ICS 59.080.01 SLOVENSKÁ TECHNICKÁ NORMA September 2025

STN	**Textílie a textilné výrobky Per- a polyfluóralkylové látky (PFAS) Časť 1: Analýza alkalického extraktu s použitím kvapalinovej chromatografie a tandemovej hmotnostnej spektrometrie**	**STN EN 17681-1 80 8940**

Textiles and textile products - Per- and polyfluoroalkyl substances (PFAS) - Part 1: Analysis of an alkaline extract using liquid chromatography and tandem mass spectrometry

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 08/25

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EN 17681-1

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English Version

Textiles and textile products - Per- and polyfluoroalkyl substances (PFAS) - Part 1: Analysis of an alkaline extract using liquid chromatography and tandem mass spectrometry

Textiles et produits textiles - Substances perfluoroalkylées et polyfluoroalkylées (PFAS) - Partie 1 : Analyse d'un extrait alcalin par chromatographie en phase liquide et spectrométrie de masse en tandem

Textilien und textile Erzeugnisse - Per- und polyfluorierte Alkylverbindungen (PFAS) - Teil 1: Untersuchung eines alkalischen Extraktes mittels Flüssigkeitschromatographie und Tandem-Massenspektrometrie

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European foreword

This document (EN 17681-1:2025) has been prepared by Technical Committee CEN/TC 248 “Textiles and textile products”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2025, and conflicting national standards shall be withdrawn at the latest by October 2025.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 17681-1:2022.

This document includes the following significant technical changes with respect to EN 17681-1:2022:

— the title has been changed;

— the introduction has been amended;

— Table 1 has been revised;

— Table 2 has been reordered and updated with regard to new EU regulations; the majority of the substance names has been aligned with EN 17892:2024 [8]; 10:2 fluorotelomer methacrylate has been added;

— Clause 1: the scope has been changed considering extraction with simultaneous alkaline hydrolysis;

— Clause 2: EN 17681-2 has been deleted;

— 3.1, 3.2 and 3.3 have been added;

— Clause 4 has been changed, describing the extraction with simultaneous alkaline hydrolysis;

— Clause 5 and Clause 6 have been amended and reorganised;

— 7.1: the note has been deleted;

— 8.4 has been technically revised, describing the extraction with simultaneous hydrolysis;

— 9.3 and 9.4 have been rephrased and amended;

— 9.5 has been deleted, statistical data on the reliability are shown in Annex D;

— Clause 10 has been rephrased;

— Table A.1: the majority of the substance names has been aligned with EN 17892:2024 [8];

— Table C.1 has been integrated into Table 2 and former Annex C has been deleted;

— former Annex D has become Annex C;

— Annex D on the reliability of the test method has been added;

— Annex E describing the methanol extraction has been added;

— Annex F describing the analysis of certain PFAS with gas chromatography with mass selective detector (GC-MSD) based on EN 17681-2:2022 [9] has been added;

— Bibliography: further references have been added.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

In the European Union, several groups of per- and polyfluoroalkyl substances (PFAS) are restricted whether on their own, in mixtures or in articles.

Regulation (EU) 2019/1021 on persistent organic pollutants (POPs) [1] restricts:

— perfluorooctane sulfonic acid and its derivatives (PFOS);

— perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds;

— perfluorohexane sulfonic acid (PFHxS), its salts and PFHxS-related compounds (status September 2024).

Regulation (EC) No 1907/2006 (REACH), Annex XVII, Entry 68 [2] restricts:

— perfluorocarboxylic acids containing 9 to 14 carbon atoms in the chain (C9-C14 PFCAs), their salts and C9-C14 PFCA-related substances;

— perfluorohexanoic acid (PFHxA), its salts and PFHxA-related substances, in textiles in clothing and related accessories for the general public from 10 October 2026, in textiles other than in clothing and related accessories for the general public from 10 October 2027 [3] (status September 2024).

Restrictions of other groups of PFAS are subject to the REACH restriction process [4].

Additionally, several per- and poly-fluorinated alkyl substances (PFAS), which are not restricted under the EU-POPs or EU-REACH regulations have been added as substances of very high concern (SVHC) to the candidate list according to Regulation (EC) No 1907/2006 (REACH), Article 59 [2].

Some of the aforementioned restrictions can also concern side-chain fluorinated polymers if they are PFOA or C9-C14 PFCA-related substances. By using methanol as extraction solvent as described in EN 17681-1:2022 and EN 17681-2:2022, the presence of side-chain fluorinated polymers cannot be determined.

This document describes a method that will result in alkaline hydrolysis of certain side-chain fluorinated polymers during the extraction process by using a mixture of methanol and aqueous sodium hydroxide solution as extraction solvent. This extraction solvent cannot only extract residual PFAS from the sample, but also cleaves the polymers that are esters of polymerized hydrocarbon acids, such as acrylic acid, and *n*:2 fluorotelomer alcohols (*n*:2 FTOHs) to release *n*:2 FTOHs as a consequence. By quantifying the amount of *n*:2 FTOHs, one can indirectly assess whether the amount of side-chain fluorinated polymers consisting of polymerised hydrocarbon acids and *n*:2 FTOHs exceeds the limits for polymers that are related substances to perfluorocarboxylic acids, which are restricted under the relevant EU-POPs or EU-REACH regulations.

Since the group of PFAS consist of several thousand substances it is not possible to test for all of them in targeted testing, e.g. for many PFAS reference standards are not available. Therefore, CEN/TC 248/WG 26 "*Textiles — Test methods for analysis of EC restricted substances*", CEN/TC 289/WG 1 "*Chemical test methods*", CEN/TC 309/WG 2 "*Footwear and environmental aspects*" and ISO/TC 216/WG 2 "*Chemical Test methods for footwear and footwear components*" formed a joint working group which discussed which PFAS are likely to be found in textiles, textile products, leather and footwear materials. Based on test results and experiences provided by experts of the joined working group, the group agreed on the PFAS listed in Table 2 as lead substances which are recommended to be tested in order to significantly minimize the risk of PFAS contaminations in textiles, textile products, leather and footwear materials. Furthermore, it was considered to only include PFAS for which analytical reference standards were available. In addition, Table 1 was added to provide background information which categories of PFAS exist and for which purpose particular groups of PFAS are or were used.

EN 17681-1:2025 (E)

WARNING — The use of this document involves hazardous materials. It does not purport to address all of the safety or environmental problems associated with its use. It is the responsibility of users of this document to take appropriate measures to ensure the safety and health of personnel and the environment prior to application of the document and fulfil statutory and regulatory requirements for this purpose.

Table 1 — Examples of subgroups of PFAS and their applications

Subgroups of PFAS	Applications	
	Use	Sources of contamination[a]
K^+, Li^+, diethanolamine (DEA) salt	Surfactant for alkaline cleaners	Surfactant in fire-fighting foam, emulsifier in floor polish, mist suppressant for metal plating baths, surfactant for etching acids for circuit boards, pesticide active ingredient for ant bait traps
Amines	—	Mist suppressant for metal plating baths
Ammonium salts	—	Emulsifier for fluoropolymer production
Amphoterics	Water/solvent repellence for leather/paper	—
Carboxylates	—	Antistatic agent in photographic paper
Amides	—	Pesticide active ingredient
Oxazolidinones	—	Waterproofing casts (electronics)
Alcohols, silanes, alkoxylates, fatty acid esters, adipates, urethanes, polyurethanes polyesters, acrylates, polyacrylates	Soil and water repellence	—
Copolymers, phosphate esters	Water repellence	Soil, oil and water repellence for plates, food containers, bags, wraps, folding cartons, containers, carbonless forms, masking papers

[a] These substances are not relevant in the manufacturing process of textiles, but it is possible to find them as contaminants.

Table 2 — PFAS regulated in the EU and considered for regulation[1]

No.	Substance		CAS Registry Number® (CAS RN®)[a]	Applicable chromatographic system		EU regulation[1]
				Liquid chromatography	Gas chromatography see informative Annex F	
C4-C5 Perfluoro carboxylic acids						
1	PFBA	Perfluoro-*n*-butanoic acid	375–22–4	X	—	Included in a proposal to amend REACH Annex XVII
2	PFPeA	Perfluoro-*n*-pentanoic acid	2706–90–3	X	—	Included in a proposal to amend REACH Annex XVII
C4-C5 Perfluoro carboxylic acids related substances						
3	4:2 FTOH	4:2 Fluorotelomer alcohol	2043–47–2	X	—	Included in a proposal to amend REACH Annex XVII
Perfluoro hexanoic acid and salts[b]						
4	PFHxA	Perfluoro-*n*-hexanoic acid	307–24–4	X	—	REACH Annex XVII[j]
4.1[b]	APFHx	Perfluoro-*n*-hexanoic acid salts – Ammonium perfluoro-*n*-hexanoate	21615–47–4	X	—	REACH Annex XVII[j]
Perfluoro hexanoic acid related substances[c]						
5	6:2 FTOH	6:2 Fluorotelomer alcohol	647–42–7	X	—	REACH Annex XVII[j]
6[f]	6:2 FTA	6:2 Fluorotelomer acrylate	17527–29–6	—	X	REACH Annex XVII[j]
7[f]	6:2 FTMA	6:2 Fluorotelomer methacrylate	2144–53–8	—	X	REACH Annex XVII[j]
8	6:2 FTS	6:2 Fluorotelomer sulfonic acid	27619–97–2	X	—	REACH Annex XVII[j]

[1] Table 2 lists certain PFAS that are restricted or proposed for restriction according to the technical view of CEN/TC 248 of September 2024. The list is not exhaustive. Users of this document should pay attention for updated information. The assignment of the PFAS listed to specific regulations in the column “EU regulation” express the technical view of CEN/TC 248 and does not constitute legal advice. Users of this document remain responsible for their own compliance with the restrictions.

No.	Substance		CAS Registry Number® (CAS RN®)[a]	Applicable chromatographic system		EU regulation[1]
				Liquid chromatography	Gas chromatography see informative Annex F	
Perfluoro heptanoic acids						
9	PFHpA	Perfluoro-*n*-heptanoic acid	375–85–9	X	—	REACH (SVHC)
10	7HPFHpA	7H-Perfluoroheptanoic acid	1546–95–8	X	—	Included in a proposal to amend REACH Annex XVII
Perfluoro octanoic acid and salts[b]						
11	PFOA	Perfluoro-*n*-octanoic acid	335–67–1	X	—	POPs and REACH (SVHC)
11.1[b]		Perfluoro-*n*-octanoic acid salts		X	—	POPs
	APFO	– Ammonium perfluoro-*n*-octanoate	3825–26–1			
	Na-PFO	– Sodium perfluoro-*n*-octanoate	335–95–5			
	K-PFO	– Potassium perfluoro-*n*-octanoate	2395–00–8			
	Ag-PFO	– Silver perfluoro-*n*-octanoate	335–93–3			
Perfluoro octanoic acid related substances[c]						
12[e]	F-PFO	Perfluoro-*n*-octanoyl fluoride	335–66–0	X	—	POPs
13[e]	Me-PFOA	Methyl perfluoro-*n*-octanoate	376–27–2	—	X	POPs
14[e]	Et-PFOA	Ethyl perfluoro-*n*-octanoate	3108–24–5	—	X	POPs
15[g]	8:2 FTOH	8:2 Fluorotelomer alcohol	678–39–7	X	—	POPs and REACH Annex XVII
16[f]	8:2 FTA	8:2 Fluorotelomer acrylate	27905–45–9	—	X	POPs
17[f]	8:2 FTMA	8:2 Fluorotelomer methacrylate	1996–88–9	—	X	POPs
18	8:2 FTS	8:2 Fluorotelomer sulfonic acid	39108–34–4	X	—	POPs

No.	Substance		CAS Registry Number® (CAS RN®)[a]	Applicable chromatographic system		EU regulation[1]
				Liquid chromatography	Gas chromatography see informative Annex F	
C9-C14 Perfluoro carboxylic acids and salts[c]						
19	PFNA	Perfluoro-*n*-nonanoic acid	375–95–1	X	—	REACH Annex XVII and SVHC
19.1[b]	Na-PFN	Perfluoro-*n*-nonanoic acid salts – Sodium perfluoro-*n*-nonanoate	21049–39–8	X	—	REACH Annex XVII and SVHC
20	PFDA	Perfluoro-*n*-decanoic acid	335–76–2	X	—	REACH Annex XVII and SVHC
20.1[b]	NH4-PFD Na-PFD	Perfluoro-*n*-decanoic acid salts – Ammonium perfluoro-*n*-decanoate – Sodium perfluoro-*n*-decanoate	3108–42–7 3830–45–3	X	—	REACH Annex XVII and SVHC
21	PFUnA	Perfluoro-*n*-undecanoic acid	2058–94–8	X	—	REACH Annex XVII and SVHC
22	PFDoA	Perfluoro-*n*-dodecanoic acid	307–55–1	X	—	REACH Annex XVII and SVHC
23	PFTrDA	Perfluoro-*n*-tridecanoic acid	72629–94–8	X	—	REACH Annex XVII and SVHC
24	PFTeDA	Perfluoro-*n*-tetradecanoic acid	376–06–7	X	—	REACH Annex XVII and SVHC
25	PF-3,7-DMOA	Perfluoro(3,7-dimethyloctanoic acid)	172155–07–6	X	—	REACH Annex XVII

No.	Substance		CAS Registry Number® (CAS RN®)[a]	Applicable chromatographic system		EU regulation[1]
				Liquid chromatography	Gas chromatography see informative Annex F	
C9-C14 Perfluoro carboxylic acids related substances[c]						
26	4HPFUnA	2H,2H,3H,3H-Perfluoro-*n*-undecanoic acid	34598–33–9	X	—	REACH Annex XVII
15[g]	8:2 FTOH	8:2 Fluorotelomer alcohol	678–39–7	X	—	POPs and REACH Annex XVII
27	10:2 FTOH	10:2 Fluorotelomer alcohol	865–86–1	X	—	REACH Annex XVII
28[f]	10:2 FTA	10:2 Fluorotelomer acrylate	17741–60–5	—	X	REACH Annex XVII
29[f]	10:2 FTMA	10:2 Fluorotelomer methacrylate	2144–54–9	—	X	REACH Annex XVII
30	10:2 FTS	10:2 Fluorotelomer sulfonic acid	120226–60–0	X	—	REACH Annex XVII
Perfluoro octane sulfonic acid and its salts[d]						
31	PFOS	Perfluoro-*n*-octane sulfonic acid	1763–23–1	X	—	POPs
31.1[b]	PFOS-X	Perfluoro-*n*-octane sulfonic acid salts $C_8F_{17}SO_2X$ – Potassium perfluoro-*n*-octane sulfonate – Lithium perfluoro-*n*-octane sulfonate – Ammonium perfluoro-*n*-octane sulfonate – Bis(2-hydroxyethyl)ammonium perfluoro-*n*-octane sulfonate – Tetraethyl ammonium perfluoro-*n*-octane sulfonate – Didecyl(dimethyl) azanium perfluoro-*n*-octane sulfonate	2795–39–3 29457–72–5 29081–56–9 70225–14–8 56773–42–3 251099–16–8	X	—	POPs

No.	Substance		CAS Registry Number® (CAS RN®)[a]	Applicable chromatographic system		EU regulation[1]
				Liquid chromatography	Gas chromatography see informative Annex F	
Perfluoro octane sulfonic acid derivates[d]						
32	FOSA	Perfluoro-1-octanesulfonamide	754–91–6	X	—	POPs
33	*N*-MeFOSA	*N*-Methylperfluoro-1-octanesulfonamide	31506–32–8	X	—	POPs
34	*N*-EtFOSA	*N*-Ethylperfluoro-1-octanesulfonamide	4151–50–2	X	—	POPs
35	*N*-MeFOSE	2-(*N*-Methylperfluoro-1-octanesulfonamido)-ethanol	24448–09–7	X	—	POPs
36	*N*-EtFOSE	2-(*N*-Ethylperfluoro-1-octanesulfonamido)-ethanol	1691–99–2	X	—	POPs
37[h]	PFOSF	Perfluoro-1-octanesulfonyl fluoride	307–35–7	X	—	POPs
Perfluoro sulfonic acids and its salts[b]						
38	PFBS	Perfluorobutanesulfonic acid	375–73–5	X	—	REACH (SVHC)
39	PFHxS	Perfluoro-*n*-hexanesulfonic acid	355–46–4	X	—	POPs
40	PFHpS	Perfluoro-*n*-heptanesulfonic acid	375–92–8	X	—	Included in a proposal to amend REACH Annex XVII
41	PFDS	Perfluoro-*n*-decanesulfonic acid	335–77–3	X	—	Included in a proposal to amend REACH Annex XVII
42	4:2 FTS	4:2 Fluorotelomer sulfonic acid	757124–72–4	X	—	Included in a proposal to amend REACH Annex XVII

No.	Substance		CAS Registry Number® (CAS RN®)[a]	Applicable chromatographic system		EU regulation[1]
				Liquid chromatography	Gas chromatography see informative Annex F	
Perfluoro-2-propoxypropanoic acid its salts[b] and derivatives						
43	HFPO-DA	Perfluoro-2-propoxypropanoic acid	13252–13–6	X	—	REACH (SVHC)
43.1	HFPO-DA-X	Perfluoro-2-propoxypropanoic acid salts and acyl halides				
		X = F[i]	2062–98–8	X	—	REACH (SVHC)
		X = NH_4[b]	62037–80–3	X	—	
		X = K[b]	67118–55–2	X	—	

[a] CAS Registry Number® (CAS RN®) is a trademark of the American Chemical Society (ACS). This information is given for the convenience of users of this document and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.

[b] Salts cannot be identified by the method described in this document and only be quantified as the corresponding acid.

[c] If required legally or as agreed with the customer the results of related substances shall be summed up (9.3).

[d] If required legally or as agreed with the customer the results of PFOS and its derivates shall be summed up and calculated as PFOS (9.3).

[e] Substance is hydrolysed and releases PFOA when treated with methanol/sodium hydroxide solution (8.4). It contributes to the amount of PFOA if present in the sample.

[f] Substance is hydrolysed and releases related fluorotelomer alcohols (*n*:2 FTOH) when treated with methanol/sodium hydroxide solution (8.4). It contributes to the amount of the related *n*:2 FTOH if present in the sample.

[g] 8:2 FTOH can degrade to PFOA and is thus a PFOA-related substance [7]. It contains a $C_8F_{17}C$-moiety which is also characterized as a C9-C14 PFCA-related substance [5].

[h] Substance will convert to PFOS.

[i] Substance is hydrolysed and can only be quantified as HFPO-DA.

[j] Coming into force for textiles in clothing and related accessories for the general public from 10 October 2026, for textiles other than in clothing and related accessories for the general public from 10 October 2027 [3].

1 Scope

This document specifies a test method, including the degradation of certain side-chain fluorinated polymers during the extraction with simultaneous alkaline hydrolysis, and using liquid chromatography (LC) and tandem mass spectrometry (MS/MS) for identification and quantification of certain per- and polyfluoroalkyl substances (PFAS). The document is applicable to all materials of textile products.

Table 2 indicates a list of target PFAS which can be analysed with this document. PFAS of Table 2 marked with the footnote e) and footnote f) undergo alkaline hydrolysis and only their per- or polyfluorinated degradation products such as PFOA or *n*:2 fluorotelomer alcohols (*n*:2 FTOHs, *n* = 4, 6, 8, 10) can be determined.

Through the methods outlined in the informative Annex E and Annex F, free *n*:2 FTOHs, PFOA and non-polymeric PFAS of Table 2 marked with the footnote e) and footnote f), that are not stable to alkaline hydrolysis, can be identified and quantified.

Certain side-chain fluorinated polymers release *n*:2 FTOHs (*n* = 4, 6, 8, 10) under the described extraction conditions. Since these side-chain fluorinated polymers can be PFOA or C9-C14 PFCA-related substances restricted by the EU-POPs [1] or EU-REACH [2] regulations, the amounts of released *n*:2 FTOHs can be used to indirectly assess whether the concentration of the aforementioned side-chain fluorinated polymers exceed limits for PFOA or C9-C14 PFCA-related substances.

This document is also applicable to the determination of further PFAS, provided that the method is validated with the additional substances and that these PFAS are stable to alkaline hydrolysis and dehydrofluorination.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 3696, *Water for analytical laboratory use — Specification and test methods (ISO 3696)*

EN ISO 4787, *Laboratory glass and plastic ware — Volumetric instruments — Methods for testing of capacity and for use (ISO 4787)*

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