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Difference between ASTM A213 and A269 Stainless steel tubing

What are the main differences between the ASTM A213 and A269 Stainless Steel Tubing Standards, other than their stated uses in the standard? Is one better than the other for general service Type 304 instrumentation tubing?

Also why is the finish on some tubing conforming to these standards dull while another source might have a polished surface?

A-213 pertains to seamless ferritic and austenitic alloy tubing of minimum wall thickness. Some of the ferritic compositions within the spec are not truly stainless. A-269 is seamless and welded austenitic stainless steel without specifying minimum wall. In 304 there are some minor composition differences, but these are generally not consequential. Most 304 on the market will meet either composition spec. The difference between the bright and dull finish depends on whether the producer finished by bright annealing or by pickling. A-269 is more commonly used for specifying instrumentation tubing. I suggest specifying passivated tubing, and if to be installed by welding, be aware of the significant effect of sulfur level on weld penetration and the difficulty of welding two pieces with very different sulfur contents.

Difference between ASTM A249, A270, A269, and A554 Stainless steel tubing

Surface Finish

A249 and A269 both require Surfaces "free of scale" – annealing of the tube is normally done in a controlled atmosphere and this "bright annealed" finish is considered acceptable.

A270 requires selection of both internal and external Surfaces. The possible conditions range from a "mill finish" (i.e. the strip's 2B finish, without any subsequent polishing), to abrasive polishing with 80, 120, 180 or 240 grit, to special polishing and electro polishing. Surface finishes may also be specified in terms of Ra values, but no limits are given in the specification.

A554 requires only "free of scale" and implies a "direct off mill" finish as standard. Clause 11.2 does allow - "If special finishes are required, they shall be stated in the order". Thus a large proportion of A554 tube used in the Australian market is supplied in the externally polished or buffed conditions, in the range of about 180 - 320#, or with a very highly polished Surface, typically stated as 600#.

AS1528 specifies the external Surface "as produced" or "buff polished", as agreed. The internal Surface is required to be 2B finish, quoted as typically 0.3µm Ra. Work done by Neelcon Steel indicates that for 1.6mm 2B coil (the starting material for welded tube) the typical roughness is 0.10 - 0.20 µm Ra; this would be expected to not be significantly degraded in the manufacture of tube. With weld bead rolling it would be expected that the finish of the weld would be similar to that of the parent tube.



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Weld Bead

The food industry generally requires a tube with no weld bead remnant on the inside Surface if the intended service is handling product.

A249 requires that at least the weld be cold worked after welding and before final heat treatment.

A269 does not require any weld bead control or cold working.

A270 makes no mention of weld bead.

A554 can be supplied with the weld bead left on, but in recent years Australasian manufacturers of As Welded tube have all made internal weld bead rolling a fairly routine procedure; this therefore complies with the "Bead Removed" option of A554. (Weld bead rolling is not generally possible in sizes below 31.8mm, although sizes down to 25.4 or even smaller can be hammer swaged if specifically ordered).

AS1528 requires removal of the weld bead (except in the small sizes where the procedure is not possible). There is also a requirement that the internal Surface be smooth, with no lack of weld penetration and no crevices adjacent to welds. This requirement addresses the heart of the issue - freedom from sites for product or bacterial build-up.

Heat Treatment

A249, A269 and A270 all require that "all material shall be furnished in the heat treated condition". Heat treatment is annealing (also referred to as solution treatment or solution annealing). In practice this is not a common requirement for food industry tube unless it requires significant bending or flaring.

A554 is normally supplied "as welded", ie. no heat treatment after tube forming (although the tube will be produced from strip which has itself been annealed just prior to the final cold roll). There is the possibility of calling for A554 tube in the annealed condition, but this is never done - annealed tube ("As Welded Annealed" or AWA) is more usually specified to ASTM A269.

AS1528 allows either annealed or un-annealed conditions to be specified by the purchaser.



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Mechanical Properties

A249 is intended for critical environments in boilers or heat exchangers, and hence extensive mechanical testing is required. Full tensile and hardness testing is standard, as are flattening, flange and reverse bend.

A269 requires no tensile testing, but does require hardness tests, plus flange, reverse flattening.

A270 requires a reverse flattening test only.

A554 requires no mechanical testing as standard.

AS1528 requires no tensile or hardness testing, but does require the tube to be made from strip compliant with ASTM A240 - which itself has tensile strength requirements.

Non-Destructive Inspection

A249, A269, A270 and AS1528.1 all require 100% hydrostatic or eddy current testing.

A554 includes the possibility of non-destructive testing as a supplementary requirement, but this is not usual for A554 tube.

Which Specification

ASTM A249 is written for a quite different application area. It does specify weld bead removal, but this requirement can be met from other standards, without unnecessarily calling up the stringent mechanical properties of A249. The annealing mandatory in A249 will also not be required in most food applications. A high cost option.

ASTM A269 again requires tube in the annealed condition. Conversely, it does not specify internal weld bead removal, which generally is a food industry requirement. A269's main positive aspect is that it is frequently a stock item. It will prove uncompetitive against un-annealed tube.

ASTM A270 also has problems in that it requires the tube in the annealed condition, and says nothing about weld bead. The finish options available in this specification are very comprehensive. Usually request inner polish as well as outer Surfaces

ASTM A554 in its usual supply condition is intended for mechanical applications, not for pressure containment and not for sanitary use.

AS1528 is by far the safest option, and the most cost-effective. It is specifically directed at food industry applications, specifying the features necessary to ensure high integrity lines for hygienic applications without requiring high cost additional mechanical testing. Annealing is possible if required and Surface finishes can be further specified. Batch traceability marking (considered essential to validate many food and pharmaceutical plants) is mandatory. Another key benefit is the existence of matching specifications for associated tube fittings.