Ficha de datos de seguridad según Reglamento (CE) Nr. 1907/2006, Anexo II

SECCIÓN 1: Identificación de la sustancia o la mezcla y de la sociedad o la empresa

1.1 Identificador del producto

Refrigerante R 1234yf
8887100019/8887100016
2,3,3,3-Tetrafluoropropene
Número de registro (ECHA): 01-0000019665-61-XXXX
Index: ---
EINECS, ELINCS, NLP: 468-710-7
CAS: 754-12-1

1.2 Usos pertinentes identificados de la sustancia o de la mezcla y usos desaconsejados

Usos pertinentes identificados de la sustancia o de la mezcla:
Refrigerante

Usos desaconsejados:
En la actualidad no existen informaciones al respecto.

1.3 Datos del proveedor de la ficha de datos de seguridad

Dometic WAECO International GmbH, Hollefeldstr. 63, 48282 Emsdetten, Alemania
Teléfono:+49 (0) 2572 879 0, Fax:+49 (0) 2572 879 300
info@dometic-waeco.de, www.airconservice.de

Dometic Spain S.L., Avenida Sierra del Guadarrama, 16, 29691 Villanueva de la Cañada, España
Teléfono:+34 91 833 6089, Fax:+34 900 100 245
info@dometic.es, www.airconservice.es

Dirección de correo electrónico de la persona especializada: info@chemical-check.de, k.schnurbusch@chemical-check.de - por favor, NO utilizar para pedir hojas de datos de seguridad.

1.4 Teléfono de emergencia

Servicios de información para casos de emergencia / Organismo consultivo oficial:

Servicio de Información Toxicológica (Instituto Nacional de Toxicología y Ciencias Forenses) Teléfono: +34 91 562 04 20
Información en español (24 h/365 dias). Únicamente con la finalidad de proporcionar respuesta sanitaria en caso de urgencia.

Teléfono de urgencias de la sociedad:
+49 (0) 700 / 24 112 112 (CCWA)

SECCIÓN 2: Identificación de los peligros

2.1 Clasificación de la sustancia o de la mezcla

Clasificación de acuerdo con el Reglamento (CE) 1272/2008 (CLP)

Clase de peligro	Categoría de peligro	Indicación de peligro
Flam. Gas	1	H220-Gas extremadamente inflamable.
Press. Gas	(Liq.)	H280-Contiene gas a presión, peligro de explosión en caso de calentamiento.

2.2 Elementos de la etiqueta

Etiquetado de acuerdo con el Reglamento (CE) 1272/2008 (CLP)

2,3,3,3-Tetrafluoropropene
CAS: 754-12-1, Index:--- EC: 468-710-7

Peligro

H220-Gas extremadamente inflamable. H280-Contiene gas a presión, peligro de explosión en caso de calentamiento.

P210-Mantener alejado del calor, de superficies calientes, de chispas, de llamas abiertas y de cualquier otra fuente de ignición. No fumar.
P377-Fuga de gas en llamas: No apagar, salvo si la fuga puede detenerse sin peligro. P381-En caso de fuga, eliminar todas las fuentes de ignición.
P410+P403-Proteger de la luz del sol. Almacenar en un lugar bien ventilado.

2.3 Otros peligros
Sin ninguna sustancia vPvB
Sin ninguna sustancia PBT
Las salpicaduras de líquido o de niebla meona pueden provocar congelaciones.
Peligro de estallar al calentarse

SECCIÓN 3: Composición/información sobre los componentes

3.1 Sustancia

2,3,3,3-Tetrafluoropropene	
Número de registro (REACH)	01-0000019665-61-XXXX
Index	---
EINECS, ELINCS, NLP	468-710-7
CAS	754-12-1
% rango	
Clasificación de acuerdo con el Reglamento (CE) 1272/2008 (CLP)	Flam. Gas 1, H220 Press. Gas (Liq.), H280

3.2 Mezcla
n.u.

Texto de las frases H y abreviaturas de clasificación (SGA/CLP), véase sección 16.
Las sustancias mencionadas en esta sección se indican con su clasificación real correspondiente!
Esto significa que en el caso de las sustancias listadas en el Anexo VI, Tabla 3.1 del Reglamento (UE) n.º 1272/2008 (CLP) se han tenido en cuenta todas las posibles observaciones mencionadas en el mismo para la clasificación aquí mencionada.

SECCIÓN 4: Primeros auxilios

4.1 Descripción de los primeros auxilios
¡Los responsables de los primeros auxilios deben recordar protegerse a sí mismos!
No instile ningún líquido en la boca de personas inconscientes!

Inhalación
Alejar a la persona de la zona de peligro.
Conducir aire fresco al afectado y llamar inmediatamente al médico.
En caso de desmayo, colóquese en una posición lateral estable y consúltese al médico.
Paro respiratorio - Aparato de respiración artificial necesario.

Contacto con la piel
Lavar exhaustivamente con agua abundante, y desvestir enseguida la ropa contaminada e impregnada, si la piel se irrita (eritema cutáneo etc.), consultar al médico.
Cubrir las congelaciones esterilizadamente.

Contacto con los ojos
Quitarse las lentillas.
Aclarar exhaustivamente con abundante agua durante varios minutos, llamar inmediatamente al médico tener la hoja de datos a mano.

Ingestión
Por lo general no existe vía de absorción.

4.2 Principales síntomas y efectos, agudos y retardados
Cuando proceda, se podrán encontrar los principales síntomas y efectos retardados en el párrafo 11.º o, en caso de vías de exposición, en el párrafo 4.1.
En determinados casos puede ocurrir que los síntomas de intoxicación no se manifiesten hasta que haya transcurrido mucho tiempo/después de varias horas.
amodorramiento
Dolores de cabeza
embriaguez
En caso de concentraciones altas:
Efecto asfixiante.
La víctima no nota que se está ahogando.

4.3 Indicación de toda atención médica y de los tratamientos especiales que deban dispensarse inmediatamente
Tratamiento sintomático.
No administrar preparados de adrenalina-efedrina.
La información de la composición actualizada del producto ha sido remitida al Servicio de Información Toxicológica (Instituto Nacional de Toxicología y Ciencias Forenses).
En caso de intoxicación llamar al Servicio de Información Toxicológica: Tfno (24horas) 91 562 04 20

SECCIÓN 5: Medidas de lucha contra incendios

5.1 Medios de extinción
Medios de extinción apropiados
Chorro de agua disperso/espuma resistente al alcohol/CO2/polvo seco para extinción de fuegos
Medios de extinción no apropiados
Chorro compacto de agua
5.2 Peligros específicos derivados de la sustancia o la mezcla
En caso de fuego se pueden formar:
Fluoruro de hidrógeno
Oxidos de carbono
Gases venenosos
Peligro de estallar al calentarse
5.3 Recomendaciones para el personal de lucha contra incendios
En caso de incendio y/o de explosión no respire los humos.
Aparato de respiración, independiente de la atmósfera local.
Protección completa
Refrigerar con agua los recipientes expuestos a riesgos.
Eliminar el agua prevista contra incendios que esté contaminada conforme a la normativa oficial.

SECCIÓN 6: Medidas en caso de vertido accidental

6.1 Precauciones personales, equipo de protección y procedimientos de emergencia
Mantener alejado al personal innecesario.
Alejar materiales inflamables, no fumar.
Procurar que haya una buena aireación.
Evitar el contacto con ojos y piel, así como su inhalación.

6.2 Precauciones relativas al medio ambiente
Evitar la penetración del producto en las aguas superficiales y subterráneas, así como en el suelo.
Impida la penetración en el alcantarillado, sótanos, zanjas de obras u otros lugares en los que la acumulación pueda ser peligrosa.
Si por accidente entra el producto en a la canalizatión, informar a las autoridades competentes.

6.3 Métodos y material de contención y de limpieza
Si hay un escape de aerosol o de gas, procurar que haya suficiente aire fresco.
Deje vaporizar.

6.4 Referencia a otras secciones
Equipamiento de protección personal, véase sección 8 e indicaciones sobre la eliminación, véase sección 13.

SECCIÓN 7: Manipulación y almacenamiento

Además de la información que se facilita en esta sección, la sección 8 y 6.1 también puede contener información relevante.

7.1 Precauciones para una manipulación segura

7.1.1 Recomendaciones generales
Procurar que haya una buena ventilación.
Ventilación de los espacios incluyendo los de altitud cero.
Evitar inhalar los vapores.
Evitar el contacto con ojos y piel.
Alejar materiales inflamables - No fumar.
Tomar medidas contra la carga electroestática.
Utilizar aparatos protegidos contra explosiones.
No se debe utilizar sobre superficies calientes.
Está prohibido: comer, beber, fumar, así como guardar productos alimenticios en el puesto de trabajo.
Siga las indicaciones de la etiqueta y las instrucciones de uso.
Proceder según las indicaciones de la empresa.

7.1.2 Indicaciones sobre medidas generales de higiene en el sitio de trabajo
Se deben emplear las medidas de higiene y precaución generales para el trato de productos químicos.
Lávense las manos antes de hacer una pausa y al terminar la jornada.
Manténgase lejos de alimentos, bebidas y piensos.
Antes de entrar a zonas donde se ingieren alimentos, retirar la ropa y el equipamiento de protección contaminados.

7.2 Condiciones de almacenamiento seguro, incluidas posibles incompatibilidades
Consérvese alejado de las personas no autorizadas.
Almacenar el producto sólo en su embalaje original y cerrado.
No almacenar el producto en pasillos y escaleras.
No almacenar junto a sustancias que favorezcan la expansión del fuego o que sean autoinflamables.
Protegerlo de los rayos solares y de temperaturas que sobrepasen los 50°C.
Almacenar en lugar fresco.
Almacenar en lugar bien ventilado.
Tener en cuenta reglamentos especiales por gases.

7.3 Usos específicos finales
En la actualidad no existen informaciones al respecto.

SECCIÓN 8: Controles de exposición/protección individual

8.1 Parámetros de control

8.2 Controles de la exposición

8.2.1 Controles técnicos apropiados

Encárguese de que la ventilación sea buena. Esto se puede conseguir con aspiración local o una salida de aire general.
Si esto no es suficiente para mantener la concentración por debajo de los valores máximos permitidos para el lugar de trabajo (VLA, AGW), debe llevarse una mascarilla.
Sólo es de aplicación si se incluyen los valores límites de exposición.

8.2.2 Medidas de protección individual, tales como equipos de protección personal

Se deben emplear las medidas de higiene y precaución generales para el trato de productos químicos.
Lávense las manos antes de hacer una pausa y al terminar la jornada.
Manténgase lejos de alimentos, bebidas y piensos.
Antes de entrar a zonas donde se ingieren alimentos, retirar la ropa y el equipamiento de protección contaminados.

Protección de los ojos/la cara:
Gafas de protección ajustadas con protecciones laterales (EN 166).

Protección de la piel - Protección de las manos:
Guantes de piel
Eventualmente
Guantes aislantes NE 511 (frío)
Los tiempos de exposición obtenidos conforme a la EN 16523-1 no se han comprobado en la práctica.
Se recomienda un tiempo máximo de uso que no supere el 50% del tiempo de exposición.

Protección de la piel - Otros:
Trabajar con el traje de proteción (p.e. zapatos de seguridad EN ISO 20345, vestimenta protectora de mangas largas).

Protección respiratoria:
Si la aireación es insuficiente, emplear aparato de respiración.
Aparato de respiración, independiente de la atmósfera local.
Téngase en cuenta las limitaciones para el tiempo de uso del equipo respirador.

Peligros térmicos:
Si son aplicables, se mencionan en las medidas individuales de protección (protección de ojos/cara, de piel o respiratoria).

Información adicional para la protección de las manos - No se ha realizado ningún ensayo.
La selección de las mezclas se ha realizado al leal saber y entender y sobre la base de las informaciones acerca de los contenidos.
La selección en el caso de las sustancias ha sido hecha a partir de las indicaciones del fabricante de guantes.
La selección final del material de los guantes se tiene que realizar teniendo en cuenta el tiempo de rotura, la tasa de permeación y la degradación.
La selección de unos guantes apropiados depende del material y de otras características de calidad, lo cual difiere según el fabricante.
Para las mezclas, la resistencia de los materiales de los guantes no se puede calcular por adelantado, por lo que es necesario comprobarla antes del uso.
Consulte con el fabricante de guantes el tiempo exacto de rotura del material de los guantes y respete este tiempo.

8.2.3 Controles de exposición medioambiental

En la actualidad no existen informaciones al respecto.

SECCIÓN 9: Propiedades físicas y químicas

9.1 Información sobre propiedades físicas y químicas básicas

Estado físico:	Gas licuado
Color:	Incoloro
Olor:	Pequeño
Umbral olfativo:	No determinado
Valor del pH al:	n.u.
Punto de fusión/punto de congelación:	No determinado
Punto inicial de ebullición e intervalo de ebullición:	-29,4 °C
Punto de inflamación:	n.u.

Tasa de evaporación:	No determinado
Inflamabilidad (sólido, gas):	Extremadamente inflamable
Límite inferior de explosividad:	6,2 Vol-%
Límite superior de explosividad:	12,3 Vol-%
Presión de vapor:	6067 hPa (21°C)
Presión de vapor:	14203 hPa (54°C)
Densidad de vapor (aire = 1):	4
Densidad:	1,1 g/cm3 (25°C)
Densidad de compactado:	No determinado
Solubilidad(es):	No determinado
Solubilidad en agua:	198,2 mg/l (24°C, Regulation (EC) 440/2008 A.6. (WATER SOLUBILITY))
Coeficiente de reparto (n-octanol/agua):	2,15 (Regulation (EC) 440/2008 A.8. (PARTITION COEFFICIENT))
Temperatura de auto-inflamación:	405 °C
Temperatura de descomposición:	No determinado
Viscosidad:	No determinado
Propiedades explosivas:	El producto no tiene peligro de explosión. En el uso: posible formación de gases, mezclas de aire y vapores explosivos.
Propiedades comburentes:	No determinado

9.2 Información adicional

Miscibilidad:	No determinado
Liposolubilidad / disolvente:	No determinado
Conductividad:	No determinado
Tensión superficial:	No determinado
Contenido en disolvente:	No determinado
Masa molar:	114 g/mol

SECCIÓN 10: Estabilidad y reactividad

10.1 Reactividad
El producto no ha sido comprobado.

10.2 Estabilidad química
Estable si se realiza un almacenamiento y un manejo reglamentarios.

10.3 Posibilidad de reacciones peligrosas
No se conoce ninguna reacción peligrosa.

10.4 Condiciones que deben evitarse
Véase también sección 7.
Calor, en proximidad de llamas, fuentes de ignición

10.5 Materiales incompatibles
Véase también sección 7.
Metales alcalinos
Magnesio
Zinc
Metales ligeros

10.6 Productos de descomposición peligrosos
Véase también sección 5.2.
No se disuelve con un uso según lo establecido.

SECCIÓN 11: Información toxicológica

11.1 Información sobre los efectos toxicológicos
Eventualmente, consultar el párrafo 2.1 (clasificación) para obtener más información acerca de efectos sobre la salud.

Toxicidad / Efecto	Punto final	Valor	Unidad	Organismo	Método de verificación	Observación
Toxicidad aguda, oral:						n.d.

Toxicidad aguda, dérmica:						n.d.
Toxicidad aguda, por inhalación:						n.d.
Corrosión o irritación cutáneas:						n.d.
Lesiones o irritación ocular graves:						n.d.
Sensibilización respiratoria o cutánea:						n.d.
Mutagenicidad en células germinales:						n.d.
Carcinogenicidad:						n.d.
Toxicidad para la reproducción:						n.d.
Toxicidad específica en determinados órganos - exposición única (STOT-SE):						n.d.
Toxicidad específica en determinados órganos - exposición repetida (STOT-RE):						n.d.
Peligro de aspiración:						n.d.
Síntomas:						n.d.

SECCIÓN 12: Información ecológica

Eventualmente, consultar el párrafo 2.1 (clasificación) para obtener más información acerca de efectos sobre el medio ambiente.

Toxicidad / Efecto	Punto final	Tiempo	Valor	Unidad	Organismo	Método de verificación	Observación
12.1. Toxicidad en peces:							n.d.
12.1. Toxicidad con daphnia:							n.d.
12.1. Toxicidad con algas:							n.d.
12.2. Persistencia y degradabilidad:							n.d.
12.3. Potencial de bioacumulación:							n.d.
12.4. Movilidad en el suelo:							n.d.
12.5. Resultados de la valoración PBT y mPmB:							n.d.
12.6. Otros efectos adversos:							n.d.

SECCIÓN 13: Consideraciones relativas a la eliminación

13.1 Métodos para el tratamiento de residuos
Para la sustancia / mezcla / cantidades residuales

Código de basura número, CE:
Las pautas indicadas para los desperdicios constituyen recomendaciones basadas en la utilización prevista de este producto. Pero según la utilización especial y las condiciones de eliminación por parte del usuario, eventualmente también se puedan aplicar otras pautas para los desperdicios. (2014/955/UE)
14 06 01 Clorofluorocarburos, HCFC, HFC

Recomendación:
Se desaconsejerá el vertido de aguas residuales.
Tener en cuenta las prescripciones de las autoridades locales.
Por ejemplo una instalación de incineración apropiada.

Para material de embalaje sucio

Tener en cuenta las prescripciones de las autoridades locales.
recomendación:
Devuélvase al fabricante con la presión residual.
15 01 04 Envases metálicos

SECCIÓN 14: Información relativa al transporte

Indicaciones generales

14.1. Número ONU: 3161

Transporte por carretera / ferrocarril (ADR/RID)

14.2. Designación oficial de transporte de las Naciones Unidas:
UN 3161 LIQUEFIED GAS, FLAMMABLE, N.O.S. (R-1234YF)

14.3. Clase(s) de peligro para el transporte: 2.1
14.4. Grupo de embalaje: -
Código de clasificación: 2F
LQ: 0
14.5. Peligros para el medio ambiente: No aplicable
Tunnel restriction code: B/D

Transporte por navegación marítima (Código IMDG)

14.2. Designación oficial de transporte de las Naciones Unidas:
LIQUEFIED GAS, FLAMMABLE, N.O.S. (R-1234YF)

14.3. Clase(s) de peligro para el transporte: 2.1
14.4. Grupo de embalaje: -
EmS: F-D, S-U
Contaminante marino (Marine Pollutant): n.u.
14.5. Peligros para el medio ambiente: No aplicable

Transporte aéreo (IATA)

14.2. Designación oficial de transporte de las Naciones Unidas:
Liquefied gas, flammable, n.o.s. (R-1234YF)

14.3. Clase(s) de peligro para el transporte: 2.1
14.4. Grupo de embalaje: -
14.5. Peligros para el medio ambiente: No aplicable

14.6. Precauciones particulares para los usuarios

Las personas encargadas del transporte de materiales peligrosos deberán estar debidamente instruidas.
Las personas encargadas del transporte deberán tener especialmente en cuenta las normativas de seguridad.
Se deben tomar precauciones para evitar siniestros.

14.7. Transporte a granel con arreglo al anexo II del Convenio Marpol y del Código IBC

El flete no se realiza a granel, sino en fardos, por lo que no procede.
Aquí no se tienen en cuenta regulaciónes sobre cantidades mínimas.
Código peligro, así como codificación del embalaje, si se demanda.
Seguir las disposiciones especiales (special provisions).

SECCIÓN 15: Información reglamentaria

15.1 Reglamentación y legislación en materia de seguridad, salud y medio ambiente específicas para la sustancia o la mezcla

Tener en cuenta restricciones:
Tener en cuenta las normativas de las cooperativas de trabajo y de la medicina laboral.

Directiva 2012/18/UE ("Seveso-III"), anexo I, parte 1: se aplican a este producto las siguientes categorías (en ciertas circunstancias, se deben tener en cuenta otras en función del almacenamiento, manipulación, etc.):

Categorías de peligro	Notas del anexo I	Cantidades umbral (en toneladas) de las sustancias peligrosas a que se hace referencia en el artículo 3, apartado 10, a efectos de aplicación de los - Requisitos de nivel inferior	Cantidades umbral (en toneladas) de las sustancias peligrosas a que se hace referencia en el artículo 3, apartado 10, a efectos de aplicación de los - Requisitos de nivel superior
P2		10	50

Para la asignación de las categorías y los límites de cantidades siempre hay que tener en cuenta las notas al anexo I de la Directiva 2012/18/UE, en especial las mencionadas aquí en las tablas y las notas 1 - 6.

Directiva 2010/75/UE (COV): 100 %

15.2 Evaluación de la seguridad química

Se ha realizado una evaluación de la seguridad química.

SECCIÓN 16: Otra información

Secciones modificadas: 1
Se requiere que los empleados reciban instrucción sobre el manejo de mercancías peligrosas.
Estas indicaciones se refieren al producto en sus condiciones de recepción.
Se requiere que los empleados reciban instrucción/formación sobre el manejo de sustancias peligrosas.
Las siguientes frases representan las frases H prescritas, código de clase de peligro (SGA/CLP) de los ingredientes (mencionados en los párrafos 2 y 3).
H280 Contiene gas a presión, peligro de explosión en caso de calentamiento.
H220 Gas extremadamente inflamable.

Flam. Gas — Gases inflamables (incluidos los gases químicamente inestables)
Press. Gas (Liq.) — Gases a presión-Gas licuado

Abreviaturas y acrónimos que pueden aparecer en este documento:

AC Article Categories (= Categorías de artículos)
ACGIH American Conference of Governmental Industrial Hygienists
ADR Accord européen relatif au transport international des marchandises Dangereuses par Route
Anot. Anotación
AOEL Acceptable Operator Exposure Level
AOX Adsorbable organic halogen compounds (= Compuestos halogenados orgánicos adsorbibles)
aprox. aproximadamente
ATE Acute Toxicity Estimate (= Estimaciones de la toxicidad aguda - ETA) de acuerdo con el Reglamento (CE) 1272/2008 (CLP)
BAM Bundesanstalt für Materialforschung und -prüfung (Alemania)
BAuA Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (= Instituto federal para la protección del trabajo y la medicina laboral, Alemania)
BCF Bioconcentration factor (= factor de bioconcentración - FBC)
BHT Butylhydroxytoluol (= 4-metil-fenol de 2,6-di-t-butilo)
BOD Biochemical oxygen demand (= Demanda bioquímica de oxígeno - DBO)
BSEF Bromine Science and Environmental Forum
bw body weight (= peso corporal)
CAS Chemical Abstracts Service
CE Comunidad Europea
CEC Coordinating European Council for the Development of Performance Tests for Fuels, Lubricants and Other Fluids
CEE Comunidad Económica Europea
CESIO Comité Européen des Agents de Surface et de leurs Intermédiaires Organiques
CIPAC Collaborative International Pesticides Analytical Council
CLP Classification, Labelling and Packaging (REGLAMENTO (CE) No 1272/2008 sobre clasificación, etiquetado y envasado de sustancias y mezclas)
CMR carcinogenic, mutagenic, reproductive toxic (cancerígenos, mutágenos, tóxicos para la reproducción)

COD Chemical oxygen demand (= Demanda química de oxígeno - DQO)
Código IMDG International Maritime Code for Dangerous Goods - IMDG-code (= Código Marítimo Internacional de Mercancías Peligrosas)
CTFA Cosmetic, Toiletry, and Fragrance Association
DMEL Derived Minimum Effect Level
DNEL Derived No Effect Level (= nivel sin efecto derivado)
DOC Dissolved organic carbon (= Carbono orgánico disuelto - COD)
DT50 Dwell Time - 50% reduction of start concentration
dw dry weight (= masa seca)
ECHA European Chemicals Agency (= Agencia Europea de Sustancias y Mezclas Químicas)
EEE Espacio Económico Europeo
EINECS European Inventory of Existing Commercial Chemical Substances
ELINCS European List of Notified Chemical Substances
EPA United States Environmental Protection Agency (United States of America)
ERC Environmental Release Categories (= Categoría de emisiones al medio ambiente)
etc. etcétera
Fax. Número de fax
gral. general
GWP Global warming potential (= Calentamiento de la Tierra)
HET-CAM Hen's Egg Test - Chorionallantoic Membrane
HGWP Halocarbon Global Warming Potential
IARC International Agency for Research on Cancer (= La Agencia International para la Investigacion sobre el Cancer)
IATA International Air Transport Association (= Asociación Internacional de Transporte Aéreo)
IBC Intermediate Bulk Container
IBC (Code) International Bulk Chemical (Code)
IUCLID International Uniform ChemicaL Information Database
LQ Limited Quantities
n.d. no disponible / datos no disponibles
n.e. no ensayado
n.u. no utilizable
NIOSH National Institute of Occupational Safety and Health (United States of America)
ODP Ozone Depletion Potential (= Capacidad de agotamiento de la capa de ozono)
OECD Organisation for Economic Co-operation and Development
OMS Organización Mundial de la Salud (= World Health Organization - WHO)
org. orgánico
p. ej., p.e. por ejemplo
PAK polyzyklischer aromatischer Kohlenwasserstoff (= hidrocarburos aromáticos policíclicos)
PBT persistent, bioaccumulative and toxic (= persistentes, bioacumulativas, tóxicas)
PC Chemical product category (= Categoría de productos químicos)
PE Polietileno
PNEC Predicted No Effect Concentration (= concentración prevista sin efecto)
PROC Process category (= Categoría de procesos)
PTFE Politetrafluoroetileno
REACH Registration, Evaluation, Authorisation and Restriction of Chemicals (REGLAMENTO (CE) N o 1907/2006 relativo al registro, la evaluación, la autorización y la restricción de las sustancias y preparados químicos)
REACH-IT List-No. 9xx-xxx-x No. is automatically assigned, e.g. to pre-registrations without a CAS No. or other numerical identifier. List Numbers do not have any legal significance, rather they are purely technical identifiers for processing a submission via REACH-IT.
RID Règlement concernant le transport International ferroviaire de marchandises Dangereuses
SADT Self-Accelerating Decomposition Temperature
seg. según
SGA Sistema Globalmente Armonizado de clasificación y etiquetado de productos químicos
SU Sector of use (= Sectores de uso)
SVHC Substances of Very High Concern
ThOD Theoretical oxygen demand (= Demanda teórica de oxígeno - DTO)
Tlf. Telefónico
TOC Total organic carbon (= Carbono orgánico total - COT)
UE Unión Europea
UN RTDG United Nations Recommendations on the Transport of Dangerous Goods (las Recomendaciones de las Naciones Unidas relativas al transporte de mercancías peligrosas)
VbF Verordnung über brennbare Flüssigkeiten (= Ordenanza sobre líquidos inflamables (Austria))

VLA-ED, VLA-EC VLA-ED = Valor Límite Ambiental-Exposición Diaria, VLA-EC = Valor Límite Ambiental-Exposición de Corta Duración (LEP - Límites de Exposición Profesional para Agentes Químicos en España)
VLB Valor Límite Biológico (LEP - Límites de Exposición Profesional para Agentes Químicos en España)
VOC Volatile organic compounds (= compuestos orgánicos volátiles (COV))
vPvB very persistent and very bioaccumulative
wwt wet weight

Las indicaciones hechas aquí deben describir el producto con vistas a las disposiciones de seguridad necesarias, no sirven para garantizar determinadas propiedades y están basadas en el estado actual de nuestros conocimientos. Responsabilidad descartada.
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Annex of Safety data sheet

Identified use: ES and title	**Sector of Use (SU)**	**Product Category (PC)** **Article Category (AC)**	**Process category (PROC)**	**Environmental Release Category (ERC)**
ES 1 : Industrial Use, Heat Transfer Fluids – Refrigerants, Coolants	SU 3, 10, 17	PC 16 AC 1, 2	PROC 8b, 9	ERC 7
ES 2 : Professional Use, Heat Transfer Fluids – Refrigerants, Coolants	SU 22	PC 16 AC 1, 2	PROC 8a	ERC 9b
ES 3 : Formulation of preparations	SU 3, 10, 17	PC 16 AC 1, 2	PROC 3	ERC 2
ES 4 : Use, service life, and waste stage environmental exposure	SU 3, 10, 17, 21, 22	Only environmental releases evaluated	Only environmental releases evaluated	ERC 2, 7, 9a, and 9b

Overview of Uses and Exposure Scenarios

HFO-1234yf is used as a heat transfer fluid in mobile air conditioning (MAC) equipment and in stationary air conditioning and refrigeration equipment. It is imported into the European Union (EU) and used by workers at Original Equipment Manufacturers (OEMs) to charge MAC and stationary equipment. Workers also use HFO-1234yf when servicing charged equipment during its service life or when dismantling charged equipment at the end of its service life. In addition, workers use the substance during blending and repackaging activities. Worker exposure may potentially occur during the activities associated with these uses, but exclusively when disconnecting and/or connecting the tight seal shut-off valve coupler hoses during transfer operations. Therefore, the exposure potential is limited in time and minimalized in amount due to the coupler system employed. Environmental exposure is also a possibility when conducting these transfer operations. Minimal releases to the ambient air may potentially occur during activities such as blending and repackaging of the substance, charging and servicing of equipment, dismantling of equipment, and if leakages occur from the charged equipment during its service life. Releases to other environmental compartments beside the ambient air are not possible because HFO-1234yf is a liquefied gas.
Potential consumer exposure is limited to those extremely rare occasions when all of the following conditions are met: the MAC is leaking, HFO-1234yf vents directly into the passenger compartment of the automobile, the passenger compartment remains totally closed, and passengers are present in the car.

1.1 Exposure Scenario ES1
Industrial Use, Heat Transfer Fluids – Refrigerants, Coolants
Industrial uses : Uses of substances as such or in preparations at industrial sites (SU3) ; Formulation [mixing] or preparations and/or re-packaging (excluding alloys) (SU10) : General manufacturing, e.g., machinery, equipment, vehicles, other transport equipment (SU17) excluding buses
Contributing environmental scenario CS1: Industrial use of substances in closed systems (ERC7). Quantified in ES4
Contributing worker scenario CS2: Transfer of substance or preparation into small containers (dedicated filling line, including weighing) (PROC9) Contributing worker scenario CS3: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (PROC8b)
Exposure Scenario 1 (ES 1) describes the activities and processes covered when workers charge various types of packaging, A/C and refrigeration equipment in an industrial setting. It includes: • Refrigerant packaging workers, • Automobile original equipment manufacturer (OEM) assembly workers, and • Stationary equipment OEM assembly workers.
1.2.1 Contributing scenario CS1 controlling environmental exposure for ERC 7
Industrial use of substances in closed systems
Assessed and quantified in ES4
Product characteristics
Low global warming potential (GWP) liquefied gas with a concentration of 100%; Not biodegradable
Amounts used
9000 tonnes per annum (tpa) – EU
Frequency and duration of use
Continuous use/8-hour shift, 200 operating days/year; Intermittent release
Environmental factors not influenced by risk management
None
Other given operational conditions affecting environmental exposure
Under normal conditions of use, exposure would primarily occur when workers disconnect the couplings. Conservatively assumed that approximately 1% (5 grams/mobile A/C) released to air (Henne et al., 2012; Reimann & Shallcross et al., 2011) (release fraction of 0.01).
Technical conditions and measures at process level (source) to prevent release
Process designed to minimize releases to wastewater; Process designed to minimize releases to soil; Ensure that the valves of the cylinders are tightly closed and not leaking; Handle substance within a closed system; Transfer via enclosed lines; Clear transfer lines prior to de-coupling.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
None
Organizational measures to prevent/limit release from site

Use of ATEX 137 and ATEX 95 Directives to mitigate flammability properties of HFO-1234yf and/or Chemical Substances at Work (Directive 98/24/EC); Regular inspection and maintenance of equipment and machines.
Conditions and measures related to municipal sewage treatment plant
No STP
Conditions and measures related to external treatment of waste for disposal
Not applicable
Conditions and measures related to external recovery of waste
Not applicable
1.2.2 Contributing scenario CS2 controlling worker exposure for PROC 9
Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Product characteristic
Liquefied gas; Covers percentage substance in the product up to 100 % (unless stated differently); Assumes activities are at room temperature.
Amounts used
120 kg/8-hour shift – worker; ~50 000 kg/y for plant site producing 100 000 vehicles per year
Frequency and duration of use/exposure
Duration of use/exposure: Intermittent; 20 min/8-hour shift (Under normal operation exposure occurs only at ending of filling process (disconnection), estimated at 0.083 min (5 sec) per disconnecting process x1 processes/fill x 30 fills/hr x 8 hr/shift) Frequency: 200 days/year
Human factors not influenced by risk management
Light work, respiration volume = 10 m^3/8-hour shift
Other given operational conditions affecting workers exposure
Indoor use; Under normal conditions of use, exposure would primarily occur when workers disconnect the couplings.
Technical conditions and measures at process level (source) to prevent release
Ensure that the valves of the cylinders are tightly closed and not leaking; Handle substance within a closed system; Transfer via enclosed lines; Clear transfer lines prior to de-coupling.
Technical conditions and measures to control dispersion from source towards the worker
Mechanical ventilation giving at least [ACH]: 3; Room volume: >50 m^3.; Local exhaust ventilation (Effectiveness: < 10 ppm)
Organizational measures to prevent/limit releases, dispersion and exposure
Use of ATEX 137 and ATEX 95 Directives to mitigate flammability properties of HFO-1234yf and/or Chemical Substances at Work (Directive 98/24/EC); Use of ISO 13043 (April 15, 2011) (Road vehicles – Refrigerant systems used in mobile air conditioning systems (MAC) – Safety requirements) and SAE J639 (Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems), SAE J2843 (R-1234yf [HFO-1234yf] Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems) and SAE J2845 (Technician Certification for Service and Containment of Refrigerants Used in Mobile A/C Systems); Regular inspection and maintenance of equipment and machines.; Ensure operatives are trained to minimise

exposures.
Conditions and measures related to personal protection, hygiene and health evaluation
Use eye protection to EN 166 or ANSI Z87.1, designed to protect against liquid splashes. Wear suitable gloves tested to EN374 or complying with U.S. OSHA guidelines.
1.2.3 Contributing scenario CS3 controlling worker exposure for PROC 8b.
Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
Product characteristic
Liquefied gas; Covers percentage substance in the product up to 100 % (unless stated differently); Assumes activities are at room temperature.
Amounts used
Not applicable
Frequency and duration of use/exposure
Duration of use/exposure: Intermittent; Conservatively assumed less than 15 minutes/day Frequency: 200 days/year
Human factors not influenced by risk management
Light work, respiration volume = 10 m^3/8-hour shift
Other given operational conditions affecting workers exposure
Outdoor use; Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.
Technical conditions and measures at process level (source) to prevent release
Ensure that the valves of the cylinders are tightly closed and not leaking; Handle substance within a closed system; Transfer via enclosed lines; Clear transfer lines prior to de-coupling.
Technical conditions and measures to control dispersion from source towards the worker
None
Organizational measures to prevent/limit releases, dispersion and exposure
Use of ATEX 137 and ATEX 95 Directives to mitigate flammability properties of HFO-1234yf and/or Chemical Substances at Work (Directive 98/24/EC); Use of ISO 13043 (April 15, 2011) (Road vehicles – Refrigerant systems used in mobile air conditioning systems (MAC) – Safety requirements) and SAE J639 (Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems), SAE J2843 (R-1234yf [HFO-1234yf] Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems) and SAE J2845 (Technician Certification for Service and Containment of Refrigerants Used in Mobile A/C Systems); Regular inspection and maintenance of equipment and machines.; Ensure operatives are trained to minimise exposures.
Conditions and measures related to personal protection, hygiene and health evaluation
Use eye protection to EN 166 or ANSI Z87.1, designed to protect against liquid splashes. Wear suitable gloves tested to EN374 or complying with U.S. OSHA guidelines.
1.3. Exposure estimation and reference to its source
ASSESSMENT METHOD: CS1: ECETOC TRA v.3. ; CS2 and CS3: Available measured data for HFC-134a were used to evaluate the worker exposure to HFO-1234yf. For comparison purposes only, ECETOC TRA v.3 was also used to estimate inhalation exposure for workers.

Information for CS1: Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Process and substance knowledge	**Initial release factor:** ERC7 assumes 5% **Final release factor:** 0% **Local release rate:** 0 kg/day **Explanation / Justification:** Substance is a liquefied gas.
Air	Henne et al., 2012; Reimann & Shallcross et al., 2011	**Initial release factor:** ERC7 assumes 5% **Final release factor:** ~1% **Local release rate:** ~350 kg/day across entire 27 EU countries plus Croatia, Norway, Switzerland, and Turkey (EU-27+) after 90% of fleet is converted and at a steady state. **Explanation / Justification:** 5 grams/charging event, which is approximately 1% of the total charge volume (500+ or – grams); Henne et al, 2012; Reimann & Shallcross et al., 2011.
Soil	Process and substance knowledge	**Initial release factor:** ERC7 assumes 5% **Final release factor:** 0% **Local release rate:** 0 kg/day **Explanation / Justification:** Substance is a liquefied gas.

The exposure concentrations and RCRs for both HFO-1234yf and its potential degradation product TFA are reported in ES4.

Information for CS2: Exposure concentrations and risks for worker

Route of exposure and type of effects	Exposure concentration	Source for exposure concentration	Exposure concentration and DNEL (or DMEL) units	DNEL (or DMEL)	Risk characterisation
Inhalation, systemic, long-term	37	Bureau Veritas North America, 2008; data generated on HFC-134a	mg/m^3	950	0.039
	190	TRA v.3 tool used to estimate exposure concentration for comparison purposes only			0.2
Inhalation, systemic, acute	Not needed	Not needed			Not needed
Inhalation, local, long-term	Not needed	Not needed			Not needed
Inhalation, local, acute	Not needed	Not needed			Not needed

Dermal, systemic, long-term	Not needed	Not needed			Not needed
Dermal, systemic, acute	Not needed	Not needed			Not needed
Dermal, local, long-term	Not needed	Not needed			Not needed
Dermal, local, acute	Not needed	Not needed			Not needed
Combined routes, systemic, long-term					0.039
Combined routes, systemic, acute					Not needed

The RCR for inhalation exposure was <1. This indicates that adverse impact to workers is not expected.

Information for CS3: Exposure concentrations and risks for worker

Route of exposure and type of effects	Exposure concentration	Source for exposure concentration	Exposure concentration and DNEL (or DMEL) units	DNEL (or DMEL)	Risk characterisation
Inhalation, systemic, long-term	37	Bureau Veritas North America, 2008; data generated on HFC-134a	mg/m^3	950	0.039
	50	TRA v.3 tool used to estimate exposure concentration for comparison purposes only			0.05
Inhalation, systemic, acute	Not needed	Not needed			Not needed
Inhalation, local, long-term	Not needed	Not needed			Not needed
Inhalation, local, acute	Not needed	Not needed			Not needed
Dermal, systemic, long-term	Not needed	Not needed			Not needed
Dermal, systemic, acute	Not needed	Not needed			Not needed
Dermal, local, long-term	Not needed	Not needed			Not needed
Dermal, local, acute	Not needed	Not needed			Not needed

Combined routes, systemic, long-term					0.039
Combined routes, systemic, acute					Not needed

The RCR for inhalation exposure was <1. This indicates that adverse impact to workers is not expected.

2.1. Exposure Scenario ES2

Professional Use, Heat Transfer Fluids – Refrigerants, Coolants

Professional uses: Public domain (administration, education, entertainment, services, craftsmen) (SU22)

Contributing environmental scenario CS1: Wide dispersive outdoor use of substances in closed systems (ERC9b). Quantified in ES4.

Contributing worker scenario CS2: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities (PROC8a)

Exposure Scenario 2 (ES 2) describes the activities and processes covered when professional workers service mobile or stationary A/C or refrigeration equipment. Although each of these workers may use different charge quantities of HFO-1234yf at different frequencies and in different professional settings, they all use equipment during the servicing procedure that is similar to the equipment used during industrial refrigerant charging or packaging. Therefore, professional workers have a similar potential for exposure as do industrial workers, except professional users process fewer units during the work shift and they are more likely to perform the work outdoors. If working indoors, however, their work space would likely be smaller than for industrial users. Therefore, a separate exposure scenario was deemed warranted. In general, the potential release to the environment is also the same between the various servicing workers (mobile and stationary) and industrial workers, de minimus release to only air as described in detail in ES1.

2.2.1 Contributing scenario CS1 controlling environmental exposure for ERC9b

Wide dispersive outdoor use of substances in closed systems

Assessed and quantified in ES4

Product characteristics

Low global warming potential (GWP) liquefied gas with a concentration of 100%; Not biodegradable

Amounts used

4000 tonnes per annum (tpa) – EU

Frequency and duration of use

Continuous use/release, 365 operating days/year; Intermittent release

Environmental factors not influenced by risk management

None

Other given operational conditions affecting environmental exposure

Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings. Conservatively assumed that approximately 6.4% of charge would be released if servicing completed by a skilled worker and that approximately 64% of charge would be

released if servicing completed by an unskilled worker (Henne et al, 2012) despite the fact that servicing is only allowed at professional service centers and completed by skilled workers.
Technical conditions and measures at process level (source) to prevent release
Process designed to minimize releases to wastewater; Process designed to minimize releases to soil; Ensure that the valves of the cylinders are tightly closed and not leaking; Handle substance within a closed system; Transfer via enclosed lines; Clear transfer lines prior to de-coupling.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
None
Organizational measures to prevent/limit release from site
None
Conditions and measures related to municipal sewage treatment plant
No STP
Conditions and measures related to external treatment of waste for disposal
Not applicable
Conditions and measures related to external recovery of waste
Not applicable
2.2.2 Contributing scenario CS2 controlling worker exposure for PROC 8a
Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
Product characteristic
Liquefied gas; Covers percentage substance in the product up to 100 % (unless stated differently); Assumes activities are at room temperature.
Amounts used
Mobile A/C: 0.5 kg/service event; Stationary Equipment: 0.05 – 300 kg/service event
Frequency and duration of use/exposure
Duration of use/exposure: Intermittent; Mobile A/C: ~1 minute/ 8-hour shift (0.083 minutes (5 seconds) per connecting process x 2 connecting processes per vacuuming/re-charging procedure x 1 servicing event per hour x 8 hours per shift) Stationary Equipment: ~< 1 minute/8-hour shift (0.083 minutes (5 seconds) per connecting process x2 connecting processes per vacuuming/ re-charging procedure x up to 4 servicing events per 8-hour shift) Frequency: 200 days/year
Human factors not influenced by risk management
Light work, respiration volume = 10 m^3/8-hour shift
Other given operational conditions affecting workers exposure
Indoor use; Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.
Technical conditions and measures at process level (source) to prevent release
Ensure that the valves of the cylinders are tightly closed and not leaking; Handle substance within a

closed system; Transfer via enclosed lines; Clear transfer lines prior to de-coupling.

Technical conditions and measures to control dispersion from source towards the worker

None

Organizational measures to prevent/limit releases, dispersion and exposure

Use of ATEX 137 and ATEX 95 Directives to mitigate flammability properties of HFO-1234yf and/or Chemical Substances at Work (Directive 98/24/EC); Use of ISO 13043 (April 15, 2011) (Road vehicles – Refrigerant systems used in mobile air conditioning systems (MAC) – Safety requirements) and SAE J639 (Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems), SAE J2843 (R-1234yf [HFO-1234yf] Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems)and SAE J2845 (Technician Certification for Service and Containment of Refrigerants Used in Mobile A/C Systems); EN 378 (Refrigerating systems and heat pumps – Safety and environmental requirements); Regular inspection and maintenance of equipment and machines.; Ensure operatives are trained to minimise exposures.

Conditions and measures related to personal protection, hygiene and health evaluation

Use eye protection to EN 166 or ANSI Z87.1, designed to protect against liquid splashes. Wear suitable gloves tested to EN374 or complying with U.S. OSHA guidelines.

2.3. Exposure estimation and reference to its source

ASSESSMENT METHOD: **CS1:** TRA v.3. **CS2:** Available measured data on HFC-134a were used to evaluate the professional worker exposure to HFO-1234yf. For comparison purposes only, TRA v.3 was also used to estimate inhalation exposure for workers.

Information for CS1: Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Activity and substance knowledge	**Initial release factor:** ERC9b assumes 5% **Final release factor:** 0% **Local release rate:** 0 kg/day **Explanation / Justification:** Substance is a liquefied gas.
Air	Henne et al., 2012	**Initial release factor:** ERC9b assumes 5% **Final release factor:** ~6.4% of initial charge if servicing by skilled workers; ~64% of initial charge if servicing by unskilled workers **Local release rate:** 4 580 kg/day across entire EU-27+. **Explanation / Justification:** Release estimates made by Henne et al., 2012 under the assumption that 90% of entire EU-27+ fleet is converted and at a steady state.
Soil	Activity and substance knowledge	**Initial release factor:** ERC9b assumes 5% **Final release factor:** 0% **Local release rate:** 0 kg/day **Explanation / Justification:** Substance is a liquefied gas.

The exposure concentrations and RCRs for both HFO-1234yf and its potential degradation product TFA are reported in ES4.

Information for CS2: Exposure concentrations and risks for worker

Route of exposure and type of effects	Exposure concentration	Source for exposure concentration	Exposure concentration and DNEL (or DMEL) units	DNEL (or DMEL)	Risk characterisation
Inhalation, systemic, long-term	85.6	Gjolstad et al., 2003; refrigeration repair workers' data generated on HFC-134a	mg/m^3	950	0.09
	5.1	Bureau Veritas North America, 2007; mobile A/C workers; data generated on HFC-134a			0.005
	240	TRA v.3 tool used to estimate exposure concentration for comparison purposes only			0.25
Inhalation, systemic, acute	Not needed	Not needed			Not needed
Inhalation, local, long-term	Not needed	Not needed			Not needed
Inhalation, local, acute	Not needed	Not needed			Not needed
Dermal, systemic, long-term	Not needed	Not needed			Not needed
Dermal, systemic, acute	Not needed	Not needed			Not needed
Dermal, local, long-term	Not needed	Not needed			Not needed
Dermal, local, acute	Not needed	Not needed			Not needed
Combined routes, systemic, long-term					0.09
Combined routes, systemic, acute					Not needed

The RCR for inhalation exposure was <1. This indicates that adverse impact to workers is not expected.

3.1. Exposure Scenario ES3
Formulation of preparations
Industrial uses : Uses of substances as such or in preparations at industrial sites (SU3) ; Formulation [mixing] or preparations and/or re-packaging (excluding alloys) (SU10) : General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment (SU17) excluding buses
Contributing environmental scenario CS1: Formulation of preparations (ERC2) (Covered by ES4)
Contributing worker scenario CS2: Use in closed batch process (synthesis or formulation) (PROC3)
Exposure Scenario 3 (ES 3) describes the activities and processes covered when workers blend various types of refrigeration substances and load the products into ISO containers or tanks. The blended products may contain up to nearly 100% of HFO-1234yf. Activities are expected to occur outdoors, but with the same equipment used during the charging and/or packaging procedures described in ES 1. In this process, however, yield rates are set at 99.75%. Therefore, potential releases to ambient air are expected to be < 0.25% and releases to wastewater and soil are expected to be at 0%. The equipment used for refrigerant blending and loading employs shut-off valve couplers that do not permit release of refrigerant unless a tight seal is made between the blending/filling equipment and the unit. In addition, blending/filling hoses are designed to be connected with the system prior to opening the valve(s) of the containers holding the substances. After blending operations are finished or the containers are filled, the valve(s) are closed prior to decoupling the hoses.
3.2.1 Contributing scenario CS1 controlling environmental exposure for ERC2
Formulation of preparations
Assessed and quantified in ES4
Product characteristics
Low global warming potential (GWP) liquefied gas; Covers percentage substance in the product up to 100 % (unless stated differently); Not biodegradable
Amounts used
5000 tonnes per annum (tpa) – EU; Daily amount: 25 000 kg/day – EU
Frequency and duration of use
Continuous use/8-hour shift, 200 operating days/year; Intermittent release
Environmental factors not influenced by risk management
None
Other given operational conditions affecting environmental exposure
Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings. Assumed 0.25% released to air (12.5 tpa), 0% released to wastewater and 0% released to soil.
Technical conditions and measures at process level (source) to prevent release
Process designed to minimize releases to wastewater; Process designed to minimize releases to soil; Ensure that the valves of the cylinders are tightly closed and not leaking; Handle substance within a closed system; Transfer via enclosed lines; Clear transfer lines prior to de-coupling.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
None

Organizational measures to prevent/limit release from site
Use of ATEX 137 and ATEX 95 Directives to mitigate flammability properties of HFO-1234yf and/or Chemical Substances at Work (Directive 98/24/EC); Regular inspection and maintenance of equipment and machines.
Conditions and measures related to municipal sewage treatment plant
No STP
Conditions and measures related to external treatment of waste for disposal
Not applicable
Conditions and measures related to external recovery of waste
Not applicable
3.2.2 Contributing scenario CS2 controlling worker exposure for PROC 3
Use in closed batch process (synthesis or formulation)
Product characteristic
Liquefied gas; Covers percentage substance in the product up to 100 % (unless stated differently); Assumes activities are at ambient temperature (unless stated differently).
Amounts used
Up to 2 500 kg/shift – worker, based on conservative yearly volume estimate and two shifts/day with five workers/shift
Frequency and duration of use/exposure
Intermittent; 8-hour shift; 200 days/year; Conservatively assumed less than 15 minutes exposure duration/worker, which is based on 70 to 100 connections per day with two shifts/day, five workers/shift, and 30 seconds potential exposure/connection.
Human factors not influenced by risk management
Light work, respiration volume = 10 m^3/8-hour shift
Other given operational conditions affecting workers exposure
Outdoor use; Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.
Technical conditions and measures at process level (source) to prevent release
Ensure that the valves of the cylinders are tightly closed and not leaking; Handle substance within a closed system; Transfer via enclosed lines; Clear transfer lines prior to de-coupling.
Technical conditions and measures to control dispersion from source towards the worker
None
Organizational measures to prevent/limit releases, dispersion and exposure
Use of ATEX 137 and ATEX 95 Directives to mitigate flammability properties of HFO-1234yf and/or Chemical Substances at Work (Directive 98/24/EC); EN 378 (Refrigerating systems and heat pumps – Safety and environmental requirements); Regular inspection and maintenance of equipment and machines.; Ensure operatives are trained to minimise exposures.
Conditions and measures related to personal protection, hygiene and health evaluation
Use eye protection to EN 166 or ANSI Z87.1, designed to protect against liquid splashes. Wear suitable gloves tested to EN374 or complying with U.S. OSHA guidelines.
3.3. Exposure estimation and reference to its source

ASSESSMENT METHOD: CS1 and CS2: ECETOC TRA v.3

Information for CS1: Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Process and substance knowledge	Initial release factor: ERC2 assumes 2% Final release factor: 0% Local release rate: 0 kg/day Explanation / Justification: Substance is a liquefied gas.
Air	Process and substance knowledge	Initial release factor: ERC2 assumes 2.5% Final release factor: ~0.25% Local release rate: 62.5 kg/day across EU-27+. Explanation / Justification: Based on process knowledge.
Soil	Process and substance knowledge	Initial release factor: ERC2 assumes 0.01% Final release factor: 0% Local release rate: 0 kg/day Explanation / Justification: Substance is a liquefied gas.

The exposure concentrations and RCRs for both HFO-1234yf and its potential degradation product TFA are covered and reported in ES4.

Information for CS2: Exposure concentrations and risks for worker

Route of exposure and type of effects	Exposure concentration	Source for exposure concentration	Exposure concentration and DNEL (or DMEL) units	DNEL (or DMEL)	Risk characterisation
Inhalation, systemic, long-term	17	TRA v.3 tool used to estimate exposure concentration	mg/m^3	950	0.018
Inhalation, systemic, acute	Not needed	Not needed			Not needed
Inhalation, local, long-term	Not needed	Not needed			Not needed
Inhalation, local, acute	Not needed	Not needed			Not needed
Dermal, systemic, long-term	Not needed	Not needed			Not needed
Dermal, systemic, acute	Not needed	Not needed			Not needed
Dermal, local, long-term	Not needed	Not needed			Not needed
Dermal, local, acute	Not needed	Not needed			Not needed
Combined routes, systemic, long-term					0.018

Combined routes, systemic, acute					Not needed

The RCR for inhalation exposure was <1. This indicates that adverse impact to workers is not expected.

4.1 Exposure Scenario ES4

Use, Service Life, and Waste Stage Environmental Exposure

Industrial uses : Uses of substances as such or in preparations at industrial sites (SU3) ; Formulation [mixing] or preparations and/or re-packaging (excluding alloys) (SU10) : General manufacturing, e.g.. machinery, equipment, vehicles, other transport equipment (SU17) excluding buses; Consumer uses : Private households (=general public = consumers) (SU21) ; and Professional uses : Public domain (administration, education, entertainment, services, craftsmen) (SU22).

Contributing environmental scenario CS1: HFO-1234yf: Wide dispersive outdoor use in closed systems (ERC9b); TFA: Wide dispersive outdoor use of long-life articles, high or intended release (ERC 10b).

Contributing worker scenarios: CS2: HFO-1234yf: Use and Service life (PROC 8a, 9) related to physico-chemical properties

According to Henne et al., 2012, an estimated 19.2 Gg/yr (19 200 tonnes per annum (tpa)) of HFO-1234yf may be emitted to the air from MACs once the conversion to HFO-1234yf in the automobile fleet is complete and at a steady-state (estimated to occur in the year 2020). This value represents the high emission scenario (95% confidence band) for the EU-27+. The 19 200 tonnes estimated to be released per year was based on a predicted car fleet of about 335 million, approximately 90% of which have the substance in the MAC, and on all the lifecycle activities for the HFO-1234yf, except for chemical manufacturing, which does not presently occur in the EU-27+.

4.2.1 Contributing scenario CS1 controlling environmental exposure for ERC9b, 10b

Wide dispersive use in closed systems (ERC9b); TFA: Wide dispersive outdoor use of long-life articles, high or intended release (ERC10b)

See ES1, 2, 3 above, respectively for conditions of use covered by ES4.

Predicted yearly emissions based on Henne et al 2012 and ES3 estimated releases

Activity	Potential amount released (g/MAC)	Percentage of original fill amount potentially released (%)	Fraction of automobiles with release	Henne et al emission factor (g/yr/MAC)	How Henne et al emission factor and/or fraction of automobiles with release determined	Predicted emissions for activity (tpa)
MAC filling at Original Equipment Manufacturers	5	0.9	0.9	0.42	5 g/MAC divided by 12 years (average MAC lifetime)	127
MAC refilling by skilled personnel	35	6.4	0.81	2.92	35 g/MAC divided by 12 years	792
MAC refilling by unskilled personnel	350	64	0.09	29.2	350 g/MAC divided by 12 years	880
Regular automobile usage	35.8	6.5	0.9	35.8	In-use car data for 2002/2003 with no loss rate improvement	10 794
Irregular usage (sudden leaks from accidents, stone impacts, and component defects)	550	100	0.017	550	All or original fill released; 1.9% cars/year times 90% of cars with HFO-1234yf in MAC	3 132
MAC dismantling by skilled personnel	100	18	0.25	8.33	100 g/MAC divided by 12 years	698
MAC dismantling by unskilled personnel	400	73	0.25	33.3	400 g/MAC divided by 12 years	2 789
					Total estimated emissions for ES1 and ES2	**~19 212**
Formulation of preparations (ES3)	Not applicable	Not applicable	Not applicable	Not applicable	0.25% of 5 000 tpa	12.5
					Total estimated emissions for ES1, ES2, and ES3	**~19 225**

4.2.2 Contributing scenario CS2 controlling worker exposure for Use and Service life (PROC 8a, 9) related to physico-chemical properties
Transfer of substance at non-dedicated facilities
Product characteristic
Extremely flammable liquefied gas; Covers percentage substance in the product up to 100 % (unless stated differently); Assumes activities are at ambient temperature (unless stated differently).
Amounts used
Mobile A/C: 0.5 kg/service event; Stationary Equipment: 0.05 – 300 kg/service event
Frequency and duration of use/exposure
Duration of use/exposure: Intermittent; Mobile A/C: ~1 minute/ 8-hour shift (0.083 minutes (5 seconds) per connecting process x 2 connecting processes per vacuuming/re-charging procedure x 1 servicing event per hour x 8 hours per shift) Stationary Equipment: ~< 1 minute/8-hour shift (0.083 minutes (5 seconds) per connecting process x2 connecting processes per vacuuming/ re-charging procedure x up to 4 servicing events per 8-hour shift) Frequency: 200 days/year
Human factors not influenced by risk management
None
Other given operational conditions affecting workers exposure
Indoor use; Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.
Technical conditions and measures at process level (source) to prevent release
Ensure that the valves of the cylinders are tightly closed and not leaking; Handle substance within a closed system; Transfer via enclosed lines; Clear transfer lines prior to de-coupling.
Technical conditions and measures to control dispersion from source towards the worker
None
Organizational measures to prevent/limit releases, dispersion and exposure
Use of ATEX 137 and ATEX 95 Directives to mitigate flammability properties of HFO-1234yf and/or Chemical Substances at Work (Directive 98/24/EC); Use of ISO 13043 (April 15, 2011) (Road vehicles – Refrigerant systems used in mobile air conditioning systems (MAC) – Safety requirements) and SAE J639 (Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems), SAE J2843 (R-1234yf [HFO-1234yf] Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems)and SAE J2845 (Technician Certification for Service and Containment of Refrigerants Used in Mobile A/C Systems); EN 378 (Refrigerating systems and heat pumps – Safety and environmental requirements); Regular inspection and maintenance of equipment and machines.; Ensure operatives are trained to minimise exposures.
4.3. Exposure estimation and reference to its source
ASSESSMENT METHOD: CS1: ECETOC TRA v.3

Information for CS1:
Predicted exposure concentrations and risk characterisation ratios for HFO-1234yf:

Protection target	Exposure concentration	Exposure concentration and PNEC units	PNEC	Risk characterisation
Sewage treatment plant (STP)	Not released to STP	mg/L	Not applicable	Not applicable
Freshwater	1.11E-10	mg/L	0.1	1E-09
Sediment (freshwater)	1.67E-09	mg/kg dry weight (dwt)	1.77	9E-10
Agricultural soil	1.97E-09	mg/kg dwt	1.54	1E-09
Marine water	3.19E-11	mg/L	0.01	3E-09
Sediment (marine water)	4.81E-10	mg/kg dwt	0.178	3E-09
Man via the environment (local)	3.28E-06	mg/kg body weight/day	271 (DNEL)†	1.21E-08

† The DNEL was derived by taking the worker inhalation, long-term, systemic DNEL of 950 mg/m^3 and converting it to a dose by multiplying by a presumed daily inhalation rate of 20 m^3/day and dividing by an adult body weight of 70 kg.

The RCRs for HFO-1234yf for all protection targets were all much less than 1. This indicates that adverse impact to the environment and environmental receptors is not expected from potential releases of HFO-1234yf during original filling, refilling, regular usage, irregular usage, and dismantling.

Predicted exposure concentrations and risk characterisation ratios for TFA if instantaneous conversion after HFO-1234yf vented to air:

Protection target	Exposure concentration	Exposure concentration and PNEC units	PNEC (ECHA, 2014)	Risk characterisation
Sewage treatment plant (STP)	Not released to STP	mg/L	Not applicable	Not applicable
Freshwater	1.06E-05	mg/L	1	1E-05
Sediment (freshwater)	5.86E-05	mg/kg dry weight (dwt)	4.22	1E-05
Agricultural soil	9.23E-06	mg/kg dwt	0.0083	1E-03
Marine water	9.14E-05	mg/L	0.1	9E-05
Sediment (marine water)	5.03E-05	mg/kg dwt	0.422	1E-04
Man via the environment (local)	1.12E-04	mg/kg body weight/day	0.25 (DNEL)	4E-04

The RCRs for TFA for all protection targets were all much less than 1. This indicates that adverse impact to the environment and environmental receptors is not expected from the potential conversion of HFO-1234yf to TFA during original filling, refilling, regular usage, irregular usage, and dismantling.

Assessment method for CS2: SAE International Cooperative Research Program 1234

Information for CS2:
Predicted exposure concentrations and physicochemical risk characterisation evaluation

HFO-1234yf is classified as an extremely flammable gas. This classification is based solely on the existence of a lower and upper flammability limit in air at 20°C. The flammability limits in air are 6.2%(V) and 12.3%(V) (method: ASTM E681-04). HFO-1234yf has a boiling point of -29,4 °C
and an autoignition temperature of 405°C. The auto-ignition temperature is very high and is of no concern during normal handling and use.

As HFO-1234yf is not classified as dangerous on the basis of (eco) toxicological properties, only the risk due to its flammable properties is required to be characterized. Exposure to HFO-1234yf within the confines of an automobile as a consequence of leaks due to random collisions is the worst-case situation as higher concentrations are more easily attained because HFO-1234 may escape in a shorter period of time than during a corrosion-type leak. Again, following a collision situation, a Micro automobile with effective volume of 1.25 m^3 was used to determine if the refrigerant's lower flammability level would be attained. In the most severe situation, 70% of the refrigerant is potentially leaked into the passenger cabin after a side impact collision. According to SAE J2772, breakage of other components would more likely lead to a significant release of refrigerant to the ambient air rather than to the passenger cabin. Results from this evaluation suggest that the refrigerant reaches a maximum concentration of 127 000 mg/m^3 (27 200 ppm), well below the lower flammability level of 62 000 ppm.

Exposure to HFO-1234yf due to worst-case corrosion-type leaks (slower gradual leaks) has been shown to reach a maximum concentration of below 2% in the luxury vehicle (maximum was 1.8% as tested); typical commuter vehicles have higher body air leakage and thereby lower maximum refrigerant concentrations (maximum was 1.2% as tested) than luxury vehicles due to the reduced road noise requirement for the higher end vehicles.