Gauging and Inspection of Casing, Tubing, and Line Pipe Threads

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Introduction

The American Petroleum Institute was established in 1919 by partnership between industry executives and the U.S. Federal Government. Prior to then, companies did not have much experience working together. But after the difficulties faced during World War I with the handling and transfer of petroleum supplies for the war effort, they agreed to work with the government to address those challenging issues.

Among the founding cornerstones of API was the creation of industry standards. With numerous areas of interest in industry to have standards developed, the first publication for manufacturing pipe (line pipe, drill pipe, casing and tubing), including threading, was API No. 5, *Specifications for Steel and Iron Pipe for Oil Country Tubular Goods*, October 20, 1924.

Since then, pipes (and their threaded connections, among many other features) were able to follow common standards for manufacturers. This began allowing for desirable attributes, such as product consistency and interchangeability to be achieved. As the standards progressed over time, pipe threads were required to follow API 5B for casing and tubing products according to API 5CT and line pipe according to API 5L, and API 7-2 for drill pipe and drill stem elements according to API 5DP and API 7-1, respectively. Regardless of thread-type, all API threaded connections are required to be inspected for conformance with their applicable design specification.

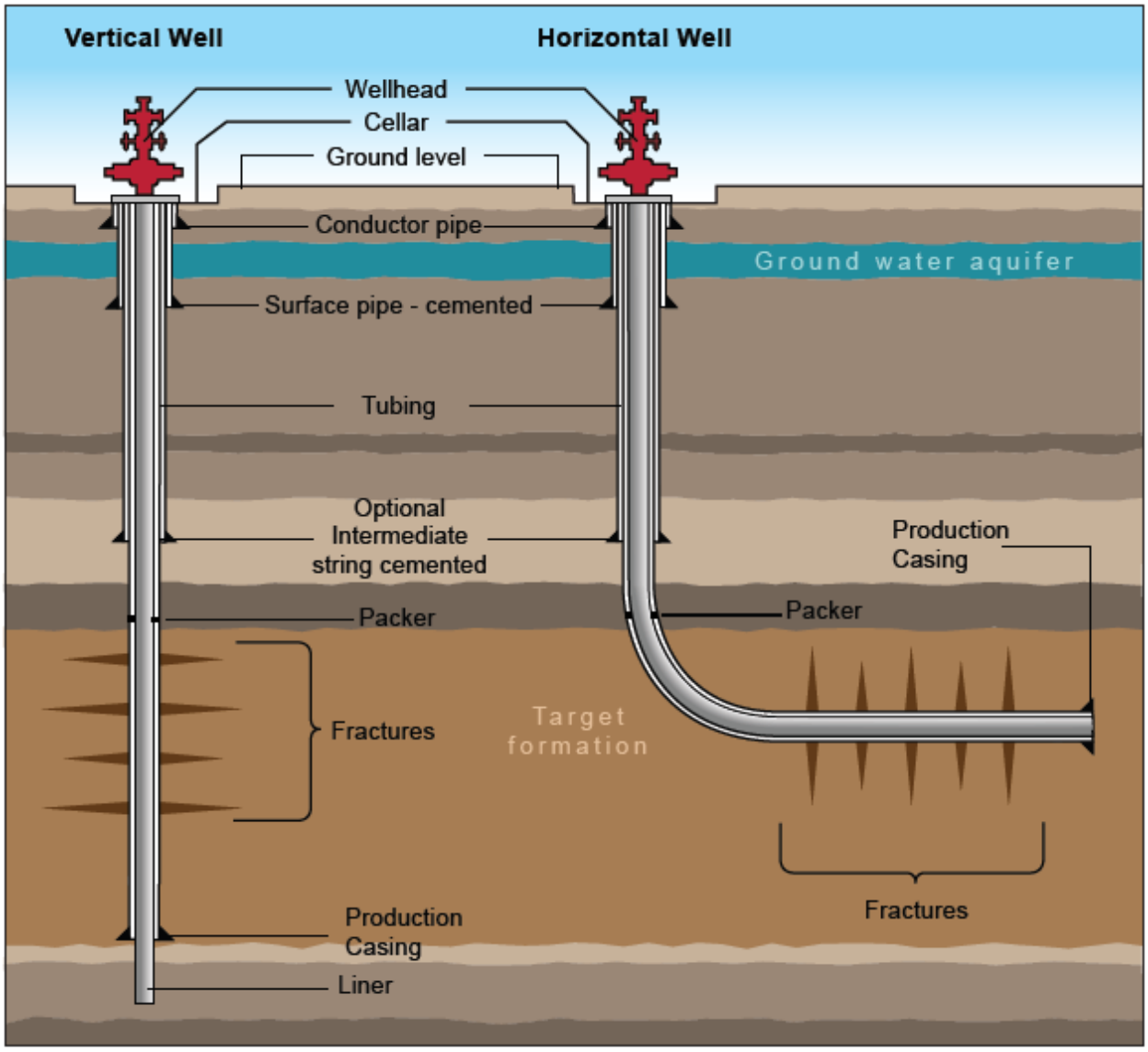
The ability of pipe to perform properly depends on the end connection. Each connection must withstand various pressures and the forces. The connection design provides the required strength and resistance to leakage for the specific application for which they are designed. Thus, all API threaded connections are designed to perform three primary functions:

- act as a mechanical fastener to connect pipe,
- provide leak resistance under pressure, and
- maintain integrity under load.

The API 5B1 standard provides the guidance and instruction on inspection techniques and equipment necessary to ensure that threads are dimensionally accurate. Information contained in this recommended practice is intended for use of pipe manufacturer inspectors, quality control personnel, field inspectors, threading unit operators, and users and purchasers of oil country tubular goods and line pipe. Inspection of the threaded pipe ends determines if the API 5B product specification is met.

It is not expected that threaded connections will gauge within specified tolerances after coating or plating is applied or after being made-up power-tight. Threaded connections can gauge differently after being coated or plated or other post-machined processes (see API 5B acceptance or rejection in the as machined condition). This publication uses figures to demonstrate the proper use of representative gauges normally used by thread inspectors. Gauges presented are limited to those appropriate to both mill and field use.

The threads competency of design and the quality of manufacturing enable pipe to achieve the desired functions that it will serve. Whether it’s casing or drill pipe used for drilling the wells, tubing used in the completion and production of wells, or line pipe used for the gathering and processing and transportation and distribution of petroleum, the importance in having standards is well recognized. See Figure 1 for a generalized illustration of typical wells’ components and configurations.



The descriptions below are general, intended to depict the concept, and should not be considered exhaustive.

— Conductor casing: Prevents drilling fluid from broaching, causing surface erosion.
— Surface casing: Protects fresh-water zones, supports wellhead installation.
— Intermediate casing: Maintains wellbore stability, isolates formations.
— Production casing/liner tie-back: Secures pay zone, allows for tubing installation.

Figure 1—Simple Example Well Diagrams

Gauging and Inspection of Casing, Tubing, and Line Pipe Threads

1 Scope

This recommended practice provides the appropriate inspection techniques to be used for comparing measurements of threaded connection product geometry with dimensions and tolerances specified in API 5B. This document supplements and augments API Spec 5CT and API Spec 5L, which mandate physical and mechanical properties of casing, tubing, and line pipe. In all cases, the latest edition of API 5B takes precedence if a dispute arises between parties.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any errata or addenda) applies.

API Specification 5B, *Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads*

API Specification 5CT, *Casing and Tubing*

API Specification 5L, *Line Pipe*

3 Terms, Definitions, Symbols, and Abbreviations

3.1 Definitions

For the purposes of this standard, the following terms and definitions apply.

3.1.1
addendum
The distance from the crest cone to the pitch cone, normal to the axis of the thread.

NOTE The opposite of addendum is dedendum (3.1.14).

3.1.2
angular misalignment
The measured angular deviation of one or both coupling-thread cones to the centerline thread cone axis.

3.1.3
basic size
The theoretical size from which all variations are measured.

3.1.4
black-crested threads
Threads that are not fully crested because the original mill surface has not been removed.

NOTE 1 They have historically been and continue to be referred to as “black-crested threads.”

NOTE 2 There can be non-full-crested threads that are not black-crested.