

American Petroleum Institute revises the API 682 standard for mechanical seals and supply systems.

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API 682, What does the 4th Edition offer?

Nearly six years of intensive work went into the current update of the API 682 mechanical seal standard, due to come into force shortly. Since its introduction in 1994, API 682 has become „the“ standard that sets the global tone for the procurement and operation of seal and supply systems for centrifugal pumps in the oil and gas sector as well as in (petro) chemistry. API 682 is a „living“ standard that directly incorporates diverse practical experience in its regular updates.

Founded in 1919 and located in Washington D.C., the American Petroleum Institute (API), which includes close to 500 companies from the oil and gas sector as well as the petrochemical industry, has intensively occupied itself with technical standards since 1924. To this day, API has adopted roughly 500 standards that address the most diverse processes and components in detail - and which ultimately ensure a maximum of operating and process reliability. API standards, which are clearly defined and partly attached to approval tests, do not take effect only in the U.S. mother country. In many cases, they have developed into worldwide industrial standards. API is often considered a synonym for safety and reliability.

Individual standards - including the API 682 regulations for mechanical seals and seal supply systems - have become so popular in the meantime that they have even been referenced in outside industry applications. The authors of the new edition point out that this had never been intended and clarify what API 682 is actually about: these are standards for seal systems in pumps - and not in agitators or compressors. And for oil & gas and (petro)chemistry - and not for water supply or the food sector.



API 682 is a common standard in refining technology

API 682 – A benchmark since the middle of the 90s

Initial information about mechanical seals was originally provided in the API 610 pump standard. During the 90s, API 682 then developed into a separate, more comprehensive standard for mechanical seals and supply systems. Typical for the API 682 standard is that it is permanently maintained and updated - by practical people, namely users and manufacturers. A further quality of the API 682 is that it does not normatively permit only a single technical solution. In addition to proven and tested standard solutions (defaults), the regulations also deliberately list alternatives (options) - and even allow customized solutions (engineered solutions). This diversity is demonstrated even more clearly in the 4th Edition than in any other previous edition.

The practically oriented manner in which API approaches the topic of seals is already indicated by the composition of the 25-member Task Force who since 2006 have been working intensively on the update of the (currently still valid) 3rd Edition of API 682 that took effect in 2004. In addition to leading seal system manufacturers (including EagleBurgmann), the American-European expert panel, who even intentionally counted on non-API member collaboration, also included renowned planning companies as well as representatives from some of the largest mineral oil groups (including ExxonMobil, Shell, and Total) - and thus the actual „Users“ of the seal solutions.

Checked and tested safety

Whereas the still valid API 682 edition barely comprised 200 pages, the 4th Edition now encompasses 260 pages. The revised edition is organized into a body of text with eleven chapters and detailed annexes with a significantly expanded scope. For example, Annex I provides precise detailed information on more than 20 pages for API-conform seal qualification tests.

„Default seals“ as well as „Options“ must be tested using five different media and clearly defined operating conditions that are representative for typical API applications. Together with the described seal designs, this yields a high number of possible test variations. In the process, the expended time per test and seal type can take up to 200 hours. The result for typical industry seal designs is documented in a test certificate and a detailed report. Customer-specific qualification tests can be agreed for Engineered Seals.

Essentially, checked and tested product safety is the core of the matter. The objective of API 682 is continuous operation of at least three years (25,000 operating hours subject to the legally stipulated emission values, or for max. „Screening Value“ of 1000 ppm vol, EPA method 21), increased operational reliability, and simplified maintenance. The standards defined by API apply exclusively to cartridge systems with a shaft diameter of 20 to 110 mm and a defined range of operating conditions.

Coding system - with even more selectivity

The 4th Edition also includes the revised product coding system (Annex D). The proven classification parameters „Category,“ „Arrangement,“ and „Type“ will be continued. They are the first thing listed in the revised code - and provide information about the set-up and field of use of the respective API seal. The arrangement includes seal arrangement: single seals (Arrangement 1) are differentiated as well as double seals with and without pressurization (Arrangement 2 and 3). Details regarding the supply system - specified as „Plan“ - are in the old and in the new code.

The addition of precise information to material selection and shaft diameter is new. This gives more meaning to the Code and guarantees a clear specification of the mechanical seal and its operation - from selection to documentation. Industry experts are already agreed that the expanded coding system will prove itself in practice and endure permanently.

More precision during the selection process due to „Risk & Hazard Code“

The selection process of an API seal system is a complicated affair. Several flow charts and tables on more than 10 pages are dedicated to this topic in the new edition. In order to provide more precision in the technical selection process when determining the arrangement, an alternative selection tool (Annex A.4) has been included in the 4th Edition for the first time. This is a method that is based on the established „Risk & Hazard Code“ and which has been tested in practice.

The starting point here is the pumped medium whose real hazard potential is accurately recorded and described by the „Hazard & Risk Code“ in the „Material Safety Data Sheets.“ Decisions can thus be made quickly and securely, for example, about whether a single seal (Arrangement 1) will suffice or if a double seal with barrier pressure system is required.

„Lived Standard“ - practical experience counts

The experience-based, „lived“ standard of the API 682 edition is also demonstrated in that the two silicon carbide (SiC) variants „Reaction Bonded Silicon Carbide“ and „Self-Sintered Silicon Carbide“ are treated equally as „default“ materials for sliding surfaces in chemical (Category 1) as well as in refinery/oil and gas applications (Category 2 or 3). Until now, sintered SiC was set for chemical applications due to its superior chemical stability, whereas the reaction bonded variant established itself in the refinery sector. This restrictive allocation was canceled due to practical application examples (Best Practices) that were brought to the attention of the Task Force - and which called for a course correction.

Chapters 8 and 9 dealing with the hardware for the supply systems and instrumentation were subjected to intense revision. They were completely reorganized, whereby the topic is now handled in three stages - thus making it more systematic. The first block introduces the supply systems in total. The piping as well as the components are addressed next.

The principle innovations of API 682 4th Edition at a glance:

Mechanical seals

- Adaptation of pressure limits: 20 bar(g) Category 1, 40 bar(g) Category 2/3
- Detailed notes to „Engineered Seals“
- Combination of „Seal Types“ in Arrangement 2/3
- Definition of vapor pressure margin
- Overview table of internal gap dimensions
- Selection SiC face material independent of category
- Optional bellows material Alloy 718 for metal bellows seals Type B
- Additional requirement for set screws for torque transmission
- New details to selection and operation of pressurized double seal systems
- Reduced minimum gap at the internal pumping device

Seal supply systems

- Transmitters instead of switches
- Alternative arrangement selection method on the basis of Risk & Hazard codes
- New API Plans 03, 55, 65A, 65B, 66A, 66B, 99
- Hydrostatic level detection for Plans 52, 53A
- Temperature measurement of gas bubble for Plan 53B
- 28-day refilling interval for barrier pressure systems
- Minimum pipe wall thicknesses of 2.5 mm for welded joints
- Temperature limits for instrumentation

Seal supply systems for Plan 53 - 28 days without refilling

Plan 53 with a pressurized barrier fluid belongs to the more complicated supply systems. In detail, three types are possible: Plan 53A is the solution with the constructively least amount of effort. The pressure on the barrier medium is generated directly via gas pressurization - normally with nitrogen - in the tank. But the application has limits, since higher barrier pressures could cause a dissolution of the nitrogen in the barrier medium. The consequence would be the risk of inadequate lubrication in the sealing gap of the mechanical seal. That is why Plans 53B and 53C are used for higher barrier pressure.

Whereas Plan 53C works with a piston accumulator, which puts it among the more sophisticated seal supply systems, Plan 53B uses an especially clever solution - making it even more popular: Pressurization occurs via an elastomer bladder in the reservoir that separates the nitrogen from the barrier fluid. Pressure monitoring with consideration of the temperature in the bladder accumulator records the values and transfers them to the control room. The fill level with consideration of any temperature impacts is calculated there and the correct time for refilling the barrier fluid is determined.

A new prescribed refilling interval of at least 28 days has also been included in the 4th Edition of API 682. The fluid reservoir must be large enough to supply the seal with barrier fluid for this entire period - without refilling. To obtain the most compact reservoirs, the seal manufacturers are required to find optimized system solutions with minimal leakage values for the barrier medium.

Also, Plans 03, 55, 65A, 65B, 66A, 66B, and 99 have been newly included in the regulations and, along with the already existing plans, are described in detail in Annex G.

Transmitters instead of switches

Regardless of pressures, temperature, flow rates, or fill levels: the 4th Edition heralds a change to modern transmitters for the supply systems. Where once switches had previously been the norm (Default), transmitters have now taken the pole position. They may be more expensive, but they transmit continuous measured values. The control room now knows the actual system status at any time and can immediately sound the alarm in case of problems.

The transition to transmitters as Default is very illustrative: the API specifications primarily concern operating and process reliability - and only then economic viability. That this has been universally applied is also verified by the decision of the Task Force to only permit seamless pipes in the future for „Piping“ for the supply systems. The use of welded pipes, which would be less expensive, was thus clearly refused.

The Task Force also addressed the topic of heat resistance of instrumentation used in supply systems extremely pragmatically - and practically oriented. In the past there were frequent debates about whether supply systems for high temperature applications - e.g. a 400°C-approved pump - has to be equipped with special instrumentation for the high temperature. Now the temperature specification for the instrumentation has been limited to a commonsensical 100°C. If instruments with higher temperature limits are required in the future the customer has to inform the seal vendor accordingly.

Clearer structure - easier to understand

The essential improvements - in addition to all the technical supplements and updates - are the clear structures of the latest API regulation. The body of text was tightened and structured appropriately, whereas technical details and background information were placed in the Annexes. Some of the wording in individual chapters were revised practically to improve understanding. The improved user friendliness is clearly shown in Annex E, which addresses structured communication and data exchange between suppliers and customers. Descriptions that previously encompassed many pages in the API 682 are now bundled into two compact checklists in the 4th Edition. The first list systematically describes what must be considered for inquiries and quotations. Specified exactly here is the data that needs to be provided - and the additional information and documents it must be combined with. For example, seal systems that deviate from the standardized API solutions (Default) must be shown separately. Annex E is rounded off by a second checklist that shows which order documentation is necessary.

Apart from the numerous technical updates and improved user friendliness, there is one detail that is visually the most striking innovation of the 4th Edition: all mechanical seals are equipped with red plugs in the supply connections of the seal gland upon delivery. Until the unit is installed, these plastic closures prevent the ingress of dirt in the seal. During operation, the connections are either assigned to pipelines, or the plastic plugs are replaced with enclosed metal plugs. A nice side effect: 4th Edition API seals are quickly identified by the red plugs.

EagleBurgmann & API

EagleBurgmann is one of the leading international providers of industrial seal technology that is used in diverse industries (oil & gas, refinery, power, chemical, energy, food, paper, water, and mining, among others). The company employs roughly 6,000 employees worldwide. 60 subsidiaries and 250 locations stand for global presence - and the associated proximity to the customer. The comprehensive product portfolio includes everything from well-engineered serial seals to application-related individual constructions.

API conform mechanical seals and supply systems take an important place in the EagleBurgmann range. For more than 20 years, the company has been consequently providing its know-how in further developing API specifications for the design of seal systems for the oil & gas and (petro)chemistry sectors - and is active in the API 682 Task Force. Worldwide there are more than 21,000 EagleBurgmann API seal systems in use.

API 682
4th edition

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