A New Edition of API 670

25 Years and Still Going Strong

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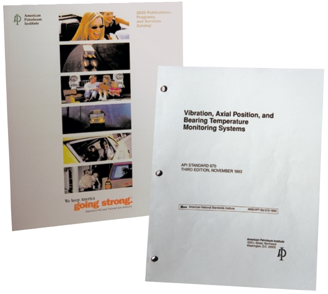
This year marks the 25th anniversary of the American Petroleum Institute (API) Standard 670, outlining the supply of Machinery Protection Systems. 2001 also marks the release of the newly revised 4th edition of the standard. This article will provide some history on API 670 – where it came from, why it is important, and when to use it. It will also summarize some of the major changes reflected in the 4th edition of this standard.

About API

The impetus for forming the API in 1919 was the need for standardized engineering specifications for drilling and production equipment. This focus on the development of standards remains one of API's most important ongoing activities. Hundreds of standards have been developed, and are constantly updated and revised through the efforts of API members and interested parties. Participants in the development of API standards come from operating petroleum companies, engineering and construction companies, manufacturers, academia, and government. However, one of the most important attributes of API standards and recommended practices is that they heavily represent the needs of end-users. Therefore, they have become some of the most widely adopted standards in the world, and for good reason: they reflect the realities of real machinery and operating practices in real plants.

The standards that are of most interest to many of Bently Nevada's customers are generated by the Subcommittee on Mechanical Equipment, part of API's Committee on Refining Equipment. This group is responsible for developing and maintaining standards on a wide variety of rotating and reciprocating equipment including gas turbines, steam turbines, compressors, gears, and pumps. Interestingly, this mechanical equipment subcommittee is also responsible for the development and maintenance of an *instrumentation* standard – API 670. All other instrumentation standards are developed and maintained by other API subcommittees, such as those dealing with electrical or instrument systems. API 670 is therefore unique in that it is an instrumentation standard residing within a machinery subcommittee. This is consistent with the close involvement machinery engineers have had with vibration instrumentation over the years.



About API 670

A significant milestone in Bently Nevada's history was in 1970 when the American Petroleum Institute's Subcommittee on Mechanical Equipment adopted the proximity probe as the measurement device for determining acceptable shaft vibration during factory acceptance testing. This requirement was added to API 617, the standard for centrifugal compressors, which became the forerunner of API 670. As a result, shaft vibration measurement with proximity probes rapidly emerged as the industry standard for turbomachinery acceptance testing and machinery protection.

Prior to the early 1970s, many critical machines either had no vibration instrumentation at all, or used less capable methods such as casing velocity measurements. By the mid-1970s, vibration instrumentation based on proximity probe measurements was gaining acceptance in industry and many users were beginning to receive machinery with proximity probes already installed. However, there was wide variation in the types and configurations of systems being supplied. Outputs varied – some supplied a 100 mV/mil signal while others used 200 mV/mil. System lengths and extension cables also varied widely with numerous lengths and types supplied. Some OEMs employed XY probe configurations; others installed only a single probe at each radial bearing. Some provided dual-thrust probes and others only a single probe. Sporadic use of Keyphasor® reference transducers was also seen. The resultant confusion was compounded when one considers that the average machine train represented numerous machinery manufacturers, each with their own instrumentation preferences. For example, the turbine supplier might have one approach, the gearbox vendor another, and the compressor manufacturer still another.

The end-user was left with the challenging task of connecting this assortment of systems to the appropriate monitors and maintaining a myriad of spare parts. Clearly, a standard that could be employed by end-users, machinery manufacturers, and instrumentation manufacturers alike was needed: one that required an appropriate complement of transducers to properly protect the machine and made interconnectivity and spare parts less onerous.

It was in this rather chaotic state of affairs that a group of proximity probe customers first approached API about development of a standard. From that basic need, API 670 was born. The first edition appeared in June 1976 and covered radial vibration and axial position. Content pertaining to both transducers and monitoring systems was included in this first edition.

The standard was revised to the 2nd edition ten years later and added content concerning bearing temperature monitoring. In November 1993, the 3rd edition appeared, adding material for casing vibration measurements on gearboxes – material previously covered in the now-obsolete API Standard 678. The 3rd edition also reflected newer, digital-based monitoring systems rather than older, strictly analog-based systems.

In January 2001, the 4th edition of this standard was released. Later in this article, there will be a summary of some of the major changes from the 3rd edition.

What Value Does API 670 Provide?

Because API 670 was the result of a request for standardization from *end-users*, it significantly addresses their real-world needs. This makes it a very practical standard, detailing how to properly select, install, and document an instrumentation system that will adequately protect critical machinery. API standards incorporate the accumulated knowledge of thousands of users – not just in America, but throughout the world. Hence, these standards embody the very essence of "good engineering practice" when it comes to machinery that is designed, instrumented, and operated properly to meet the demands of industrial use.

Basically, API 670 is a *purchasing* standard. It allows the user to procure instrumentation that meets certain minimum requirements, reflecting generally recognized "good engineering practice" for a vibration monitoring system designed to protect the machine. Where options exist, API standards supply "default" configurations. Thus, even if the user does not specify any details other than "supply an API 670-compliant system," they will receive equipment that provides satisfactory functionality for a machinery protection system. Transducer components will meet minimum criteria, monitors will provide adequate indication, alarming, and connectivity options, and system accuracy will meet appropriate requirements.

While other vibration standards tend to deal with methods and theory behind vibration monitoring, they are not as prescriptive as API 670 at guiding the customer in *what to purchase*. Also, API 670 represents the input of nearly a dozen vibration instrumentation manufacturers, numerous machinery manufacturers – and most importantly – hundreds of end-user companies. The result is an unbiased document reflecting the collective wisdom of many people – not just one particular entity. For these reasons, API 670 has become, without question, the most useful and widely applied standard for vibration monitoring in the world. Bently Nevada strongly advocates the use of this standard when specifying instrumentation for protecting any critical machine, regardless of the industry in which it is used.

Other API Standards

As mentioned previously, other API standards pertaining to rotating and reciprocating machinery exist. API 617 covers centrifugal compressors, API 612 covers special-purpose steam turbines, and API 613 covers gears, to name a few. Notable in all of these standards is the use of proximity probes as the basis of a machinery protection system for radial vibration and axial position. Standardization on proximity probe technology has improved the operation, availability, reliability, and diagnosis of machinery in countless ways. The endorsement of the API for proximity probe measurements helps underscore that this type of instrumentation is the correct way to protect and manage machinery for the vast majority of applications.

About the 4th Edition

API requires all their standards be re-affirmed or revised every five years to reflect changes in industry and technology. API 670 last underwent revision in 1993, and a Task Force was convened in 1998 to review the standard. After numerous requests for revisions, the Task Force worked for three years to generate an enhanced standard, reflecting today's needs and practices.

The primary changes to API 670 from the 3rd edition to the 4th edition are summarized in Table 1.

Obtaining a Copy of API 670

Standards development is a significant and expensive undertaking. Consequently, API must charge for these standards, and they may not be copied. Global Engineering Documents is API's primary distribution center and will handle sales, distribution and customer service related to API publications and standards.

To order API publications, use the following options:

Online Orders: www.global.ihs.com

Mail Orders: API Publications
Global Engineering Documents
15 Inverness Way East
M/S C303B
Englewood, CO 80112-5776 USA

Phone Orders: 1-800-854-7179 (Toll-free in the U.S. and Canada)
303-397-7956 (Local and International)

API standards are also available electronically for an annual fee, often the best option when several individuals in the same organization require access to these standards regularly. Contact Global Engineering Documents for details.

Change	Comment
• Retitled "Machinery Protection Systems"	• Standard now encompasses more than just vibration, position, and temperature measurements.
• Overspeed Detection moved from API 612 to API 670. API 670 now contains material on minimum standards for overspeed monitoring and protection.	• Overspeed pertains to many machine types, not just steam turbines. 670 seemed a more logical place for this material to reside.
• Accuracy requirements altered to reflect current technology, and stated in terms that are more easily measured in the field.	• Accuracy is now easier to understand, measure, and meet.
• 4140 steel becomes default standard target material for probes.	• Widely used, but never standardized formally until now.
• Default probe type is now 8 mm reverse-mount.	• 5 mm probes, the previous standard, are less robust due to their smaller size. Reverse-mount probes allow a single type of spare probe to be carried, reducing the types of spares that need to be stocked. Previously, forward-mount probes were the default standard.
• DIN-mounting option for oscillators/demodulators added.	• Reflects preferred mounting method for many other field-installed devices, allows higher-density installations.
• Material on magnetic speed sensors added.	• Widely used for overspeed measurements, but no standards previously existed.
• Accelerometers with external charge amplifiers deleted.	• Accelerometers with integral charge amplifiers are the prevailing industry preference.
• New monitor system configurations permitted, such as "blind" monitors with remote displays.	• Allows monitoring systems to assume a more distributed architecture as long as certain minimum functionality is maintained.
• Provides options for additional redundancy and integrity requirements, allowing 670 systems to be used in Safety Instrumented System (SIS) applications.	• Redundant power supply requirements and Triple Modular Redundancy (TMR) now exist as "when specified" options.
• Change from analog (i.e., 4 to 20 mA) to digital (i.e., Modicon Modbus®) communications as the standard output for interfacing to process control systems.	• Better reflects dominant industry practice and capabilities of contemporary process control systems.
• Adds piston rod drop as a new measurement type.	• Intended for reciprocating compressors or the type covered in API Standard 618.
• New appendix added covering theory and use of trip multiply functions.	• Provides tutorial material, helping to assure that this monitor feature is specified and applied properly.
• Appendix added on overspeed measurements.	• Tutorial material on the proper use of proximity probes and magnetic pickups for this critical measurement.

Table 1.