



BSI Standards Publication

Textiles and textile products — Per- and polyfluoroalkyl substances (PFAS)

Part 1: Analysis of an alkaline extract using liquid chromatography and tandem mass spectrometry

National foreword

This British Standard is the UK implementation of EN 17681-1:2025. It supersedes BS EN 17681-1:2022, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee TCI/100, Co-ordination of activities in textiles and clothing.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2025
Published by BSI Standards Limited 2025

ISBN 978 0 539 26412 8
ICS 59.080.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2025.

Amendments/corrigenda issued since publication

Date	Text affected

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

This European Standard was approved by CEN on 14 March 2025.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents

Page

European foreword.....	3
Introduction	5
1 Scope	14
2 Normative references	14
3 Terms and definitions	14
4 Principle	15
5 Reagents	15
6 Apparatus.....	16
7 Sampling.....	16
7.1 General.....	16
7.2 Sampling based on area	16
7.3 Sampling based on mass.....	17
8 Procedure.....	17
8.1 Preparation of stock solutions	17
8.2 Preparation of the check solution for recovery rate	17
8.3 Preparation of calibration solutions.....	17
8.4 Extraction and alkaline hydrolysis.....	17
8.5 Analysis.....	18
9 Expression of results.....	19
9.1 Calibration	19
9.2 Calculation of the results of individual PFAS	19
9.3 Calculation of the sums of certain PFAS.....	20
9.4 Limits of quantitation of the test method.....	20
9.5 Reliability of the test method	20
10 Test report.....	20
Annex A (normative) Usable ions and limits of quantification for PFAS analysis of sample matrix by LC-MS/MS	21
Annex B (informative) Interferences with LC-MS/MS.....	24
Annex C (informative) Instrumental conditions.....	25
Annex D (informative) Reliability of the test method.....	27
Annex E (informative) Extraction with methanol	30
Annex F (informative) Analysis with GC-MSD	31
Bibliography.....	40

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.

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, alkoxyates, 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 regulation¹

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- <i>n</i> -butanoic acid	375-22-4	X	Included in a proposal to amend REACH Annex XVII
2	PFPeA	Perfluoro- <i>n</i> -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- <i>n</i> -hexanoic acid	307-24-4	X	REACH Annex XVIIj
4.1 ^b	APFHx	Perfluoro- <i>n</i> -hexanoic acid salts – Ammonium perfluoro- <i>n</i> -hexanoate	21615-47-4	X	REACH Annex XVIIj
Perfluoro hexanoic acid related substances ^c					
5	6:2 FTOH	6:2 Fluorotelomer alcohol	647-42-7	X	REACH Annex XVIIj
6 ^f	6:2 FTA	6:2 Fluorotelomer acrylate	17527-29-6	—	REACH Annex XVIIj
7 ^f	6:2 FTMA	6:2 Fluorotelomer methacrylate	2144-53-8	—	REACH Annex XVIIj
8	6:2 FTS	6:2 Fluorotelomer sulfonic acid	27619-97-2	X	REACH Annex XVIIj

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	375-85-9	X	—	REACH (SVHC)
10	7HPFHpA	1546-95-8	X	—	Included in a proposal to amend REACH Annex XVII
Perfluoro octanoic acid and salts ^b					
11	PFOA	335-67-1	X	—	POPs and REACH (SVHC)
11.1 ^b	APFO	3825-26-1	X	—	POPs
	Na-PFO	335-95-5			
	K-PFO	2395-00-8			
	Ag-PFO	335-93-3			
Perfluoro octanoic acid related substances ^c					
12 ^e	F-PFO	335-66-0	X	—	POPs
13 ^e	Me-PFOA	376-27-2	—	X	POPs
14 ^e	Et-PFOA	3108-24-5	—	X	POPs
15 ^g	8:2 FTOH	678-39-7	X	—	POPs and REACH Annex XVII
16 ^f	8:2 FTA	27905-45-9	—	X	POPs
17 ^f	8:2 FTMA	1996-88-9	—	X	POPs
18	8:2 FTS	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- <i>n</i> -nonanoic acid	X	—	REACH Annex XVII and SVHC
19.1 ^b	Na-PFN	Perfluoro- <i>n</i> -nonanoic acid salts – Sodium perfluoro- <i>n</i> -nonanoate	X	—	REACH Annex XVII and SVHC
20	PFDA	Perfluoro- <i>n</i> -decanoic acid	X	—	REACH Annex XVII and SVHC
20.1 ^b	NH4-PFD Na-PFD	Perfluoro- <i>n</i> -decanoic acid salts – Ammonium perfluoro- <i>n</i> -decanoate – Sodium perfluoro- <i>n</i> -decanoate	X	—	REACH Annex XVII and SVHC
21	PFUnA	Perfluoro- <i>n</i> -undecanoic acid	X	—	REACH Annex XVII and SVHC
22	PFDoA	Perfluoro- <i>n</i> -dodecanoic acid	X	—	REACH Annex XVII and SVHC
23	PFTTrDA	Perfluoro- <i>n</i> -tridecanoic acid	X	—	REACH Annex XVII and SVHC
24	PFTTeDA	Perfluoro- <i>n</i> -tetradecanoic acid	X	—	REACH Annex XVII and SVHC
25	PF-3,7-DMOA	Perfluoro(3,7-dimethyloctanoic acid)	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- <i>n</i> -undecanoic acid	X	—	REACH Annex XVII
15 ^g	8:2 FTOH	8:2 Fluorotelomer alcohol	X	—	POPs and REACH Annex XVII
27	10:2 FTOH	10:2 Fluorotelomer alcohol	X	—	REACH Annex XVII
28 ^f	10:2 FTA	10:2 Fluorotelomer acrylate	—	X	REACH Annex XVII
29 ^f	10:2 FTMA	10:2 Fluorotelomer methacrylate	—	X	REACH Annex XVII
30	10:2 FTS	10:2 Fluorotelomer sulfonic acid	X	—	REACH Annex XVII
Perfluoro octane sulfonic acid and its salts ^d					
31	PFOS	Perfluoro- <i>n</i> -octane sulfonic acid	X	—	POPs
31.1 ^b	PFOS-X	Perfluoro- <i>n</i> -octane sulfonic acid salts C ₈ F ₁₇ SO ₂ X			POPs
		– Potassium perfluoro- <i>n</i> -octane sulfonate			
		– Lithium perfluoro- <i>n</i> -octane sulfonate			
		– Ammonium perfluoro- <i>n</i> -octane sulfonate			
		– Bis(2-hydroxyethyl)ammonium perfluoro- <i>n</i> -octane sulfonate			
		– Tetraethyl ammonium perfluoro- <i>n</i> -octane sulfonate			
		– Didecyl(dimethyl) azanium perfluoro- <i>n</i> -octane sulfonate			

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 derivatives ^d					
32	FOSA	754-91-6	X	—	POPs
33	<i>N</i> -MeFOSA	31506-32-8	X	—	POPs
34	<i>N</i> -EtFOSA	4151-50-2	X	—	POPs
35	<i>N</i> -MeFOSE	24448-09-7	X	—	POPs
36	<i>N</i> -EtFOSE	1691-99-2	X	—	POPs
37 ^h	PFOSF	307-35-7	X	—	POPs
Perfluoro sulfonic acids and its salts ^b					
38	PFBS	375-73-5	X	—	REACH (SVHC)
39	PFHxS	355-46-4	X	—	POPs
40	PFHpS	375-92-8	X	—	Included in a proposal to amend REACH Annex XVII
41	PFDS	335-77-3	X	—	Included in a proposal to amend REACH Annex XVII
42	4:2 FTS	757124-72-4	X	—	Included in a proposal to amend REACH Annex XVII