

Recommended Practice for Care and Use of Casing and Tubing

API RECOMMENDED PRACTICE 5C1
EIGHTEENTH EDITION, MAY 1999

REAFFIRMED, JULY 2020



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Upstream Segment

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FOREWORD

The bar notations identify parts of this standard that have been changed from the previous API edition.

This standard is under the jurisdiction of the API Committee on Standardization of Tubular Goods and includes items approved by the letter ballot through 1999.

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Recommended Practice for Care and Use of Casing and Tubing

1 Scope

Note: No provision of this recommended practice shall be cause for rejection of casing or tubing provided the threads are in accordance with the requirements of the latest edition of API Standard 5B.

1.1 The statements on corrosion of casing and tubing as given herein were developed with the cooperation of the Technical Practices Committee on Corrosion of Oil and Gas Well Equipment, NACE International (formerly the National Association of Corrosion Engineers).

1.2 It is suggested that the selection of a thread compound for casing and tubing be given careful consideration by the user, bearing in mind that a satisfactory compound should possess certain properties, the major of which are (a) to lubricate the thread surfaces to facilitate joint makeup and break-out without galling, and (b) to seal voids between the mating thread surfaces and effectively prevent leakage. Compounds that have given outstanding service for casing and tubing under both laboratory and field conditions are described in the latest edition of API Bulletin 5A2.

Note: Thread compounds described in the latest edition of API Bulletin 5A2 should not be used on rotary shouldered connections.

1.3 Some generalized suggestions on prevention of damage to casing and tubing by corrosive fluids are given in 4.8.16 and 5.5.15. It is not, however, within the scope of this recommended practice to provide detailed suggestions for corrosion control under specific conditions. Many variables may be involved in a specific corrosion problem and interrelated in such a complex fashion as to require detailed attention to the specific problem. For more complete technical information on specific corrosion problems, the user should consult the official publication of NACE International, *Corrosion*, or contact: Chairman, Technical Practices Committee on Corrosion of Oil and Gas Well Equipment, T-1, NACE Int'l, 1440 South Creek Drive, P.O. Box 218340, Houston, Texas 77218-8340.

2 References

2.1 GENERAL

This recommended practice includes by reference, either in total or in part, the most recent editions of the following standards:

API

- | | |
|---------|---|
| Bul 5A2 | <i>Bulletin on Thread Compounds for Casing, Tubing, and Line Pipe</i> |
| Bul 5C2 | <i>Bulletin on Performance Properties of Casing, Tubing, and Drill Pipe</i> |

- | | |
|------------------|---|
| Bul 5C3 | <i>Bulletin on Formulas and Calculations for Casing, Tubing, Drill Pipe, and Line Pipe Properties</i> |
| RP 7G | <i>Recommended Practice for Drill Stem Design and Operating Limits</i> |
| Spec 5B | <i>Specification for Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads</i> |
| Spec 5CT | <i>Specification for Casing and Tubing</i> |
| AWS ¹ | |
| Spec A5.1 | <i>Covered Carbon Steel Arc Welding Electrodes</i> |

2.2 REQUIREMENTS

Requirements of other standards included by reference in this recommended practice are essential to the safety and interchangeability of the equipment produced.

2.3 EQUIVALENT STANDARDS

Other nationally or internationally recognized standards shall be submitted to and approved by API for inclusion in this recommended practice prior to their use as equivalent standards.

3 Definitions

- 3.1 shall:** is used to indicate that a provision is mandatory.
- 3.2 should:** is used to indicate that a provision is not mandatory, but recommended as good practice.
- 3.3 may:** is used to indicate that a provision is optional.

4 Running and Pulling Casing

4.1 PREPARATION AND INSPECTION BEFORE RUNNING

4.1.1 New casing is delivered free of injurious defects as defined in API Specification 5CT and within the practical limits of the inspection procedures therein prescribed. Some users have found that, for a limited number of critical well applications, these procedures do not result in casing sufficiently free of defects to meet their needs for such critical applications. Various nondestructive inspection services have been employed by users to ensure that the desired quality of

¹American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135.

casing is being run. In view of this practice, it is suggested that the individual user:

- a. Familiarize himself with inspection practices specified in the standards and employed by the respective mills, and with the definition of “injurious defect” contained in the standards.
- b. Thoroughly evaluate any nondestructive inspection to be used by him on API tubular goods to assure himself that the inspection does in fact correctly locate and differentiate injurious defects from other variables that can be and frequently are sources of misleading “defect” signals with such inspection methods.

4.1.2 All casing, whether new, used, or reconditioned, should always be handled with thread protectors in place. Casing should be handled at all times on racks or on wooden or metal surfaces free of rocks, sand, or dirt other than normal drilling mud. When lengths of casing are inadvertently dragged in the dirt, the threads should be recleaned and serviced again as outlined in 4.1.7.

4.1.3 Slip elevators are recommended for long strings. Both spider and elevator slips should be clean and sharp and should fit properly. Slips should be extra long for heavy casing strings. The spider must be level.

Note: Slip and tong marks are injurious. Every possible effort should be made to keep such damage at a minimum by using proper up-to-date equipment.

4.1.4 If collar-pull elevators are used, the bearing surface should be carefully inspected for (a) uneven wear that may produce a side lift on the coupling with danger of jumping it off, and (b) uniform distribution of the load when applied over the bearing face of the coupling.

4.1.5 Spider and elevator slips should be examined and watched to see that all lower together. If they lower unevenly, there is danger of denting the pipe or badly slip-cutting it.

4.1.6 Care shall be exercised, particularly when running long casing strings, to ensure that the slip bushing or bowl is in good condition. Tongs may be sized to produce 1.5 percent of the calculated pullout strength (API Bulletin 5C3) with units changed to ft-lb (N • m) (150 percent of the guideline torque found in Table 1). Tongs should be examined for wear on hinge pins and hinge surfaces. The backup line attachment to the backup post should be corrected, if necessary, to be level with the tong in the backup position so as to avoid uneven load distribution on the gripping surfaces of the casing. The length of the backup line should be such as to cause minimum bending stresses on the casing and to allow full stroke movement of the makeup tong.

4.1.7 The following precautions should be taken in the preparation of casing threads for makeup in the casing strings:

- a. Immediately before running, remove thread protectors from both field and coupling ends and clean the threads thoroughly, repeating as additional rows become uncovered.
- b. Carefully inspect the threads. Those found damaged, even slightly, should be laid aside unless satisfactory means are available for correcting thread damage.
- c. The length of each piece of casing shall be measured prior to running. A steel tape calibrated in decimal feet (millimeters) to the nearest 0.01 feet (millimeters) should be used. The measurement should be made from the outermost face of the coupling or box to the position on the externally threaded end where the coupling or the box stops when the joint is made up power tight. On round-thread joints, this position is to the plane of the vanish point on the pipe; on buttress-thread casing, this position is to the base of the triangle stamp on the pipe; and on extreme line casing, this position is to the shoulder on the externally threaded end. The total of the individual lengths so measured will represent the unloaded length of the casing string. The actual length under tension in the hole can be obtained by consulting graphs that are prepared for this purpose and are available in most pipe handbooks.
- d. Check each coupling for makeup. If the standoff is abnormally great, check the coupling for tightness. Tighten any loose couplings after thoroughly cleaning the threads and applying fresh compound over entire thread surfaces, and before pulling the pipe into the derrick.
- e. Before stabbing, liberally apply thread compound to the entire internally and externally threaded areas. It is recommended that a thread compound that meets the performance objectives of API Bulletin 5A2 be used; however, in special cases where severe conditions are encountered, it is recommended that high-pressure silicone thread compounds as specified in API Bulletin 5A2 be used.
- f. Place a clean thread protector on the field end of the pipe so that the thread will not be damaged while rolling pipe on the rack and pulling into the derrick. Several thread protectors may be cleaned and used repeatedly for this operation.
- g. If a mixed string is to be run, check to determine that appropriate casing will be accessible on the pipe rack when required according to program.
- h. Connectors used as tensile and lifting members should have their thread capacity carefully checked to ensure that the connector can safely support the load.
- i. Care should be taken when making up pup joints and connectors to ensure that the mating threads are of the same size and type.

4.2 DRIFTING OF CASING

4.2.1 It is recommended that each length of casing be drifted for its entire length just before running, with mandrels conforming to API Specification 5CT. Casing that will not pass the drill test should be laid aside.



4.2.2 Lower or roll each piece of casing carefully to the walk without dropping. Use rope snubber if necessary. Avoid hitting casing against any part of derrick or other equipment. Provide a hold-back rope at window. For mixed or unmarked strings, a drift or “jack rabbit” should be run through each length of casing when it is picked up from the catwalk and pulled onto the derrick floor to avoid running a heavier length or one with a lesser inside diameter than called for in the casing string.

4.3 STABBING, MAKING UP, AND LOWERING

4.3.1 Do not remove thread protector from field end of casing until ready to stab.

4.3.2 If necessary, apply thread compound over the entire surface of threads just before stabbing. The brush or utensil used in applying thread compound should be kept free of foreign matter, and the compound should never be thinned.

4.3.3 In stabbing, lower casing carefully to avoid injuring threads. Stab vertically, preferably with the assistance of a man on the stabbing board. If the casing stand tilts to one side after stabbing, lift up, clean, and correct any damaged thread with a three-cornered file, then carefully remove any filings and reapply compound over the thread surface. After stabbing, the casing should be rotated very slowly at first to ensure that threads are engaging properly and not cross-threading. If spinning line is used, it should pull close to the coupling.

Note: Recommendations in 4.3.4 and 4.4.1 for casing makeup apply to the use of power tongs. For recommendations on makeup of casing with spinning lines and conventional tongs, see 4.4.2.

4.3.4 The use of power tongs for making up casing made desirable the establishment of recommended torque values for each size, weight, and grade of casing. Early studies and tests indicated that torque values are affected by a large number of variables, such as variations in taper, lead, thread height and thread form, surface finish, type of thread compound, length of thread, weight and grade of pipe, etc. In view of the number of variables and the extent that these variables, alone or in combination, could affect the relationship of torque values versus made-up position, it was evident that both applied torque and made-up position must be considered. Since the API joint pullout strength formula in API Bulletin 5C2 contains several of the variables believed to affect torque, using a modified formula to establish torque values was investigated. Torque values obtained by taking 1 percent of the calculated pullout value were found to be generally comparable to values obtained by field makeup tests using API modified thread compound in accordance with API Bulletin 5A2. Compounds other than API modified thread compound may have other torque values. This procedure was therefore used to establish the makeup torque values listed in Table 1. All values are rounded to the nearest 10 ft-lb (10 N • m). These values shall be considered as a guide only, due to the very wide variations

in torque requirements that can exist for a specific connection. Because of this, it is essential that torque be related to made-up position as outlined in 4.4.1. The torque values listed in Table 1 apply to casing with zinc-plated or phosphate-coated couplings. When making up connections with tin-plated couplings, 80 percent of the listed value can be used as a guide. The listed torque values are not applicable for making up couplings with PTFE (polytetrafluoroethylene) rings. When making up round thread connections with PTFE rings, 70 percent of the listed values are recommended. Buttress connections with PTFE seal rings may make up at torque values different from those normally observed on standard buttress threads.

Note: Thread galling of gall-prone materials (martensitic chromium steels, 9 Cr and 13 Cr) occurs during movement—stabbing or pulling and makeup or breakout. Galling resistance of threads is primarily controlled in two areas—surface preparation and finishing during manufacture and careful handling practices during running and pulling. Threads and lubricant must be clean. Assembly in the horizontal position should be avoided. Connections should be turned by hand to the hand-tight position before slowly power tightening. The procedure should be reversed for disassembly.

4.4 FIELD MAKEUP

4.4.1 The following practice is recommended for field makeup of casing:

- a. For round thread, sizes $4\frac{1}{2}$ through $13\frac{3}{8}$.
 1. It is advisable when starting to run casing from each particular mill shipment to make up sufficient joints to determine the torque necessary to provide proper makeup. See 4.4.2 for the proper number of turns beyond hand-tight position. These values may indicate that a departure from the values listed in Table 1 is advisable. If other values are chosen, the minimum torque should be not less than 75 percent of the value selected. The maximum torque should be not more than 125 percent of the selected torque.
 2. The power tong should be provided with a reliable torque gauge of known accuracy. In the initial stages of makeup, any irregularities of makeup or in speed of makeup should be observed, since these may be indicative of crossed threads, dirty or damaged threads, or other unfavorable conditions. To prevent galling when making up connections in the field, the connections should be made up at a speed not to exceed 25 rpm.
 3. Continue the makeup, observing both the torque gauge and the approximately position of the coupling face with respect to the thread vanish point position.
 4. The torque values shown in Tables 1, 2, and 3 have been selected to give recommended makeup under normal conditions and should be considered as satisfactory providing the face of the coupling is flush with the thread vanish point or within two thread turns, plus or minus, of the thread vanish point.
 5. If the makeup is such that the thread vanish point is buried two thread turns and 75 percent of the torque

shown in Table 1 is not reached, the joint should be treated as a questionable joint as provided in 4.4.3.

6. If several threads remain exposed when the listed torque is reached, apply additional torque up to 125 percent of the value shown in Table 1. If the standoff (distance from face of coupling to the thread vanish point) is greater than three thread turns when this additional torque is reached, the joint should be treated as a questionable joint as provided in 4.4.3.

b. For buttress thread casing connections in sizes $4\frac{1}{2}$ through $13\frac{3}{8}$ OD, makeup torque values should be determined by carefully noting the torque required to make up each of several connections to the base of the triangle; then using the torque value thus established, make up the balance of the pipe of that particular weight and grade in the string.

c. For round thread and buttress thread, sizes 16, $18\frac{5}{8}$, and 20 outside diameter:

1. Makeup of sizes 16, $18\frac{5}{8}$, and 20 shall be to a position on each connection represented by the thread vanish point on 8-round thread and the base of the triangle on buttress thread using the minimum torque shown in Table 1 as a guide.

On 8-round thread casing a $\frac{3}{8}$ -inch (9.5-millimeter) equilateral triangle is die stamped at a distance of $L_1 + \frac{1}{16}$ inch (1.6 millimeters) from each end. The base of the triangle will aid in locating the thread vanish point for basic power-tight makeup; however, the position of the coupling with respect to the base of the triangle shall not be a basis for acceptance or rejection of the product. Care shall be taken to avoid cross-threading in starting these larger connections. The tongs selected should be capable of attaining high torques [50,000 ft-lb (67,800 N • m)] for the entire run. Anticipate that maximum torque values could be five times the minimum experienced in makeup to the recommended position.

2. Joints that are questionable as to their proper makeup in 4.4.1, item a.5 or a.6 should be unscrewed and laid down to determine the cause of improper makeup. Both the pipe thread and mating coupling thread should be inspected. Damaged threads or threads that do not comply with the specification should be repaired. If damaged or out-of-tolerance threads are not found to be the cause of improper makeup, then the makeup torque should be adjusted to obtain proper makeup (see 4.4.1, item a.1). It should be noted that a thread compound with a coefficient of friction substantially different from common values may be the cause of improper makeup.

4.4.2 When conventional tongs are used for casing makeup, tighten with tongs to proper degree of tightness. The joint should be made up beyond the hand-tight position at least three turns for sizes $4\frac{1}{2}$ through 7, and at least three and one-half turns for sizes $7\frac{5}{8}$ and larger, except $9\frac{5}{8}$, and $10\frac{3}{4}$ grade P110 and size 20 grade J55 and K55, which should be made up four turns beyond hand-tight position. When using a

spinning line, it is necessary to compare hand tightness with spin-up tightness. In order to do this, make up the first few joints to the hand-tight position, then back off and spin up joints to the spin-up tight position. Compare relative position of these two makeups and use this information to determine when the joint is made up the recommended number of turns beyond hand tight.

4.4.3 Joints that are questionable as to their proper tightness should be unscrewed and the casing laid down for inspection and repair. When this is done, the mating coupling should be carefully inspected for damaged threads. Parted joints should never be reused without shopping or regauging, even though the joints may have little appearance of damage.

4.4.4 If casing has a tendency to wobble unduly at its upper end when making up, indicating that the thread may not be in line with the axis of the casing, the speed of rotation should be decreased to prevent galling of threads. If wobbling should persist despite reduced rotational speed, the casing should be laid down for inspection. Serious consideration should be given before using such casing in a position in the string where a heavy tensile load is imposed.

4.4.5 In making up the field joint, it is possible for the coupling to make up slightly on the mill end. This does not indicate that the coupling on the mill end is too loose but simply that the field end has reached the tightness with which the coupling was screwed on at the manufacturer's facility.

4.4.6 Casing strings should be picked up and lowered carefully and care exercised in setting slips to avoid shock loads. Dropping a string even a short distance may loosen couplings at the bottom of the string. Care should be exercised to prevent setting casing down on bottom or otherwise placing it in compression because of the danger of buckling, particularly in that part of the well where hole enlargement has occurred.

4.4.7 Definite instructions should be available as to the design of the casing string, including the proper location of the various grades of steel, weights of casing, and types of joint. Care should be exercised to run the string in exactly the order in which it was designed. If any length cannot be clearly identified, it should be laid aside until its grade, weight, or type of joint can be positively established.

4.4.8 To facilitate running and to ensure adequate hydrostatic head to contain reservoir pressures, the casing should be periodically filled with mud while being run. A number of things govern the frequency with which filling should be accomplished: weight of pipe in the hole, mud weight, reservoir pressure, etc. In most cases, filling every six to ten lengths should suffice. In no case should the hydrostatic balance of reservoir pressure be jeopardized by too infrequent filling. Filling should be done with mud of the proper weight, using a conveniently located hose of adequate size to expedite the filling operation. A quick opening and closing plug valve

on the mud hose will facilitate the operation and prevent overflow. If rubber hose is used, it is recommended that the quick-closing valve be mounted where the hose is connected to the mud line, rather than at the outlet end of the hose. It is also recommended that at least one other discharge connection be left open on the mud system to prevent buildup of excessive pressure when the quick-closing valve is closed while the pump is still running. A copper nipple at the end of the mud hose may be used to prevent damaging of the coupling threads during the filling operation.

Note: The foregoing mud fill-up practice will be unnecessary if automatic fill-up casing shoes and collars are used.

4.5 CASING LANDING PROCEDURE

Definite instructions should be provided for the proper string tension, also on the proper landing procedure after the cement has set. The purpose is to avoid critical stresses or excessive and unsafe tensile stresses at any time during the life of the well. In arriving at the proper tension and landing procedure, consideration should be given to all factors, such as well temperature and pressure, temperature developed due to cement hydration, mud temperature, and changes of temperature during producing operations. The adequacy of the original tension safety factor of the string as designed will influence the landing procedure and should be considered. If, however, after due consideration it is not considered necessary to develop special landing procedure instructions (and this probably applies to a very large majority of the wells drilled), then the procedure should be followed of landing the casing in the casing head at exactly the position in which it was hanging when the cement plug reached its lowest point or "as cemented."

4.6 CARE OF CASING IN HOLE

Drill pipe run inside casing should be equipped with suitable drill-pipe protectors.

4.7 RECOVERY OF CASING

4.7.1 Breakout tongs should be positioned close to the coupling but not too close since a slight squashing effect where the tong dies contact the pipe surface cannot be avoided, especially if the joint is tight and/or the casing is light. Keeping a space of one-third to one-quarter of the diameter of the pipe between the tong and the coupling should normally prevent unnecessary friction in the threads. Hammering the coupling to break the joint is an injurious practice. If tapping is required, use the flat face, never the peen face of the hammer, and under no circumstances should a sledge hammer be used. Tap lightly near the middle and completely around the coupling, never near the end nor on opposite sides only.

4.7.2 Great care should be exercised to disengage all of the thread before lifting the casing out of the coupling. Do not jump casing out of the coupling.

4.7.3 All threads should be cleaned and lubricated or should be coated with a material that will minimize corrosion. Clean protectors should be placed on the tubing before it is laid down.

4.7.4 Before casing is stored or reused, pipe and thread should be inspected and defective joints marked for shopping and regauging.

4.7.5 When casing is being retrieved because of a casing failure, it is imperative to future prevention of such failures that a thorough metallurgical study be made. Every attempt should be made to retrieve the failed portion of the "as-failed" condition. When thorough metallurgical analysis reveals some facet of pipe quality to be involved in the failure, the results of the study should be reported to the API office.

4.7.6 Casing stacked in the derrick should be set on a firm wooden platform and without the bottom thread protector since the design of most protectors is not such as to support the joint or stand without damage to the field thread.

4.8 CAUSES OF CASING TROUBLES

The more common causes of casing troubles are listed in 4.8.1 through 4.8.16.

4.8.1 Improper selection for depth and pressures encountered.

4.8.2 Insufficient inspection of each length of casing or of field-shop threads.

4.8.3 Abuse in mill, transportation, and field handling.

4.8.4 Nonobservance of good rules in running and pulling casing.

4.8.5 Improper cutting of field-shop threads.

4.8.6 The use of poorly manufactured couplings for replacements and additions.

4.8.7 Improper care in storage.

4.8.8 Excessive torquing of casing to force it through tight places in the hole.

4.8.9 Pulling too hard on a string (to free it). This may loosen the couplings at the top of the string. They should be retightened with tongs before finally setting the string.

4.8.10 Rotary drilling inside casing. Setting the casing with improper tension after cementing is one of the greatest contributing causes of such failures.

4.8.11 Drill-pipe wear while drilling inside casing is particularly significant in drifted holes. Excess doglegs in devi-