Nothing contained in any publication of the American Society for Testing Materials is to be construed as granting any right, by implication or otherwise, for manufacture, sale or use in connection with any method, apparatus or product covered by Letters Patent, nor as insuring anyone against liability for infringement of Letters Patent.
Committee D-19 on Industrial Water of the American Society for Testing Materials has long believed that something more than standard methods of testing are needed by those who look to the Society for aid. A general discussion of the nature and uses of industrial water should illuminate these prescribed procedures and specifications.

The inception of a Manual on Industrial Water occurred before World War II, but the actual preparation was begun by a section of Committee D-19 in 1946. This section consisted of R. C. Adams (chairman), A. A. Berk, T. H. Daugherty, O. M. Elliott, J. A. Holmes, C. E. Imhoff, A. K. Light, F. U. Neat, F. R. Owens, and A. H. Reynolds. Each member of the section drafted an assigned portion of the Manual with more or less assistance from his associates and from other members of Committee D-19. These drafts were modified, correlated, and assembled by the entire section so that the resulting Manual is the product of group effort in the Society tradition, not a compilation of individual authorships. Many persons not in the section contributed to the Manual. Particular acknowledgment should be made to Max Hecht, L. K. Herndon, E. P. Partridge and C. K. Rice.

This first edition of the Manual will be revised to keep it up to date, and subsequent editions should appear periodically. Any errors noted, or suggestions for revision and improvement, should be brought to the attention of the Society at its headquarters.

January, 1953.

In this 1954 printing of the Manual, the Appendix has been considerably enlarged and brought up to date by the inclusion of the new and revised methods issued in 1953 and 1954. Also, several proposed methods published as information have been included.

There have been no changes in the chapters of the Manual. Two complete tables of contents with titles and designations of the methods have been added together with an Index to facilitate use of the book.

September, 1954.

In this 1956 printing of the Manual, the Appendix has been further enlarged and brought up to date by the inclusion of the new and revised methods issued in 1955 and 1956. Also, two additional proposed methods published as information have been included.

There have been no changes in the chapters of the Manual.

December, 1956.
Note.—The Society is not responsible, as a body, for the statements and opinions advanced in this publication.
# CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Chapter I—Uses of Industrial Water</td>
<td>3</td>
</tr>
<tr>
<td>Chapter II—Difficulties Caused by Water in Industry</td>
<td>15</td>
</tr>
<tr>
<td>Chapter III—Composition of Industrial Water and Water-Formed Deposits</td>
<td>29</td>
</tr>
<tr>
<td>Chapter IV—Treatment of Industrial Water</td>
<td>43</td>
</tr>
<tr>
<td>Chapter V—Sampling of Industrial Water</td>
<td>65</td>
</tr>
<tr>
<td>Chapter VI—Analysis of Industrial Water</td>
<td>77</td>
</tr>
<tr>
<td>Chapter VII—Sampling and Identification of Water-Formed Deposits</td>
<td>101</td>
</tr>
<tr>
<td>Chapter VIII—Analysis of Water-Formed Deposits</td>
<td>117</td>
</tr>
</tbody>
</table>

## APPENDIX

### A. Methods of Sampling

**Specifications for:**

- **D 1192 - 51 T.** Equipment for Sampling Industrial Water and Steam (Tentative) ............................................. 131

**Methods of Sampling:**

- **D 860 - 54.** Water from Boilers ............................................. 137
- **D 510 - 55 T.** Industrial Water (Tentative) ......................... 140
- **D 1066 - 54 T.** Steam (Tentative) ..................................... 149
- **D 887 - 49.** Water-Formed Deposits, Field Sampling of .......... 158

### B. Methods of Analysis

**Specifications for:**

- **D 1193 - 56.** Reagent Water ............................................. 165

**Scheme for:**

- **D 1256 - 53 T.** Analysis of Industrial Water and Industrial Waste Water (Tentative) ......................................... 167

**Methods of Test for:**

- **D 1067 - 55 T.** Acidity and Basicity (Alkalinity) in Industrial Water and Industrial Waste Water (Tentative) ......................... 172
- **D 857 - 50.** Aluminum and Aluminum Ion, Total, in Industrial Water .............................................................. 178
- **D 1426 - 56 T.** Ammonia in Industrial Water and Industrial Waste Water (Tentative) ............................................. 182
- **D 932 - 51.** Bacteria, Iron, in Industrial Water and Water-Formed Deposits .......................................................... 188
- **D 993 - 51.** Bacteria, Sulfate-Reducing, in Industrial Water and Water-Formed Deposits .................................................. 197
- **D 511 - 52.** Calcium Ion and Magnesium Ion in Industrial Water ................................................................. 204
- **D 513 - 54 T.** Carbon Dioxide, Total, and Calculation of the Carbonate and Bicarbonate Ions in Industrial Water (Tentative) .. 208
- **D 1245 - 55.** Chemical Microscopy, Examination of Water-Formed Deposits ........................................................... 216
- **D 1252 - 55 T.** Chemical Oxygen Demand (Dichromate Oxygen Demand) of Industrial Waste Water (Tentative) ..................... 224

For Contents in Numeric Sequence, see p. ix.
Methods of Test for:

D 512 - 55 T. Chloride Ion in Industrial Water and Industrial Waste Water (Tentative) ........................................... 228
D 1291 - 53 T. Chlorine Requirement of Industrial Water and Industrial Waste Water (Tentative) ........................................... 233
D 1253 - 53 T. Chlorine, Residual, in Industrial Water (Tentative) ................................................................................. 239
D 1427 - 56 T. Chlorine, Residual, in Industrial Waste Water (Tentative) ................................................................. 245
D 1178 - 54 T. Chloroform-Extractable Matter in Industrial Water and Industrial Waste Water (Tentative) ......................... 254
D 888 - 49 T. Dissolved Oxygen in Industrial Water (Tentative) ..................................................................................... 257
D 1179 - 55 T. Fluoride Ion in Industrial Water and Industrial Waste Water (Tentative) .................................................. 265
D 1126 - 55 T. Hardness in Industrial Water (Tentative) ................................................................................................. 273
D 1385 - 55 T. Hydrazine in Industrial Water (Tentative) ................................................................................................. 280
D 514 - 47. Hydroxide Ion in Industrial Water and Industrial Waste Water .......................................................... 284
D 1246 - 55. Iodide and Bromide Ions in Industrial Water ............................................................................................... 286
D 1068 - 55 T. Iron in Industrial Water and Industrial Waste Water (Tentative) .............................................................. 290
D 858 - 49. Manganese in Industrial Water and Industrial Waste Water ................................................................. 297
D 1128 - 50 T. Microorganisms in Industrial Water, Identification of Types (Tentative) .................................................. 300
D 859 - 55 T. Silica in Industrial Water and Industrial Waste Water (Tentative) ............................................................. 308
D 1340 - 56. Oily Matter in Industrial Waste Water ................................................................................................. 311
D 515 - 55 T. Phosphate in Industrial Water (Tentative) ................................................................................................. 314
D 1127 - 50 T. Sodium and Potassium in Industrial Water (Tentative) ............................................................................. 318
D 1254 - 53 T. Nitrite Ion in Industrial Water (Tentative) ................................................................................................. 322
D 1292 - 53 T. Odor of Industrial Waste Water ............................................................................................................... 328
D 1340 - 56 T. Oily Matter in Industrial Waste Water ................................................................................................. 335
D 514 - 55 T. Sulfate Ion in Industrial Water and Industrial Waste Water (Tentative) ..................................................... 341
D 1339 - 54 T. Sulfite Ion in Industrial Water (Tentative) ................................................................................................. 348
D 1345 - 54 T. Toxicity, Acute, of Industrial Waste Water to Fresh-Water Fishes (Tentative) ............................................. 355
D 934 - 52. X-Ray Diffraction, Identification of Crystalline Compounds in Water-Formed Deposits ................................................................. 357
Abbreviated Methods for the Analysis of Water Supplies in the Evaporative Industry:

Hardness in Industrial Water (Proposed, Non-Referee) ................................................................................................. 402
Hydroxide Ion in Industrial Water (Proposed, Non-Referee) .......................................................................................... 404
Nitrate Ion in Industrial Water (Proposed, Non-Referee) ................................................................................................. 405
Sulfite Ion in Industrial Water (Proposed, Non-Referee) ................................................................................................. 406
Orthophosphate, Total, in Industrial Water (Proposed, Non-Referee) .................................................................................. 408

For Contents in Numeric Sequence, see p. ix.
C. Methods of Reporting Results ........................................ 411

Methods of Reporting:

D 596 - 55. Results of Analysis of Industrial Water and Industrial Waste Water .............................................. 413
D 933 - 50. Results of Examination and Analysis of Water-Formed Deposits .............................................. 417

Definitions of Terms Relating to:

D 1129 - 56. Industrial Water and Industrial Waste Water ............ 421

D. Methods of Testing .......................................... 425

Specifications for:

D 1141 - 52. Substitute Ocean Water ................................ 427

Methods of:

D 935 - 49. Corrosivity Test of Industrial Water (NDHA Method) ..... 429
D 807 - 52. Corrosivity Test of Industrial Water (USBM Embrittlement Detector Method) ................................. 433
D 1125 - 50 T. Electrical Conductivity of Industrial Water, Test for (Tentative) ............................................. 441
E 70 - 52 T. pH of Aqueous Solutions, Determination of, with the Glass Electrode (Tentative) ................................. 447
D 1341 - 54 T. Thickness of Internal Deposits, Determination of, on Tubular Heat Exchange Surfaces (Tentative) .... 454

Appearance Properties of Industrial Water (Proposed) .................. 457

E. Glossary ................................................... 471

F. Industrial Water Requirements .................................... 477

G. List of ASTM Symposia and Technical Papers on Industrial Water .................................................... 480

Index ......................................................................... 483

ASTM Membership Application Blank ................................ 491

For Contents in Numeric Sequence, see p. ix.
## LIST IN NUMERIC SEQUENCE

OF

ASTM STANDARDS RELATING TO INDUSTRIAL WATER

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>D 510 - 55 T</td>
<td>Methods of Sampling Industrial Water (Tentative)</td>
<td>140</td>
</tr>
<tr>
<td>D 511 - 52</td>
<td>Method of Test for Calcium Ion and Magnesium Ion in Industrial Water</td>
<td>204</td>
</tr>
<tr>
<td>D 512 - 55 T</td>
<td>Methods of Test for Chloride Ion in Industrial Water and Industrial Waste Water (Tentative)</td>
<td>228</td>
</tr>
<tr>
<td>D 513 - 54 T</td>
<td>Methods of Test for Total Carbon Dioxide in Industrial Water and Calculation of the Carbonate and Bicarbonate Ions in Industrial Water (Tentative)</td>
<td>208</td>
</tr>
<tr>
<td>D 514 - 47</td>
<td>Method of Test for Hydroxide Ion in Industrial Water and Industrial Waste Water</td>
<td>284</td>
</tr>
<tr>
<td>D 515 - 55 T</td>
<td>Methods of Test for Phosphate in Industrial Water (Tentative)</td>
<td>322</td>
</tr>
<tr>
<td>D 516 - 55 T</td>
<td>Methods of Test for Sulfate Ion in Industrial Water and Industrial Waste Water (Tentative)</td>
<td>408</td>
</tr>
<tr>
<td>D 596 - 55</td>
<td>Methods of Reporting Results of Analysis of Industrial Water and Industrial Waste Water</td>
<td>374</td>
</tr>
<tr>
<td>D 807 - 52</td>
<td>Method of Corrosivity Test of Industrial Water (USBM Embrittlement Detector Method)</td>
<td>413</td>
</tr>
<tr>
<td>D 857 - 50</td>
<td>Method of Test for Total Aluminum and Aluminum Ion in Industrial Water</td>
<td>433</td>
</tr>
<tr>
<td>D 858 - 49</td>
<td>Method of Test for Manganese in Industrial Water and Industrial Waste Water</td>
<td>178</td>
</tr>
<tr>
<td>D 859 - 55 T</td>
<td>Methods of Test for Silica in Industrial Water and Industrial Waste Water (Tentative)</td>
<td>297</td>
</tr>
<tr>
<td>D 860 - 54</td>
<td>Method of Sampling Water from Boilers</td>
<td>333</td>
</tr>
<tr>
<td>D 887 - 49</td>
<td>Method of Field Sampling of Water-Formed Deposits</td>
<td>137</td>
</tr>
<tr>
<td>D 888 - 49 T</td>
<td>Methods of Test for Dissolved Oxygen in Industrial Water (Tentative)</td>
<td>158</td>
</tr>
<tr>
<td>D 932 - 51</td>
<td>Method of Test for Iron Bacteria in Industrial Water and Water-Formed Deposits</td>
<td>257</td>
</tr>
<tr>
<td>D 933 - 50</td>
<td>Method of Reporting Results of Examination and Analysis of Water-Formed Deposits</td>
<td>188</td>
</tr>
<tr>
<td>D 934 - 52</td>
<td>Method for Identification of Crystalline Compounds in Water-Formed Deposits by X-Ray Diffraction</td>
<td>417</td>
</tr>
<tr>
<td>D 935 - 49</td>
<td>Method of Corrosivity Test of Industrial Water (NDHA Method)</td>
<td>397</td>
</tr>
<tr>
<td>D 992 - 52</td>
<td>Method of Test for Nitrate Ion in Industrial Water</td>
<td>429</td>
</tr>
<tr>
<td>D 993 - 51</td>
<td>Methods of Test for Sulfate-Reducing Bacteria in Industrial Water and Water-Formed Deposits</td>
<td>305</td>
</tr>
<tr>
<td>D 993 - 51</td>
<td>Methods of Test for Sulfate-Reducing Bacteria in Industrial Water and Water-Formed Deposits</td>
<td>405</td>
</tr>
<tr>
<td>D 1066 - 54 T</td>
<td>Method of Sampling Steam (Tentative)</td>
<td>197</td>
</tr>
<tr>
<td>D 1067 - 55 T</td>
<td>Methods of Test for Acidity and Basicity (Alkalinity) in Industrial Water and Industrial Waste Water (Tentative)</td>
<td>149</td>
</tr>
<tr>
<td>D 1068 - 55 T</td>
<td>Methods of Test for Iron in Industrial Water and Industrial Waste Water (Tentative)</td>
<td>172</td>
</tr>
<tr>
<td>D 1069 - 54 T</td>
<td>Method of Test for Suspended and Dissolved Matter (Suspended and Dissolved Solids) in Industrial Water and Industrial Waste Water (Tentative)</td>
<td>290</td>
</tr>
<tr>
<td>D 1125 - 50 T</td>
<td>Method of Test for Electrical Conductivity of Industrial Water (Tentative)</td>
<td>360</td>
</tr>
</tbody>
</table>
Entrance to Society’s Headquarters

American Society for Testing Materials
Organized for the promotion of knowledge of the materials of engineering, and the standardization of specifications and the methods of testing
Founded 1898  Incorporated 1902