INDEX.

A

\(\text{CO}_2\) recorder, 68.
Albion \(\text{CO}_2\) recorder, 68.
American boiler plants, efficiency of, 48.
American Society of Mechanical Engineers—
   Address, Introduction, vi.
   Auxiliary steam or power, 94, 99.
   Coal analysis, 56, 57.
   Duration of test, 53.
   Feed-water measurement, 81, 82.
   Flue gas analysis, 68.
   Fuel calorimeter recommended, 57.
   History of test Code, Introduction, vi.
   Moisture in steam, 88, 90-91.
   Separate boiler testing Code, necessity of, 49-50.
   Testing water meters, 86, 87.
Analysis of coal. See Coal analysis.
   — feed-water. See Feed-water.
   — flue gases, automatic. See Flue gas.
   — — hand. See Flue gas.
Andre, evaporative figures of different coals, 3.
Ash, methods of analysis used in the author’s tests, 8.
   — data suggested for International Code, 147.
   — handling, mechanical, steam or power used, 96, 97, 99.
Attendance, suggestion to include in test calculations, 127 130.
Auto \(\text{CO}_2\) recorder, 68.
Automatic gas analysis. See Flue gas.
Avery automatic water weigher, 83.

B

Bailey steam meter, 132.
   — water meter C4, 84.
   — — — V Notch, 83.
BOILER PLANT TESTING

Barometer, question of reading for tests, 111-112.
Barrus calorimeter, 57.
Bayer steam meter, 132.
Berthelot-Mahler fuel calorimeter, 57.
Bimeter CO₂ recorder, 68.
Black smoke, 148.
Boiler, calculations suggested for heat absorption, 118.
— Cornish. See Boilers, small cylindrical.
— data for suggested International Code, 135.
— egg-ended, number still at work, 15.
— — typical performance figures, 35.
— feed-pump. See Pumps.
— feed-water. See Feed-water.
— small cylindrical, typical performance figures, 30-32.
— test Codes. See Civils Code.
— — — See American Society of Mechanical Engineers.
— vertical, typical performance figures, 32-33.
— water tube, typical performance figures, 29-30.
Brame, J. S. S., figures for hydrogen in coal, 57-58.
Breckenridge, methods of flue gas analysis, 75.
British-Thomson Houston steam meter, 132.
— — water meter, 84.

C

Calculations, 115-123.
— author’s methods for heat value of fuel, 8.
— chimney draught, 43.
— criticism of Civils Code methods, 121-123.
— efficiency figures suggested, International Code, 151.
— factor for the diminishing heat value of the coal, 124-128.
— heat absorbed by the boiler, 118.
— heat absorbed by the economiser, 118.
— heat absorbed by the superheater, 119.
— lbs. water from and at 212 F., 119.
— improved methods suggested, 115-120.
— — nett working efficiency, 119.
— — saving in coal hill, economisers, 120.
— — — superheaters, 120.
— suggestions to include labour, attendance, repairs, upkeep, interest, and depreciation, 127-130.
Calorimeter, fuel, Barrus, 57.
— Berthelot-Mahler, 57.
— Mahler-Cook, 57.
INDEX

Calorimeter, fuel, Mahler-Donkin, 8, 57.
— — gross and nett heating value, 57-64.
— — necessity of bomb type, 56.
— — recommendations of American Code, 57.
— — recommendations of Civils Code, 57.
Calorimeter, steam, difficulties in the use of, 88-89.
Cambridge Electrical CO₂ recorder, 69.
Carbon dioxide. See CO₂.
Chemical works, efficiency figures for sixty boiler plants, 15.
Chimney, data suggested for International Code, 139.
— draught. See Draught.
Civils Code, address for Code, Introduction, vi.
— — auxiliary steam or power, 94-99.
— — calorimeter (fuel) recommended, 57.
— — coal analysis, 56-57.
— — duration of test, 52.
— — feed-water measurement, 80-81.
— — flue gas analysis, methods, 68, 73-74.
— — moisture in steam, 88-89.
— — object of boiler plant testing, 51-52.
— — separate boiler testing Code, necessity of, 49-50.
— — specific heat of superheated steam, 92-94.
— — thickness of fires, 112-114.
CO₂, curve showing fuel loss at all percentages, 72.
— figures for 250 boiler plants, 11.
— — — 400 boiler plants, 71-72.
— — — Lancashire boiler plants, 23.
— — — water-tube boiler plants, 29.
— — — small cylindrical boiler plants, 31.
— — — vertical boiler plants, 33.
— — — egg-ended boiler plants, 35.
— — theory of, in flue gases, 65.
— recorders, accuracy, method of testing, 69.
— — Ades, 68.
— — Albion, 68.
— — American Society of Mechanical Engineers, remarks, 68.
— — Auto, 68.
— — Bimeter, 68.
— — Cambridge electrical, 69.
— — Civils Code, remarks, 68.
— — Duplex mono, 66-69.
— — Hay's, 69.
CO₂, recorders, methods used by the author, 70-71.
- - Mono, 67.
- - Sarco, 68.
- - Simmance-Abady, 68.
- - Ward, 68.
- - W.R. indicator, 69.
Coal analysis, 57-64.
- - American Society of Mechanical Engineers, 56.
- - Civils Code, remarks, 56.
- - curve showing deduction for hydrogen, 63.
- - data suggested for International Code, 147.
- - gross and nett heating value, 57-64.
- - hydrogen, suggestion to abandon determination, 61-63
- - methods used in the author’s tests, 7.
- - moisture, average figures for, 57.
- - necessity of bomb calorimeter, 56.
- - recommendations by the author, 61.
- - sampling of coal, 56.
- - See also Calorimeters, fuel.
- - consumption in Great Britain, 38.
- - mechanical handling, steam or power used, 96, 97, 99.
Codes, boiler test. See American Mechanical Engineers.
- - See Civils Code.
Collieries, performance figures for 100 boiler plants, 14.
Combustion, critical point of efficient, 67.
Cornish boiler. See Boilers.
Corrosion, electrolytic anti-process, steam or power used, 96, 97, 110.
Curnon steam meter, 132.
Curve, efficiency for diminishing heat value of coal, 128.
- - CO₂, showing fuel loss at all percentages, 72.
- - hydrogen in coal, calculations, 63.
- - specific heat of water, 117.
- - superheated steam, Knoblauch and Jakob, 93.
Cylindrical boilers. See Boilers.

D

Depreciation, suggestion to include in test calculations, 127-130.
Donkin, Bryen, results of boiler tests, 2.
- - and A. B. W. Kennedy, results of boiler tests, 4.
Draught, calculations for chimney draught, 40.
- - chimney, disadvantages of, 43.
- - choking by economisers, 43.
INDEX

Draught, figures for Lancashire boiler plant, 21-22.
- - - - water-tube boiler plant, 26-28.
- - - - small cylindrical boiler plant, 31.
- - - - vertical boiler plant, 33.
- - - - egg-ended boiler plant, 35.
- - forced, advantages of, 45.
- - - amount of steam or power taken, 45, 96, 97, 110.
- - - induced, advantages of, 45.
- - - amount of steam or power taken, 45, 96, 97, 110.
- - mechanical, data suggested for International Code, 140-142.
- - - figures for use in Great Britain, 43.
- - - method of measurement used by the author, 10.

Drier, steam. See Steam.

Duplex-mono flue gas analysing machine, 66-69.

Duration of test, general consideration, 52-56.
- - - - American Mechanical Engineers, remarks, 53.
- - - - Civils Code, remarks, 52.
- - - - long check test, 54-55.
- - - - suggestions by the author, 54.

Dust in chimney gases, 54.

Dyeing, etc., industry, performance figures for sixty-five boiler plants, 17-18.

E.

Economisers, calculation for heat absorbed by, 118.
- - calculation for fuel saving, 129.
- - choking of draught by, 13-14.
- - data suggested for International Code, 138-140.
- - figures for 250 boiler plant tests, 49.
- - - - Lancashire boiler plant, 24.
- - - - water-tube boiler plant, 29.
- - - - national loss through lack of, 41.
- - steam or power used by the scraper drive, 96, 97, 110.
- - sweating, 60.

Efficiency, American boiler plants, 48.
- - British boiler plants, 30.
- - chemical works, sixty boiler plants, 15.
- - collieries, 100 boiler plants, 14.
- - cylindrical boilers, small, 31.
- - dyeing, etc., industry, sixty-five boiler plants, 17.
- - egg-ended boiler plants, 35.
- - French boiler plants, 48.
- - Lancashire boiler plants, 21, 25
- - mechanical stoker plants, 42.
Efficiency, 250 typical steam boiler plants, 18-19.
  400 typical steam boiler plants, 12.
  vertical boiler plants, 32-33.
  water-tube boiler plants, 26, 30.
  See also Calculations.

Egg-ended boilers. See Boilers.

Electrolytic anti-corrosion methods, steam or power used, 90, 97, 110.

Factor for the diminishing heat value of fuel, 124-127.

Feed-water analysis, methods used by the author, 10.
  average figures for Great Britain, 41.
  figures for Lancashire boiler plants, 23.
  water-tube boiler plants, 29.
  measurement, American Code, remarks, 81-82.
  Civils Code, remarks, 80-81.
  data suggested for International Code, 142-144.
  tank method, 80-81.
  See also Meters, water.

Firing, hand. See Hand firing.

Mechanical. See Mechanical firing.

Flues, data suggested for International Code, 137, 139, 148.

Flue gas analysis, 64-89.
  Automatic. See CO₂ recorders.
  Civils Code, calculations based on, 121-122.
  methods suggested, 68-70.
  permanent installation recommended, 75.
  data suggested for International Code, 137, 139, 148.
  hand methods, 76-78.
  heat balance, 78.
  methane, presence of, 65.
  principle of the methods used, 66.
  sulphur dioxide, presence of, 65.
  theory of, 65.
  temperatures. See Temperature.

Forced Draught. See Draught.

French boiler plants, efficiency of, 48.

Fuel analysis. See also Calorimeters, fuel.
  See Coal analysis.
  sampling, 59.

Furnaces, steam jet. See Steam jets.
INDEX

G

Gooldenough, G. A., specific heat of superheated steam, 92.
Grit in chimney gases, 130-131.
Gross heating value of fuel, 57-64.

H

Hand-fring, results in comparison with mechanical, 42.
Hay's CO₂ recorder, 49.
— flue gas collector, 76-78.
Hempel gas analysis apparatus, 68.
Hirn's formule, specific heat of superheated steam, 93.
Huntly, G. Nevil, flue gas analysis, 74-74.
Hutton, W. S., performance figures for different types of boiler, 2.
Hydrogen, author's suggestion to abandon determination of in coal, 93.
— Brame, J. S. S., figures for coal constitution, 57-58.
— curve showing effect on heat value of coal, 93.
— flue gas, presence in, 65.

I

Ingenieurs Civils de France, Introduction, vi.
Introduction of Chemical Engineers, Introduction, vi.
— Civil Engineers. See Civils.
— Electrical Engineers, Introduction, vi.
— Mechanical Engineers, Introduction, vi.
— Mining Engineers, Introduction, vi.
Interest, suggestion to include in boiler test calculations, 127-128.

K

Kennedy water meter, 83.
— A. B. W., boiler tests, 4.
Kent displacement type water meter, 84.
— V Notch water meter, 83.
— steam meter, 132.
Kempe, performance of boiler plant, 4.
Knoblauch and Jakob, specific heat of superheated steam, 93.

L

Labour, suggestions to include in test calculations, 127-130.
Lancashire boiler. See Boilers.
Latent heat of steam. See Steam.
Lea V Notch water meter, 83.
Leinert water meter, 83.

M

Mahler-Cooke fuel calorimeter, 57.
Mahler-Donkin fuel calorimeter, 57.
Mechanical coal and ash handling, data suggested for International Code, 135.
--- steam or power used, 96, 97, 99.
Mechanical draught. See Draught.
--- figures for the performance of eighty boiler plants, 42.
--- national coal bill of, 42.
--- steam or power used by, 96, 97, 99.
--- steam used by steam jets. See Steam jets.
Meters, steam, American Mechanical Engineers, 101-103.
--- Bailey, 132.
--- Bayer, 132.
--- British-Thomson Houston, 132.
--- Curnon, 132.
--- data suggested for International Code, 140.
--- Kent, 132.
--- St. John, 132.
--- Sarco, 132.
--- water, American Mechanicals Code, 81-82.
--- Avery automatic water weigher, 83.
--- Bailey fluid meter C4, 84.
--- V Notch meter, 83.
--- Civils Code, remarks, 80-81.
--- data suggested for International Code, 145.
--- Kennedy meter, 83.
--- Kent displacement meter, 84.
--- V Notch meter, 83.
--- Lea V Notch recorder, 83.
--- Leinert meter, 83.
--- Paterson fluxograph, 83.
--- Rheograph water flow recorder, 83.
--- Sarco disc meter, 84.
--- piston meter, 83.
--- tippling meter, 83.
--- Siemans' disc meter, 84.
--- and Adamsen meter, 84.
--- Simmance-Abady precision meter, 83.
INDEX

Meters, testing, American Mechanical Engineers, 86-87.
— — methods suggested by the author, 85-86.
— Worthington duplex meter, 83.
— — turbine meter, 84.
— — Venturi meter, 80, 82, 84.
Moisture in fuel gas, 65.
Methane in fuel gas, average figures, 57.
— — steam. See Steam.
Molesworth, performance figures for boilers, 13.
Mono, CO automatic gas analysing machine, 69.
— — CO₂ recorder, 67.

N

Nett heating value of coal, 57-64.
— — working efficiency of boiler plant, 110.

O

Object of boiler plant testing, 57.
Orsat apparatus, general principle of, 66.
— — Civils Code, remarks, 74.

P

Papermaking industry, performance figures of forty boiler plants, 18.
Paterson fluxograph water meter, 83.
Pounds of water from and at 212 F. per 1,000,000 B.Th.U., 111.
Pumps, boiler-feed, steam or power used, 96, 97, 110.
— — data suggested for International Code, 144.
Pyrometers. See Temperature.

R

Radiation, tests for losses by oil boiler plant, 120-121.
Regnault and Hirn, specific heat of superheated steam, 93.
Repairs, suggestions to include in boiler test calculations, 127-130.
Rheograph flow water meter, 83.

S

St. John steam meter, 132.
Sampling fuel, 56.
— steam, 89-90.
• Sarco CO₂ recorder, 68.
  disc water meter, 84.
  piston water meter, 83.
  steam meter, 132.
  tippling water meter, 83.
Siemens’ disc water meter, 84.
  and Adamson water meter, 84.
Simmance-Abady CO₂ recorder, 68.
  precision water meter, 83.
Specific heat of water. See Water.
  superheated steam. See Steam.
Steam, auxiliary, 94-111.
  American Society of Mechanical Engineers, 99.
  boiler-feed pumps, 96, 97, 110.
  Civils Code, remarks, 95-96.
  data suggested for International Code, 159.
  drawing showing the various items, 96-97.
  Economiser engine, 96, 97, 110.
  electrolytic anti-corrosion, 96, 97, 110.
  figures for Lancashire boiler plants, 25.
  coal and ash handling, 96, 97, 99.
  mechanical draught, 96, 97, 110.
  mechanical stoking, 96, 97, 99.
  steam jet. See Steam jets.
  water-softening plant, 96, 97, 110.
  water-tube boiler plant, 29.
  calorimeters. See Calorimeters.
  Driers, Civils Code, remarks, 80.
  Stefco, 89.
  Tracy, 89.
  generation, figures for coal consumption of Great Britain, 38,
  jets, 45-47, 100-110.
  determination of, American Society of Mechanical Engineers,
  101-102.
  Civils Code, 100, 109, 110.
  cold water method, 106.
  gauge glass method, 102.
  method used by the author, 107-109.
  * steam meters, American Code, 103.
  * author’s suggestion, 103.
  figures for 250 boiler plants, 45.
  * hand-fired furnaces, 46.
  * mechanical stokers, 46.
  in detail of 153 boiler tests, 104-107.
INDEX

Steam jets, number of plants in Great Britain fitted, 47.
— latent heat, different figures in use, 112.
— Meters. See Meters.
— moisture in, 9, 88-92.
— American Society of Mechanical Engineers, 88.
— Civils Code, 88.
— figures for average conditions, 88.
— method of sampling, 80-80.
— recommendations by the author, 91-92.
— Unwin's paper, 89.
— See also Steam driers.
— pressure, average figures for Great Britain, 11.
— specific heat of, 92-94.
— Civils Code, remarks, 92.
— Goodenough, 92.
— Knoblauch and Jakob's curves, 93.
— Regnault and Hinr, 93.
— superheated. See Superheated steam.
— tables, Marks and Davis, 92.
Stefco steam drier, 89.
Stoking, hand. See Hand-firing.
— mechanical. See Mechanical stoking.
Sulphur dioxide in flue gases, 65.
— superheated steam, calculations, heat absorbed by superheater, 110.
— saving in coal bill, 120.
— figures for 250 boiler plants, 48.
— Lancashire boiler plants, 24.
— national fuel loss through lack of, 48.
— specific heat, 92-94.
Svenska Aktiebolaget Mono. See Duplex mono.

T

Tank method of measuring feed-water. See Feed-water.
Temperature, feed-water, Civils Code, remarks, 112.
— data suggested for International Code, 145.
— figures for 250 boiler plants, 12.
— use of oil, 112.
— flue gases, Civils Code, remarks, 112.
— electric resistance pyrometers, 10.
— figures for 250 tests, 10.
Test codes. See American Society of Mechanical Engineers.
- Civils Code.
- sheets, suggestions for International Code, 132-152.
Testing of water meters, 85-87.
Thickness of fires, Civils Code instructions, 112-114.
Tracy steam drier, 89.

Upkeep, suggestions to include in boiler test calculations, 127-130.
Unwin, Dr. W. C., moisture in steam, 89.

Venturi meters, 80, 82-84.
Vertical boilers. See Boilers.

W
Ward CO₂ recorder, 68.
Water-softening, average figures for Great Britain, 41.
- data suggested for International Code, 143.
- steam or power used by, 96, 97, 110.
Water, specific heat, Civils Code figures, 116-117.
- curve for varying temperatures, 117.
- formula recommended by the author, 117.
Water-tube boilers. See Boilers.
W.R. combustion indicator, 69.
Worthington duplex water meter, 83.
-- turbine water meter, 84.