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European Chemicals Agency (ECHA)
Telakkakatu 6, 00150
Helsinki, Finland

RE: ECHA Annex XV Restriction Report: Per- and Polyfluoroalkyl substances (PFAS)

Dear Sir or Madam:

The American Petroleum Institute (API) respectfully submits the following comments and response to the European Chemicals Agency (ECHA) proposed restriction on per- and polyfluoroalkyl substances (PFAS) published on February 7, 2023. In this letter, API provides general comments on the proposed restriction, and API submits this letter jointly with an analysis of API standards that demonstrates the critical uses of PFAS in the natural gas and oil industry and in international standards and European regulations.

API is the U.S. national trade association representing all facets of the natural gas and oil industry, which supports 9.8 million U.S. jobs and 8% of the U.S. economy and provides critical energy to the European continent. While API represents North American--based companies, API members include multinational corporations with business in Europe and U.S. companies that trade with the European Union (EU), both of which would be significantly affected by the proposed PFAS restriction. API's approximately 600 members include large integrated companies, as well as exploration and production, refining, marketing, pipeline, marine businesses, and service and supply firms.

In addition, API is the global leader in convening subject matter experts across segments to develop, maintain, and distribute consensus standards and safety programs for the natural gas and oil industry. API's goal is to enhance operational safety, environmental protection, and sustainability across the industry, especially through the global adoption of standards. API standards are developed under the American National Standards Institute (ANSI) accredited process, ensuring that the API standards are recognized not only for their technical rigor but also for their third-party accreditation. This accreditation facilitates the incorporation of API standards into regulations by state, federal, and international regulators.

As outlined in this letter, API has significant concerns with aspects of ECHA's proposed PFAS restriction and encourages ECHA to reconsider components of the proposal, including the broad classification of all PFAS, the restriction of fluoropolymers that have not been scientifically shown to be harmful, and the lack of consideration of risk-based approaches. PFAS-containing equipment and materials in the natural gas and oil industry include polymeric seals, gaskets, valves, coatings, lubrication, flexible pipe sheath layers, electrical insulation, and more. These products prevent fugitive emissions, are paramount for the safe handling and transport of petroleum products and chemicals, avert fires, and are key components to large, vital equipment, such as motors, storage tanks, and heat exchangers which help supply affordable energy to society. If promulgated as proposed, this restriction would jeopardize the interests

this restriction aims to protect by creating significant unintended impacts on operational safety, trade, and global supply chains—resulting in fragmented markets, increased emissions, and possible harm to industry personnel and the environment

This letter accompanies an analysis of API standards that reference the direct use of PFAS in equipment and operations. Approximately 55 API standards reference specific PFAS, indicating their essential use in various equipment and materials across all segments of the natural gas and oil industry. While these standards reference PFAS directly, many more API standards require the use of PFAS-containing equipment that must meet certain criteria without mentioning the exact chemical characteristics of the equipment. For example, a standard may require a seal that meets temperature requirements and can withstand corrosive liquids, and while the standard does not strictly mandate the use of a fluoropolymer, polymeric seals are often the only ones that meet the criteria. The attached analysis provides further background on API standards and the role of PFAS therein.

API standards have been referenced more than 1,100 times in international laws, regulations, and national standards, and are referenced in various International Organization for Standardization (ISO) documents. These international references emphasize API standards' role in ensuring safe practices that optimize interoperability and efficiency while safeguarding environmental protection and human health. API's PFAS standards analysis identifies where the EU and Norway reference API and ISO standards in their national and international standards and regulations, underscoring the paramount role of PFAS in European natural gas and oil safety practices.

API appreciates ECHA's proposed 12-year derogation for the petroleum and mining sectors but urges ECHA to grant a permanent derogation for the essential uses of particular PFAS outlined below in all segments of the industry.[1] The use of PFAS-containing equipment and material in the natural gas and oil industry does not have viable alternatives that meet the unique, combined criteria of corrosion resistance, thermal tolerance, durability, excellent sealing properties, lubricity, dielectric strength, and low flammability. The accompanying analysis of API standards further demonstrates these critical uses. API encourages ECHA to justify the reasoning on selecting the specific 6 and 12 years of derogations; if an alternative is not in sight now, a viable alternative will improbably be available within 12 years, if ever. In addition, API requests that ECHA takes a risk-based approach, in lieu of a purely hazard-based approach, for each individual use of PFAS-containing equipment and material. A risk-based approach when assessing each use would identify and prioritize the risks to human health and the environment with the handling of the chemical and determine what is regulatorily required to safely manage those chemicals, which would minimize unintended consequences of a blanketed ban.

The ECHA proposal states: "...some PFASs have been documented as toxic and/or bioaccumulative substances, both with respect to human health as well as the environment. Without taking action, their concentrations will continue to increase, and their toxic and polluting effects will be difficult to reverse." API respects ECHA's mandate to protect human health and the environment and shares that mission. However, the majority of PFAS used in the natural gas and oil industry are fluoropolymers that are not water soluble or bioavailable, thus not posing a threat to environmental and human health. Moreover, the use of these fluoropolymers and fluoroelastomers is strictly within industrial operations, and consumers and the broader public do not come into contact with the PFAS-containing equipment that falls under this proposal.

[1] Including, but not limited to, exploration and production, refining, marketing, pipeline, marine transportation, and service and supply firms.

The proposal also utilizes the Organization for Economic Co-operation and Development (OECD) definition of PFAS published in 2021, but the same publication states, "the term 'PFAS' is a broad, general, non-specific term, which does not inform whether a compound is harmful or not."[2] The umbrella classification of PFAS in the proposal is a misrepresentation that falsely implies all PFAS are harmful, which is not the case. API urges ECHA to reconsider the definition of PFAS to exclude fluoropolymers since they have not been shown to be a threat.

The proposed restriction would compromise the EU's energy supply and climate neutrality goals and would cause major disruptions to trade, both with energy and fluoropolymer products. PFAS-containing equipment— such as fluoropolymeric seals for cryogenics, fugitive emission valves, centrifugal pumps, pipeline valves—is essential for liquefied natural gas (LNG) storage and transport. These components have no viable alternative and ensure safety by preventing emissions and product loss in LNG handling. In addition, other energy sources, such as photovoltaics and wind energy, use fluoropolymers on solar panels and wind turbines while LNG also plays a role in decreasing greenhouse gas (GHG) emissions. Preventing the use of these essential fluoropolymers would endanger these environmental goals and ultimate reduction of GHG emissions.

Fourteen European countries have LNG import facilities, and European LNG imports reached an all-time high in 2022 (16.5 billion cub feet per day (Bcf/d) on average in April 2022).[3] The U.S. (including API members) has become a critical supplier of LNG to Europe as the continent's demand has soared to compensate for the sharp decline in pipeline imports of natural gas from Russia that preceded its invasion of Ukraine. U.S. LNG exports to the continent increased by 141% in 2022 alone,[4] and they now represent Europe's second-largest source of natural gas.[5] Europe's ability to import and handle LNG – and accordingly, its energy security – would be significantly diminished if ECHA bans vital fluoropolymers used in facilities, tankers, and operations.

Beyond energy trade disruptions, the proposed restriction would create trade barriers and disrupt supply chains. European fluoropolymers have a high demand that is expected to strongly grow with a projected compounded annual growth rate (CAGR) of 6.5% (if undisrupted by the ban) and currently has a market size of 541.4 million Euros.[6,7] Key industries beyond the energy sector use these polymers in products and daily operations, including aerospace, electronics, machinery, automotive, medical devices, and more. Germany, France, and Italy are major consumers and Germany is the top producer in Europe. A ban on fluoropolymer products would lead to major supply chain and trade issues with both European manufacturers and consumers being directly affected. Moreover, Europe is a net exporter of fluoropolymers, so the negative economic impact of restricting their manufacturing would reverberate outside of Europe as international fluoropolymer consumers—including API members—would not have access to the specialty equipment that the EU supplies.

[2] https://one.oecd.org/document/ENV/CBC/MONO(2021)25/En/pdf
[3] https://www.eia.gov/todayinenergy/detail.php?id=52758
[4] https://www.eia.gov/todayinenergy/detail.php?id=55920
[5] https://features.csis.org/us-lng-remapping-energy-security/
[6] https://fluoropolymers.plasticseurope.org/application/files/1216/5485/3500/Fluoropolymers_Market_Data_Update_-_Final_report_-_May_2022.pdf
[7] https://www.mordorintelligence.com/industry-reports/europe-fluoropolymer-market

ECHA is already aware of the extreme complications of finding alternatives—if ever possible—for the use of fluoropolymers in the natural gas and oil industry. As Annex E Section 2.15.2.6 of the proposal underscores: "in the case of fluoropolymers, manufactures and suppliers have indicated that it could take a relatively long time (several years to several decades) to transition towards using alternatives that can achieve the same level of performance."[8] Furthermore, many of the PFAS products are replacement products and/or components of large, expensive pieces of equipment. Access to spares is imperative to maintain longevity of operations, energy affordability, and safety. If the EU bans these spare products from the market, it will lead to the premature obsolescence of field equipment with costly reverberations for years to come.

API has a strong interest in this proposed restriction on PFAS and recognizes ECHA's responsibility to safely regulate chemicals to protect the environment and human health. However, as stated with the reasons above, API asks ECHA to consider excluding fluoropolymers from the ban and to take a risk-based approach for other critical PFAS uses. API is actively engaged on issues related to PFAS and understands the complex public policy decisions regulators must make in addressing these chemicals' effects and environmental presence.

API appreciates the opportunity to provide feedback on ECHA Annex XV Restriction Report: Per- and Polyfluoroalkyl substances (PFAS) and would welcome further dialogue. Please do not hesitate to contact me ([redacted]@api.org, [redacted]) should you have any questions or comments, or require additional information.

Sincerely,

Alexa Burr
Vice President, Standards & Segment Services
Global Industry Services

[8] https://echa.europa.eu/documents/10162/8de11d7c-c56f-e204-5072-e89f11071219

ATTACHMENT 1 – API Standards: PFAS Analysis

The American Petroleum Institute (API) presents the following analysis on the critical role of per- and polyfluoroalkyl substances (PFAS) throughout the natural gas and oil industry, as well as the chemical industry. There are ongoing regulatory assessments of per- and polyfluoroalkyl substances (PFAS) in Europe by the European Chemicals Agency (ECHA) which could lead to broad scale restrictions on their manufacture, use, and sales in the EU market, with subsequent impacts on global markets. The United States is the primary supplier of liquefied natural gas (LNG) to the EU, and API members lead the effort to meet the EU's energy demand. As described below, PFAS are essential to LNG distribution and storage, with no viable alternatives that meet all property requirements, and the proposed restriction will compromise the U.S.'s ability to supply this critical energy to Europe. While PFAS producers will be directly impacted, the broader industrial use of these substances across sectors for other energy production, engineering, and chemical manufacturing (among others) purposes is anticipated to be significantly larger, affecting sectors, including chemical producers, pharmaceuticals, textiles, and product manufacturers across the globe.

API Background

Founded in 1919 as a standards developing organization (SDO), API serves as the global leader in convening subject matter experts across all segments of the natural gas and oil industry to establish, maintain, and distribute consensus standards. API is the primary U.S. trade association of the natural gas and oil industry with nearly 600 members involved in all aspects of the industry – exploration and production, midstream transportation, and refining and petrochemicals. Moreover, API develops and maintains more than 800 consensus-based standards to enhance operational safety, environmental protection, and sustainability across the industry, especially through the global adoption of these standards. API is accredited by the American National Standards Institute (ANSI), which ensures API standards are developed in a transparent, consensus-led process. API standards development is an open, balanced process that includes over 10,000 expert volunteers from the public and private sectors, over 2,000 of which are international participants that strengthen the standards' global applicability.

Companies across the globe use API standards, and over 31 markets adopt API standards for usage as national standards or technical regulations by governments to optimize regulatory efficiency and mandate safe industry practices. There are over 670 references to API Standards in the U.S. Code of Federal Regulations (CFR), 3,800 references to API standards in U.S. state regulations, and over 1,100 references by international regulators across 31 markets. Further, international standards organizations, such as the International Organization for Standardization (ISO), along with other global standards developers, incorporate and reference API standards in their documents, which are used in the EU and internationally.

PFAS in API Standards and Oil and Gas Equipment and Operations

The use of PFAS is essential to safe and sustainable global energy and manufacturing operations, as demonstrated by their use in API standards. In oil and gas industrial use, PFAS—especially fluoropolymers and fluoroelastomers—are critical for their high range of temperature tolerance, chemical resistance, low flammability, excellent sealing properties, physical durability, lubricity, high dielectric strength, hydrocarbon fluid containment in the bore of flexible pipes, low friction resistance, and more. API has approximately 55 standards that have specific reference to the use of PFAS as a critical safety element in various uses, including but not limited to:

- Various seals for storage tanks, hoses, valves, and more.

- Gaskets
- Valve seats and packing for various valves, such as ball valves, relief valves, and more.
- PTFE tape for emissions and loss of primary containment (LOPC) avoidance
- Coating of various equipment, such as pipes, bolts, nuts, and more.
- Flanges
- Fugitive emission packing and pump seals
- Electric grid insulation
- O-rings
- Lubrication
- Flexible pipe liner/pressure sheath layers
- Flexible hoses
- Tubes
- Compressors – reciprocating, centrifugal, and liquid ring
- Firefighting foam

API standards are performance-based—requiring or recommending action (including technology and quality certifications, and functional interchangeability) to ensure operational efficiency and safety, rather than being overly prescriptive in all aspects of the equipment and process. This performance-based approach allows standards users to be innovative with their processes and technology as long as they meet the basic safety and functional requirements. However, API standards can have prescriptive components that require certain materials and processes when critical for human or environmental safety and operational integrity. While PFAS is referenced and/or required in approximately 55 API standards, there are many more API standards that mandate PFAS-containing equipment and products without specifically mentioning the chemicals or each component of the equipment (i.e., a standard may require the use of a ball valve, which contains fluoropolymers in the valve seat, but the standard does not mention the many components that make up the valve).

The functional interchangeability of API standards enables the use of spare and sub-parts and products to maintain the longevity and reuse of deployed equipment. The continued market access to these parts and products that contain PFAS (such as seals, gaskets, liners, etc.) are essential to maintaining safe operation and avoiding premature obsolescence of deployed equipment covered in API standards. For example, a polymeric seal is required for an LNG storage tank. If the seal needs to be replaced, it is imperative that there is access to an adequate seal in the market to allow the LNG tank to remain usable.

See **Annex 1** for list of API standards with PFAS references and engineering justifications.

The list above and in **Annex 1** enumerates specific equipment and materials that contain PFAS, and these materials and devices are used ubiquitously throughout industry and are essential components of larger equipment, such as storage tanks (including LNG storage), pipelines, heat exchangers, motors and rotary equipment, heaters, depressurizing systems, and more.

For example, gaskets and seals are essential in the natural gas and oil industry by creating a tight and reliable seal between two pieces of equipment, such as valves, pipelines, flanges, pumps. These seals prevent leakage of liquids and gases, which is essential for safety, operational efficiency, and environmental protection. It is paramount that these gaskets and seals have extreme temperature tolerance (high and low), resistance to corrosive material, flexibility, strong durability, and pressure

resistance, all criteria that cannot be met without the use of fluorinated polymers and elastomers. More details on the essential role of other PFAS-containing equipment are included in **Annex 1**.

PFAS in Environmental Safety and Emissions Reduction

The sealing properties of the polymers and elastomers prevent environmental disasters and play a key role in the reduction of greenhouse gas emissions. The use of polymers to seal pipelines, storage tanks, and valves support the safe transport and handling of critical substances that could cause potential safety risks, environmental contamination, and loss of resources if the seals did not meet necessary properties that PFAS provide.

The demand for natural gas is growing exponentially in Europe and provides approximately 25% of the EU's energy supply, according to the European Commission[9]. In addition, the EU includes liquefied natural gas as a key tenet in the EU Energy Union Strategy, enhances energy security in a time of scarcity and war, and significancy reduces greenhouse gas emissions. Polymeric seals and gaskets are essential for the handling and transportation of LNG for storage tanks and pipeline transportation. These PFAS-containing seals tolerate the low temperatures (-162° C) for liquifying natural gas and help prevent fugitive emissions.

In addition, a majority of PFAS used in the natural gas and oil industry are fluoropolymers (PTFE, PVDF, FKM/FKKM) and fall under the category of polymers of low concern (PLC), as defined by the Organization for Economic Co-operation and Development (OECD).[10] A recent study published in *Integrated Environmental Assessment and Management*, a scientific journal, demonstrates that PVDF, FKM/FKKM, and other fluoropolymers meet the criteria of PLC.[11] The study does not address PTFE, but PTFE has also been confirmed to meet the PLC criteria, as shown in Table 2 of a separate article in the same journal. [12]

The proposed ban aligns with the OECD definition of PFAS, but the OECD report that defines PFAS, *Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance (2021)* also states, "the term 'PFAS' is a broad, general, non-specific term, which does not inform whether a compound is harmful or not." The fluoropolymers referenced in API standards and used in the natural gas and oil industry have been shown not to pose a threat to human or environmental health, as evinced by these studies and OECD PLC criteria and PFAS definition.

European Use and Reference of API Standards

At least 20 references to standards containing specific mentions of PFAS were identified in the policies, regulations, and guidance issued by relevant bodies in eight European states (see Table 1 below). As standards usage in most cases is voluntary and/or company-specific, this severely understates the usage rate of these API standards—but is intended to demonstrate how API standards utilizing PFAS are crucial to regulatory requirements for health and environmental safety in Europe. When standards are incorporated into policies and regulations, they become mandatory in order to meet a regulatory objective. The list below underscores the importance and reliance on API standards to protect human health and the environment across the EU and Norway.

[9] https://energy.ec.europa.eu/topics/oil-gas-and-coal/liquefied-natural-gas_en
[10] OECD Criteria for Polymers of Low Concern (PLC): https://www.oecd.org/env/ehs/risk-assessment/42081261.pdf
[11] https://setac.onlinelibrary.wiley.com/doi/epdf/10.1002/ieam.4646
[12] https://setac.onlinelibrary.wiley.com/doi/10.1002/ieam.4035#:~:text=We%20will%20show%20that%20fluoropolymers,human%20health%20and%20the%20environment.

Table 1: Examples of References of API Standards in EU and Norwegian National Policies

Denmark	*Guidelines for Drilling*	API 13B-1, Field Testing Water-based Drilling Fluids
Germany	*BVEG Guidelines: Well Integrity Guidelines (7/2021)*	API 6A, Wellhead and Tree Equipment
	BVEG Well Control: Drilling, Workover, Well Intervention (9/2015)	API 16A, Specification for Drill-through Equipment
	Announcement of the Technical Rule for Long-Distance pipelines according to § 9 Paragraph 5 of the Pipeline Ordinance	API standards for flanges, gaskets, bolts and nuts (including API 608, 600, 594, 623, 609, 526, 599; gaskets, bolt, and nuts are universal in O&G equipment in all segments.)
Greece	*Presidential Decree #64, Implementation of the Regulation for the Safe Refueling of Ships with Liquefied Natural Gas as Fuel (June 20, 2019)*	API 520-1, Sizing, Selection, and Installation of Pressure-relieving Devices, Part I—Sizing and Selection
		API 520-2, Sizing, Selection, and Installation of Pressure-relieving Devices, Part II—Installation
Italy	*Directorial Decree of 29 November 2004, Safety Requirements for Special Type Installations in Drilling Activities*	API 16A, Specification for Drill-through Equipment
Netherlands	*Mining Regulation of the Netherlands, January 2003*	API 17B, Recommended Practice for Flexible Pipe
		API 17J, Specification for Unbonded Flexible Pipe
Norway	*Guidelines regarding the Technical and Operation Regulations (2020)*	API 520-1, Sizing, Selection, and Installation of Pressure-relieving Devices, Part I—Sizing and Selection
		API 520-2, Sizing, Selection, and Installation of Pressure-relieving Devices, Part II—Installation
	Guidelines regarding Facilities Regulations (2020)	API 520-1, Sizing, Selection, and Installation of Pressure-relieving Devices, Part I—Sizing and Selection
		API 520-2, Sizing, Selection, and Installation of Pressure-relieving Devices, Part II—Installation
		API 17J, Specification for Unbonded Flexible Pipe, Recommended Practice for Flexible Pipe
	Guidelines regarding the Activities Regulations (2020)	API 17B, Flexible Pipe

Portugal	*Ministry of Economy, Innovation, and Development, Ordinance No. 137/2011* *Summary: Adopts, as Regulation of the Terminal for Reception, Storage and Regasification of Liquefied Natural Gas (LNG), the NP EN 1473 standard, "Installation and equipment for liquefied natural gas - Design of onshore installations"*	API 520-1, Sizing, Selection, and Installation of Pressure-relieving Devices, Part I—Sizing and Selection
		API 520-2, Sizing, Selection, and Installation of Pressure-relieving Devices, Part II—Installation
	Ministry of Economy, Ordinance No. 670/2001 *Summary: Adopts, as the Technical Regulation Relating to the Design, Construction, Operation and Maintenance of the Terminal, the EN 1473 standard.*	API 520-1, Sizing, Selection, and Installation of Pressure-relieving Devices, Part I—Sizing and Selection
		API 520-2, Sizing, Selection, and Installation of Pressure-relieving Devices, Part II—Installation
Spain	*Resolution of May 7, 2012, of the Secretariat of State for the Environment, which formulates Environmental Impact Declaration of the Development of the Montanazo and Lubina fields, Tarragona*	API standards pertaining to pipelines (API 17B, API 17J, API 15S)

*Note: this table is not all inclusive of European policies that reference API standards.

ISO Standards Utilizing PFAS

International Organization for Standardization (ISO) standards are widely used across Europe and incorporate PFAS as an essential element in the standards. API works to harmonize its standards with ISO standards, and conversely, ISO standards reference API standards and publications that require PFAS.

The 16 ISO standards below directly reference PFAS, as shown below. As noted above with API standards, many more ISO standards require the use of PFAS-containing equipment but do not directly reference the chemical:

- *ISO 12086, Plastics — Fluoropolymer dispersions and moulding and extrusion materials — Part 1: Designation system and basis for specifications*
- *ISO 23936, Oil and gas industries including lower carbon energy — Non-metallic materials in contact with media related to oil and gas production — Part 1: Thermoplastics*
- *ISO 10684, Fasteners — Hot dip galvanized coatings*
- *ISO 1629, Rubber and latices — Nomenclature*
- *ISO 16961 Internal coating and lining of steel storage tanks*
- *ISO 31800 Energy independent, prefabricates, community-scale, resource recovery units*
- *ISO 17782 Scheme for conformity assessment of manufacturers of special materials*
- *ISO 23936-2 Non-metallic materials in contact with media relation to oil and gas production – Part 2: Elastomers*

- *ISO 10423 Drilling and production equipment*
- *ISO 13628 Design and operation of subsea production system – Parts 3, 10, and 15*
- *ISO 10400 Formulae and calculations for the properties of casing, tubing, drill pipe, and line pipe used as casing or tubing*
- *ISO 11960 Steel pipes for use as casing or tubing for wells*
- *ISO 13678 Evaluation and testing of thread compounds for use with casing, tubing, line pipe and drill stem elements*
- *ISO 15463 Field inspection of new casing, tubing, and plain-end drill pipe*
- *ISO 27914 Carbon dioxide capture, transportation, and geological storage – Geological Storage*
- *ISO 27916 Carbon dioxide capture, transportation, and geological storage – Carbon dioxide storage using enhanced oil recovery*

Of these standards, 11 of the 16 above (excluding ISO 31800, ISO 27914, ISO 27916, ISO 1629, and ISO 12086) have been adopted directly by the European Committee for Standardization (CEN) as regional European Standards (EN), making them critical for European safety, manufacturing, trade, and industry operations. As a result, EU member states have adopted some or all these as national standards by their respective national standards bodies.

Additionally, ISO 12086 has been adopted as a national standard by:

- Austria
- France
- Italy
- Netherlands

European states and the EU also reference ISO standards in national policy and regulations. **Table 2** below shows some examples:

Table 2: Examples of ISO Standards Referenced in European Policy Measures

Country	Policy Measure	ISO Reference
European Union	*Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives*	ISO 27914
Germany	*WirtschaftsverbandErdöl- und Erdgasgewinnung e.V (WEG) Best Practice: Hydraulic Fracturing in Conventional Reservoir Rocks**	ISO 11960 ISO 10400

	*Wirtschaftsverband Erdöl- und Erdgasgewinnung e.V. Technical Rule: Casing Calculation**	ISO 11960 ISO 10400
France	*Legal Journal of France*	ISO 11960 ISO 10423 ISO 13678 ISO 15463
Norway	Petroleum Activities Regulations Guidelines	ISO 10423
	Petroleum Facilities Regulations Guidelines	ISO 10423 ISO 13628
	CO2 Safety Regulations Guidelines	ISO 27914

* *WirtschaftsverbandErdöl- und Erdgasgewinnung e.V* (Economic Association for Oil and Gas Production) is the national upstream oil and gas industry association for Germany. While German regulators do not issue them, regulators endorse their use, and industry operators follow them.

ISO standards are prominent in Europe, and as shown above, they are often mandated by regulation or encouraged to be used at the national and international level in Europe, including in all five countries that proposed the PFAS restriction. ISO standards are developed by international experts and approved by an international body that sets the basic safety and operational requirements. ISO standards establish a common framework for consistency, compatibility, and interoperability of industry equipment, processes, and regulations and are used by industry to streamline supply chains within and outside of the EU. If the ECHA proposal is passed, it would prevent compliance with these ISO standards where required, which could in turn, disrupt oil and gas operations throughout the continent and upend supply chains.

NATO Standards

Both API and ISO standards have a critical role in European regional security. The North Atlantic Treaty Organization (NATO) utilizes standards for military equipment and procedures for NATO members, and NATO standards often reference and mandate the use of civilian standards, including both API and ISO standards. NATO standards are classified, and therefore API cannot share further details. However, it is confirmed that API standards are referenced in NATO standards, and over 440 ISO standards are referenced in NATO standards.

Conclusion

API's analysis of API and ISO standards underscores the crucial role of PFAS in the natural gas and oil, chemical, and broader manufacturing industries, which supply the European continent with necessary energy in a time of scarcity. API appreciates the 13.5-year derogation in the proposal for the natural gas and oil, but if the proposed ban is passed as is, it will affect approximately all 600 API members integrated in all segments of the natural gas and oil industry, as well as have significant impacts on broader manufacturing industries. The risk of PFAS restriction in other industry sectors that may negatively impact the natural gas and oil sector should be carefully evaluated. The proposed ban would create impediments to industry operators and manufacturers that provide safe, reliable energy to the European continent and would present challenges to achieving carbon neutrality and greenhouse gas reduction goals.

Annex 1 – PFAS References in API Standards

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Downstream	**551**	Process Measurement	2	Refinery instruments use seals made of FFKM; Fluorinated polymers are required for installing oxygen instruments informative on fluoroelastomer temp limitations and material codes; references the use of fluoropolymer covers for horn antennas; PVDF: "the probe is insulated with a material with a high resistivity, e.g. PVDF, TFE, or a ceramic. PVDF maximizes the capacitance.	3.6.4; 7.3.8.3; 7.3.6.3	Trade names and material codes for materials are required and must comply with the relevant standards; long list of PFAS-containing materials included (3.6.3); an insulated probe is required as part of RF capacitance/admittance level transmitters when measuring conductive liquids; PVDF is recommended to maximize the capacitance. Refinery instruments rely on o-rings and special gasket to seal their components; FFKM is a preferred seal material because it has a higher operable temp (600F) and some grades are resistant to steam; For oxygen instrument installations, there is a high fire hazard and fluorinated polymers are required as opposed to other polymers because of their fire resistance and good lubricant performance, which decreases the risk of incident.	

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Downstream	**553**	Refinery Valves and Accessories for Control and Safety Instrumented Systems	2	4.22 Bonnet gaskets should be fully retained spiral wound with PTFE Explains the importance of PTFE for lubricating properties and how it is the most common valve packing material; 4.2.4 Fugitive Emissions: "FFKM (perfluoroelastomer) has excellent inertness and good lubricating properties"	4.22 and throughout informatively covering valve spec packing; 4.2.4: FFKM for fugitive emissions	Fluoropolymers and fluoroelastomers are critical and essential for the gasket and valve industries and safety in the oil and gas industries. PTFE, FKKM, and other PFAS-containing materials are used in these applications for optimal sealing and thermal and chemical tolerance that prevents fugitive emissions that compromise safety and harm the environment.	
Downstream	**574**	Inspection Practices for Piping System Components	4	Optional inspection to perform electrical conductivity test on fluoropolymer tube hose	10.5 Flexible Hoses	Fluoropolymer tubing withstands corrosive materials that react with metal tubing and is comprised of a chemically inert composition; fluoropolymers used for flexible tube hoses and tested to ensure electrical continuity;	
Downstream	**584**	Integrity Operating Windows	2	7.4 "temperatures higher than 300F will cause permanent damage to PTFE brushing that insulate the electric grids"	7.4	The PTFE insulation material for electric grids allows them to operate in harsh environments due to the material's high dielectric strength, resistance, flexibility, and excellent thermal and electrical properties. On the insulation of electric grids it cannot exceed 300F.	
Downstream	**588**	RP for Source Inspection and Quality Surveillance of Fixed Equipment	1	13.3.10 "generally the spiral wound gasket has a metal alloy wound outwards in a circular spiral with a filler material (PTFE);	13.3.10 informatively	spiral round gaskets are made of a metallic strip with a filler material. PTFE is often used as the filler material for optimal salability, inherent resiliency, and gasket blowout resistance.	

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Downstream	**608**	Metal Ball Valves-Flanges, Threaded, and Welding Ends	5	4.3.1 Seat Rating for PTFE and R-PTFE: valves employing PTFE or modified PTFE seats and valves…shall have pressure-temperature ratings equal or higher than the values shown in Table 1 and 2; normative by requiring rating for the PTFE valves	4.3.1; 4.3.2; Table 1 and 2	the ball valve industry for petroleum and petrochem could not exist without PTFE, which is used in the lining, seats, and packing. The valves contain an upstream and downstream seat that keep liquids or gases from escaping. PTFE is the material used for seating because of its flexible, extreme durability, chemical resistance, and high temperature range, all which support safety when dealing with hazardous materials. It is required to select the pressure and temperature ranges with the tables in API 608. PTFE, FKM, and other fluoropolymers are used for packing with ball valves (see 662 and 553), which prevents fugitive emissions.	
Downstream	**609**	Butterfly Valves	9	Same info as in 608 (4.3.1); normative by requiring rating for the PTFE valves	4.3.1	Same justification applies to butterfly valves as it does to ball valves (API 608) (and other types of valves)	
Downstream	**610**	Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries	12	Perfluoroalkoxy (PFA) in Table H.3 (nonmetallic wear part materials); PTFE - coating requirements	Annex H (normative annex) for PFA; PTFE - 7.6.1.7; requires PTFE or another material acceptable to purchaser; included in table H.1.	Specifies PTFE coating requirements for equipment, which is a preferred coating material.	

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Downstream	**621**	Reconditioning of Metallic Gate, Globe, and Check Valves	5	Figure B.4: PTFE V-ring Packing Arrangement; informative info on gasket types with PTFE throughout	Figure B.4 in normative annex	PTFE is used for valve packing due to its resilience and excellent sealing properties. Packing in valves stops leakage between the stuffing box and the stems, thus preventing fugitive emissions that compromise safety and are environmentally injurious.	
Downstream	**622**	Type Testing of Process Valve Packing for Fugitive Emissions	2	PTFE Content Determination in Lubricant	6.3.1	PTFE is used in lubricants due to its low coefficient of friction (higher lubricity); PTFE is used for valve packing due to its resilience and excellent sealing properties. Packing in valves stops leakage between the stuffing box and the stems, thus preventing fugitive emissions that compromise safety and are environmentally injurious.	
Downstream	**650**	Welded Tanks for Oil Storage	13	Informative table for guidance on seal material for fluid stores (crude oil, refined products, gasoline): each includes fluoropolymers and/or fluoroelastomers as a guidance (along with other materials))	H.4.4.2	PFAS are essential in seals for tanks for oil storage and LNG storage (which requires cryogenic temperatures that fluoropolymers and fluoroelastomers can withstand); the fluoropolymer and fluoroelastomeric has high thermal and chemical resistance required for sealing storage tanks.	ISO 16961: 2015; ISO/DIS 16961; ISO 31800:2020;
Downstream	**660**	Shell and Tube Heat Exchangers		use of PTFE as a filler material in gaskets	Table 3	Table 3 outlines Assembly Gasket Stress, which is based on the use of facing layers or filler materials (such as PTFE). PTFE is often used as the filler material for optimal sealability, inherent resiliency, and gasket blowout resistance. Gasket stresses are required to comply with the table…	

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Downstream	**661**	Air-cooled Heat Exchangers	7	7.2.10.10: the exposure temperature shall not exceed 150 C for PTFE base composite bearing material 8.4.2: louver bearings shall be of either PTFE base material …….or an approved alternative	7.2.10.10 and 8.4.2	Louver bearings use PTFE to withstand the high temperatures for the heat exchangers.	
Downstream	**664**	Spiral Plate Heat Exchangers	1	7.8.1: gasket cover sheet material shall be non-asbestos compressed fiber, PTFE, graphite, or equal; this is determined by the user for which option best fits their needs.	7.8.1	The only non-metallic components of these exchangers are the gaskets made up of PTFE and FKM for its resistance and resiliency.	
Downstream	**667**	Plate-and-Frame Heat Exchangers	1	Standard gives requirements and recommendations for the mechanical design, materials selection, fabrication, inspection, testing, and preparation of gasketed plate heat exchangers. The standard gaskets for these units are elastomeric, where fluoropolymers, FKM, FKKM, and similar materials are used		Fluoropolymer and fluoroelastomers are required in the gasket industry, especially with gasketed plate heat exchangers, due to its for optimal sealability, inherent resiliency to chemicals, high range of temperature tolerance, and gasket blowout resistance.	

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Downstream	**670**	Machinery Protection Systems	5	C.3 (normative annex): Cable material limits shall be considered. For example, PTFE-insulated cables cannot normally be used above 200C; mention of elastomeric material for sealing (6.2.4.6)	C.3	Fluoroelastomers used for sealing and PTFE-insulated cables used without as long as it is below 200C (approx. 400C). It is often the preferred material and has higher temperature tolerance than other materials.	
Downstream	**675**	Positive Displacement Pumps	3	references ASTM standards for FKM and FFKM (ASTM D1418)	Annex B	ASTM D1418 is the standard practices for rubber and rubber latices--Nomenclature; this document classifies and codes rubbers according to chemical composition of the polymer chain	

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Downstream	**682**	Pumps-shaft sealing systems for centrifugal and rotary pumps	4	6.1.1.10 "o-ring grooves shall be sized to accommodate perfluoroelastomer (FFKM) O-rings (includes important note under this requirement) 6.1.6.5.2: requires the use of FFKM for secondary seals O-rings. B.3.3.2.3 FFKM has a PTFE polymer base and is not typed like FKM. The chemical inertness of the full fluorinated backbone allows excellent resistance to acids and bases, oxidizers, water and hydrocarbons. Special FFKM compound are required for amine and steam service Seal Selection Guide (annex A) recommends families FKM and FFKM based on successful user experience Many PFAS throughout this doc (PTFE, FKM, FFKM). Mostly recommends FFKM throughout doc.	6.1.1.10; B.3.3.2.3, Annex A recommends FFKM throughout	O-rings are comprised of FKM, FFKM, PTFE, or other fluoroelastomeric and fluoropolymeric materials due to the sealing properties, chemical inertness, thermal resistance, etc.	

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Downstream	**692**	Dry Gas Sealing Systems for Axial Centrifugal, Rotary Screw Compressors, and Expanders	1	6.8.3 Abradable Seals contain PTFE in the stationary component of the seal; underscores use of PTFE as polymer seal throughout the standard	6.10; F.3.1; 6.8.3; H.6.2	Fluoropolymers used for dry gas seals due to its resiliency against gas and chemicals; used in stationary component of abradable seals for durability against the rotating labyrinth teeth.	
Downstream	**939-D**	Stress Corrosion Cracking of Carbon Steel in Fuel-Grade Ethanol	2 A1	"[API report 1132] showed that most companies increase their usage of FKM and PTFE for elastomer parts subjected to static sealing and dynamic sealing while in contact with gasoline containing oxygenates"	Informative and referencing API Report 1132	FKM and PTFE selected due to their chemical and fire resistance, which is a major hazard with gasoline containing oxygenates (additive).	
Downstream	**2001**	RP on Fire Protection in Refineries	10	informative: use of AFFF as fire fighting foam		Aqueous film forming foam (AFFF) is made from PFAS and is highly effective for fighting hazardous flammable liquid fires, such as oil and gasoline.	
Downstream	**2021**	Management of Atmospheric Storage Tank Fires	4	Details PFAS-containing firefighting foam (AFFF) and SFFF; currently under revision		Aqueous film forming foam (AFFF) is made from PFAS and is highly effective for fighting hazardous flammable liquid fires, such as oil and gasoline; Synthetic Fluorine Free Foams (SFFF) do not contain PFAS	

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Downstream	**12B**	Specification for Bolted Tanks for Storage of Production Liquids	17	4.8.1: "the head of the bolt shall be encapsulated with PVDF, ABS, or polyester, and a sealing ring shall be molded under the head of the bolt 4.8.2" nuts in contact with stored liquid shall be protected with threaded PVDF nut caps"	4.8.1; 4.8.2	PFAS coating required for resiliency and fluoropolymeric seals required for its excellent resiliency and sealing qualities.	ISO 27916:2019
Downstream	**520-1**	Sizing, Selection, and Installation of Pressure-relieving Devices Part 1	9	Includes mentions of fluoroelastomers in the Table D.1 - Instructions for Spring-loaded PRV Specification Sheet	Table D.1	Fluoroelastomeric and fluoropolymeric materials used in pressure-relief valve manufacture specification for its excellent sealing properties, which optimizes operational safety.	
Downstream	**520-2**	Sizing, Selection, and Installation of Pressure-relieving Devices	7	states fluoropolymers gaskets are suitable	A.3 Gasket Selection	Fluoropolymer gaskets are used for its resistance to chemical abrasion, heat resistance, insulation, and more, which is ideal for high pressure devices.	
Midstream	**14.1**	MPMS Chapter 14 Section 1	7	11.5 "floating Piston cylinders should have the following features….PTFE seals or equivalent”	11.5	PTFE used for durable and excellent sealing properties.	

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Upstream	**1PER15K-1**	Protocol for Verification and Validation of High-pressure High-temperature Equipment	1	PTFE (Teflon), RYTON, perfluoroelastomer, fluoroelastomers, and more are detailed throughout the doc for elastomeric seals, general nonmetallic seal properties, mechanical properties, and temperature resistant properties. Document also details the effects of gas, chemicals, heat, and more on elastomers. 6.1.7.8 qualification of seals and manufacturers Table 7 and 8	entire document	PTFE and other fluoropolymers and fluoroelastomers used for the sealing to ensure impermeability, chemical resistance, thermal resilience, etc.	
Upstream	**11S4**	RP for Sizing and Selection of Electrical Submersible Pump Installations	1	Includes max. service temps for fluoroelastomers and TFE/P (partially fluorinated polymer);	8.2.1	Standards includes considerations for seal selection, and operating temperature is a point for consideration. Maximum service temperatures for multiple elastomers included; Fluoroelastomer compounds have highest heat resistance	

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Upstream	**11S5**	RP for the Application of Electrical Submersible Cable Systems	1	Definitions section includes many references to PFAs- fluoropolymers, PVF, ECTFE, PVDF. However, not directly mentioned in the body, but the doc is short and the definitions are used as background on the RP for application.	Definitions	PFAS, especially fluoropolymers) used in electrical submersible cable systems for the material's high dielectric strength, chemical and liquid resistance, flexibility, and excellent thermal properties.	
Upstream	**11S7**	RP for Application and Testing of Submersible Pump Seal Chamber Section	1	Includes max. service temps for fluoroelastomers and TFE/P (partially fluorinated polymer);		Standard includes considerations for seal selection, and operating temperature is a point for consideration. Maximum service temperatures for multiple elastomers included; Fluoroelastomer compounds have highest heat resistance	
Upstream	**13B-1**	Field Testing Water-based Drilling Fluids	5	A.5.2.6 in Normative Annex: requires the use of stopcock valve that are made of PTFE components in testing drilling fluids.	A.5.2.6 and throughout	Stopcock valve is required to test for soluble carbonates in a drilling fluid system; the stopcock requires PTFE material for sealing and corrosion resistance.;	ISO 13501:2011 ISO 10416:2008 (2003 version of 13B-1) ISO 11961:2018 ISO 10414-1:2008

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Upstream	**13k**	RP for Chemical Analysis of Barite	4	6.4 Sample preparation and testing requires PTFE acid digestion vessel, cells, plug, and stirring rod; includes the required step-by-step use of PTFE in the procedures for the chemical analysis	6.4 and throughout	PTFE acid digestion vessel, plug, cells, and stirring rod required for chemical testing because of its extreme chemical resistance properties that makes the testing possible.	
Upstream	**13l**	Lab Testing of Drilling Fluids	9	recommends use of PTFE inserts and liners throughout	14.3.4.5, 14.3.7; 15.2.2; 15.3.2.4:	PTFE inserts, stirrers, and liners used throughout in the testing equipment for its durability when interacting with testing substances.	
Upstream	**14G**	RP for Fire Prevention and Control on Fixed Open-type Offshore Production Platforms	4	"examples of active fire protection systems would be fire water, AFFF, CO, or dry chemical systems"	9.1	Aqueous film forming foam (AFFF) is made from PFAS and is highly effective for fighting hazardous flammable liquid fires, such as oil and gasoline	
Upstream	**15CLT**	RP for Composite Lined Steel Tubular Goods	1	PTFE in corrosion barrier (CB) ring manufacture; shall be determined by ASTM D4745; mentions that CB rings are made from PTFE	6.2; 4.2; throughout	Corrosion barrier rings are filled with PTFE for thermal resistance and physical resilience. They are required to be specified according to ASTM D4745 - Standard Classification System and Basis for Specification for Filled PTFE Molding and Extrusion materials	

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Upstream	**16A**	Specification for Drill-through Equipment	4	Fluoroelastomer (Viton) requires fluoroelastomer compound marking code when used for nonmetallic components, such as seals and ring gaskets; the marking required for the material must comply with ASTM D1418. Provides temperature ratings and requirements for nonmetallic seals.	table 4 table 43	If FKM is used as the nonmetallic seal or gasket, it must be marked as per ASTM D1418. Its use is determined by the experts based on specific criteria needed for the drilling equipment. It is often used in applications that require high tolerance for a wide range of chemicals and temperatures. Table 4 provides temperature ratings and requirements for nonmetallic seals (i.e. fluoropolymers). In addition, coatings that contain PTFE, PFA and FEP (e.g., Xylan) may be used by many OEMs to provide a low friction, corrosion resistant coating on parts inside and outside the pressure containing assemblies. They are typically applied by spraying or brushing and then baked.	

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Upstream	**17B**	RP for Flexible Pipe	5	This document focuses heavily on the use of Polyvinylidene Fluoride (PVDF) throughout the entire doc, mostly focused on PVDF layers in piping (PVDF-based pipes); Fluoropolymer coatings referenced in sections addressing corrosion-resistant coatings for end fittings, they are commonly used for end fittings	Throughout the entire document, including annexes tailored to just PVDF; Fluoropolymers coating references for end fittings (6.2.5 and 6.3.4)	PVDF is used in piping for resiliency, chemical resistance, thermal tolerance, and flexibility.	
Upstream	**17D**	Specification for Subsea Wellhead and Tree Equipment	3	"adherent coatings, such as PTFE... are acceptable on the flange working surfaces"	Annex F	The coating is used for its high temperature properties, a low coefficient of friction, and chemical and abrasion resistance. Some fluoropolymer coatings can reach up to 500F.	

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Upstream	**17F**	Standard for Subsea Production Control Systems	4	Annex C: qualification test of control fluids: "select aging vessels that are of 316 or better quality stainless steel for wetted components. An inner lining of PTFE is recommended" C.11: "cervices shall be formed by PTFE washers…and PTFE O-rings"; included informatively throughout the annex and document; Includes info on fluoroelastomer compatibility	Annex C	Fluoroelastomer seals are essential for subsea exploration and production and well equipment for sealing properties, resistance to corrosive material, and resiliency with sour oil and gas. The fluoroelastomeric high temperature tolerance is required in these operations.	
Upstream	**17TR1**	Evaluation Std for Internal Pressure Sheath Polymers for High Temperature Flexible Pipes	1	Highly technical informative details about PVDF properties as part of internal pressure sheath for high temp. flexible pipes throughout Annex A and F and mentioned in section 7; many mentions of polymers for high temp. flexible pipes throughout	Annex A, Annex F, and 7.3.3	PVDF used in piping (especially flexible piping) for resiliency, chemical resistance, thermal tolerance, flexibility, and pressure tolerance.	

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Upstream	**17TR8**	High-pressure High-Temperature Design Guidelines	2 A1	Elastomeric seals and nonmetallic seals mentioned throughout: B.5: elastomer seal system is likely to contain a mixture of metallic materials for packing retainsers….it is important to ensure that elastomer sealing configurations provide equivalent sealing protection to the metallic sealing protection systems.	B.5 and seals/elastomeric seals mentioned throughout	Fluoroelastomeric seals used as non-metal sealing for its strong chemical resistance, sealing properties, thermal properties, and durability.	
Upstream	**17J**	Specification for Unbonded Flexible Pipe	4 A1	Table 8-Flexible Pipe Layer Design Criteria: gives max. allowable bending strain for PVDF in static applications and for storage in dynamic applications. "for quasi-dynamic and dynamic-supported applications, higher maximum bending strain shall be allowed for PVDF, if validated by testing	Table 8; 5.3.2.1.5	PVDF used in piping (especially flexible piping) for resiliency, chemical resistance, thermal tolerance, and flexibility; however, bending strain max. allowance must be taken into consideration when using in operations.	

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Upstream	**19D**	Measuring Conductivity of Proppants	2	6.1.2 Sealing Rings: "testing at all temperatures shall use rings made of higher temperature fluoro-rubber (FKM), such as Viton (trademark name)	6.1.2	FKM and fluoroelastomers required for high temperatures because of its high temp. tolerance	
Upstream	**20G**	Welding Services for Equipment Used in Petroleum and Natural Gas Industry		Informative checklist in Annex A, Weld Supplier Audit Process. PTFE related question asks if tubes are made of PTFE or other suitable material for gas; while informative and in a checklist, the question underscores that PTFE is a good material for gas lines and tubes to avoid leakage or avoid use of poor quality/porous material	A.8	PTFE used in tubing and gas lines for chemical resilience, corrosion and heat resistance, sealing properties, and overall durability while maintaining flexibility.	

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Upstream	**21TR1**	Materials Selection for Bolting	E2 A2	Fluoropolymer: 4.6.4 reference of fluoropolymer as the typical topcoat for lubricity required for uniform torque. Use of FP as nonmetallic coatings for a combination of corrosion resistance, wear resistance, and lubricity. PTFE: 4.6.3: typical coatings and plating used in oil and gas industry includes PTFE-based coating; specifies lubricity of PTFE coating.	4.6.4; 4.6.3	The coating is used for its high temperature properties, a low coefficient of friction, and chemical and abrasion resistance. Some fluoropolymer coatings can reach up to 500F, and it is a choice for bolting.	
Upstream	**2RD**	Dynamic Riser for Floating Production Systems	2	7.10.3 any coating of bolts shall be selected with due considerations of how such coatings affect stud tensioning. "NOTE: ptfe coating have low friction coefficient and the torque has to be applied accordingly"	7.10.3	As stated, PTFE is often used for bolt coatings due to its resilience and lubricity. Lubricity needs to be taken into account when using the bolts with PTFE coating due to its slickness.	
Upstream	**5C1**	RP for Care and Use of Casing and Tubing	18	both sections state "when making up round-thread connections with PTFE rings, 70 percent of the listed values are recommended"	4.3.4 and 5.3.1		ISO/TR 10400:2018 ISO 11960:2020 ISO 13678:2010

Segment	Designation	Name of Standard	Ed.	Content	Section(s)	Engineering Justification	ISO Reference
Upstream	**5C5**	Procedures for Testing Casing and Tubing Connections	4	5.7.5.4: Ported Box Leak Trap Device. “Assemble the ported box in the following manner: c) install threaded fitting into holes using thread sealer, such as PTFE"	5.7.5.4	Preferred sealing due to its excellent sealing properties and resistant to temp, chemicals, and other elements.	ISO/TR 10400:2018 ISO 13678:2010
Upstream	**5CT**	Case and Tubing	10	K.8.2 "rings shall be made from virgin PTFE…the starting PTFE shall be free of filler"	Annex K	Virgin grade PTFE is recommended for these O-rings/seal ring couplings for tubing because it is purer (no fillers), thus giving it better resistance and sealing properties.	ISO 27914:2017 (2011 version of 5ct) ISO/TR 10400:2018 ISO 11960:2020 ISO 15463:2003 ISO 13678:2010
Upstream	**6A**	Spec for Wellhead and Tree Equipment	21 A2	Informative "a coefficient of friction of 0.07 approximates threads and nut face coated with fluoropolymer material Table K.5 specifies seals for top connector plugs for H2S service (FKM)	Annex H (informative)	O-ring sizes determined by pressure and nominal size for hydrogen sulfide; FKM is the go to material for O-ring due to its excellent sealing properties and is required for hydrogen sulfide sealing due to its chemical resistance to gas. A coefficient of friction is the measure of lubricity for lubrication, and the low coefficient for fluoropolymers makes it an ideal additive to lubrication. The use of fluoropolymer lubricant (such as PTFE) is commonly used and needed for nuts and bolts for its durability and resistance to elements.	ISO 27914:2017 ISO 13628-15:2011 ISO 13628-10:2005 ISO 27916:2019 ISO 17782:2018 ISO 13628-6:2006

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Upstream	**6FA**	Standard for Fire Test of Valves	5	describes different plastics and valve types being made and installed with PTFE; in addition, it provides many examples of fluoroelastomers (FKM) valves that are used for API 6FA coverage	Annex A	Fluoropolymers and fluoroelastomers used in valves for their excellent sealing properties, resiliency, and thermal tolerance (often as a component in fire safety).	
Upstream	**6J**	Testing of Oilfield Elastomers	2	4.6 "conventional oilfield elastomers such as NBR are much more susceptible to storage degradation than chemically resistant materials such as fluoroelastomers"	4.6 storage conditions	While nitrile butadiene rubber (NBR) has some resistance, FKM and other fluoroelastomers have a much better and excellent resistance to chemicals, swelling, and deformation. In addition, FKM has a higher temperature range.	ISO 27914:2017 ISO 27916:2019

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Upstream	**15S**	Spec for Spoolable Reinforced Plastic Line Pipe	3	4.2.1.1 "polymeric compounds shall be specified using the standard classification systems described in Table 1" 4.2.3 "polymer material used for cover layers manufactured by melt extrusion onto the pipe shall be specified using the standard classification systems described in Table 1" Table 1 requires PVDF cover layers to be specified by ASTM D5575 and ASTM D3222	4.2.3; 4.2.1.1; Table 1	PVDF used in piping for resiliency, chemical resistance, thermal tolerance, and flexibility. The PVDF covering material must comply with ASTM D5575 and D322 in these applications for reinforced plastic line piping.	