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Figure-77-NEW-PFMOBA-and-PFMOPrA-Immune/ |
|  | Cardiovascular, Hepatic, Nervous, Respiratory, Urinary, Whole Body | https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Figure-78-NEW-PFMOBA-and-PFMOPrA-and-Non-Immune/ |
| **Perfluoro(4-methoxybutanoic acid)** DTXSID60500450 | Literature Tag Tree | https://hawcprd.epa.gov/summary/visual/assessment/100500085/PFAS-150-Perfluoro4-methoxybutanoic-DTXSID60500450/ |
|  | Immune | https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Figure-77-NEW-PFMOBA-and-PFMOPrA-Immune/ |
|  | Cardiovascular, Hepatic, Nervous, Respiratory, Urinary, Whole Body | https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Figure-78-NEW-PFMOBA-and-PFMOPrA-and-Non-Immune/ |
| **Perfluoromethylcyclopentane**DTXSID7061982 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoromethylcyclopentane-dtxsid7061982/> |
| **Perfluorooctanesulfonamide**DTXSID3038939 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluorooctanesulfonamide-dtxsid3038939/> |
| **Perfluorooctanesulfonyl fluoride**DTXSID5027140 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluorooctanesulfonyl-fluoride-dtxsid50/> |
| **Perfluoropentanoic acid**DTXSID6062599 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoropentanoic-acid-dtxsid6062599/> |
| **Perfluoropropanoic acid**DTXSID8059970 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoropropanoic-acid-dtxsid8059970/> |
| **Perfluorotetradecanoic acid**DTXSID3059921 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluorotetradecanoic-acid-dtxsid3059921/> |
|  | Cardiovascular, Developmental, Endocrine, Gastrointestinal, Hematologic, Hepatic, Immune, Metabolic, Musculoskeletal, Nervous, Ocular, Reproductive, Urinary, Whole Body | https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Figure-80-NEW-PFTA-and-All-System-Effects/ |
| **Perfluorotridecanoic acid**DTXSID90868151 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluorotridecanoic-acid-dtxsid90868151/> |
|  | Endocrine, Developmental, Metabolic, Reproductive, Whole Body | https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Figure-79-NEW-PFTrDA-and-System-Effects/ |
| **Perfluoroundecanoic Acid**DTXSID8047553 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-perfluoroundecanoic-acid-dtxsid8047553/> |
|  | Cardiovascular and Hematologic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-61-perfluoroundecanoic-acid-and-cardiovascu/> |
|  | Developmental and Reproductive | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-60-perfluoroundecanoic-acid-and-reproductiv/> |
|  | Endocrine and Gastrointestinal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-62-perfluoroundecanoic-acid-and-endocrine-a/> |
|  | Hepatic and Urinary | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-63-perfluoroundecanoic-acid-and-hepatic-and/> |
|  | Immune, Nervous, and Respiratory | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-64-perfluoroundecanoic-acid-and-immune-nerv/> |
|  | Multi-system, Musculoskeletal, and Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-65-perfluoroundecanoic-acid-and-other-healt/> |
| **Propanoic acid, 3-[1-[difluoro[(trifluoroethenyl)oxy]methyl]-1,2,2,2-tetrafluoroethoxy]…**DTXSID70880533 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-propanoic-acid-3-1-difluorotrifluoroethen/> |
| **Sodium perfluorodecanesulfonate**DTXSID60892443 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/PFAS-150-Sodium-perfluorodecanesul-DTXSID60892443/>  |
| **Tetrabutylphosphonium perfluorobutanesulfonate**DTXSID40881850 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-tetrabutylphosphonium-perfluorobutanesulf/> |
| **Tetraethylammonium perfluorooctanesulfonate**DTXSID5069128 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-tetraethylammonium-perfluorooctanesulfona/> |
| **Trichloro((perfluorohexyl)ethyl)silane**DTXSID50229163 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-trichloroperfluorohexylethylsilane-dtxsid/> |
| **Triethoxy((perfluorohexyl)ethyl)silane**DTXSID1074915 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-triethoxyperfluorohexylethylsilane-dtxsid/> |
|  | Developmental and Reproductive | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-51-triethoxyperfluorohexylethylsilane-and-r/> |
|  | Endocrine, Hematologic, Hepatic, Immune, Nervous, Ocular, Respiratory, and Urinary | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-52-triethoxyperfluorohexylethylsilane-and-o/> |
| **Trifluoroacetic Acid**DTXSID9041578 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-trifluoroacetic-acid-dtxsid9041578/> |
|  | Cardiovascular and Hematologic(Females or Combined) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-42-trifluoroacetic-acid-and-cardiovascular/> |
|  | Cardiovascular and Hematologic(Males) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-41-trifluoroacetic-acid-and-cardiovascular/> |
|  | Dermal, Ocular, and Musculoskeletal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-49-trifluoroacetic-acid-and-dermal-ocular-a/> |
|  | Developmental | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-39-trifluoroacetic-acid-and-developmental-e/> |
|  | Developmental *a* (Offspring; Multiple Chemicals) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Main-Report_Offspring-Abnorm_Oral/> |
|  | Endocrine | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-45-trifluoroacetic-acid-and-endocrine-effec/> |
|  | Gastrointestinal | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-46-trifluoroacetic-acid-and-gastrointestina/> |
|  | Hepatic | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-43-trifluoroacetic-acid-and-hepatic-effects/> |
|  | Hepatic *a*(Weight; Multiple Chemicals) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/Main-Report_Hepatic_Weight_Oral/> |
|  | Immune, Nervous, and Respiratory | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-44-trifluoroacetic-acid-and-immune-nervous/> |
|  | Reproductive | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-40-trifluoroacetic-acid-and-reproductive-ef/> |
|  | Urinary(Reproductive/Developmental Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-48-trifluoroacetic-acid-and-urinary-effects/> |
|  | Urinary(Subchronic Studies) | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-47-trifluoroacetic-acid-and-urinary-effects/> |
|  | Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure-50-trifluoroacetic-acid-and-whole-body-effe/> |
| **Trifluoromethanesulfonic Acid**DTXSID2044397 | Literature Tag Tree | <https://hawcprd.epa.gov/summary/visual/assessment/100500085/pfas-150-trifluoromethanesulfonic-acid-dtxsid20443/> |
|  | Developmental, Multi-system, Reproductive, and Whole Body | <https://hawcprd.epa.gov/summary/data-pivot/assessment/100500085/figure53_trifluoromethanesulfonic-acid-and-health/> |

*a*These visuals are also included as figures in the manuscript

#### References

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