Designation: A802 – 19

Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination [1]

This standard is issued under the fixed designation A802; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (′) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This practice covers the acceptance criteria for the surface inspection of steel castings by visual examination. Four levels of acceptance standards are provided.

1.2 Acceptance levels utilize Steel Castings Research and Trade Association (SCRATA) [2] graded reference comparators for the visual determination of surface texture, surface roughness, and surface discontinuities described as follows:

Acceptance levels

A – Surface Texture
B – Nonmetallic Inclusions
C – Gas Porosity
D – Solidification Discontinuities
E – Sand Expansion Discontinuities
F – Metal Inserts
G – Thermally Cut Surfaces
H – Mechanically Prepared Surfaces
J – Welded Surfaces

1.3 Descriptions of terms related to casting discontinuities are in Section 2.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

Expansion Discontinuities

2.1.1 *rat tails, n*—long, narrow, linear depressions or small steps occurring on a casting surface. Rat tails form as a result of sand expansion and minor buckling of the mold surface during filling of the mold with liquid metal.

2.1.2 *scab, n*—a raised, rough area on a casting that usually consists of a crust of metal covering a layer of sand. Sometimes, a scab consists of a raised, rough area of essentially solid metal on the surface of a casting.

2.1.3 *veins, n*—raised, narrow, linear ridges that form upon cracking of the sand mold or core due to expansion of sand and the resulting mold or core stresses during filling of the mold with liquid steel.

External Chills

2.1.4 *external chills, n*—usually metal blocks, or graphite and carbon blocks, that are incorporated into the mold to locally increase the rate of heat removal during solidification. Brackets have the same purpose but represent an integral part of the casting. Brackets are produced by providing suitable cavities in the mold or core. External chills may produce flat spots and edges (raised areas or depressions) on the casting surface. Brackets merely change the casting appearance due to their presence. Brackets may be removed or allowed to remain on the casting.

2.1.5 *parting line and core print fins, n*—thin projections of excess metal at the parting plane between mold halves or core and mold. Causes are improper closing of the mold, insufficient weighting or clamping of the mold for pouring, or uneven pattern surfaces at the matching locations. Core print fins are usually caused by improper dimensions of core prints of the pattern or core box, by rough placement of cores in a soft mold, or by inadequately secured cores.

Fusion Discontinuities

2.1.6 *gas porosity, n*—a concave discontinuity in castings due to the evolution of gas, either from the solidifying metal or the surrounding mold.

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[1] This practice is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.18 on Castings.

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[2] Available from Castings Technology International, Advanced Manufacturing Park, Brunel Way, Rotherham, S60 5WG, South Yorkshire, England. http://www.castingstechnology.com.

***A Summary of Changes section appears at the end of this standard**

2.1.7 *laps, folds, and cold shuts, n*—interchangeable terms to describe the appearance of the casting surface that is actually folded over. They develop due to low temperature, unfavorable flow conditions caused by oxide films, or combinations thereof.

2.1.8 *misrun, n*—an incompletely formed casting, due to only partial filling of the mold cavity when the liquid metal solidifies prematurely. The resulting casting appearance is characterized by rounded edges, for a mild degree of misrun. Irregular, malformed edges of more severe misruns, and not fully formed castings, are characteristic. Frequently, misruns are associated with such discontinuities as wrinkles or laps and folds, or both.

2.1.9 *wrinkles, n*—elongated, smooth depressions of the casting surface, frequently appearing in closely spaced groups. Wrinkles result from irregularities of the liquid metal flow in the mold cavity, frequently associated with low temperature, and are distinguished from the more severe phenomenon of laps, folds, or cold shuts where the casting surface is actually folded over.

Inserts

2.1.10 *chaplets, n*—metallic (steel) devices used to maintain the spacing between the core and the mold. Low liquid metal temperature and unfavorable flow conditions in the mold may produce insufficient fusion and cause irregular contact areas on the casting surface.

2.1.11 *internal chills, n*—metallic (steel) devices used to locally increase the rate of heat removal during solidification. Incomplete fusion due to low liquid steel temperatures and prevailing flow conditions may produce irregularities of the surface similar to those that may be associated with chaplets.

2.1.12 *linear discontinuities, n*—elongated discontinuities are considered linear if their length equals or exceeds three times the width.

2.1.12.1 *cracks, n—cold and hot*, less jagged, sometimes straight ruptures that occur after solidification of the casting, due to excessive strain. Sometimes cracks are referred to as cold, hot, or heat-treat cracks to indicate the condition of the castings, or the operation during which the cracks occur.

2.1.12.2 *hot tears, n*—jagged ruptures in castings that occur during the final stages of solidification, while there is still some liquid in the interdendritic spaces, or shortly after solidification is complete.

2.1.13 *metal removal marks, n*—flame cutting and air carbon-arc cutting produce parallel grooves in the cut-off area. Finer marks are produced with the abrasive cut-off wheel and grinding.

2.1.14 *nonmetallic inclusions, n*—casting surface inclusions such as ceroxides, slag, and sand are partially or completely removed during the cleaning process of pressure blasting. Surface discontinuities left by these inclusions are referred to by the inclusion type that caused their formation:

2.1.14.1 *Discussion*—Ceroxides cause depressions on the surface of the casting by displacement of molten metal. Ceroxides consist of a mixture of low-melting oxides and partially fused sand. The crater-like appearance of the casting surface depression is typical.

2.1.14.2 *Discussion*—Depressions on the casting surface caused by slag are similar to those caused by ceroxides. They differ by a more rounded appearance of the depression and do not exhibit the crater-like appearance of ceroxides.

2.1.14.3 *Discussion*—Depressions caused by sand are simi- lar to those of ceroxides and slag. Their appearance may, at times, more closely reflect the granular nature of the sand.

2.1.15 *shrinkage under risers and gates, and revealed by machining, n*—a shrinkage void is a discontinuity in castings due to the lack of available liquid feed metal during solidification contraction. Riser removal and machining may reveal shrinkage that extends from the interior of the casting to the near surface area.

2.1.16 *surface texture, n*—cast surfaces have a multi-directional lay, without the uniform sequence of ridges and valleys of machined surfaces.

Welding

2.1.17 *weld spatter, n*—weld metal droplets that solidified against and adhere to the component being welded.

2.1.18 *weld undercuts, n*—narrow elongated depressions that border the weld contour and result from improper welding conditions or inadequate control of welding operations.

3. Ordering Information

3.1 The inquiry and order should specify the following information:

3.1.1 *Acceptance Level*—More than one acceptance level may be specified for different surfaces of the same casting (see Section 4),

3.1.2 If any types of discontinuities are unacceptable,
3.1.3 Extent of casting surfaces to be examined, and
3.1.4 Number of castings to be examined.

4. Acceptance Standards

4.1 Levels of acceptance for visual inspection are listed in Table 1.

4.2 Surface discontinuities not covered in Practice A802 shall be a matter of agreement between the purchaser and the manufacturer.

5. Keywords

5.1 steel castings; surface acceptance standards; visual

TABLE 1 Visual Inspection Acceptance Criteria [A]

Surface Feature	Level I	Level II	Level III	Level IV
Surface texture	A1	A2	A3	A4
Nonmetallic inclusions	B1	B2	B4	B5
Gas porosity [B]	C2	C1	C3	C4
Fusion discontinuities	... [C]	D1	D2	D5
Expansion discontinuities	... [C]	... [C]	E3	E5
Inserts	... [C]	... [C]	F1	F3
Metal removal marks:				
Thermal	G1	G2	G3	G5
Mechanical	H1	H3	H4	H5
Welds	J1	J2	J3	J5

[A] Level 1 is the highest acceptance level. Level IV is the lowest acceptance level.

Comparator plates listed in higher acceptance levels are acceptable in all lower acceptance levels.

[B] See Appendix X1.

[C] No reference comparator plate is available for this surface feature and level.

APPENDIX

(Nonmandatory Information)

X1. NOTES ON GAS POROSITY COMPARATOR PLATES

X1.1 Comparator plates C1 and C2 show different types of porosity and surface roughness. C1 has fewer but larger pores with a smoother surface finish, whereas C2 has a greater number of smaller pores with a rougher surface finish. This same allocation of C1 and C2 is also observed in ISO11971, EN12454, and EN1370.

X1.2 ANSI/MSS-SP-55 considers that both comparator plates C1 and C2 are equivalent to the acceptance criteria of SP-55.

X1.3 The purchaser may choose to select more/smaller or fewer/bigger as more important, but this is largely based on aesthetics and does not currently pertain to performance.

X1.4 A purchaser is free to specify, in agreement with the producer, the gas porosity comparator plate which better suits their application.

SUMMARY OF CHANGES

Subcommittee A01.18 has identified the location of selected changes to this standard since the last issue (A802 – 95 (2015)) that may impact the use of this standard. (Approved Sep. 1, 2019.)

(1) Added footnotes B and C to Table 1.
(2) Added Appendix X1 to further explain why comparators C1 and C2 are not in numerical order.