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:620.179:621.753.1

June 1985

Technical delivery conditions for castings made from metallic materials

Steel castings; classification into severity levels on the basis of non-destructive testing

DIN 1690 Part 2

Technische Lieferbedingungen für Gußstücke aus metallischen Werkstoffen; Stahlgußstücke; Einteilung nach Gütestufen aufgrund zerstörungsfreier Prüfungen

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

The subclauses marked with two dots •• give specifications which are optional and may be agreed upon at the time of ordering.

1 Field of application

1.1 As a supplement to the general technical delivery conditions for castings specified in DIN 1690 Part 1, this standard gives a classification into various severity levels for the external and internal condition of steel castings in the as delivered condition (see Explanatory notes).

The classification is based on the requirements with regard to the results of non-destructive tests.

1.2 This standard does not apply to fabrication welds (for definition, see DIN 1690 Part 1). For these, special agreements regarding the internal and external condition and checking of these shall be made at the time of ordering.

2 Severity levels

2.1 Classification by severity levels

The classification by severity levels for the external condition shall be made on the basis of magnetic particle inspection or penetrant inspection on the basis of the characteristics given in table 1 or table 2 or on the basis of the series of illustrations in Appendices A and B. In cases of dispute, the values given in table 1 or table 2 shall be mandatory.

The classification by severity levels for the internal condition is based on ultrasonic tests or radiographic tests for the characteristics given in table 3 or table 4 (see subclause 3.3.2.1).

2.2 Choice of severity levels

2.2.1 •• With regard to the permissibility of external or internal discontinuities in steel castings, specifications in material standards or in the order, based on the classification by severity levels as in subclause 2.1 and using standard designations as in subclause 2.3 may be agreed. For this purpose, the following factors shall be borne in mind according to the level, type and distribution of the loads:

2.2.1.1 •• Different severity levels may be agreed for different areas of the casting. In such cases, the areas concerned shall be clearly specified, i.e.

- by giving their location and their length and width;
- in the case of ends for welding and in special surface zones as described in subclause 2.2.3, additionally by giving their depth.

2.2.1.2 •• In addition to severity levels of equal value, different severity levels may also be agreed for internal and external condition.

2.2.1.3 Severity level 1 is only applicable for ends for welding and for special surface zones as described in subclause 2.2.3.

2.2.1.4 The shape of the castings affects their condition and their testability. Apart from this, the testability of a casting also depends on its surface condition.

2.2.2 If no severity level has been agreed at the time of ordering, and if not otherwise specified in the material standards, the requirements for severity level 5 shall apply.

2.2.3 •• In special cases, a higher, i.e. numerically lower, severity level as for the remaining wall thickness may be agreed for an outer layer of the outer zone as shown in figure 1 (briefly referred to as "special outer zone"), for example in the case of surfaces to be machined by the manufacturer (see subclause 2.3, example 3).

2.2.4 •• For production welds (for definition, see DIN 1690 Part 1), the same requirements shall apply as for the parent metal, unless other requirements have been agreed at the time of ordering.

2.3 Standard designation

The standard designation for the severity level shall consist of the following elements, as shown in the example below:

- the term "severity level";
- the number of this standard;
- the symbol S (= surface) for the severity level relating to the external condition (see tables 1 and 2);
- the symbol V (= volume) for the severity level, relating to the internal condition (see tables 3 and 4).

Example 1:

Severity level DIN 1690 – S2 – V4

•• In cases where, contrary to the specifications given in subclause 3.3.2.1 the choice of test method is not being left to the manufacturer, the following code letters for

Continued on pages 2 to 16

the test method shall be added to the symbol for the severity level, as shown in examples 2 and 3:

for magnetic particle inspection, M;
for penetrant inspection, E;
for ultrasonic inspection, U;
for radiographic inspection, R.

Example 2:

Severity level DIN 1690 – MS2 – RV4

Example 3:

Severity level DIN 1690 – MS2 – RV4, on all surfaces to be machined: MS1; in a zone down to 20 mm below the surface: UV1

3 Testing

3.1 •• Agreements with regard to testing and documents on materials testing

3.1.1 In cases where castings assigned to severity levels 01 to 3 have been ordered, retesting for conformity of the consignment with the relevant requirements is also deemed to have been agreed.

3.1.2 In cases where castings assigned to severity level 4 or 5 have been ordered, retesting for conformity of the consignment with the relevant requirements, where this is desired by the purchaser, shall be agreed at the time of ordering.

3.1.3 Unless otherwise agreed at the time of ordering, an inspection certificate B as specified in DIN 50 049 shall be issued giving the results of non-destructive testing of the consignment.

3.2 •• Scope of test programme

Unless otherwise agreed at the time of ordering (for example, in the case of series production), all the castings being supplied shall be appropriately tested at the points to which the severity level applies.

3.3 Test methods

3.3.1 Magnetic particle inspection or penetrant inspection

Magnetic particle inspection as specified in *Stahl-Eisen-Prüfblatt* (Iron and steel test sheet) 1935 or penetrant testing as specified in *Stahl-Eisen-Prüfblatt* 1936 shall be used for verifying that the steel casting conforms to the requirements regarding the external condition as given in table 1 or 2. In the case of castings made from non-magnetizable grades of cast steel, penetrant inspection shall be used, and in the case of castings of magnetizable (ferromagnetic) grades of cast steel, magnetic particle inspection shall be used for preference.

Magnetic particle inspection shall be used for inspecting machined surfaces unless otherwise agreed (see subclause 2.3).

The series of illustrations shown in Appendix A may be used as an aid for assessing non-linear indications on the basis of magnetic particle inspection and the series of illustrations shown in Appendix B may be used for assessing non-linear indications on the basis of penetrant inspection (see subclause 2.1). Each illustration corresponds to one of the severity levels 1 to 5 as in table 1 or severity levels 01 to 5 as in table 2. The procedure for determining the severity level is to place a frame with inside dimensions of 148 mm X 105 mm (size A6) over the least favourable area and to find the same or the next least favourable reference illustration in the series.

3.3.2 Radiographic or ultrasonic inspection

3.3.2.1 Unless otherwise agreed at the time of ordering, the choice of test method shall be left to the manufacturer. The following should be observed when making the choice:

In the case of austenitic materials, only radiographic inspection shall be carried out.

In the case of ferritic (including pearlitic and martensitic) steels, radiographic inspection shall be used for preference for examining thin-walled castings, ends for welding and, where necessary, as a supplement to ultrasonic inspection for determining the type of defect (see table 3, line 11).

Ultrasonic inspection should be considered for preference for thicker castings and for examining production welds and as a supplement to radiographic inspection for determining the position in depth and the thickness of defects (see table 4, footnote 2).

The size of defect to be detected and the casting geometry shall also be taken into account in choosing the test method. For this reason, it is not possible to define precisely the demarcation between the terms "thick" and "thin" used above. It lies in the range between 50 and 100 mm.

3.3.2.2 •• Ultrasonic inspection

Ultrasonic inspection shall be carried out as described in *Stahl-Eisen-Prüfblatt* 1922.

Test class I shall apply for severity levels 1 to 4 and test class II for severity level 5.

3.3.2.3 •• Radiographic inspection

DIN 54 109 Part 1 and Part 2 shall apply for radiographic inspection, and also DIN 54 111 Part 2.

The test shall be carried out as described in DIN 54 111 Part 2, test class A, unless otherwise specified for particular areas. Image quality class II as in DIN 54 109 Part 2 shall be complied with.

Table 1. **Maximum permissible indications in the case of magnetic particle inspection as in *Stahl-Eisen-Prüfblatt* 1935** (reference area: 105 mm × 148 mm, corresponding to size A6 as in DIN 476)

Severity level (see subclause 2.3)	Diameter or length of smallest indication to be recorded	Non-linear indications [1] (excluding aligned indications) [2]		Linear indications [1] or aligned indications [2]					
				Maximum permissible length [4]					
		total area	length of an isolated indication [3]	of an isolated linear indication or aligned indications	of all linear indications and aligned indications	of an isolated linear indication or aligned indications	of all linear indications and aligned indications	of an isolated linear indication or aligned indications	of all linear indications and aligned indications
		(not used as criteria)		with a casting thickness at the tested area of					
				up to 16 mm		over 16 up to 50 mm		over 50 mm	
	mm	mm^2	mm	mm	mm	mm	mm	mm	mm
01 [5]	0,3	–	1	1	1	1	1	2	2
1	1,5	10	2	2	4	3	6	5	10
2	2	35	4	4	6	6	12	10	20
3	3	70	6	6	10	9	18	15	30
4	5	200	10	10	18	18	27	30	45
5	5	500	16	18	25	27	40	45	70

[1] Indications whose length is greater than three times their width and those whose length is three times their width or less are known respectively as linear or non-linear indications (see also footnote 2).

[2] If at least three linear or non-linear indications are arranged one behind the other at a distance of 2 mm at the most, these shall be regarded as aligned and hence be referred to as "aligned indications".

[3] No more than two indications of the maximum permitted length may be present within the reference area.

[4] The length of one group of aligned indications shall be taken as the distance between the start of the first and the opposite end of the last indication of the group.

[5] Severity level 01 shall only be used in the case of highly stressed small castings and machined surfaces.

Table 2. **Maximum permissible indications in the case of dye penetrant testing as in *Stahl-Eisen-Prüfblatt* 1936** (reference area: 105 mm X 148 mm, corresponding to size A6 as in DIN 476)

Severity level (see subclause 2.3)	Diameter or length of smallest indication to be recorded	Non-linear indications [1] (excluding aligned indications) [2]		Linear indications [1] or aligned indications [2]					
		number of indications (not used as criteria)	sizes of indications (not used as criteria)	Maximum permissible length [3] with a casting thickness at the tested area of up to 16 mm		over 16 up to 50 mm		over 50 mm	
				of a single linear indication or aligned indications	all linear indications and aligned indications	of a single linear indication or aligned indications	all linear indications and aligned indications	of a single linear indication or aligned indications	all linear indications and aligned indications
	mm		mm	mm	mm	mm	mm	mm	mm
01 [4]	0,3	–	1	1	1	1	1	2	2
1	1,5	8	3	2	4	3	6	5	10
2	2	8	6 [5]	4	6	6	12	10	20
3	3	12	9 [5]	6	10	10	18	18	30
4	5	20	14 [5]	10	18	18	27	30	45
5	5	32	21 [5]	18	25	27	40	45	70

[1] Indications whose length is greater than three times their width and those whose length is three times their width or less are known respectively as linear and non-linear indications (see also footnote 2).

[2] If at least three linear or non-linear indications are arranged one behind the other at a distance of 2 mm at the most, these shall be regarded as aligned and hence be referred to as "aligned indications".

[3] The length of one group of aligned indications shall be taken as the distance between the start of the first and the opposite end of the last indication of the group.

[4] Severity level 01 shall only be used in the case of highly stressed small castings and machined surfaces.

[5] The frequency distribution of the sizes of the isolated indications shall roughly correspond to the illustrations in Appendix B, but no indication shall be larger than the value given in this table. If on the reference area linear indications also occur in addition to non-linear indications they shall meet the requirements for linear indications; in addition they shall be included with the number of non-linear indications.

Table 3. **Requirements regarding the maximum permissible values for features of indications in the case of ultrasonic inspection as in *Stahl-Eisen-Prüfblatt* 1922**

	1	2	3												
Line	Feature	Zone (see figure 1)	Requirements regarding features as in column 1, applicable to severity level												
			1	2			3			4			5		
			with a casting thickness, in mm, at the tested area of												
			[1]	≤ 50	> 50 ≤ 100	> 100 ≤ 600	≤ 50	> 50 ≤ 100	> 100 ≤ 600	≤ 50	> 50 ≤ 100	> 100 ≤ 600	≤ 50	> 50 ≤ 100	> 100 ≤ 600
	Test class as in SEP 1922														
1			I										II		
	Reflectors with no measureable extension [2]														
2	Largest diameter of equivalent circular reflector, in mm	Mid zone Outer zone	} 3	See line 10d.									Not used as criterion.		
3	Number of reflectors meeting the minimum limit for recording, per dm² of tested area	Mid zone Outer zone	a) If distance A (see figure 2) between the reflectors in each case is larger than the sound beam diameter [2] the following maximum values shall apply: } 3 | } 3 | } 3 | 3 each | } 5 | } 5 | 5 each | Not used as criterion. b) If distance A (see figure 2) between two or more reflectors is less than or equal to the sound beam diameter [2], even if the maximum values listed under a) are not exceeded, proceed as in lines 10 and 11.												
	Reflectors of measureable extension [2]														
4	Largest diameter of equivalent circular reflector, in mm	Mid zone Outer zone	Not permitted, i.e. < 3.	See line 10d.									Not used as criterion.		
5	Back-wall echo attenuation at 2 MHz, if this is not determined by the shape of the casting or by the coupling	Mid zone Outer zone	6 dB (50 %)	12 dB (75 %) [3]									20 dB (90 %) [3]		
6	Maximum values of the ratio of the thickness of the reflection area to the thickness d of the casting at the test location, in %	Mid zone [4] Outer zone [4]	Not permitted	15 10	15 10	15 10	15 10	15 10	15 10	15 10	15 10	15 10	25 15	25 15	25 15
7	Maximum length L, in mm, for width B not exceeding sound beam diameter	Mid zone Outer zone		75 75	75 75	100 75	75 75	75 75	120 75	100 75	100 75	150 75	100 75	100 75	150 75
8	Largest individual area, in cm² (see figure 2)	Mid zone [5] Outer zone		100 6	100 10	150 10	150 6	150 20	200 20	150 20	150 20	200 20	300 40	300 40	400 40
9	Largest total area, in cm² (see figure 2)	Mid zone Outer zone		100 100	150 100	150 100	150 100	200 100	200 100	150 100	200 150	200 150	300 150	400 200	400 200
	For a reference area, in cm², of			1500 (≈ 39 × 39)			1000 (≈ 32 × 32)								

See page 6 for [1] to [5].

Table 3 (continued). **Requirements regarding the maximum permissible values for features of indications in the case of ultrasonic inspection as in *Stahl-Eisen-Prüfblatt* 1922**

	1	2	3												
Line	Feature	Zone (see figure 1)	Requirements regarding features as in column 1, applicable to severity level												
			1	2			3			4			5		
			with a casting thickness, in mm, at the tested area of												
			[1]	≤ 50	> 50 ≤ 100	> 100 < 600	≤ 50	> 50 ≤ 100	> 100 ≤ 600	≤ 50	> 50 ≤ 100	> 100 ≤ 600	≤ 50	> 50 ≤ 100	> 100 ≤ 600
Reflectors with special features															
10	Indication areas with indications that a) suggest defects in the casting in a position unfavourable with regard to the sound ray or b) suggest clusters of defects with a definite extension, in length or in depth or c) suggest cracks or other defects having a significant effect on the usability of the casting, e.g. leaks, or, d) in the case of wall thicknesses not greater than 50 mm, exceed a circular reflector of 8 mm diameter, or in the case of wall thicknesses greater than 50 mm exceed a circular reflector of 8 mm diameter and lie in the outer zone, shall be recorded, even if they do not exceed the limit for recording specified in SEP 1922, and a decision made after consultation with the purchaser. Cracks are not permitted unless the minor nature of the cracks has been demonstrated by fracture testing.														
General requirement															
11	If, in the case of ambiguous results or results deviating from the above requirements, a supplementary radiographic examination has to be carried out, the requirements in table 4 shall apply. If ultrasonic inspection has suggested the presence of defects of measureable extension but no defects have been discovered in the radiographic examination, the existence of cracks cannot be precluded and therefore the procedure followed shall be as given in line 10.														

[1] See subclause 2.2.1.3.

[2] In cases of doubt, for classification of reflectors into those of measureable extension and those with no measureable extension, and for the subclassification on the basis of the distance of the reflectors without measureable extension, as in lines 3a and 3b, a test probe of 24 mm diameter, for longitudinal waves, with a frequency of 2 MHz or a probe with a sound beam characteristic which is the same as that of the probe described above shall be used.

[3] Within an area of indication, isolated back-wall echo attenuations of 100% are permitted for severity levels 2 to 5.

[4] For severity levels 2 to 5, an indication extending from the mid zone to the outer zone may have a maximum extension in depth of 15% of the wall thickness (maximum 50 mm) with not more than 10% of the wall thickness (maximum 25 mm) lying in the outer zone.

[5] If the indication in the mid zone is produced by an individual reflector, the thickness of which does not exceed 10% of the wall thickness so that it has to be classified as a mid zone shrinkage, then, in the case of severity levels 2 to 4, 50% higher values than those specified in this table are permitted. For severity level 5 there is no limit in such a case.

Table 4. **Maximum permissible defects in the case of radiographic examination and also where applicable, in the case of radiographic examination of the parent metal of the casting carried out as a supplement to ultrasonic inspection**

Type	Defect: Code letter as in ASTM [1]	Defect: For wall thicknesses	Assessment as in ASTM [1]	Maximum permissible defect for severity level 1	2 [2]	3 [2]	4 [2]	5
Blowholes	A	Up to 50 Over 50 up to 115 Over 115 up to 300	E 446 E 186 E 280	A 1 A 1 [3]	A 3 A 3 A 3	A 3 A 3 A 3	A 4 A 4 A 4	A 5 A 5 A 5
Non-metallic inclusions	B	Up to 50 Over 50 up to 115 Over 115 up to 300	E 446 E 186 E 280	B 1 B 1 [3]	B 3 B 3 B 3	B 3 B 3 B 3	B 4 B 4 B 4	B 5 B 5 B 5
Shrinkage	C	Up to 50 Over 50 up to 115 Over 115 up to 300	E 446 E 186 E 280	Ca1, Cb1, Cc1, Cd1 Ca1, Cb1, Cc1 [3]	Ca2, Cb2, Cc2, Cd2 Ca3, Cb2, Cc2 Ca2, Cb2, Cc2	Ca3, Cb3, Cc3, Cd3 Ca3, Cb3, Cc3 Ca3, Cb3, Cc3	Ca4, Cb4, Cc4, Cd4 Ca4, Cb4, Cc4 Ca4, Cb4, Cc4	Ca5, Cb5 Ca5, Cb5 Ca5, Cb5
Cracks	D + E			Not permitted.	Not permitted [4].	Not permitted [4].	Not permitted [4].	D 1, E 1 [5]
Chaplets and iron chills	F	Up to 50 Over 50 up to 115 Over 115 up to 300	E 446 E 186 E 280	Not permitted. Not permitted. Not permitted.	Not permitted. Not permitted. Not permitted.	Not permitted. Not permitted. Not permitted.	F 1 [6] F 1 [6] F 1 [6]	F 1 F 1 F 1

1) ASTM-E 446 Standard reference radiographs for steel castings up to 2 in. (51 mm) in thickness,
ASTM-E 186 Standard reference radiographs for heavy-walled (2 to 4½ in. (51 to 114 mm)) steel castings and
ASTM-E 280 Standard reference radiographs for heavy-walled (4½ to 12 in. (114 to 305 mm)) steel castings.

2) If for example it is shown by ultrasonic inspection that the defects are in the mid zone (see figure 1), the specifications for the next higher severity level (e. g. 3 instead of 2) shall apply, unless otherwise specified in the material standard or in the order.

3) The values to be adhered to shall be agreed.

4) Unless the minor nature of the cracks is proved by fracture-mechanical tests.

5) Cracks are permitted up to the following lengths according to the wall thickness:

Wall thickness s, in mm	Largest permissible crack length, in mm
Up to 10	7
Over 10 to 150	$^2/_3 \times s$
Over 150	100

6) Chaplets may be present, but they shall be welded free from cracks at the surface.

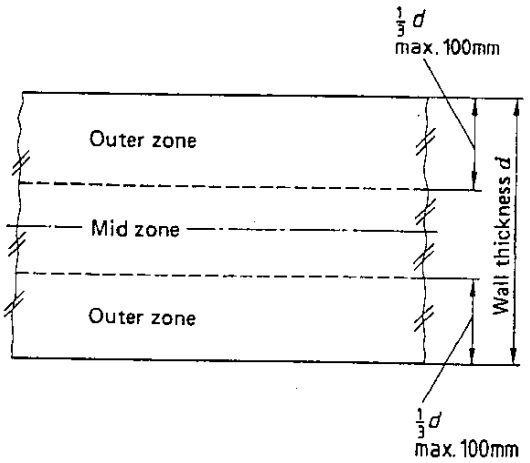

Figure 1. Division of wall into zones
(The division of the wall relates to the sizes of the casting ready for assembly)

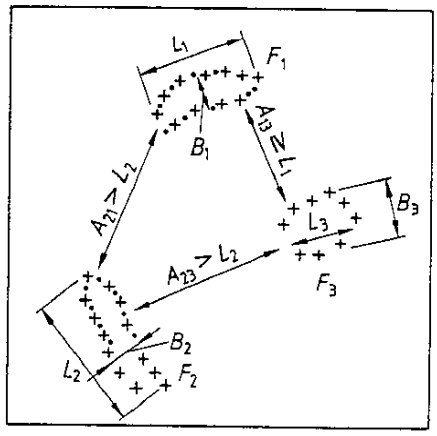

Figure 2. Explanatory note on the terms "individual area" and "total area" of indications given in table 3:

Individual areas F are areas whose distance A from the neighbouring area is greater than the largest dimension L of either of the two neighbouring areas.

In the present example therefore, F_1, F_2, F_3 are individual areas, whilst the total area is $F_1 + F_2 + F_3$.

Dimensions L and B of the indication area are obtained from the line joining the centre points of the probes during scanning of the indication area. In the case of long sound paths, if necessary, the actual extension of the indication area shall be determined, taking into account the sound field geometry and the sound propagation.

Appendix A

Series of illustrations for assessing non-linear indications with magnetic particle inspection as in *Stahl-Eisen-Prüfblatt* 1935 (see subclause 2.1)

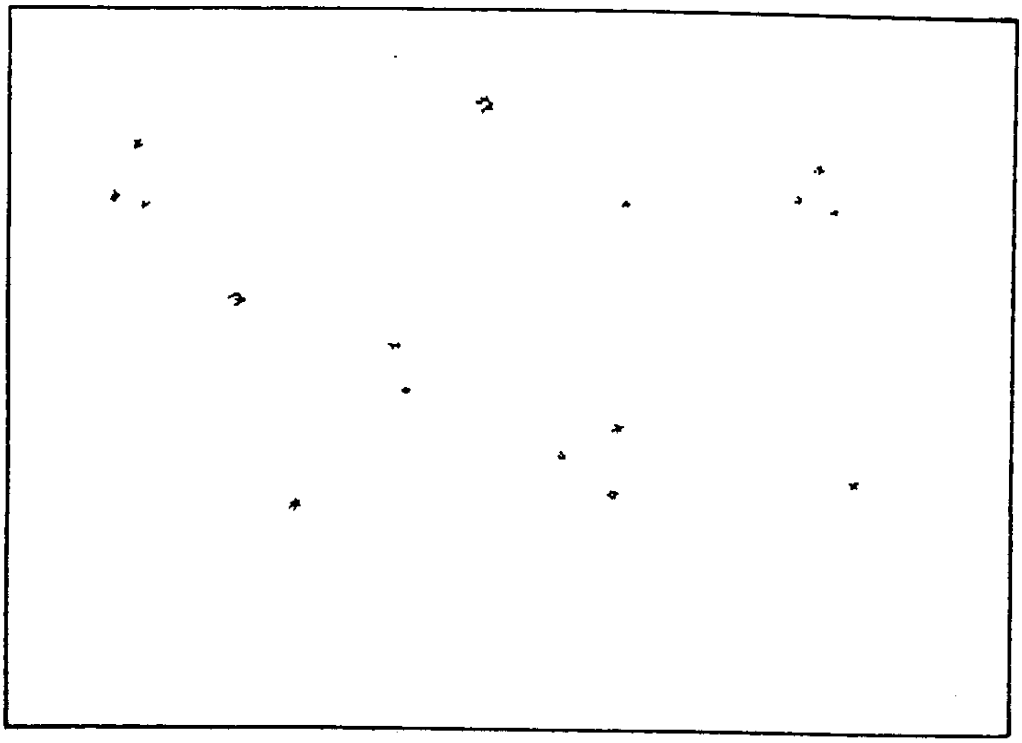

Figure A1. Indications corresponding to severity level 1.

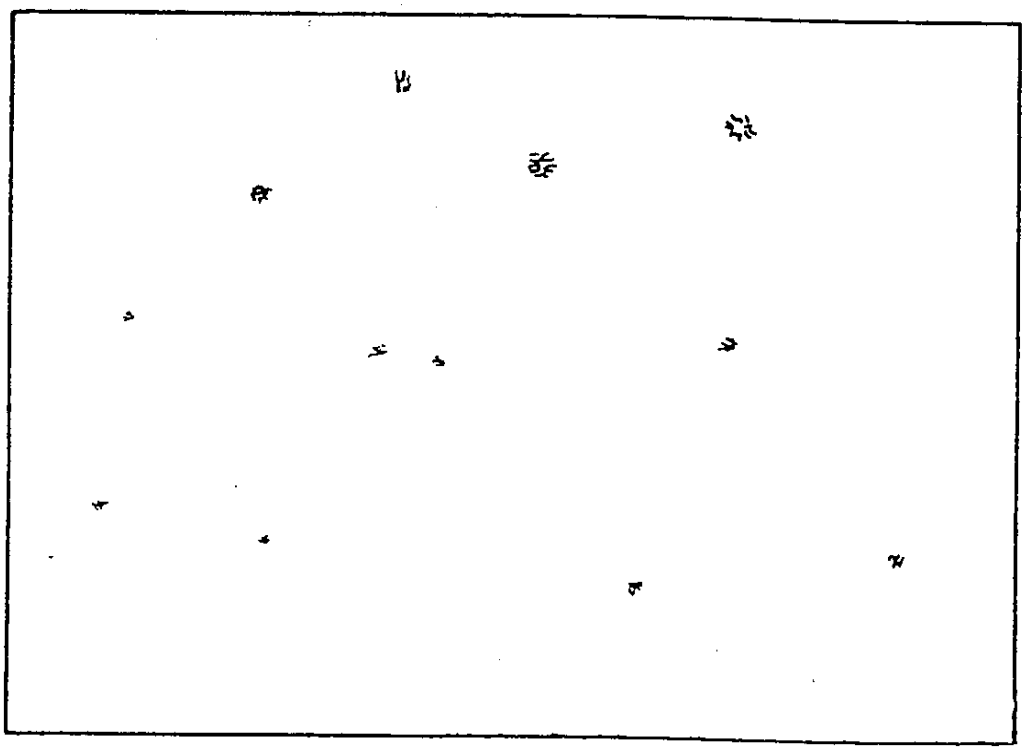

Figure A2. Indications corresponding to severity level 2.

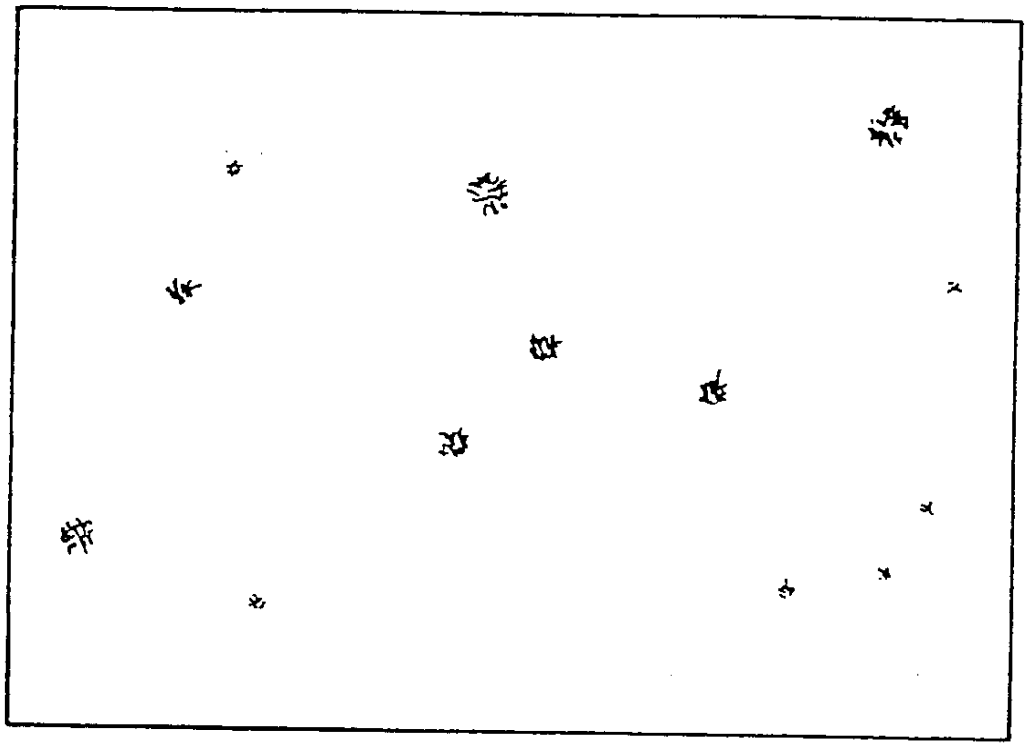

Figure A3. Indications corresponding to severity level 3.

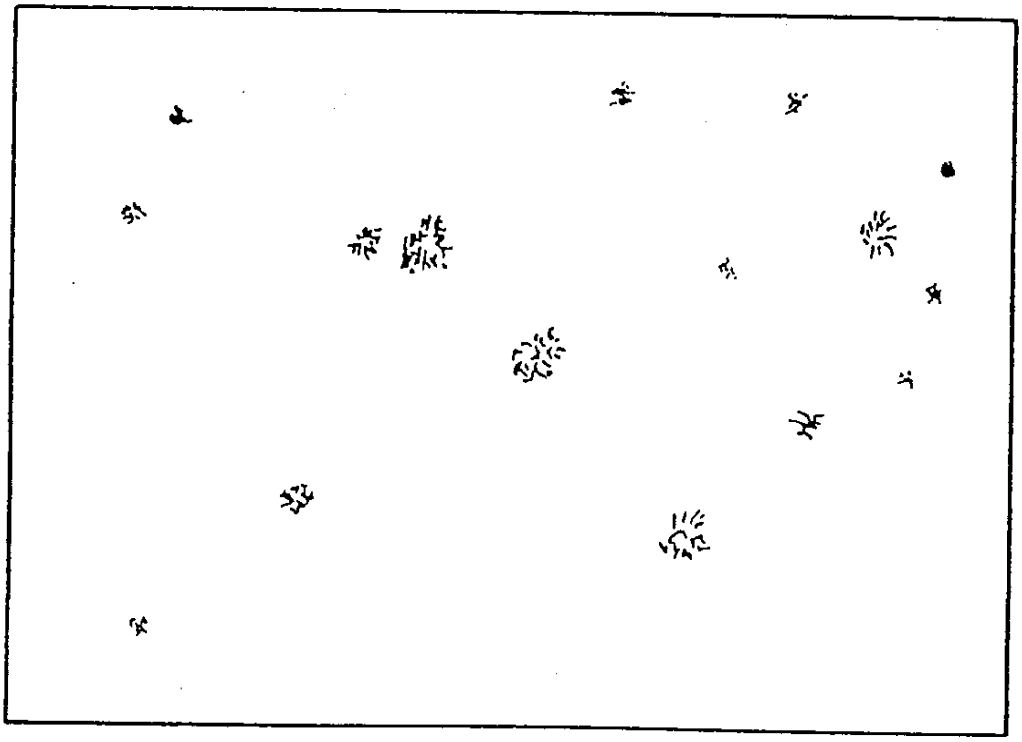

Figure A4. Indications corresponding to severity level 4.

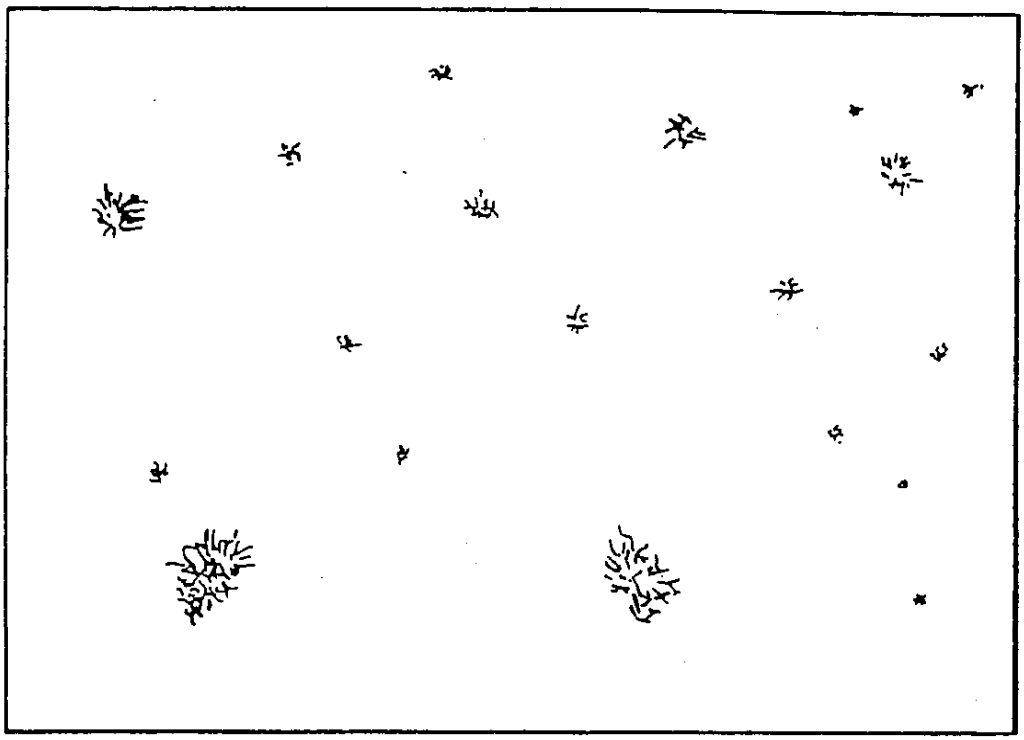

Figure A5. Indications corresponding to severity level 5.

Appendix B

Series of illustrations for assessing non-linear indications with penetrant inspection as in *Stahl-Eisen-Prüfblatt* 1936
(see subclause 2.1 and table 2, footnote 5)

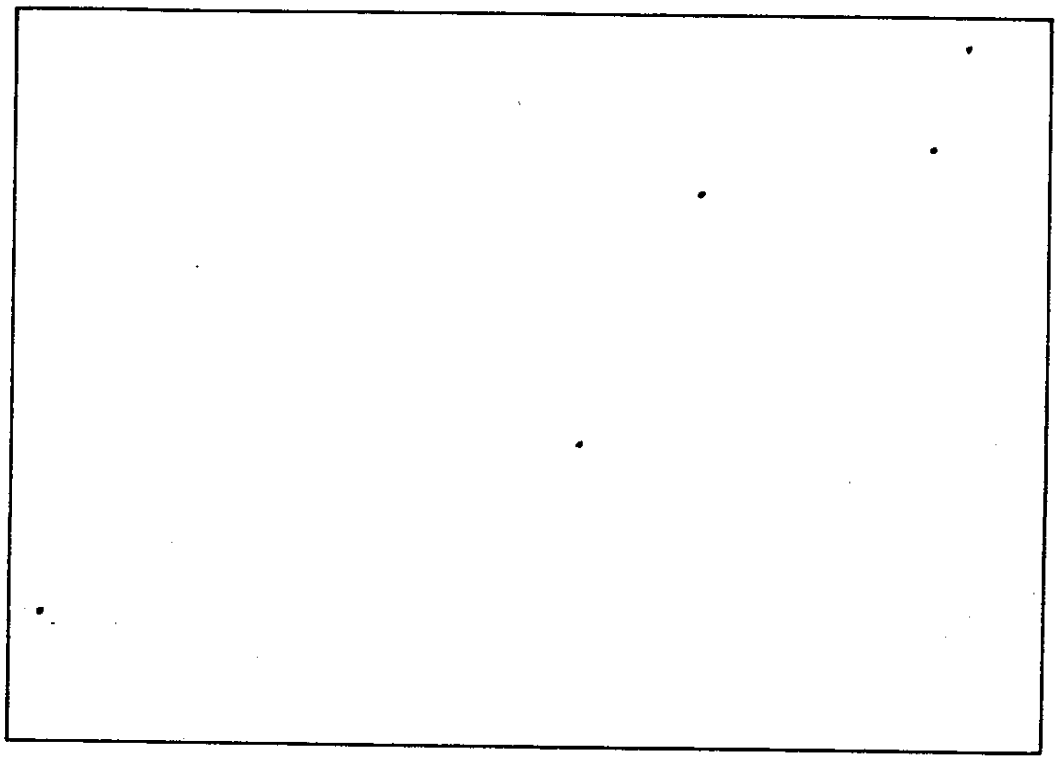

Figure B1. Indications corresponding to severity level 01.
(5 indications, the largest size of which is between 0,3 and 1 mm)

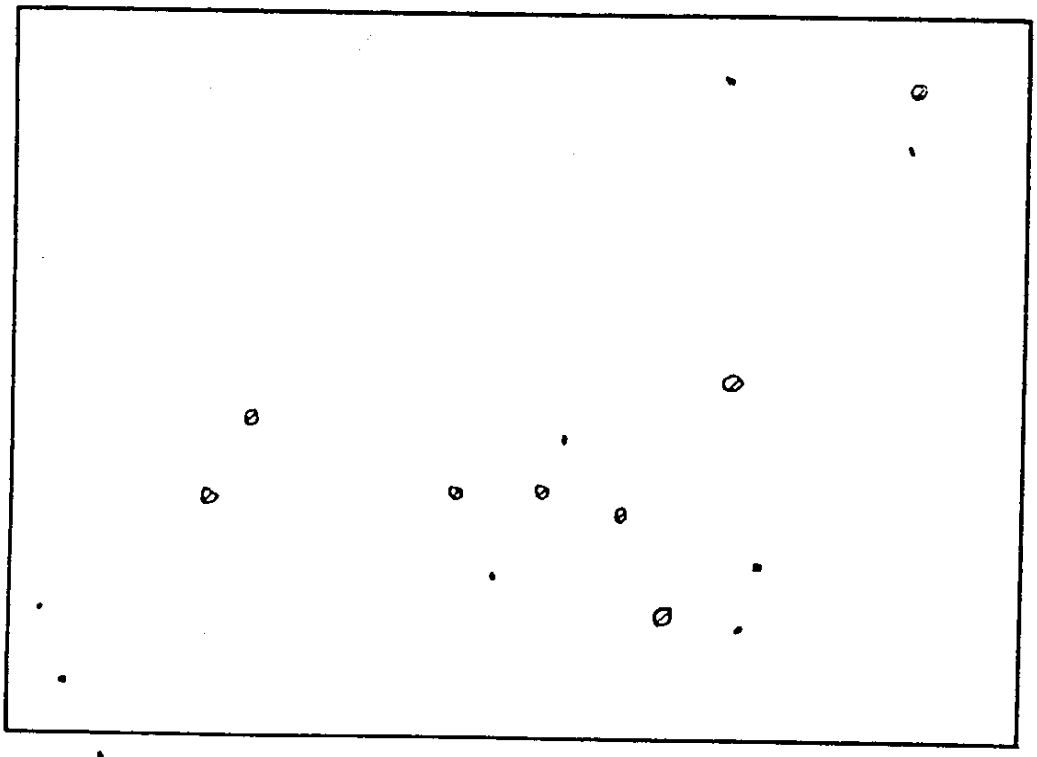

Figure B2. Indications corresponding to severity level 1.
(8 indications, the largest size of which is between 1,5 and 3 mm)

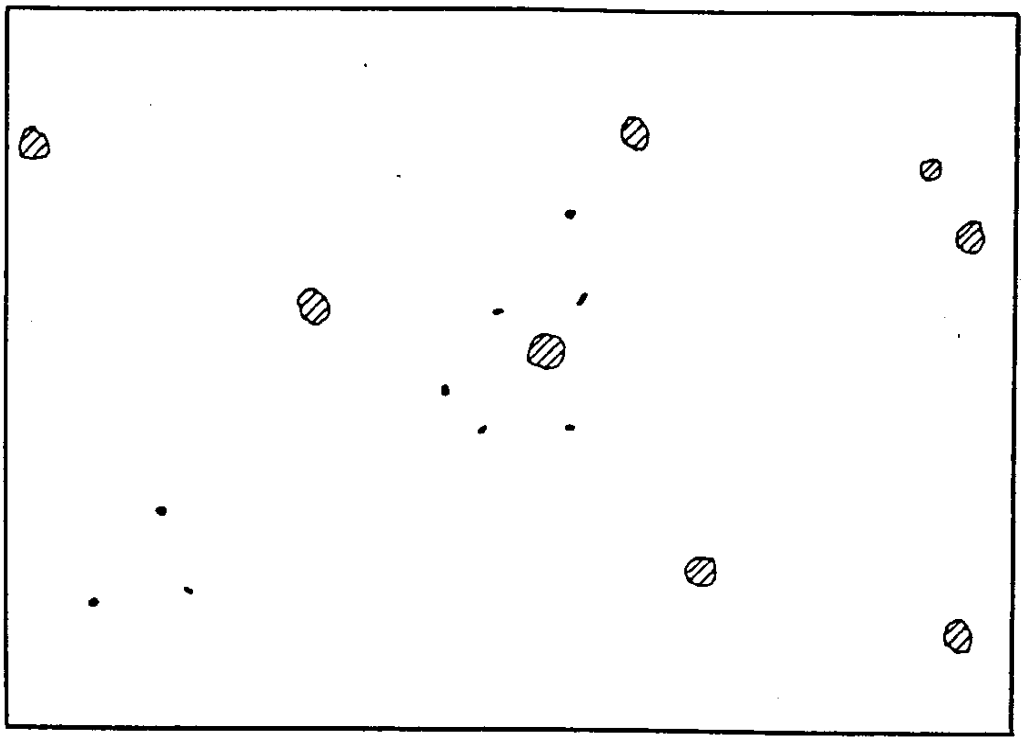

Figure B3. Indications corresponding to severity level 2.
(8 indications, the largest size of which is between 2 and 6 mm)

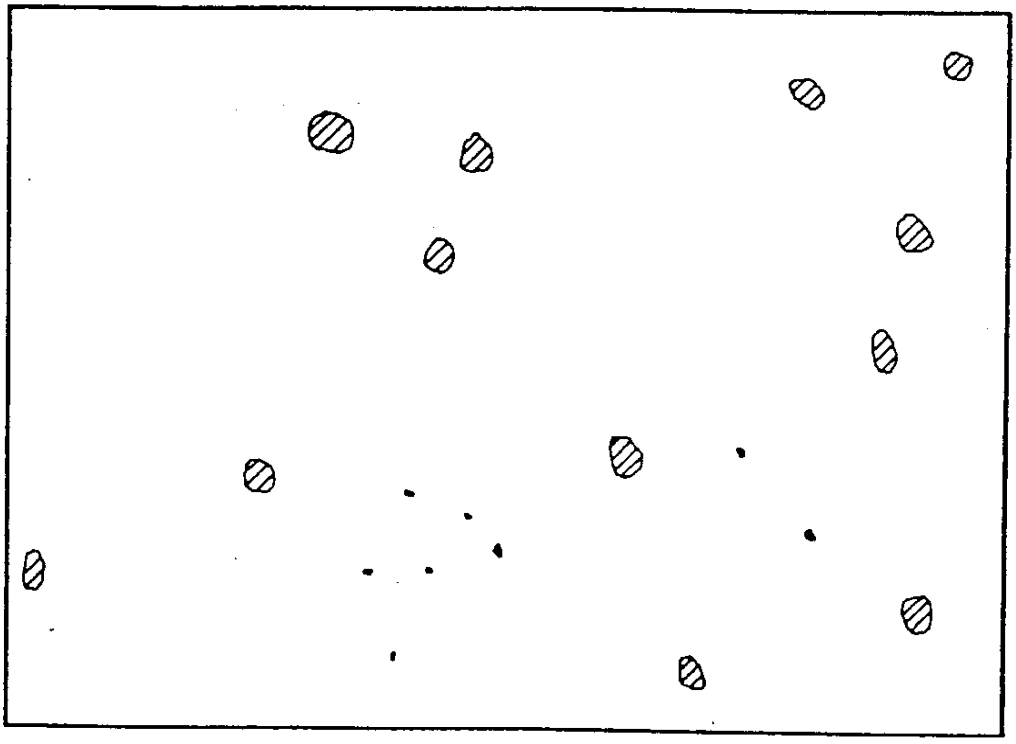

Figure B4. Indications corresponding to severity level 3.
(12 indications, the largest size of which is between 3 and 9 mm)

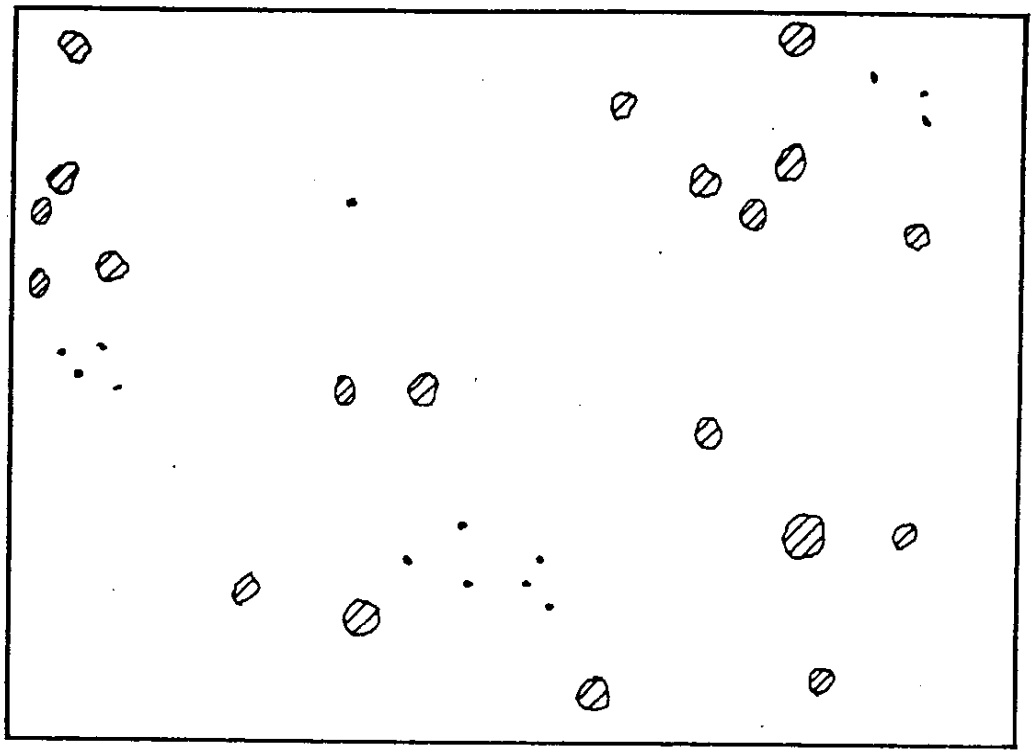

Figure B5. Indications corresponding to severity level 4.
(20 indications, the largest size of which is between 5 and 14 mm)

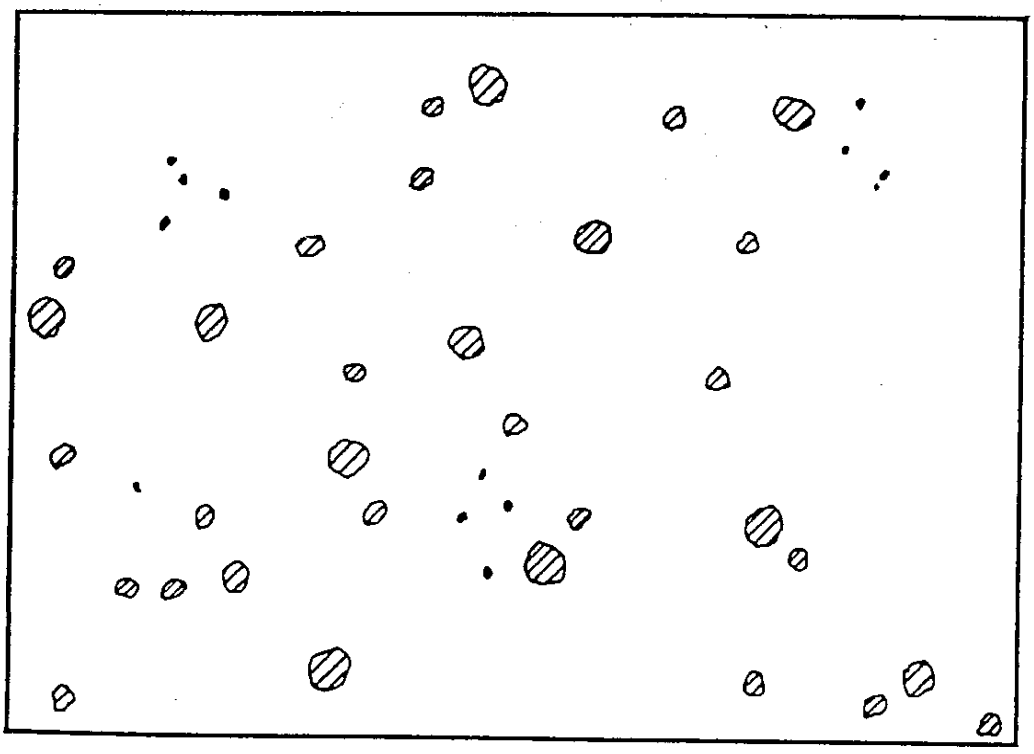

Figure B6. Indications corresponding to severity level 5.
(32 indications, the largest size of which is between 5 and 21 mm)

Standards and other documents referred to

DIN 476	Trimmed sizes of paper
DIN 1690 Part 1	Technical delivery conditions for castings made from metallic materials; general conditions
DIN 50 049	Documents on materials testing
DIN 54 109 Part 1	Non-destructive testing; image quality of radiographs of metallic materials; concepts, image quality indicators, determination of image quality index
DIN 54 109 Part 2	Non-destructive testing; image quality of X-ray and gamma-ray radiographs of metallic materials; directions for formation of image quality classes
DIN 54 111 Part 2	Non-destructive testing; testing of metallic materials by X-rays or gamma-rays; radiographic techniques for castings made from ferrous materials
Stahl-Eisen-Prüfblatt 1922[1]	*Ultraschallprüfung von Gußstücken aus ferritischem Stahl* (Ultrasonic testing of castings made from ferritic steel)
Stahl-Eisen-Prüfblatt 1935[1]	*Oberflächenrißprüfung von Gußstücken aus Stahl; Magnetpulverprüfung* (Surface crack testing of steel castings; magnetic particle inspection)
Stahl-Eisen-Prüfblatt 1936[1]	*Oberflächenrißprüfung von Gußstücken aus Stahl; Eindringprüfung* (Surface crack testing of steel castings; penetrant testing)
ASTM-E 186[2]	Standard reference radiographs for heavy-walled (2 to 4½ in. (51 to 114 mm)) steel castings
ASTM-E 280[2]	Standard reference radiographs for heavy-walled (4½ to 12 in. (114 to 305 mm)) steel castings
ASTM-E 446[2]	Standard reference radiographs for steel castings up to 2 in. (51 mm) in thickness

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[1] Obtainable from: *Verlag Stahleisen mbH,* Postfach 82 29, D-4000 Düsseldorf 1.

[2] Obtainable from: *Beuth Verlag GmbH,* Burggrafenstraße 4–10, D-1000 Berlin 30.

Explanatory notes

As a supplement to the general technical delivery conditions for castings made from metallic materials in DIN 1690 Part 1, this standard provides a classification of steel castings on the basis of severity levels determined by non-destructive testing.

The classification into quality classes as in DIN 17 245 (High temperature ferritic steel castings (October 1977 edition)) have been used as a basis for this standard. Essentially, the following amendments have been made compared with this earlier classification system.

a) An additional severity level, i.e. severity level 5, has been adopted because of the wider field of application of DIN 1690 Part 2.

b) For the surface quality, the classification into severity levels as in ISO/DP 4986 (Magnetic particle inspection of steel castings) and ISO/DP 4987 (Penetrant inspection of steel castings) has been adopted.

c) In order to bring the standard into line with the specifications given in SEP 1922, for assessing ultrasonic indications, a distinction has been made between indications without measureable extension and indications with measureable extension.

d) The division of the wall into various cross-sectional zones used for assessment of ultrasonic indications has been brought into line with that used in ISO/DP 4992 (see figure 1). In addition to this however, a higher severity level for "special outer zones" as described in subclause 2.2.3 may be agreed upon.

e) In the case of ultrasonic testing, for the mid zone, which in general is subject to less stress, less severe requirements than for the outer zone have always applied. In order to obtain better agreement between the requirements with regard to the results of ultrasonic testing and those of radiographic testing, from this point of view, footnote 2 in table 4 has been added.

f) This standard, like the ISO draft proposals, opens up the previously non-existent possibility of combining a high severity level for the external condition with a lower severity level for the internal condition and the reverse (see subclause 2.2.1.2).

There was unanimous agreement that it is impossible for the manufacturer (even after previous testing for internal defects in the zone near the surface) to agree to conform to a particular severity level with certainty in the case of surfaces that will only be produced by the purchaser. The field of application of this standard has therefore been limited to the as delivered condition. In order to remedy the problem described, as far as possible, finish machining of surfaces of high severity level (i.e. low severity level number) should be included in the as delivered condition. In the case of series production, appropriate agreements may be limited to finish machining of start-up samples. If the purchaser has to or wants to carry out finish machining himself, in order to reduce the risk of rejects, he should make use of the possibility of ordering "special outer zones" (see subclause 2.2.3) and specify his requirements regarding the zones for machining in the drawing in such a manner that the manufacturer is able, by appropriately adjusting his casting technique and/or making design changes, to reduce the frequency of unacceptable defects.

With regard to the assessment of production welds, see also DIN 8563 Part 3 (Quality assurance of welding operations; fusion welded joints on steel, requirements, evaluation groups) and *AD-Merkblatt* (AD Instruction sheet) HP 5/3 (*Herstellung und Prüfung der Verbindungen; zerstörungsfreie Prüfung der Schweißnähte*) (Production and testing of joints; non-destructive testing of welds)).

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