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Aircraft Quality Casting Standards

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REPORT NO. 4796

DATE JULY 3, 1942

ARMY AIR FORCES
TECHNICAL REPORT

Aircraft Quality Casting Standards

TITLE



ARMY AIR FORCES, MATERIEL COMMAND
WRIGHT FIELD, DAYTON, OHIO

WP-4-6-45-200

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WAR DEPARTMENT
AIR CORPS
MATERIEL DIVISION
DAYTON, OHIO

UNCLASSIFIED

AIR CORPS TECHNICAL REPORT

No. 4796

AIRCRAFT QUALITY CASTING STANDARDS

Title

BY

Robert Katz

ROBERT KATZ

Approved:

J. B. Johnson

Branch Chief

By direction of the Chief of the Materiel Division.

F. O. CARROLL, Colonel, A.A. F.

Experimental

Chief, Engineering Section

Branch No. EXP-M-56-1188
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No. of Pages 5
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AIRCRAFT QUALITY CASTING STANDARDS

These standards are to be used in connection with the Handbook of Instructions for Airplane Designers, Eighth Edition, Revision 5, Amendment 1; Volume 1, Section II, Part V, Paragraph 9, which states "No Class A Casting shall be accepted whose quality does not conform to Army Air Forces Aircraft Quality Casting Standards".

Reference is made to Specifications No. 20026, "Certification Procedure for the Certification of X-Ray Laboratories", and No. AN-QQ-M-188, "Metals, Radiographic Inspection of (Process and Application)".

In the radiography of aircraft castings, markings appearing on the film may be attributed to either the condition of the castings examined, or to some details of the radiographic process entirely unrelated to the quality of the castings. These latter patterns must be recognized and related to the radiographic process so that sound castings will not be unnecessarily rejected. Radiographs must be carefully compared with the surface irregularities of the castings they represent before an attempt is made to identify and evaluate internal discontinuities.

Discontinuities, or defects, lying within the body of a casting may be classified into two types according to whether or not they tend to cause localized stress concentrations, and may be recognized by the following description.

A. DEFECTS GENERALLY CAUSING LOCALIZED STRESS CONCENTRATIONS.

Castings containing any of the following defects shall be rejected:

1. CRACKS. Cracks are represented by darkened lines of variable width which are dendritic when caused by hot shortness, and more nearly linear or straight and of more constant width when originating from residual stresses in solid metal. A shrinkage cavity may be associated with a hot crack.

2. SHRINKAGE. Shrinkage cavities are represented by dendritic or filamentary dark regions of irregular dimensions, and indistinct outline, and are caused by an insufficient supply of molten metal to feed the particular section.

3. COLD SHUT. Cold shuts are represented by darkened areas with variable lengths and definite smooth outline which tend to be elongated and thin. They occur where the streams of molten metal have come together but have failed to completely unite. The contact surfaces are oxidized. Cold shuts may generally be detected in visual inspection.

4. MISRUNS. Misruns appear as prominent darkened areas of variable dimensions with definite smooth outlines, where the molten metal has failed to fill the section. Misruns can always be detected by visual examination.

5. DEFECTS NOT NORMALLY SERIOUS (Type B) WHICH ARE SO ALIGNED AS TO INDICATE POSSIBLE STRESS CONCENTRATIONS.

B. DEFECTS NOT GENERALLY CAUSING LOCALIZED STRESS CONCENTRATION.

These defects are undesirable when present in large degree and may generally be corrected by improved foundry practice. Rejection of castings containing these defects shall be based upon static test.

7. MOTTILING. Mottling appears as a pattern of alternate light and dark areas which tend to the size and shape of the macroscopic grains and is due to the difference in chemical composition between the grain and grain boundary material. Mottling is most frequently found in aluminum alloy castings.

Where film markings due to the radiographic process are excessive and interfere with proper interpretation re-radiographing may be required. Most such markings may be corrected by adequate darkroom precautions, and may be recognized by the following description:

1. SECONDARY RADIATION. Film markings due to secondary radiation appear as dark spots or streaks (often radial) of irregular dimensions and indistinct outline. Such markings frequently appear under thick or round sections and sections at some distance from the film during exposure and may be readily identified, especially where the section has not been penetrated by the particular exposure. These markings may be materially reduced by the use of lead screen cassettes or of low contrast emulsions.

2. DEVELOPER STREAKS. Insufficient agitation during tank development causes light and dark parallel streaks, or elongated areas which may be connected with the fact that exhausted developer, being of greater density than fresh developer, travels down the side of the film.

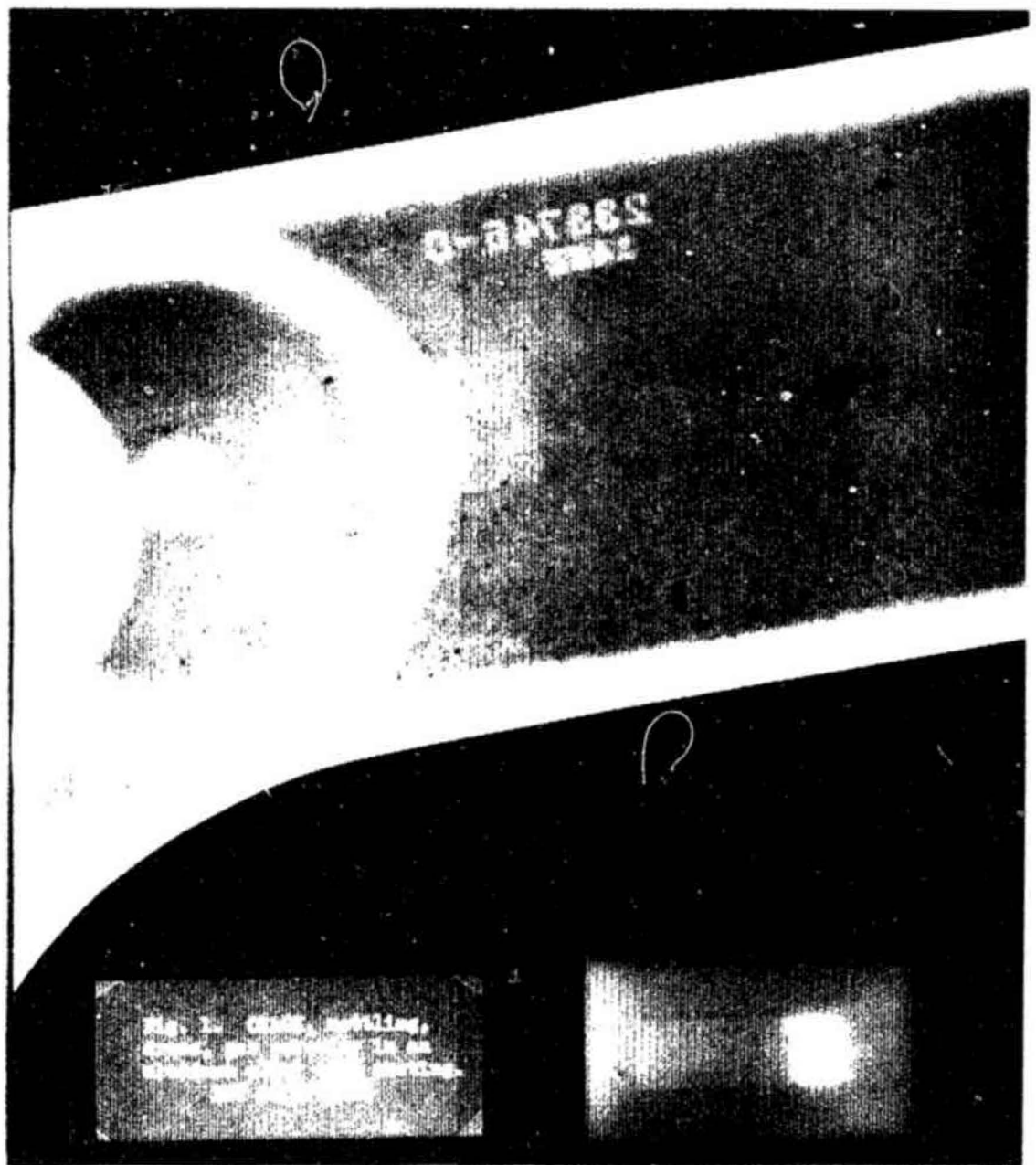
3. FIXER SPOT. Fixer spots appear as white opaque areas of smooth outline and irregular shape which occur when two films are in contact during fixation.

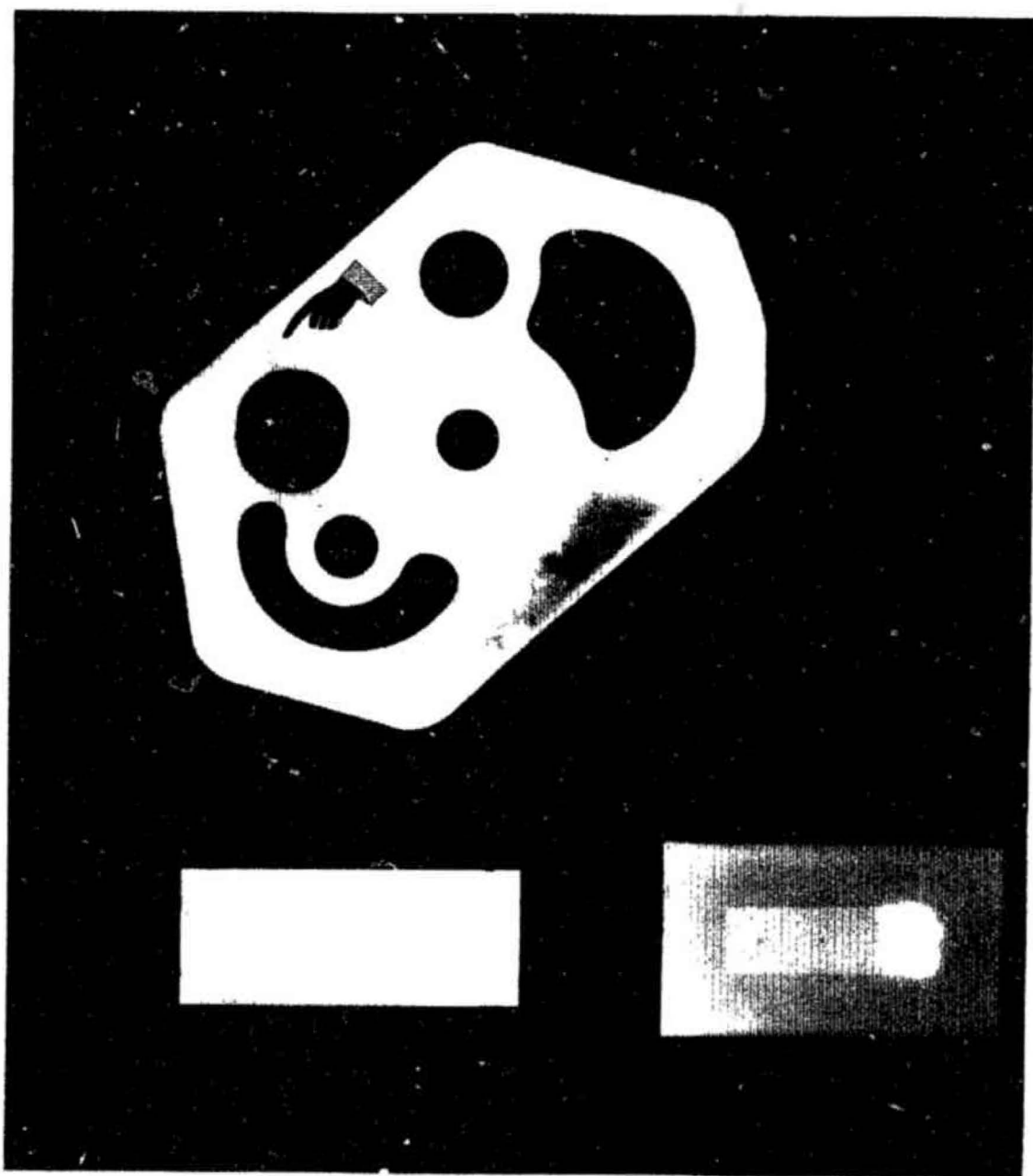
4. DRYING SPOT. Uneven drying causes transparent spots and streaks on the surface of the film which may be readily identified when viewed by reflected light.
5. SCRATCH. Scratches are caused by careless handling of wet film, and may be readily identified.
6. CRIMP. Film crimps appear as small, arc shaped dark areas, caused by sharp localized bending of the film which are readily identified when viewed by reflected light. Other light or dark areas, otherwise inexplicable, may be caused by high pressures, or large weights resting on the film surface.
7. FOGGING. Fogging may be caused by local or general exposure to light or to X-ray and appears as dark, opaque areas. General graying of unexposed parts of the film may be "chemical fog" caused by the developer.
8. STATIC. Static marks appear as thin, dark, dendritic lines, or as dark gray spots with a black interior. Static is caused by discharge of static electricity from the surface of the film and occurs in an atmosphere of low humidity.
9. DEVELOPER STAINS. Brown or iridescent markings on the film surface are caused by old, or oxidized developer.
10. CASSETTE DEFECTS. Cassette defects may be recognized by their recurrence in the same locations on several films and may be checked by a blank exposure of the cassette.
11. EMULSION DEFECTS. Film emulsion defects may be recognized by their indiscriminate locations. They may appear as light or dark spots, or as parallel lines, and may or may not be recognizable when viewed by reflected light.

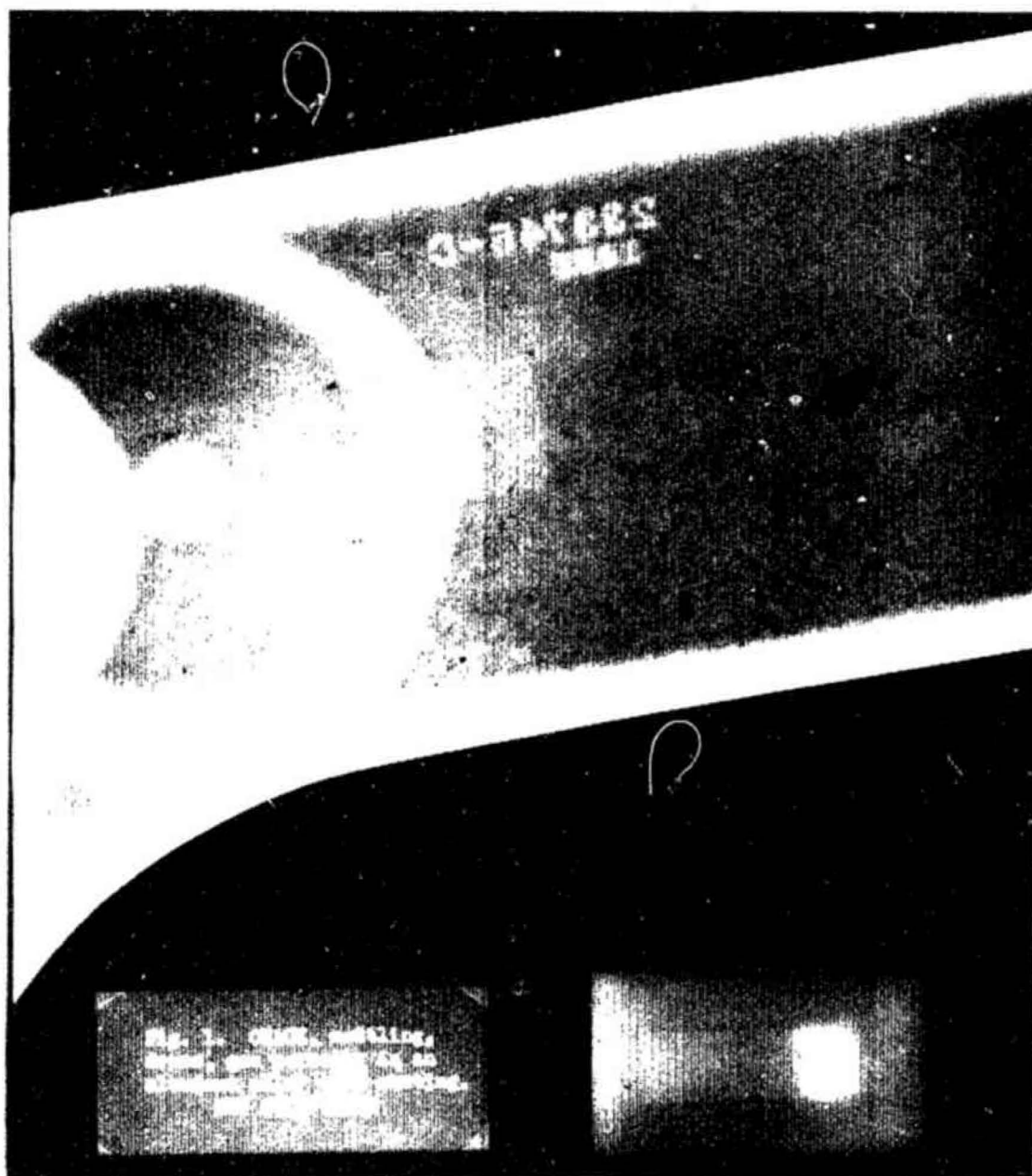
TABLE OF ILLUSTRATIONS

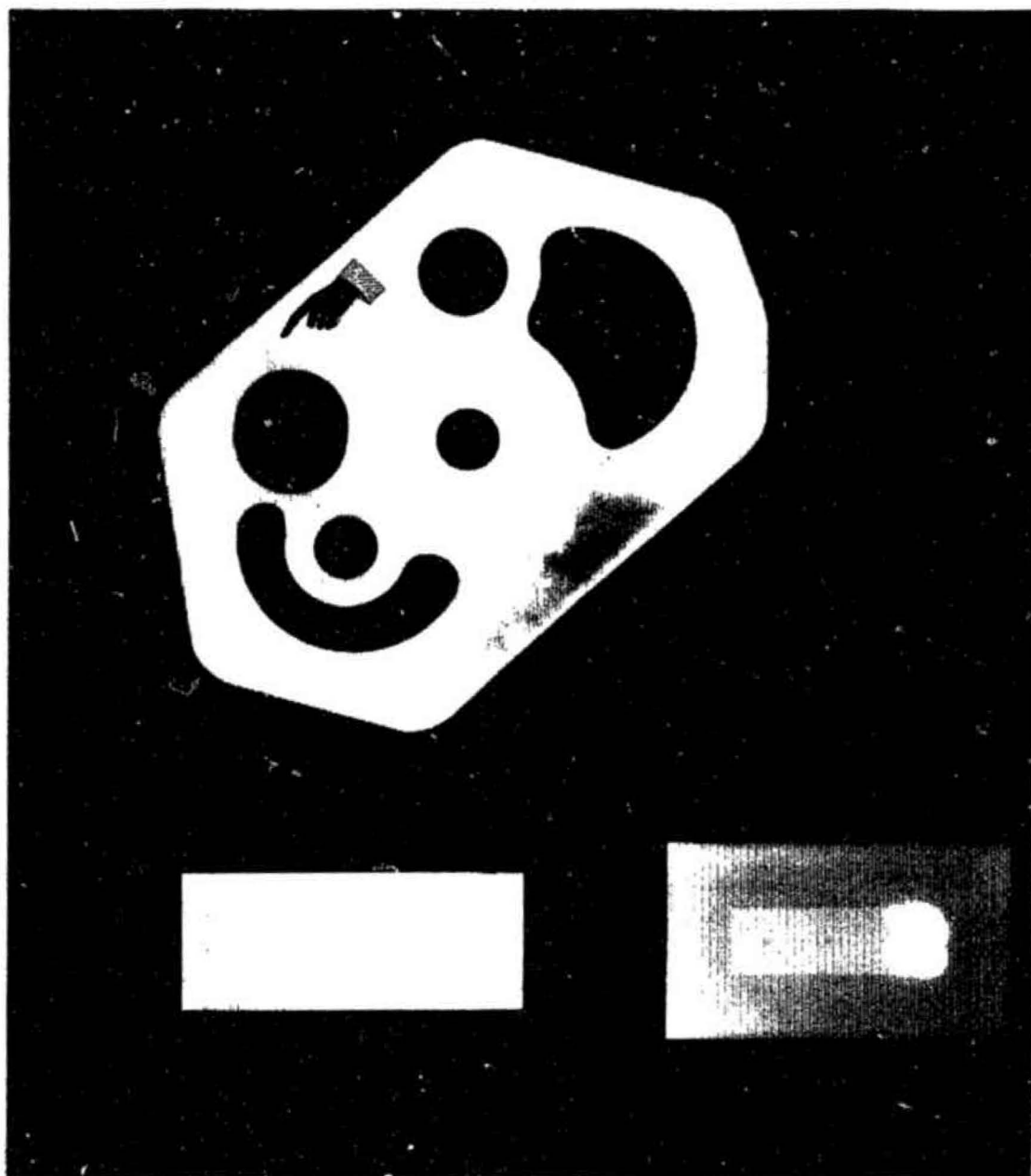
The following prints have been prepared from radiographs on file at the Materiel Center. Duplicates of the original radiographs are filed at Army Air Forces District Offices.

- Figure 1. CRACK, Mottling, Dross, Gas Porosity in an Aluminum Alloy Sand Casting. NOT ACCEPTABLE.
- Figure 2. CRACK, Microshrinkage in a Magnesium Alloy Sand Casting. NOT ACCEPTABLE.
- Figure 3. SHRINKAGE CAVITY, Mottling in an Aluminum Alloy Permanent Mold Casting. NOT ACCEPTABLE.
- Figure 4. SHRINKAGE CAVITY in an Aluminum Alloy Permanent Mold Casting. NOT ACCEPTABLE.
- Figure 5. COLD SHUT, Gas Porosity in an Aluminum Alloy Sand Casting. NOT ACCEPTABLE.
- Figure 6. COLD SHUT, Segregation in a Magnesium Alloy Sand Casting. NOT ACCEPTABLE.
- Figure 7. MISRUN in an Aluminum Alloy Sand Casting. NOT ACCEPTABLE.
- Figure 8. GAS POROSITY, BLOWHOLES IN LINEAR FORMATION in Aluminum Alloy Sand Castings. NOT ACCEPTABLE.
- Figure 9. Sound Aluminum Alloy Sand Casting Exhibiting Minor Mottling and Gas Porosity.
- Figure 10. Gas Porosity in an Aluminum Alloy Sand Casting. Undesirable. Rejection of Castings Exhibiting Similar Defects shall be based upon Static Test.



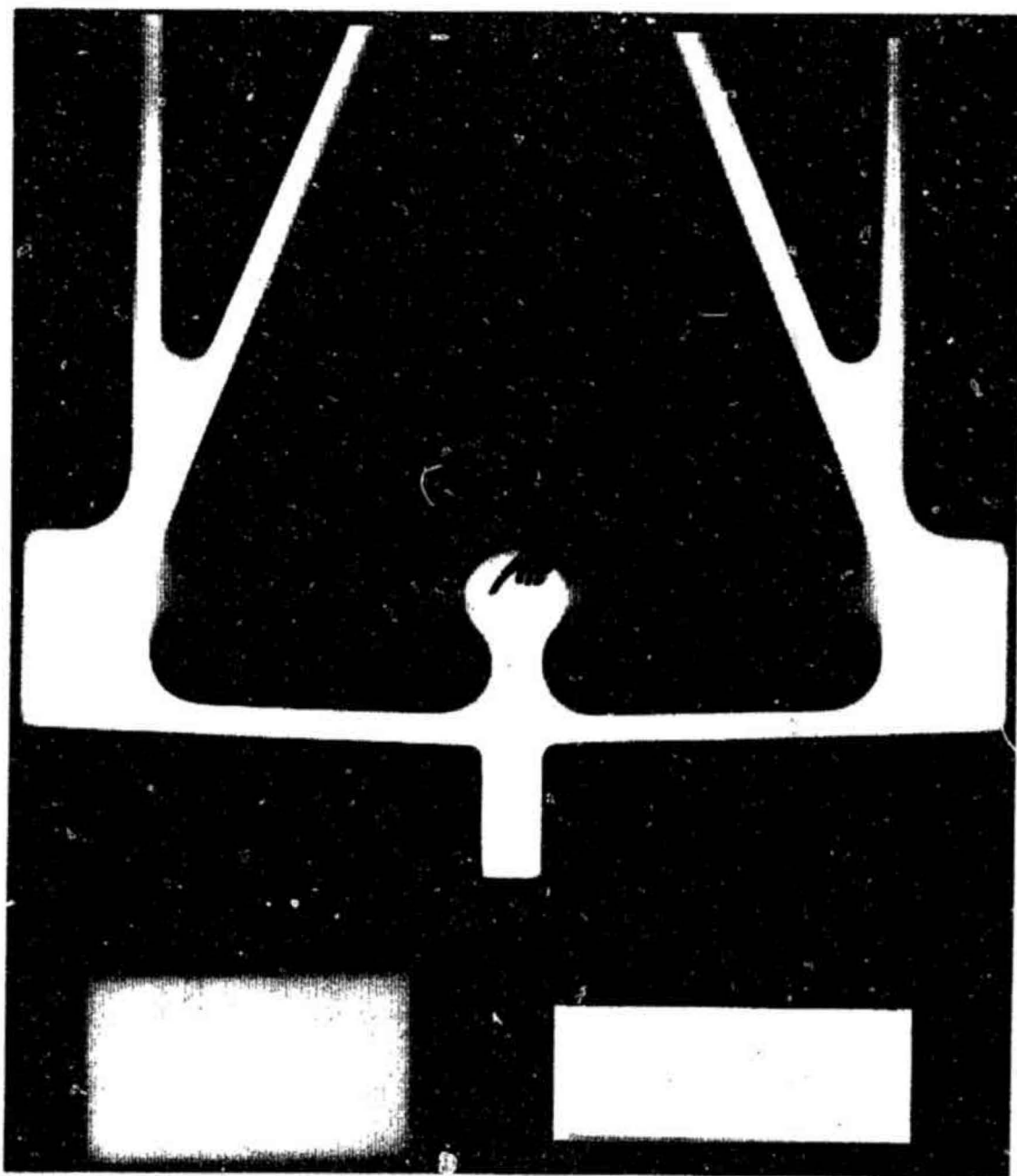






- Figure 11. Gas Porosity (Elongated) in an Aluminum Alloy Sand Casting. Undesirable. Rejection of Castings Exhibiting Similar Defects shall be based upon Static Test.
- Figure 12. Microshrinkage in Magnesium Alloy Sand Castings. Undesirable. Rejection of Castings Exhibiting Similar Defects shall be based upon Static Test.
- Figure 13. Microshrinkage in Magnesium Alloy Permanent Mold. Undesirable. Rejection of Castings containing Similar Defects shall be based upon Static Test.
- Figure 14. Blowholes in an Aluminum Alloy Sand Casting. Undesirable. Rejection of Castings containing Similar Defects shall be based upon Static Test.
- Figure 15. Blowhole, Mottling in an Aluminum Alloy Sand Casting. Undesirable. Rejection of Castings containing Similar Defects shall be based upon Static Test.
- Figure 16. Blowholes, Gas Porosity, Segregation in an Aluminum Alloy Sand Casting. Undesirable. Rejection of Castings containing similar defects shall be based on Static Test.
- Figure 17. Dross and Sand Inclusions in Aluminum Alloy Sand Casting. Rejection of Castings containing similar defects shall be based upon Static Test.
- Figure 18. Secondary Radiation Markings in a Radiograph of an Aluminum Alloy Sand Cast Foot Pedal.
- Figure 19. Crimps in a Radiograph of an Aluminum Alloy Sand Casting exhibiting several degrees of Gas Porosity.





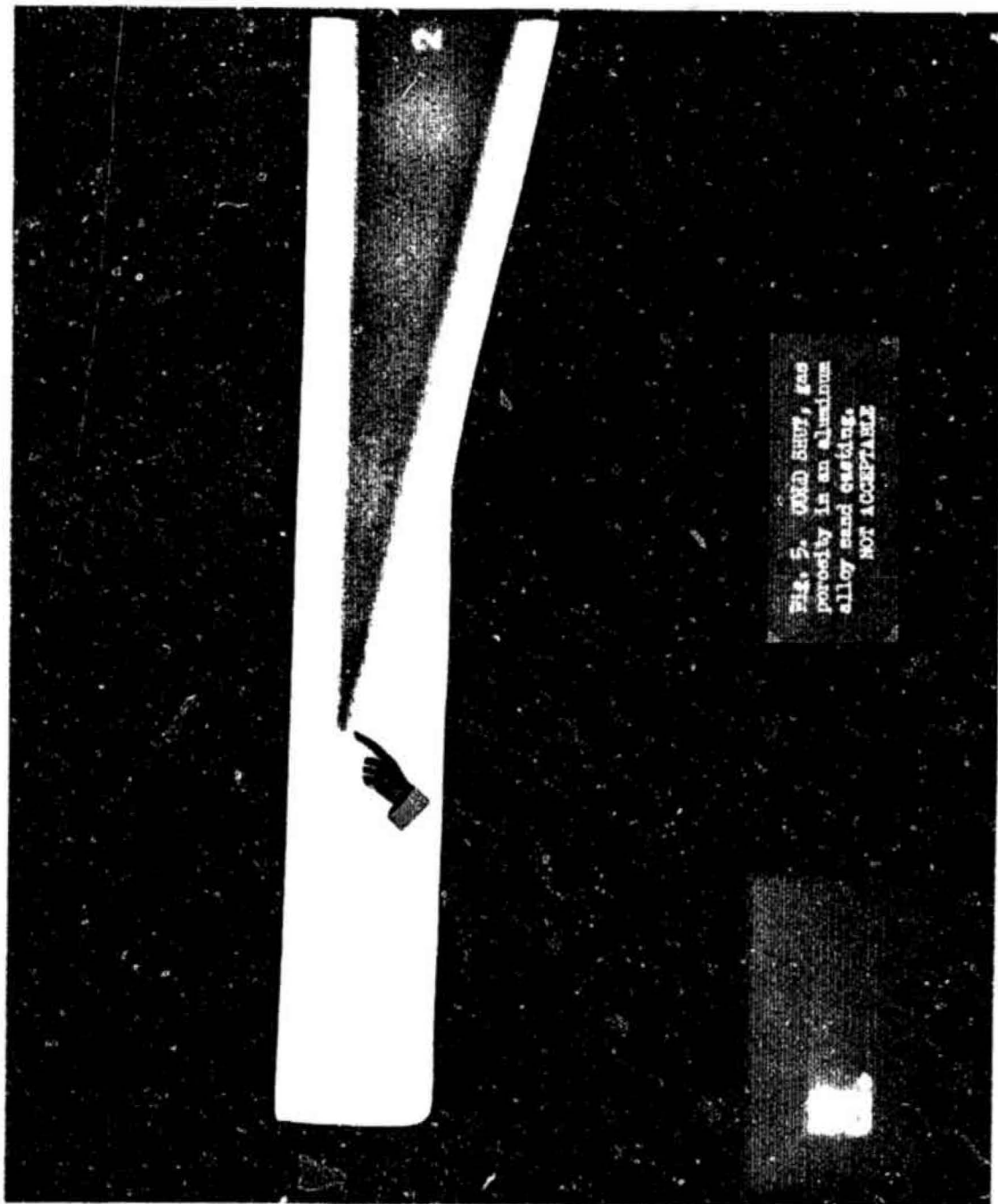


Fig. 5. UND SHUT, gas
porosity in an aluminum
alloy sand casting.
NOT ACCEPTABLE





Fig. 7.
aluminum
100







Fig. 9. Sound aluminum alloy sand casting exhibiting minor mottling and gas porosity.

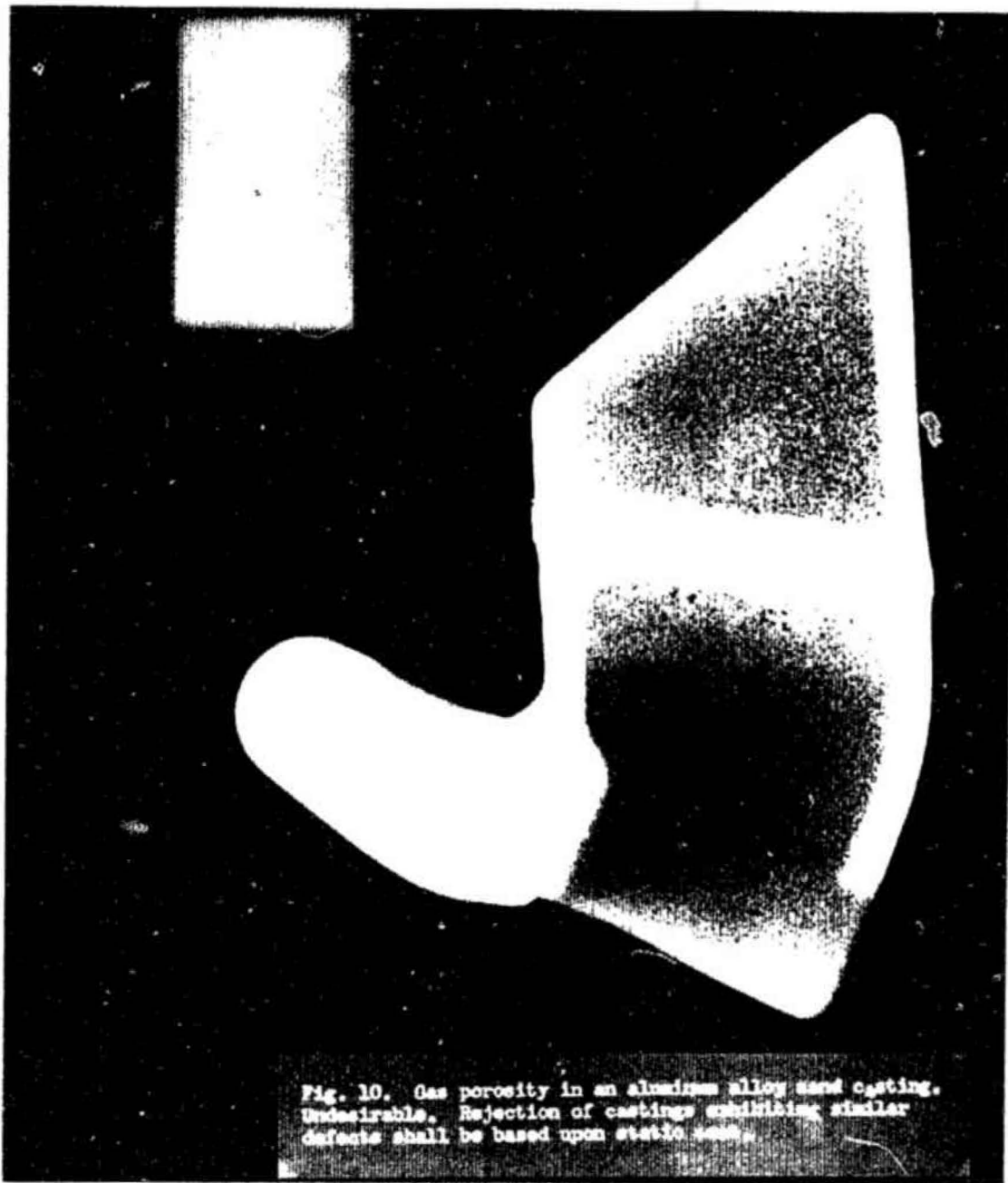


Fig. 10. Gas porosity in an aluminum alloy sand casting. Undesirable. Rejection of castings exhibiting similar defects shall be based upon static test.

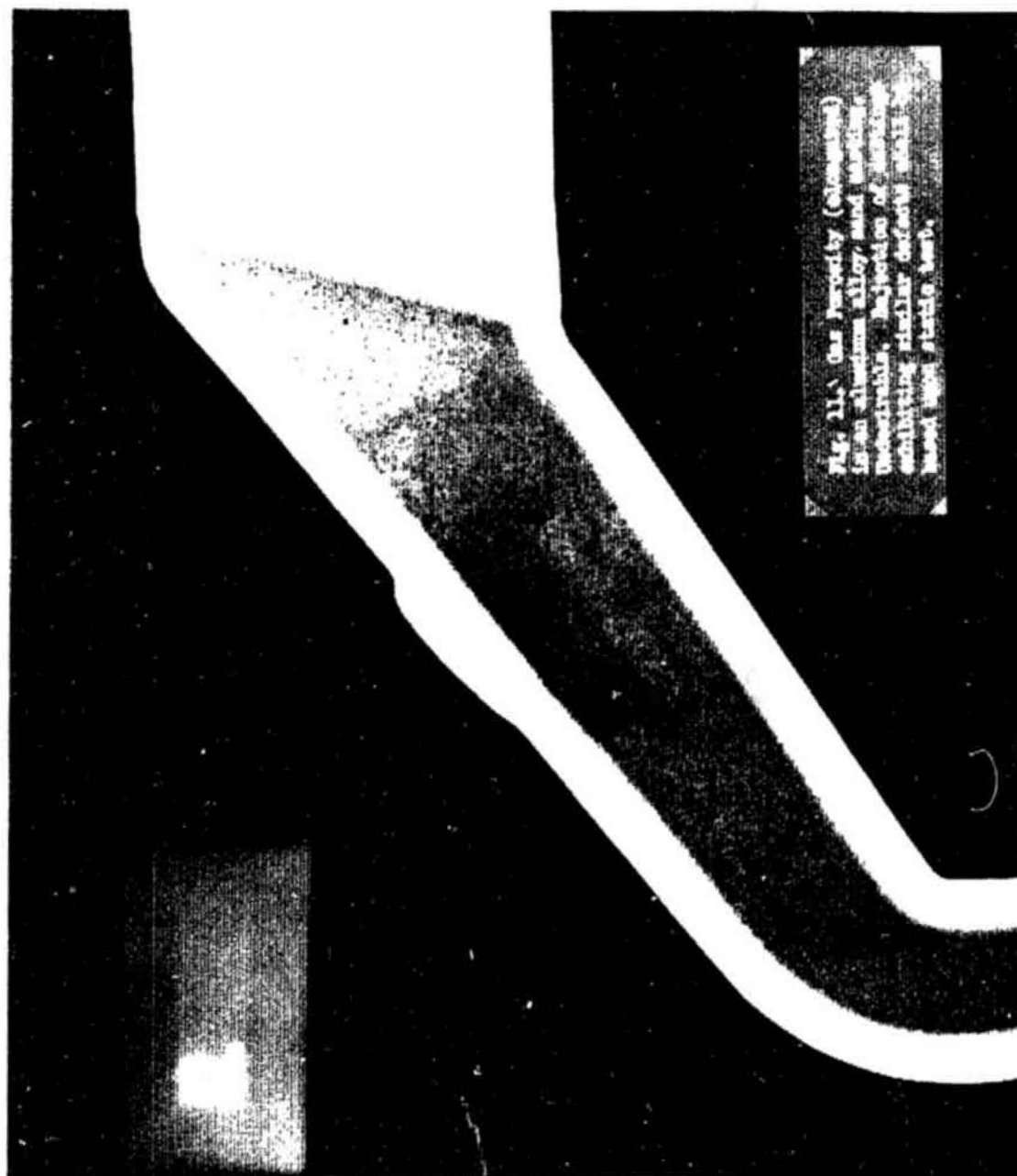
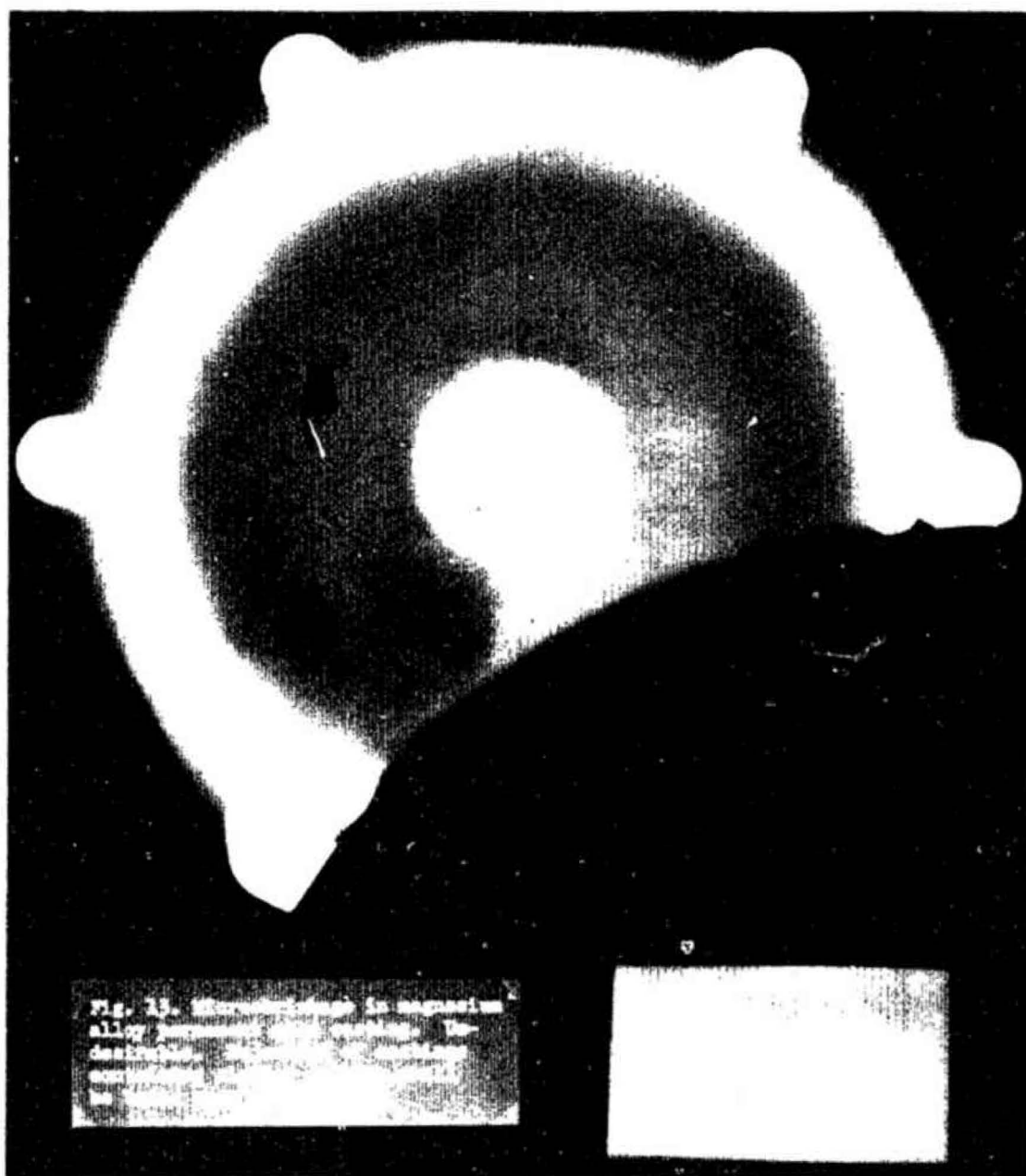


Fig. 11. Gas porosity (siliconized)
in an aluminum alloy sand casting.
Micrograph. Section of casting
exhibiting similar defects seen in
based upon particle temp.



Fig. 12. Microshrinkage in magnesium alloy sand casting. Undesirable. Rejection of castings exhibiting similar defects shall be based upon static test.



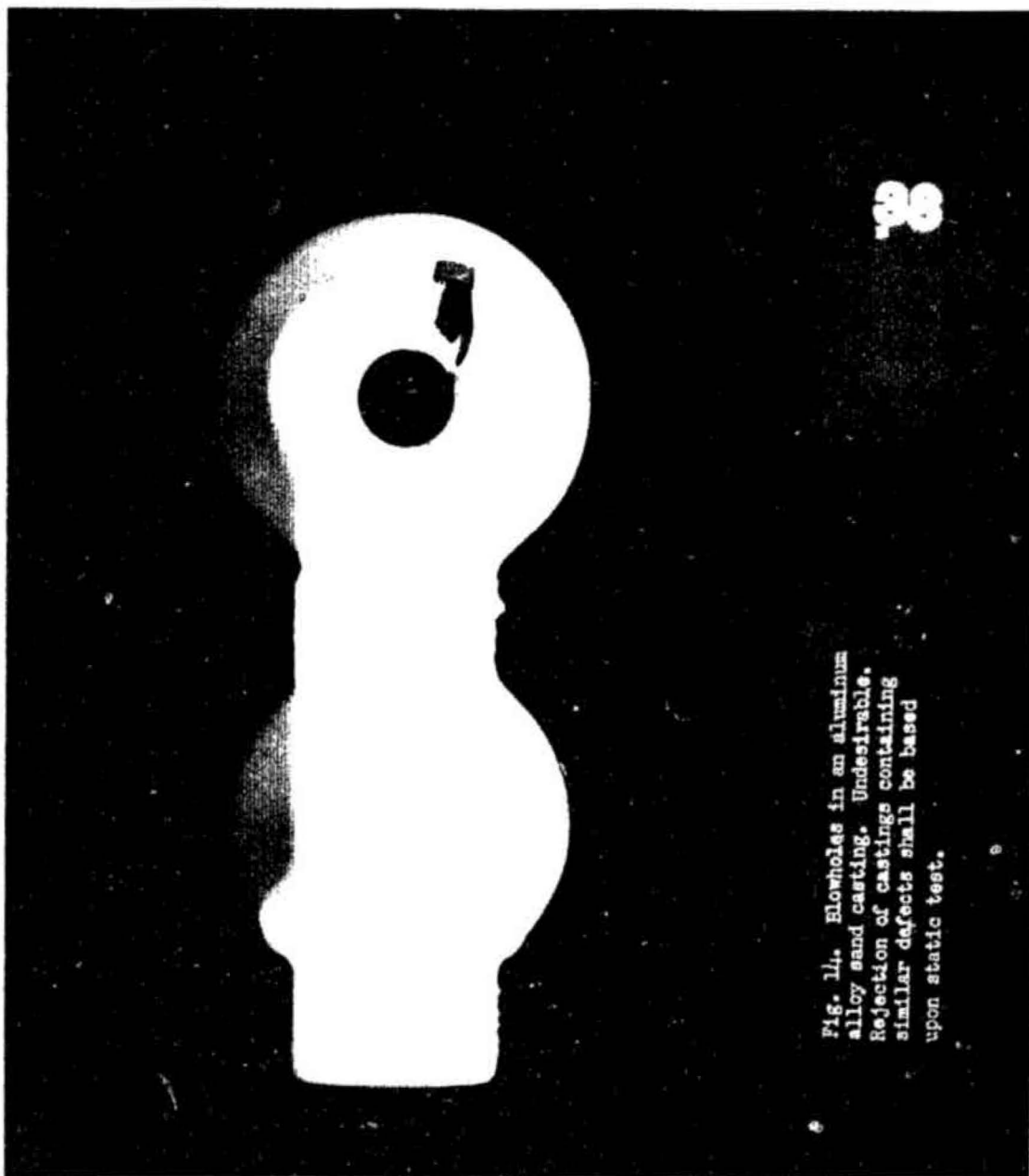


Fig. 14. Blowholes in an aluminum alloy sand casting. Undesirable. Rejection of castings containing similar defects shall be based upon static test.

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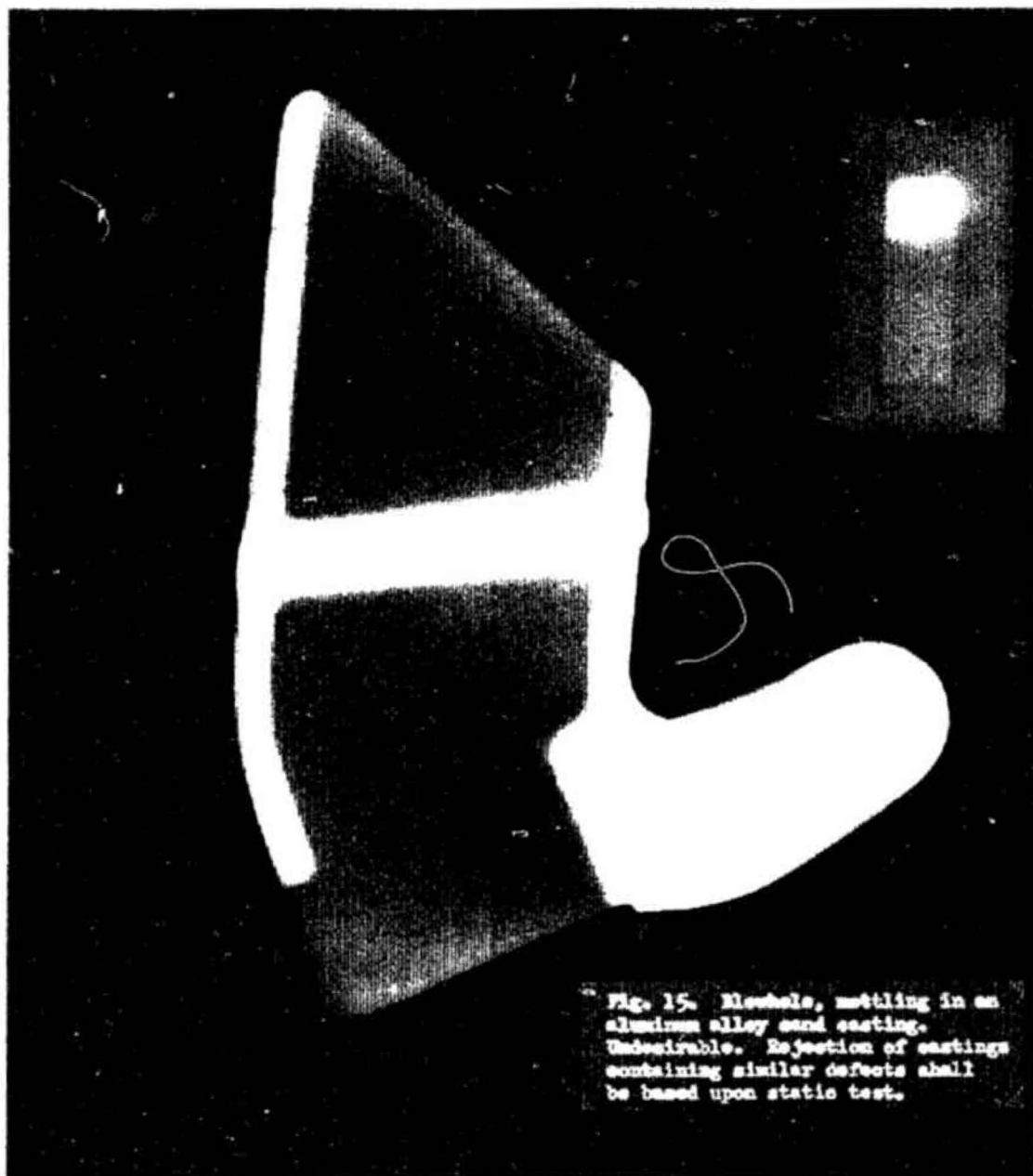
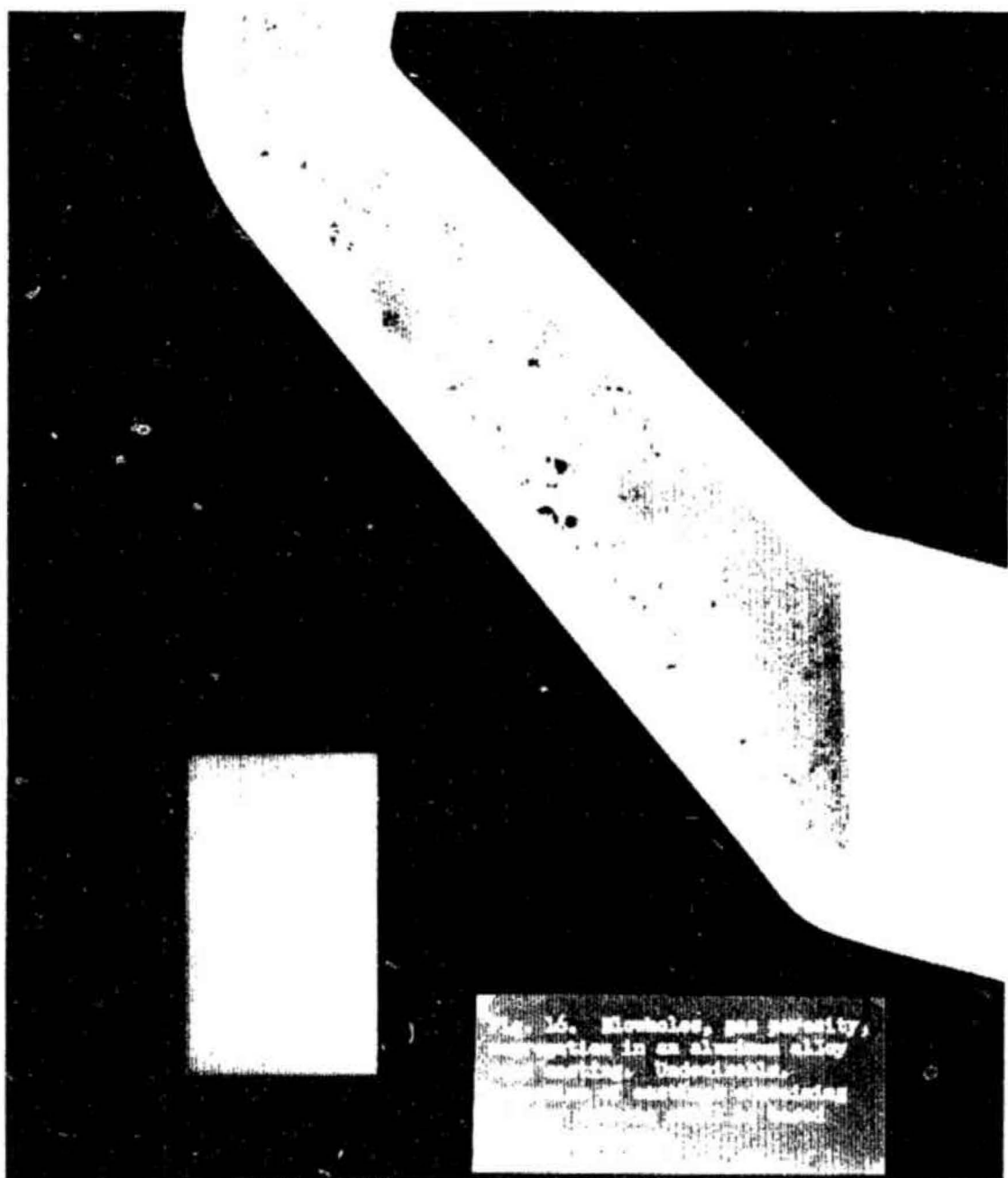


Fig. 15. Blowhole, settling in an aluminum alloy sand casting. Undesirable. Rejection of castings containing similar defects shall be based upon static test.



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FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D.C. 20535
JAN 11 1964
MEMORANDUM FOR THE DIRECTOR
SUBJECT: [Illegible]

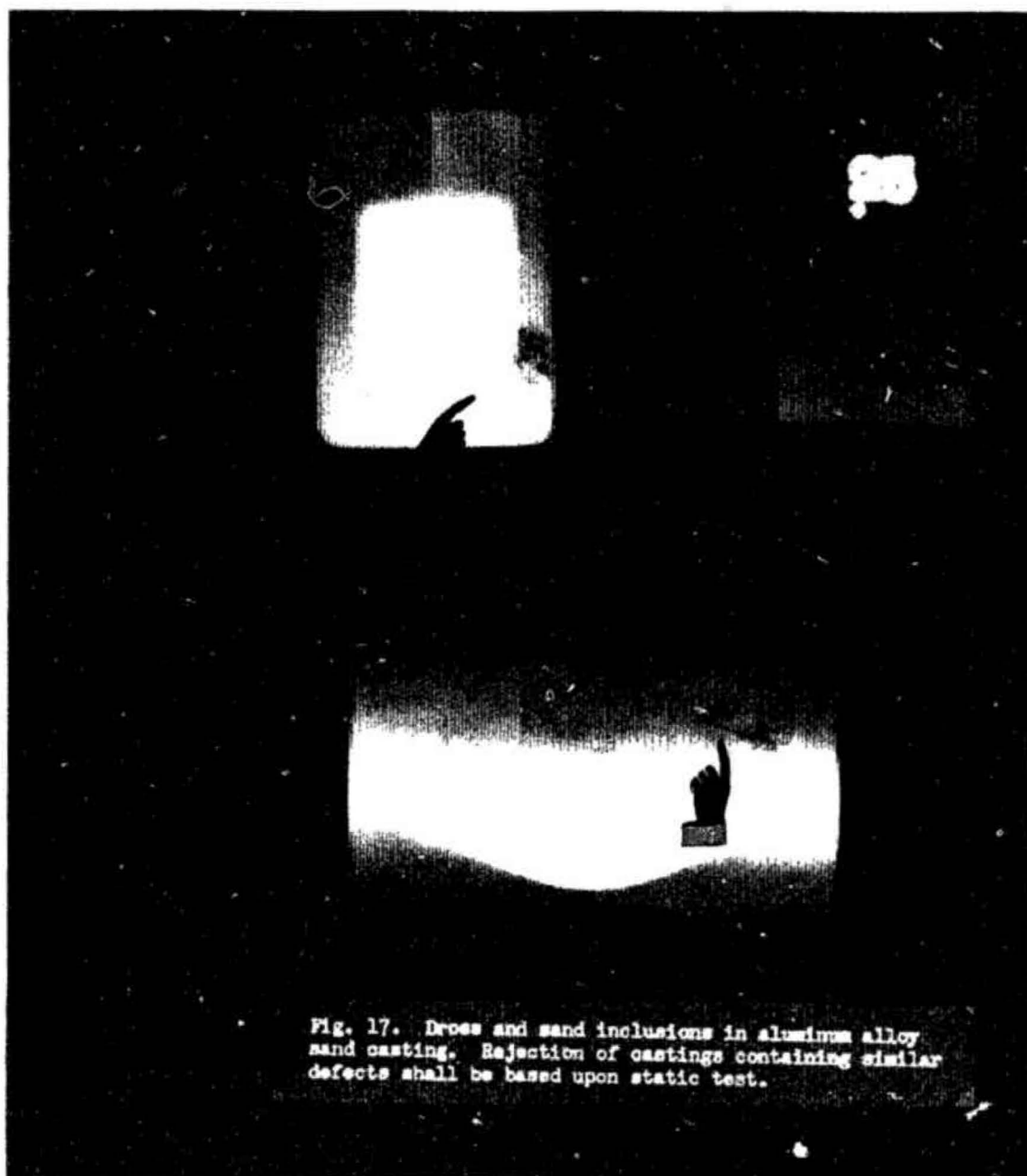


Fig. 17. Dross and sand inclusions in aluminum alloy sand casting. Rejection of castings containing similar defects shall be based upon static test.



Fig. 15. Secondary radiation
measured in a radiograph of
silicon alloy and cast iron.

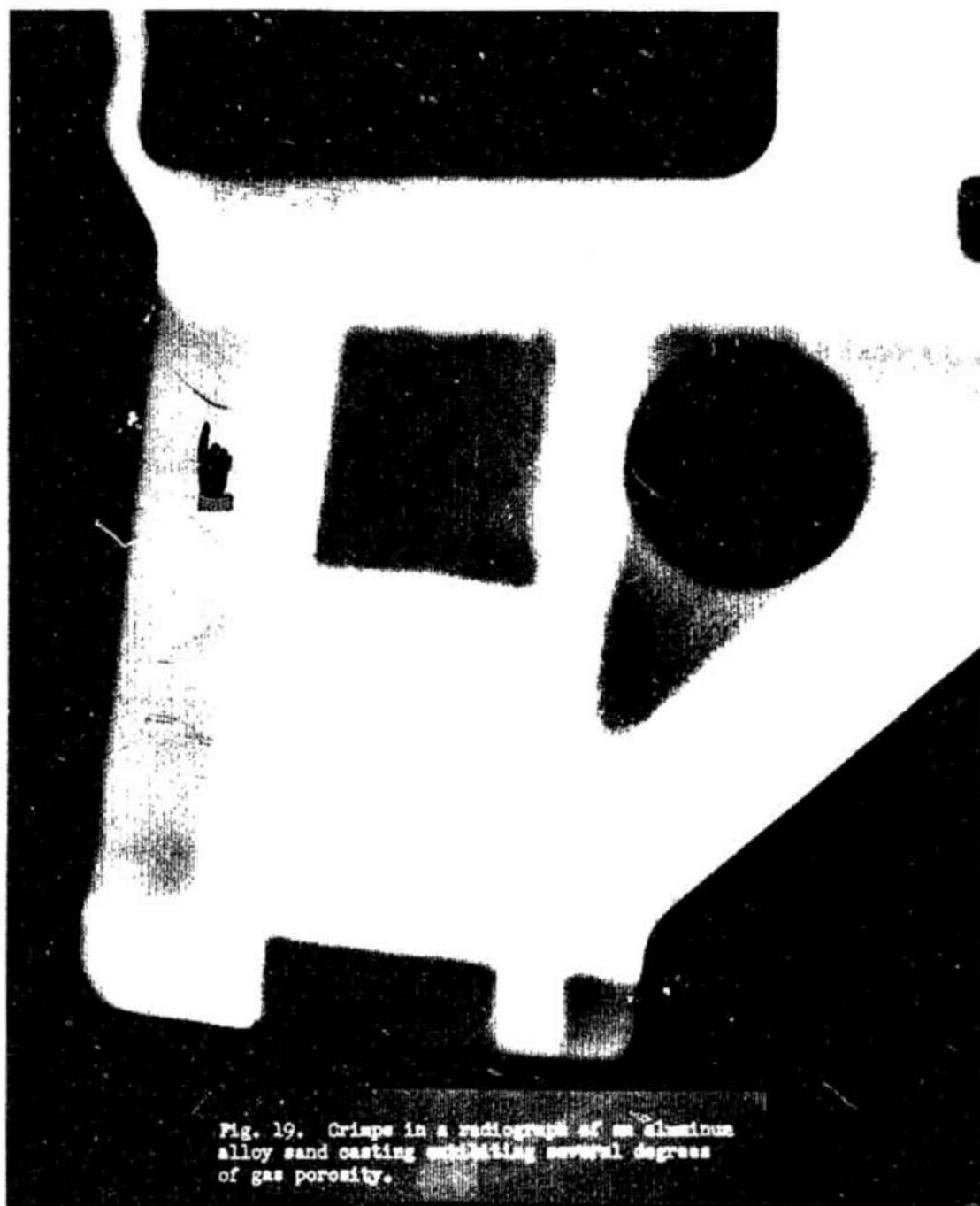


Fig. 19. Crispe in a radiograph of an aluminum alloy sand casting exhibiting several degrees of gas porosity.

TOP

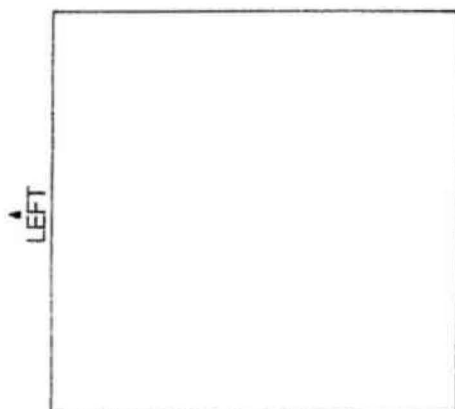
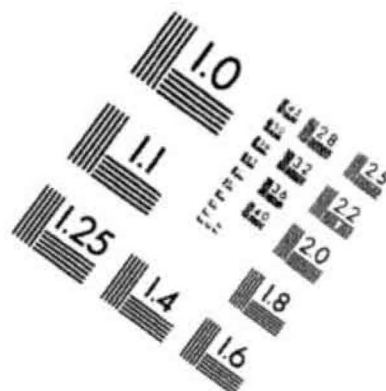
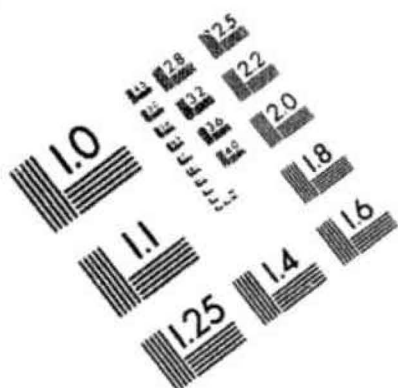
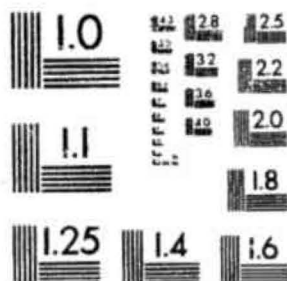
Film Identification

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PRECISION™ RESOLUTION TARGETS

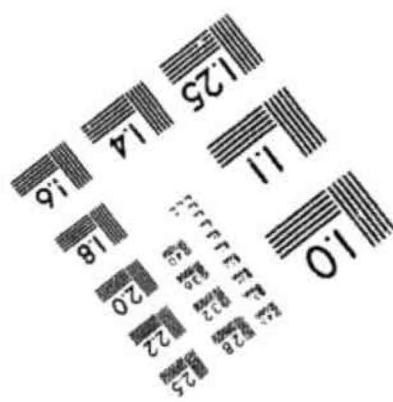
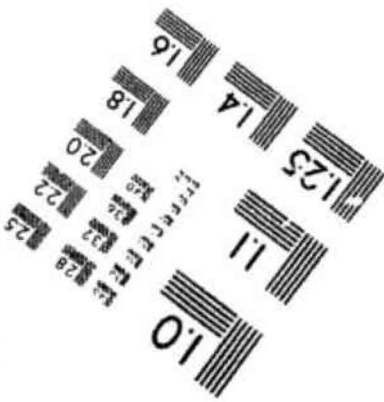


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PM-3 8 1/2" x 11" PHOTOGRAPHIC GENERAL TARGET
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