IDEAL - Standard

RESEARCH LABORATORY

BLANC-MESNIL (FRANCE)

INTRODUCTION

The Laboratories at Blanc-Mesnil were established to provide facilities to permit applied research and product develop work to be carried out for the Ideal-Standard group of companies Europe. This Laboratory facility was provided in 1953, in order replace smaller Laboratory resources which had existed since beginning of this century.

The work carried out covers all phases of the technical study and research necessary to produce new and improved produ for the Ideal-Standard manufacturing companies in Europe.

This booklet is prepared to provide visitors with a document which can be a later reminder of the installations seen during the course of the visit.

The principal departments of the Laboratory are described together with the type of equipment available, and a ré of the work that is carried out.

Since the Laboratory is intended to provide help to Companies operating in all European countries, the technical sta tends to be international. Whilst, for obvious reasons, the major of the employees are French nationals, the engineers are recruit on the basis of ability and experience rather than nationality.

It should not be supposed that Blanc-Mesnil Laboratory is the sole basis of technical studies for the Ideal-Standard group Each company has its own technical staff and technical facilities, essential for dealing with the problems within their particular territory. Blanc-Mesnil Laboratory provides additional facilities which can be used to study problems on a long term basis, to dea with problems common to several companies, or to deal with a problem of an individual company where special facilities are required, and not available at the local laboratory.

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AIR CONDITIONING DEPARTMENT

This department is responsible for developing and testing unit heaters and unit air conditioners and, more generally, all kinds of air moving devices. A wide variety of such equipments has been tested at Blanc-Mesnil Laboratory and a good experience has been gained, particularly on air cooled and/or water cooled type conditioners.

I. AIR CONDITIONING UNITS.

The tests are performed in a double room installation, which can be used for the testing of air conditioning equipments of capacities ranging from 1, 000 to 18, 000 calories/hour of cooling capacity.

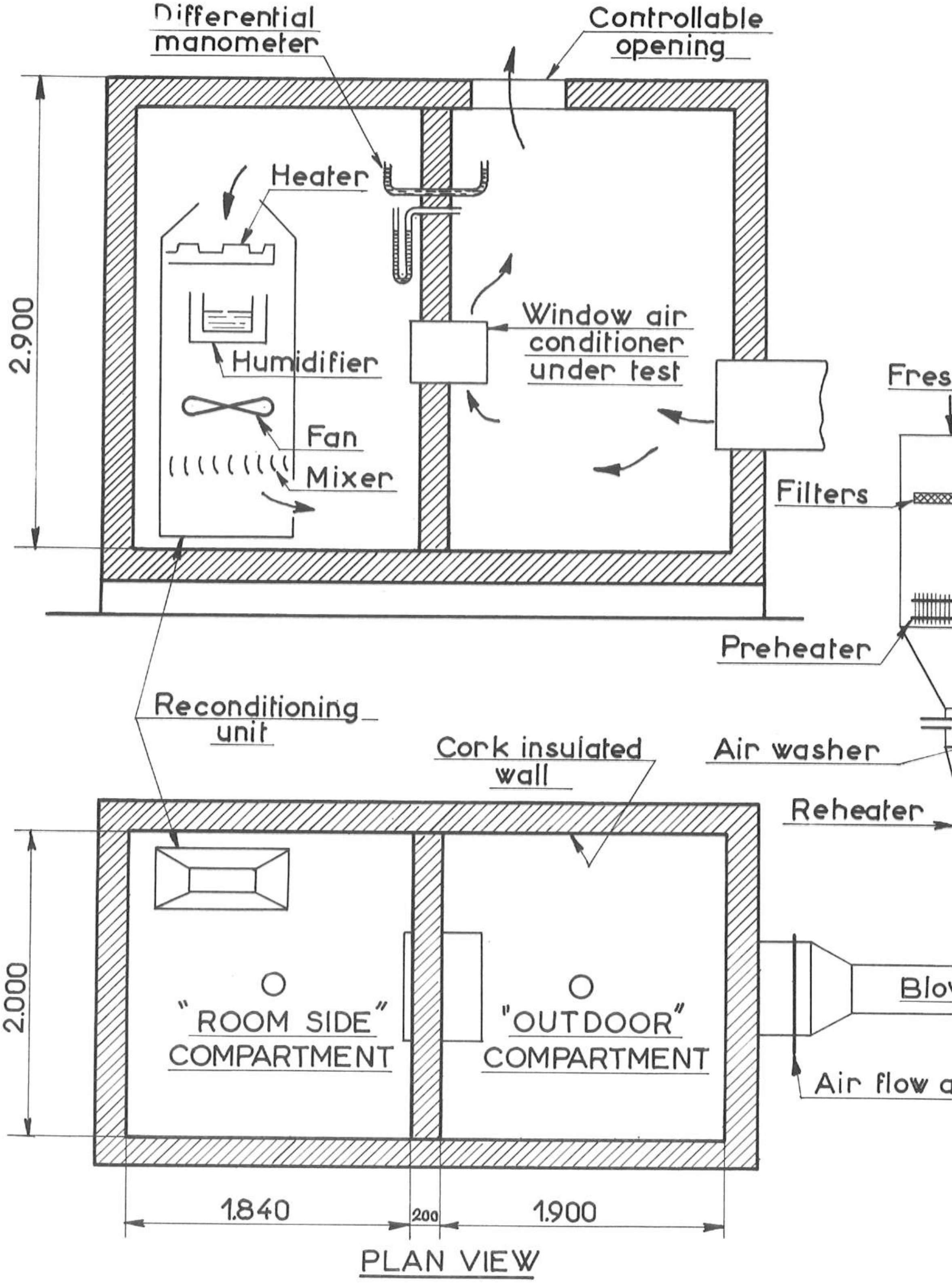
The different components of the units are selected and checked to yield maximum operating efficiency and satisfactory performance in long term use. When a prototype unit has been developed, performance tests are carried out under extreme climatic conditions and also rated according to approved code conditions.

- Test Room -

The test facilities consist of two adjacent rooms, as shown on page 3., one being the "room side" compartment, and the other the "ou compartment. The two compartments are separated by an insulated pa having an opening into which the air conditioner under test may be insta

The "room side" compartment is equipped with a system permitting to measure the heat and moisture which must be introduced compensate the de-humidifying and cooling effect of the evaporator. Th heat and moisture are furnished by adjustable heaters and humidifiers.

The "outdoor" side is provided with air maintained under presc conditions. The fresh air, taken from the outside is pre-heated, humid and re-heated by an air treating automatically controlled equipment. Tl treated air, delivered by an adjustable blower, circulates freely throug the compartment.



DOUBLE ROOM TYPE CALORIMETER

- Test conditions and procedure -

Since uniform rating conditions have not yet been agreed upon European countries, Blanc-Mesnil Laboratory uses normally the Metl Rating and Testing Air Conditioners, as defined by the American Soci Heating and Refrigerating Engineers. These methods permit accurate comparison of different units and serve to prepare information for lis purposes.

It is recalled that two basic climates are defined by these refe conditions : "Tropical" climate (high relative humidity) and "Sahara" (high dry bulb temperature and very low humidity).

In addition, the A.R.I. conditions (Air Conditioning Refrigerat Institute) are also used as a control.

The usual testing procedure is as follows :-

a) Room side compartment

Insulated air ducts are fitted to the inlet and outlet of the unit u test. The average air temperature values are obtained by the use of a number of wet and dry bulb thermometers. Air flow rate delivered by is measured by anemometer and Pitot tubes.

The total cooling load is calculated using a psychrometric char the sensible and latent heat being determined separately.

The above result is checked when compared to the heat input of reconditioning equipment installed in the room side compartment, the losses through wall being taken into consideration.

b) Outdoor side

Similar temperature measurements are made on the condenser the conditioner. These permit to determine the cooling effect from the side, taking into account the power absorbed by the fan and by the com

c) Measurements are taken when steady conditions have been reache an electronic type multiple temperature recorder.

Performances for climatic conditions different from the standar are calculated using a special psychrometric diagram where the equiv surface temperature of the evaporator is used as a reference.

II. UNIT HEATERS.

A permanent test set-up is available for the purpose of testing u heaters, both vertical and horizontal discharge units, using steam or h water.

These tests serve to obtain performance data such as the heating capacity and the air volumes moved. These data permit to develop effic heaters and to publish accurate catalogue data.

- Testing facilities -

The room where the tests are performed is dimensioned and arranged so as to maintain, during tests, the inlet air temperature as constant as possible. As shown on page 6, the horizontal discharge unit heaters are placed inside an opening made in a wall, in such a manner a to avoid possible mixture of discharged air with the air at unit inlet.

The supply of hot water or steam is ensured by an automatically controlled oil fired boiler, fitted with an accumulator tank.

A typical unit heater test set-up is shown on page 7. Vertical discharge unit heaters are tested in a similar manner.

- Testing procedure -

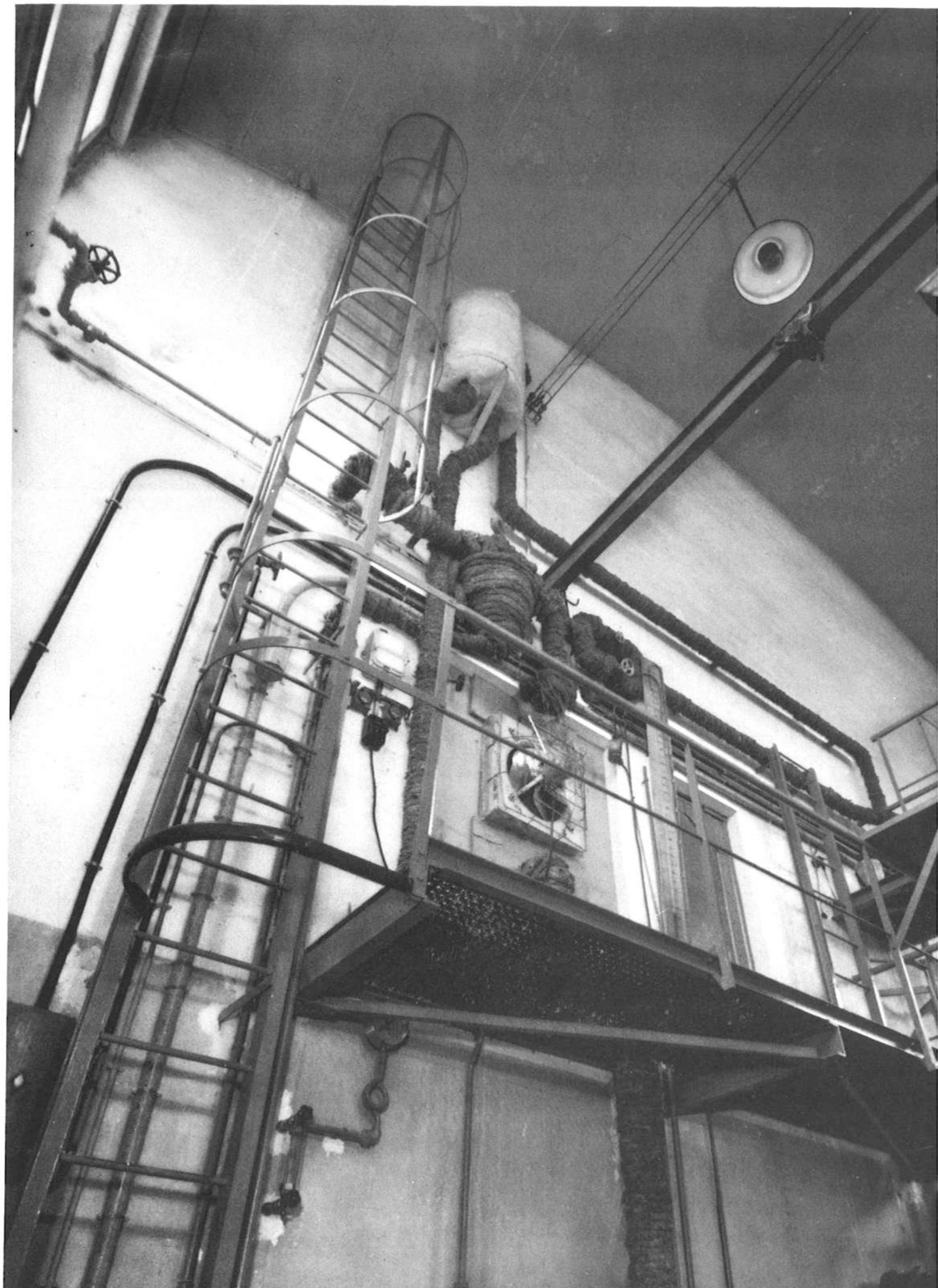
Tests are carried out under steady conditions, i.e., under stabl temperature and pressure values of the heating fluid and well stabilized flow rate and heat transfer conditions.

The inlet and outlet heating fluid temperatures are measured by means of thermometers and thermocouples. The water or the condensat rate are determined by weighing.

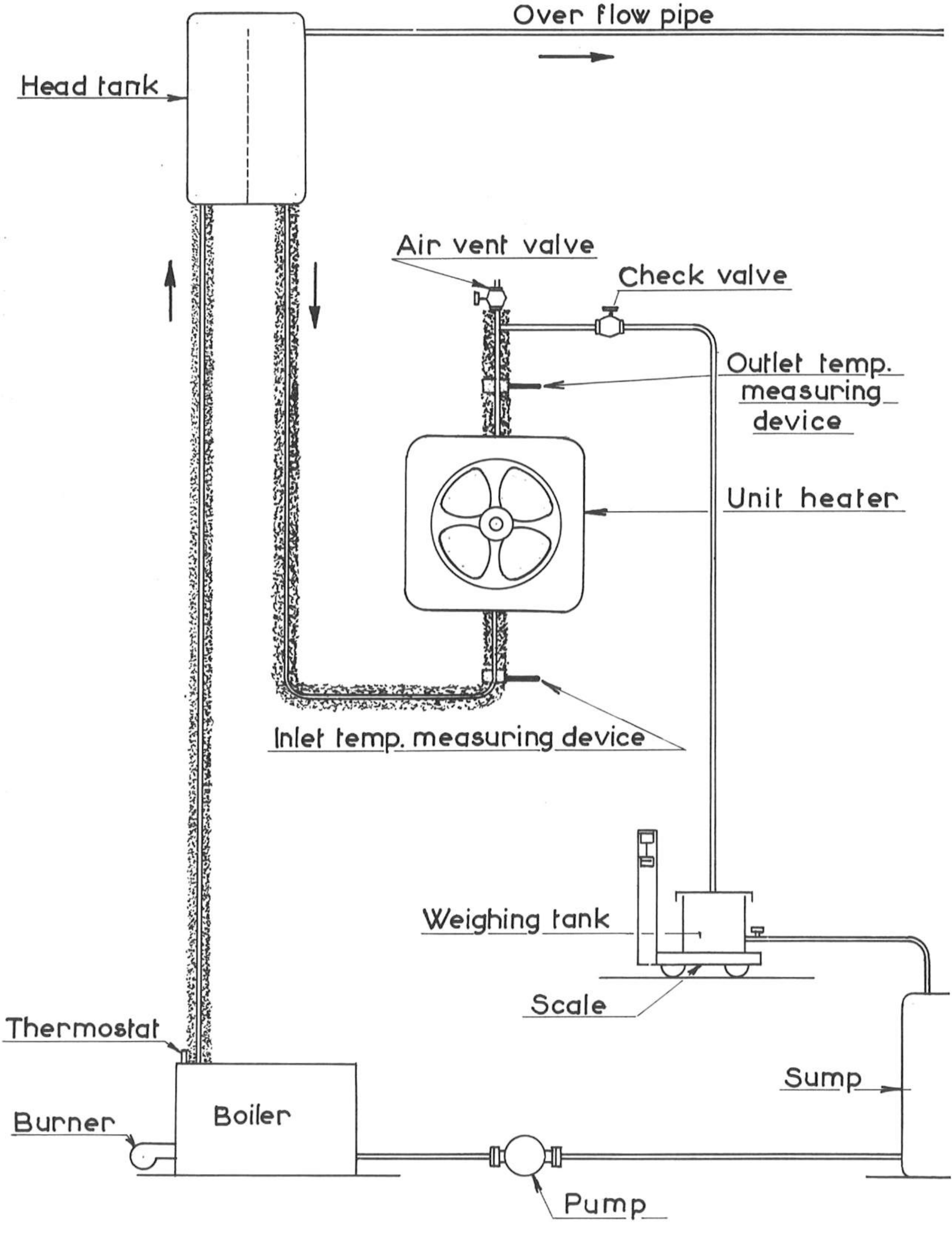
These data permit to obtain the heating capacity. Furthermore, by measuring the temperature rise of the air through the unit, using lat grids of thermocouples, the air volume is calculated.

In addition to the thermal measurement, the pressure drop thro the coil is measured as well as the warm air velocity distribution patte the unit heater outlet.

Noise measurements are carried out using a sound level meter with a weighing network.



UNIT HEATER TEST STATION



UNIT HEATER TEST SET-UP

CERAMIC DEPARTMENT

Two distinct types of sanitary product are dealt with in the Ceramic Department of the Laboratory : Vitreous china and Enamelled iron. It does not deal with design of articles, but with technical or scien problems associated with the manufacturing from the properties of raw materials, through the various stages of making, to the technical quality the products.

Pages 9 and 10 show the general view of the Ceramic Laboratory and the furnace room.

- Vitreous China -

Vitreous China is also quite correctly called sanitary porcelain, just as a closet is sometimes called a lavatory, and a lavatory may be a wash-basin. The essential property of Vitreous China is that it is non-absorbant even if it were unglazed. In addition, the glaze never crazes, that with Vitreous China you have a very hygienic material and also a ma which is tough mechanically and resists chemical attack and abrasion ve

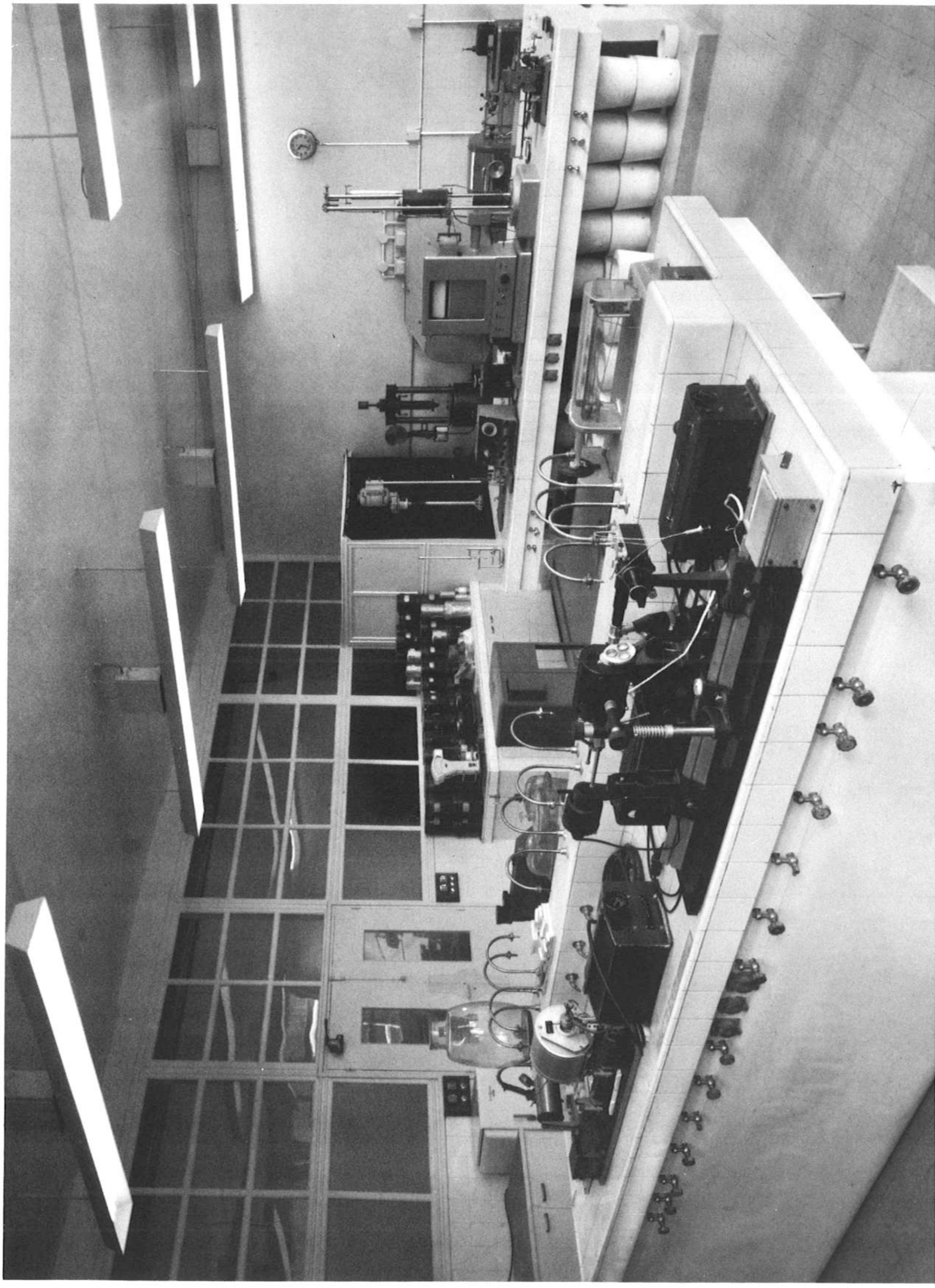
- The Raw Materials : ball clays, china clays, felspars and quar from which Vitreous China is made are checked by various means, e. g.

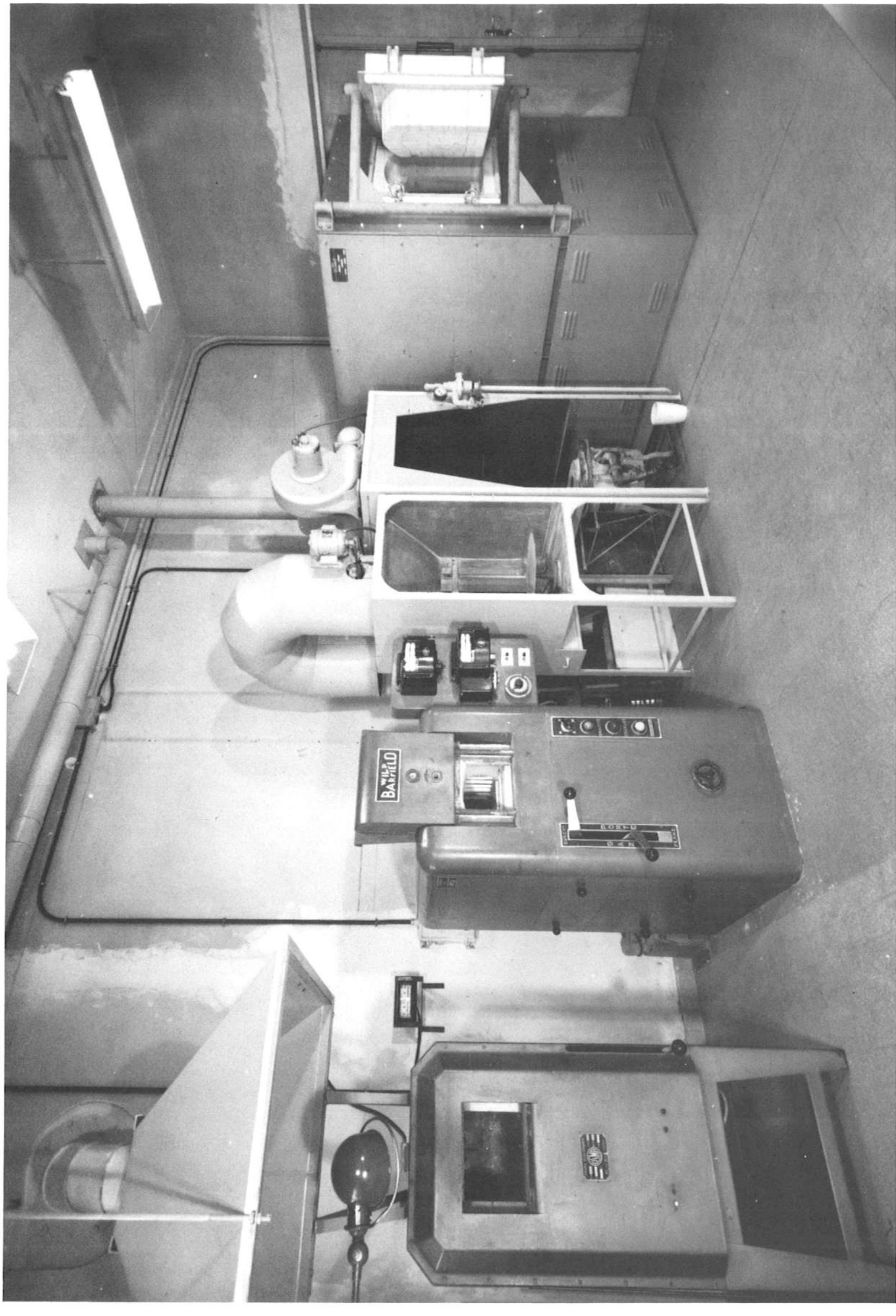
Thermal expansion
Thermogravimetric analysis
Fusibility
Fineness

- The Casting Slip : a "fluid cream" of raw materials and electro from which the articles are formed in plaster molds, must have well co density and fluid properties. A torsion viscometer is used for measurin fluidity and thixotropy, both of which influence its behaviour and its cast can be checked in Plaster of Paris test molds.

- The Unfired Body : can be checked for quality by measuring its and also its porosity (by paraffin absorption).

- The Glaze : which is a suspension of a mixture of several finel materials is usually applied to the dried, unfired article, by spraying. It properties are checked by the torsion viscometer, its fineness by a sedi test, its fusibility by means of the heating microscope and its fluidity by how it flows on an inclined plane when heated under standard conditions. expansion is determined on the expansion apparatus and the glaze body fi contraction ring or Steger Bar Test.





- The Firing of standard or experimental bodies in the Laborato can be program-controlled for cycles from 6 to 96 hours, up to 1300°C. Pyrometric cones, for comparison with industrial firings are always use

- Testing of the fired samples or product include :-

Porosity (water absorption under standardized extreme condi
Strength (modulus of rupture and compressive strengths)
Thermal shock resistance
Abrasion resistance
Resistance to chemical attack
Glaze body fit
Thermal expansion
Colour

- Enamelled Iron -

The industrial process of enamelling is copied on a small scale in the Laboratory.

- Frit making

The mixture of about a dozen raw materials is smelted in a gas fi crucible, and the molten glass is poured into cold water and shattered.

- Grinding

The frit (shattered mass) is dried and ground to give the enamel powder of certain fineness.

- Application

The powder is dusted onto the red hot cast iron and then replaced kiln for a certain time. In the Laboratory, the enamel is applied with the plate on a balance to control the thickness of enamel.

- Metal Cleaning

Before enamelling, the cast iron is shot-blasted to have a rust-fr clean rough surface, and coated with a thin layer of ground coat, which p oxidation of the surface on firing and also acts as a key to give adequate a of the enamel to the iron.

In addition to the quality control tests of colour, resistance to ac and alkali, thermal shock resistance, and abrasion resistance carried ou the normal product, the thermal expansion, fusibility, fluidity and opacity an enamel are measured when new enamel formulations are being investig

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COAL & OIL DEPARTMENT

The Coal & Oil Department of the Laboratory has available a larg boiler testing room, fully equipped with up-to-date apparatus and instrur and is staffed by engineers and technicians with a large background of experience in heating products and ancillary equipment.

- What is being tested ?

Tests cover a large variety of items, among which are water and steam boilers, domestic water heaters, burners, stokers, warm air fur etc ... They may concern final "check-outs" of a large boiler about to b released for production, or the behaviour of a small bearing in a pump t offered for eventual sale by one of the many Ideal-Standard companies. S are carried out on thermal performances as well as mechanical characte of the products, and more generally on all factors which will ensure a sa tory long term operation in the field.

Among them, are the "basic" tests which are needed to obtain the data required prior to the start of a boiler design of radically new concep

Tests are, of course, carried out also in order to define and substantiate the listed output of the heating appliances and to supply the S Departments with all necessary technical information.

Since Blanc-Mesnil is an international Laboratory, serving all European Ideal-Standard Companies, demands for adaptation of certain i to local conditions such as specific fuels or codes, arise quite frequently In such cases, modifications to equipment must be made and the result verified by test.

Among items tested, are also product manufactured by others to selected, and adapted for use or sale with Ideal-Standard products, such burners, pumps and controls. Tests are also performed on competing pr to investigate its merits.

- How are tests performed ?

The testing room is equipped with nine basic test stations, princi intended for the experimental study of boiler performance. At each test s is available a chimney and a heat exchanger. These are sized to cover th different boiler outputs ranging from a few thousand to six million Btu.

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Recording instruments for temperature, draft and stack gas analy are located in two booths. A network of cables and tubes permits to conn each test station separately to the instruments.

Where standard test methods exist, they are used, but differences may exist between the test methods recommended by the codes of the diff countries.

Tests are usually performed with those fuels with which the heati appliances will operate in the field.

The fuels used for the tests are carefully analyzed to ensure that their characteristics correspond with those for which the equipment is in and in order to obtain exact heating values for the performance calculatio

Page 14 shows a typical set up for boiler testing and the instrume used for the determination of the performance of an oil fired hot water bc

If we consider the test set-up shown on this page, the boiler woul tested as follows :-

Prior to testing, the boiler is erected in accordance with normal procedures that would be used in the field. Having prepared the boiler fo the oil burner is installed in accordance with the instructions of the manu Preliminary tests are then run to ascertain that all apparatus used in the functioning properly. During this time, the consumption of the oil burner checked and regulated in accordance with the output of the boiler to be ob for the test, the rate of water flow through the boiler is checked and prel measurements taken to verify that it is operating within the limits of the requirements.

Having determined that the boiler and measuring instruments are operating satisfactorily, the boiler is allowed to operate until stable cond have been reached. This period of time which is followed through record instruments, varies with the type of boiler and fuel used for firing.

After stable conditions have been reached, the engineer in charge the test begins to record the necessary readings on standard log sheets t specifically prepared for boiler tests. These readings are taken from ins that can be read directly by the engineer and not from the automatic reco instruments. Thus, at the end of the test, there are available two sets of to check the operating characteristics of the boiler - one set recorded by engineer and one recorded by the automatic instruments.

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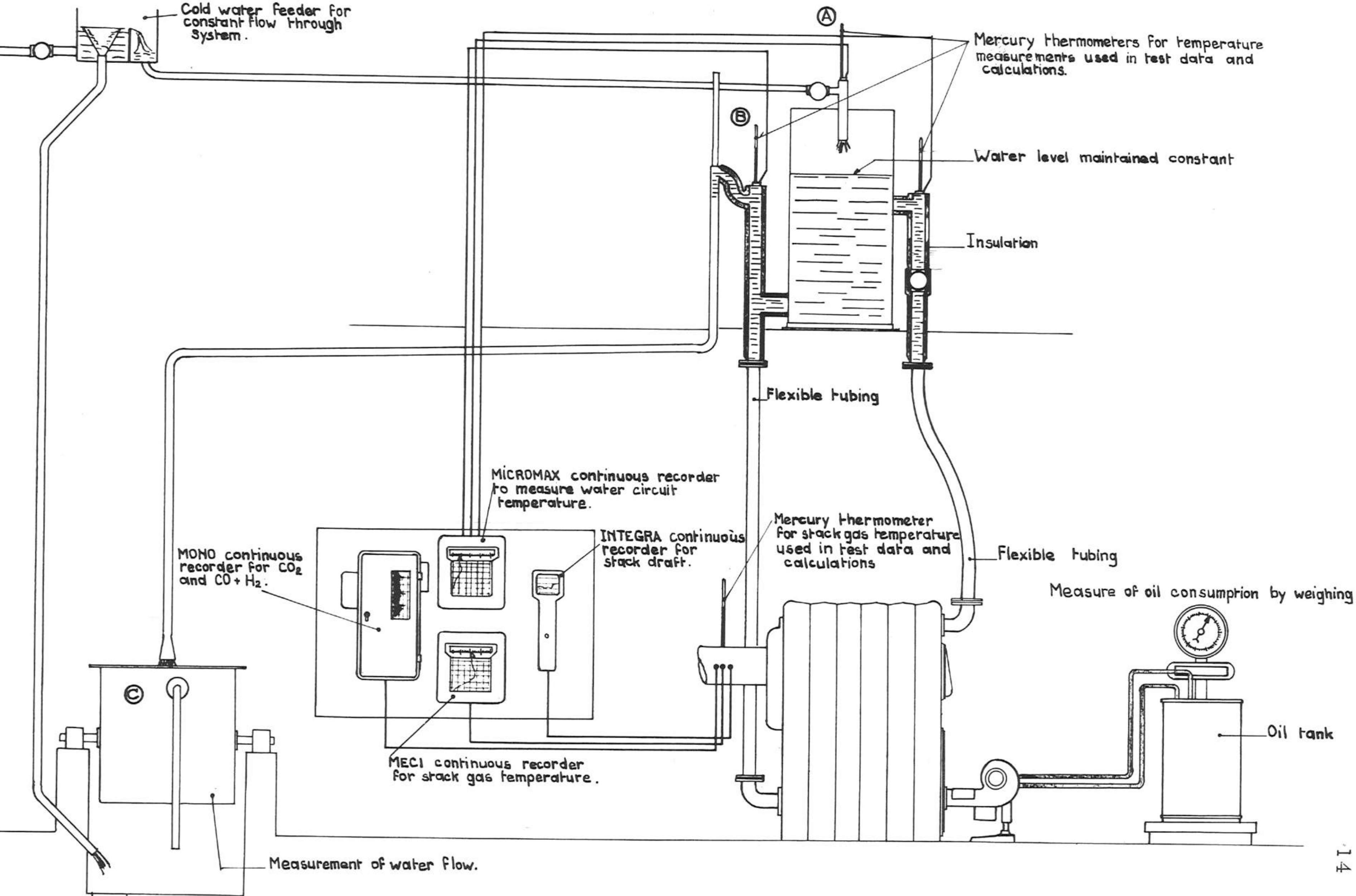
Cold water feeder for constant flow through System.
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Mercury thermometers for temperature measurements used in test data and calculations.
Water level maintained constant
Insulation
Flexible tubing
MICROMAX continuous recorder to measure water circuit temperature.
INTEGRA continuous recorder for stack draft.
MONO continuous recorder for CO2 and CO + H2.
Mercury thermometer for stack gas temperature used in test data and calculations
Flexible tubing
Measure of oil consumption by weighing
Oil tank
MECI continuous recorder for stack gas temperature.
Measurement of water flow.

Briefly, the output of the boiler - as shown on page 14 - is measur by the change in temperature recorded by thermometers A and B, of a kno quantity of water which is measured at C. The thermometers shown on va points of the sketch are read at fixed intervals by the engineer in charge. In addition, analyzes of flue gases and smoke density readings are also tak During the test, all characteristics of operation are noted, and any variati from the normal expected operation is reported on the data sheets.

The duration of the test depends on the fuel used. For example, wh fuel oil is used, the boiler is allowed to operate two or three hours at ste conditions before the test data is taken. For solid fuel, hand charged, the boiler is started with wood and partial fuel charge is allowed to burn, after which a complete fuel charge is burnt, data being taken over the total dura of the test. Analysis and calibration of fuel used is recorded.

After completion of a series of tests at different outputs, all data i analyzed and reported generally in the form of a graph, which shows effici drafts and stack gas temperatures as a function at various rates of output boiler.

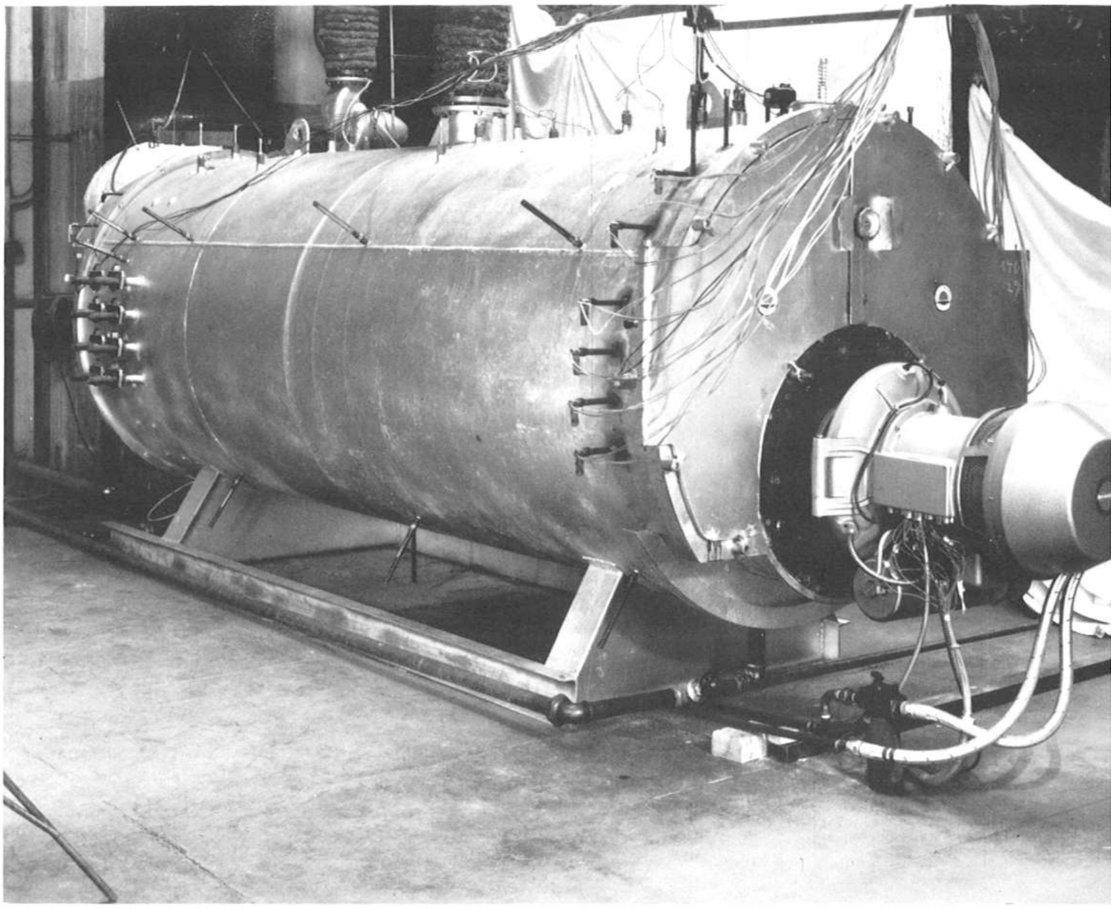
When the boiler performance has been fully analyzed and all data r a complete brochure of the test is filed for future reference.

The boiler set-up shown on page 14 refers to a hot water test. How complete facilities are available for steam tests at high and low pressures the same procedure of test is followed with variations which would apply f evaluating a steam boiler.

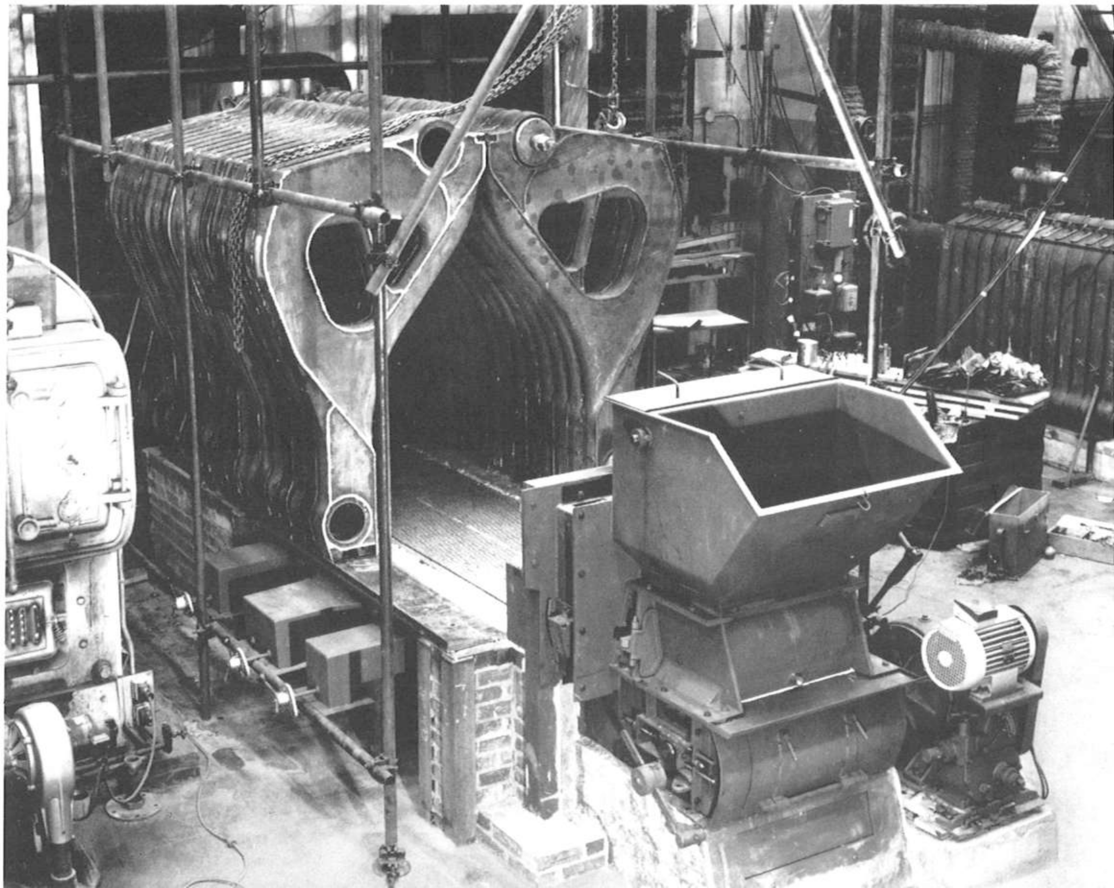
A similar procedure is followed for the testing of other types of he equipment. Particular attention is always paid to the investigation of the combustion process (flame development, air pollution, etc ...).

Page 16 shows a general view of the boiler testing room, and page 17 shows two typical arrangements of experimental boiler/burner units on

GENERAL VIEW OF BOILER TESTING ROOM



TYPICAL ARRANGEMENTS OF EXPERIMENTAL BOILER-BURNER UNITS



GAS DEPARTMENT

The use of gas is becoming increasingly important throughout Europe. The distinctive nature of appliances using gas, the special natu of the burners and the controls used with such appliances, the differing of the code requirements in various countries in Europe, and the wide v in the composition of gases in use, emphasize the necessity of a Depart concentrating on gas fired product.

The nature of the company activities, naturally requires that the major effort of this Department is devoted towards development of new but where basic data is not available from other sources, it is sometim necessary to undertake basic research work in addition.

The full scope of the work can be appreciated, if it is considerec under the following subject headings :

- complete heating units
- burners
- controls and safety equipment
- basic heat exchanger studies
- characteristics of various fuel gases

- Complete Heating Units

The Gas Department facilities permit full scale performance tes of gas fired heating units. In the case of hot water central heating boiler most commonly tested product - output and overall efficiency are measu substantially the same type of water circuit as that used for testing oil a fuel fired boilers, and reference may be made to the appropriate sectio details of the method. Measurement is made of stack gas temperature a composition and detailed analyzis results in a knowledge of quality of co heat loss in stack gases and heat conveyed to the environment from the external surface.

Similar work is carried out on warm air generators and unit hea with an analyzis of air velocities and temperatures.

Blocked chimneys and downdraft conditions are examined as a m of course to test the effectiveness of any draft diverter incorporated.

Equipment used in tests includes an ONERA infra-red analyzer, Mono continuous recording CO_2 meters and two MSA CO meters.

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- Burners

Gas burners necessarily require careful consideration and testing in the light of the differing gas characteristics and national code requirements the various European countries. Also national tradition dictates certain conc e.g., that multi-jet type burners may be used in one country, whereas atmo type burners consisting of a mixer and a burner head would be preferred in another, for similar gases.

To-date, it has been possible at Blanc-Mesnil to carry out comprehe but not always conclusive development testing of burners for particular appl Often, it has been necessary to carry out the final confirmatory tests in the country in question, in order to have available the limit gases specified for under the national code. This situation will soon be improved in that a test C Generator is being installed in the new Gas Laboratory to provide gas of any desired composition.

- Controls and Safety equipment

These constitute a major item in the specification of a gas-fired heat unit. They include safety pilots, pilot operated main gas shut-off valves, ma gas control valves actuated by boiler and room thermostats or by clock cont gas pressure regulating valves, and so on. National codes demand various performance standards, e.g., response time of pilot controlled gas valve in event of pilot-flame failure, time to ignite main burner under turn-down tes conditions, etc ....

Price, code requirements, local availability and local market prefer often lead to the adoption of differing types of control equipment for the sam of heating unit in various countries. All of the different versions are tested individually specified at Blanc-Mesnil.

- Basic Heat Exchanger studies

Studies of this nature are undertaken as the need arises in the develo of new heating product. One of the features which distinguish Blanc-Mesnil tory from the individual company laboratories, is the availability of time and to examine the fundamental heat transfer characteristics of heat exchanger Thus, a sound basis can be derived for example, for the design of extended provided in gas boiler sections to obtain high heat transfer rates per unit of surface area.

- Characteristics of various fuel gases

Full documentation is maintained regarding the characteristics of the various gases used in each country. As already indicated earlier in this text the Test Gas Generator soon to be installed at Blanc-Mesnil will be capable supplying gases of practically every type actually in use in Western Europe.

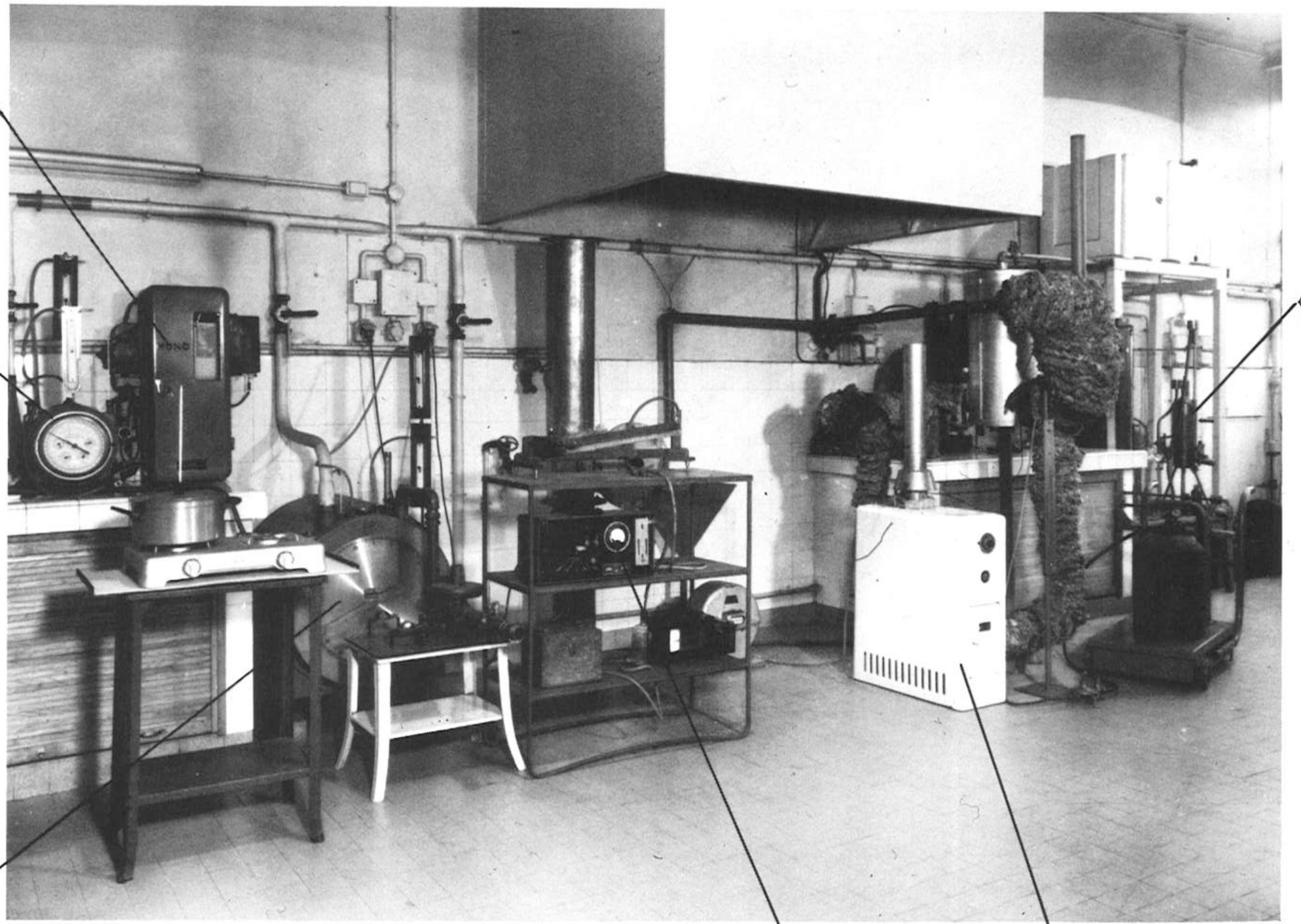
The ancillary equipment available for measurement of gas chara includes a Junkers calorimeter for city gas, a Reinche calorimeter suit all gases, a Hydro meter for measurement of gas density, and a Gaz de type test burner.

- New Gas Laboratory

Page 21 shows a part of the testing Laboratory in use until the present time.

A new Laboratory has recently been constructed in order to imp and extend facilities necessary for the increasingly large volume of wor gas fired heating product. This new Laboratory will be in operation in N

The new building comprises a main testing laboratory for full sc testing of central heating units, a separate room housing all the apparat measurement of gas characteristics, a small workshop, a store and, in upper storey, offices for engineer, technicians and draftsmen. The new Gas Generator is to be installed in a semi-enclosed annex.


Gas analysis (Automatic recorder of CO^2-CO-H_2 contents)
Gas meter for Flow Rate up to 20 m3/hr
Gas meter for Flow Rate up to 20 m3/hr
Carbon Monoxide Indicator
1GT Gas Boiler modified for propane
Junkers Calorimeter

PLUMBING DEPARTMENT

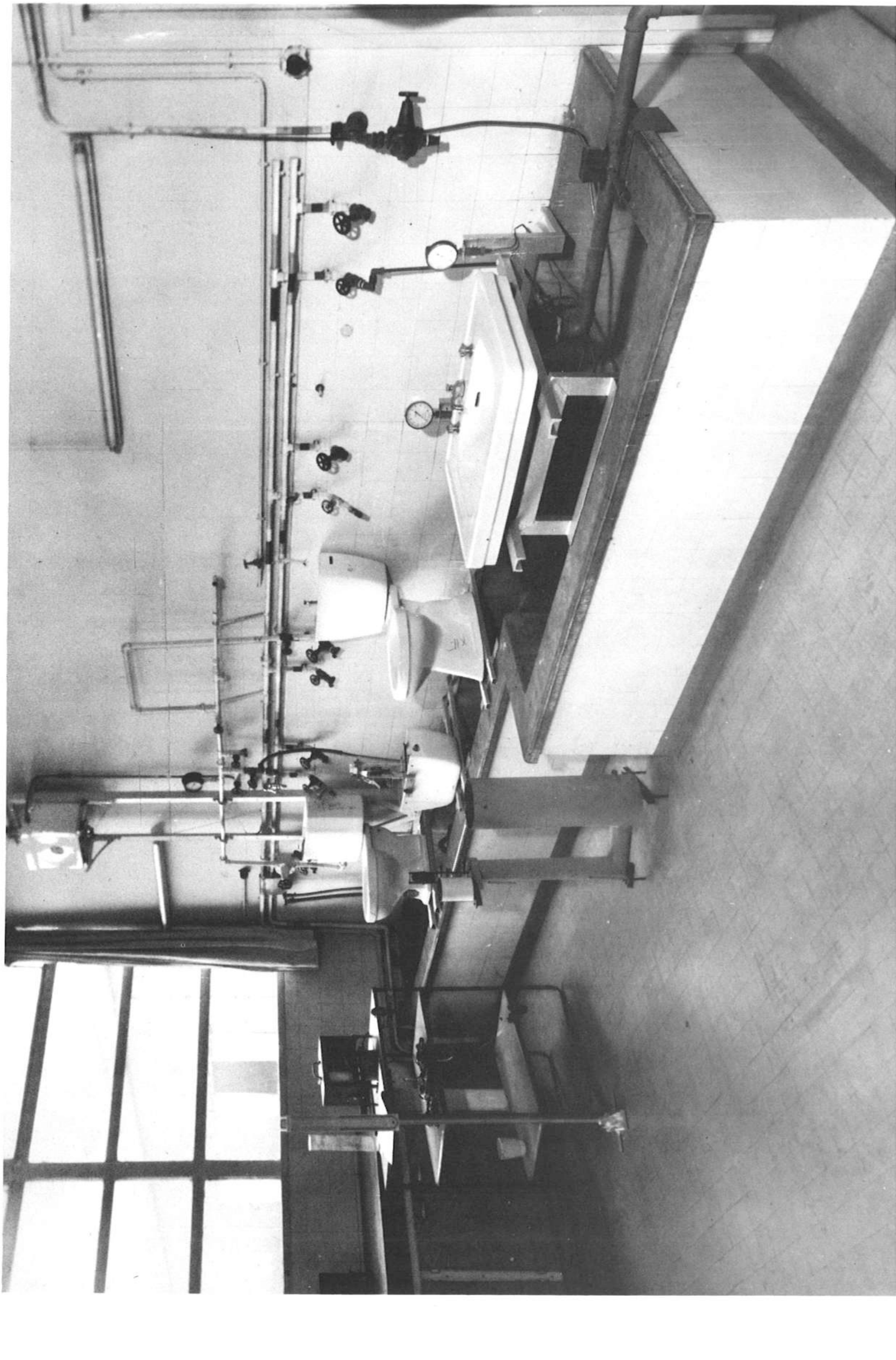
The Plumbing Department has been provided with the facilities fo practical and physical testing of all fixtures and components of the comp range of sanitary products. Sanitary fixtures, fittings and accessories a subjected to a series of comprehensive testing procedures at Blanc-Mes Laboratory. Evaluation of results thus obtained serves as a basis for determining the efficiency of sanitary product design throughout the Idea Standard group of companies. Page 23 shows a part of the testing Labor

Accurately regulated cold water supplies for testing purposes ar available from separate high and low pressure water systems, each con by its individual pressure regulating station. Independent generating fac within the Plumbing Department provide hot water for testing facilities. Adequate drainage facilities from integral masonry open troughs and re accommodate the large volumes of water discharged during the various efficiency tests. Facilities are also provided for the structural and mec testing of diverse sanitary products. A loading and impact apparatus is to determine the structural stability of wall supported fixtures. Special designed and built at the Blanc-Mesnil Laboratory, enable accelerated v of sanitary fittings and components to be performed to determine the du of these products in normal usage.

The improvements being made in fixture design, particularly wa closet bowls, are continually being investigated and evaluated. The ser practical and physical tests for water closets established at Blanc-Mes Laboratory enable the flushing efficiency of any design prototype to be r and to determine in which way modifications could be made to the bowl (in order to improve operation.

The practical tests for both washdown and syphonic action bowls used to determine the ability of the fixture to satisfactorily evacuate ma from the bowl pan under normal conditions of use. Newspaper sheets, r approximately 21 x 15 cm., artificial sponges and plastic balls of presc dimensions are used in these tests. Such tests are statistical in nature, are therefore repeated a given number of times, and the average numbe items evacuated is recorded as a percentage.

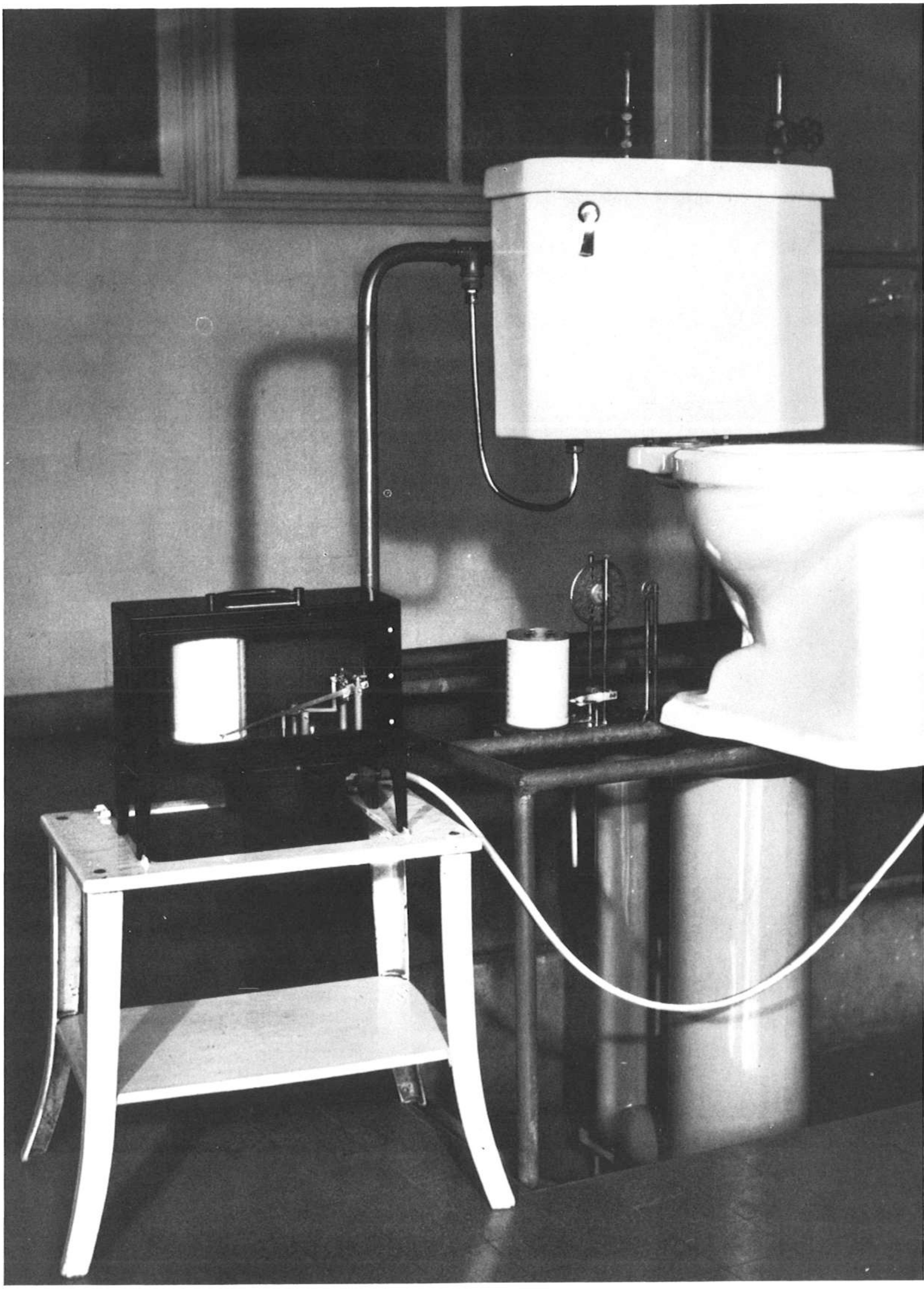
A dye test is made to check the renewal of water in the bowl afte flushing. The test is made using a potassium permanganate solution at concentration of 158 mg. per litre of water. Satisfactory renewal of wa is checked by visual inspection, although in cases requiring greater acc comparison of water samples before and after flushing may be determin a photocolorimeter. To determine the washing action of water from the flushing rim, two handfuls of sawdust are scattered around the previou wetted inner walls of the bowl to within 25mm of the flushing rim. The is then flushed, and the results are determined by visual inspection.



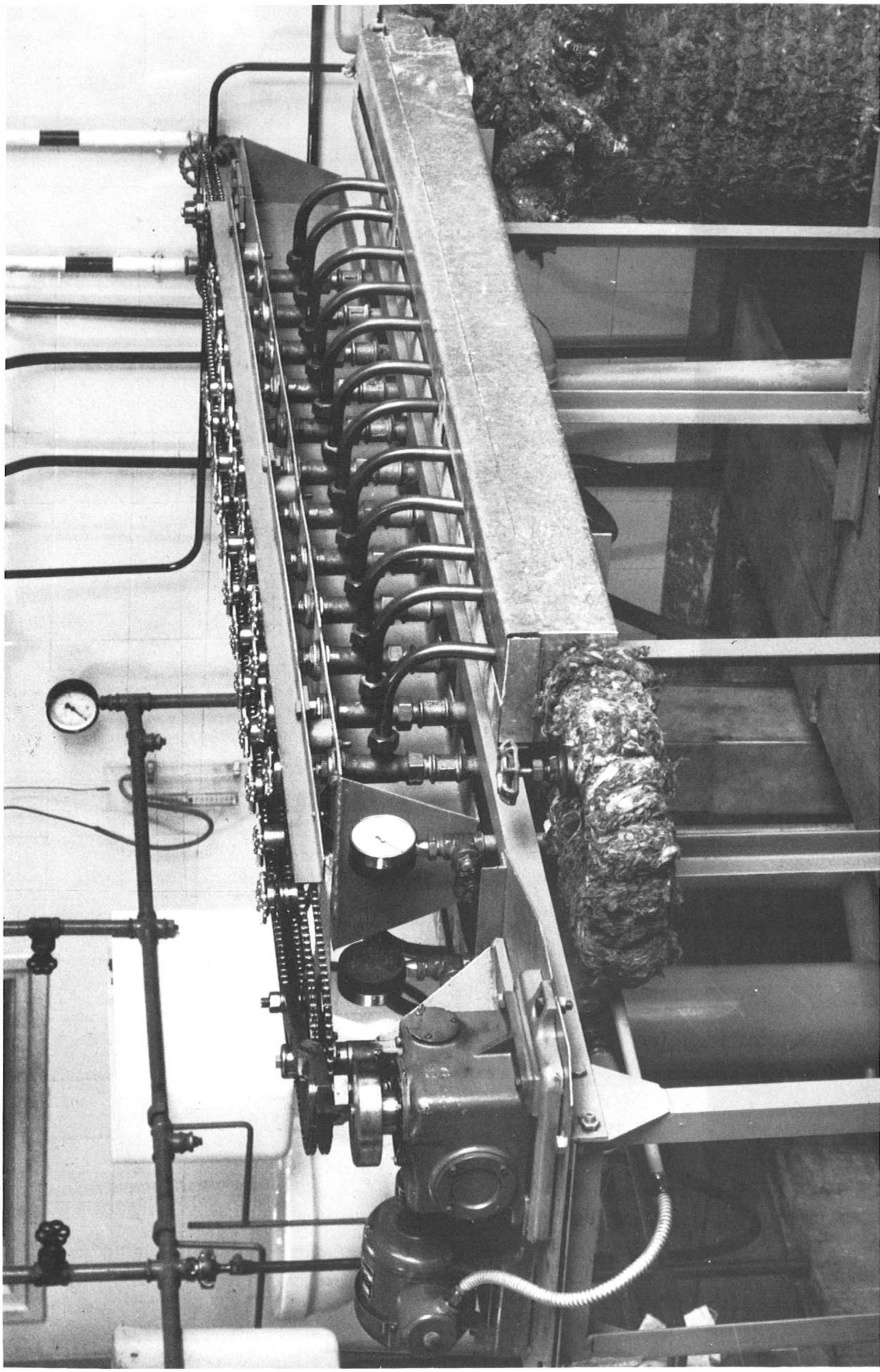
The physical tests are intended to determine the relationship between the actual performance of the water closet and its flushing characteristics, and are performed in addition to the foregoing practic tests.

A representative syphonic bowl testing installation is illustrate on page 25. The recording instrument at the left of the photograph insc the curves showing the depression at the top of the syphon as a functio time taken from tripping the tank flushing lever. The vacuum gauge is connected to a small hole drilled in the side wall of the upper part of tl syphon. A mean curve is then plotted from the recorded chart to repre the function. In most cases, a better flushing action is indicated by an occurrence of the depression. The instantaneous rate of discharge is r by the instrument mounted directly beneath the water closet in the phot Designed and built in the Laboratory, this apparatus records the insta rate of discharge curve. Water collected in the cylindrical tank actuat float in the adjacent smaller cylinder. The float transmits changes in level to the stylus on the recording drum by means of reduction gears. to the constant section of the collecting tank and cylinder, a linear rel exists between the water level and the movement of the stylus. The re drum rotates at a constant speed, a measurement of the amount of wat flushed versus time is thereby achieved.

The machine shown on page 26 was designed and fabricated in t Laboratory in order that accelerated wear tests could be conducted on sanitary faucets and component parts. Each faucet mounted in the test machine is turned on and off, through an angle of 280°, at the rate of approximately seven cycles per minute. According to reasonable estir an average sanitary faucet may be opened and closed approximately 40 per day. Tests conducted during a 5-week period, in which time some cycles would have been completed, for instance, would therefore repr more than four years of normal usage. The testing machine is provide both hot and cold water manifolds, and water is delivered at a line pre of approximately 2.5 kg/cm^2. Hot water is recirculated, providing a delivery temperature of approximately 80°C. Periodic tests are made high pressure to check for possible leaks not discernible under the no line pressure. As leaks are detected, the number of cycles at which tl occurred and subsequent adjustment data is recorded. Upon completio accelerated wear tests, each faucet is removed from the machine, an examination is made of all component parts. Microscopic examination packing materials may be made to reveal imbedded metallic dust. Res obtained by means of these procedures readily enable correct evaluati design characteristics, manufacturing procedures and packing materi sanitary fittings.



CLOSET BOWL TEST SET-UP



It is to be noted that new testing procedures are continually being developed to keep pace with the ever-changing aspects and requi rements of sanitary product.

RADIATOR / CONVECTOR DEPARTMENT

The Radiator/Convector Department is carrying out studies kinds of heat emitters, i.e., on conventional radiators and convec type space heaters, as well as panel heating systems, baseboards, etc ... Possible new forms of heat emitters are also being studie

These studies deal with the heat emission measurements, h fluid circulation inside the heat emitters and mechanical character of such units (deformation under pressure, handling, etc ...). Sc studies have also been carried out concerning the relative effect o comfort of different heat emitters, but generally speaking, the cor affecting comfort vary so widely between different buildings that th subject is considered rather to be one where wide experience of tl heating installation is probably a better guide than can be gained f laboratory tests which could, in any case, only cover a limited fi

A heat emitter testing room was first installed in Europe b Company in 1928, and careful consideration was given to the type installation which should be used for this purpose.

What is the reason for testing heat emitters? The answer question, obviously, is to provide data to the installer such that h accurately assess the sizes of the heat emitters necessary to prov good conditions within a building. Thus, it was concluded at that that the tests must be carried out under conditions which would ha close relationship with the conditions assumed by the heating engin making his calculations. In other words, since heat loss calculati are based on the difference between the mean temperature in the r and the outside atmospheric conditions, it was obvious that the hea emission from an emitter must be measured and stated with relati the mean temperature conditions within the room. In an installati operating under the average temperature conditions in Europe, a v large number of tests had shown that the mean temperature of the is usually found at the mid-height. In consequence, tests carried in our installation have always been reported in relation to the ten of the room at the mean height, i.e., 1m.50 for a room approxim 3m. high. This was the basis on which all the early work was ca out in the Ideal-Standard Laboratories. Just prior to the time whe Blanc-Mesnil Laboratory was built, considerable discussion had be taking place concerning the possibility of a "low-cost test installati and a Warm Wall Booth was proposed and supported by many autho It was therefore decided to build inside the Laboratory, a Warm W Booth and a Cold Wall Room, in order to continue experimental wo previously carried out by the Ideal-Standard Companies. Both roo were located in the center of the main building, in order to minim the influence of climatic conditions.

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The Warm Wall Booth installed in Blanc-Mesnil Laboratory wa
originally designed in accordance with the practice recommended in th
U.S.A. It was very rapidly found that the results obtained were not
reproducible, and did not agree with those in the Cold Room. Modificat
were therefore progressively carried out to the Warm Wall Booth insta
until finally the Warm Wall Booth originally an open booth, became a C
Room, the walls of which were cooled by means of an air conditioner.
Nevertheless, in spite of these improvements, this Warm Wall Booth
installation is only used for comparative studies, the emission data be
obtained by carefully controlled tests in the Cold Room. It should be no
that this Cold Room installation is substantially in accordance with the
requirements of the appropriate British Standards.

DESCRIPTION OF RADIATOR TEST ROOM

The Cold Room installation presently in use at Blanc-Mesnil
Laboratory is thought to be the most accurate means of measuring outp
from heating appliances and, in addition, actual conditions of installati
are closely simulated.

This test installation consists of a cold wall test room erected
the centre of a controlled temperature enclosure, and of an instrument
as described thereafter.

- Test room -

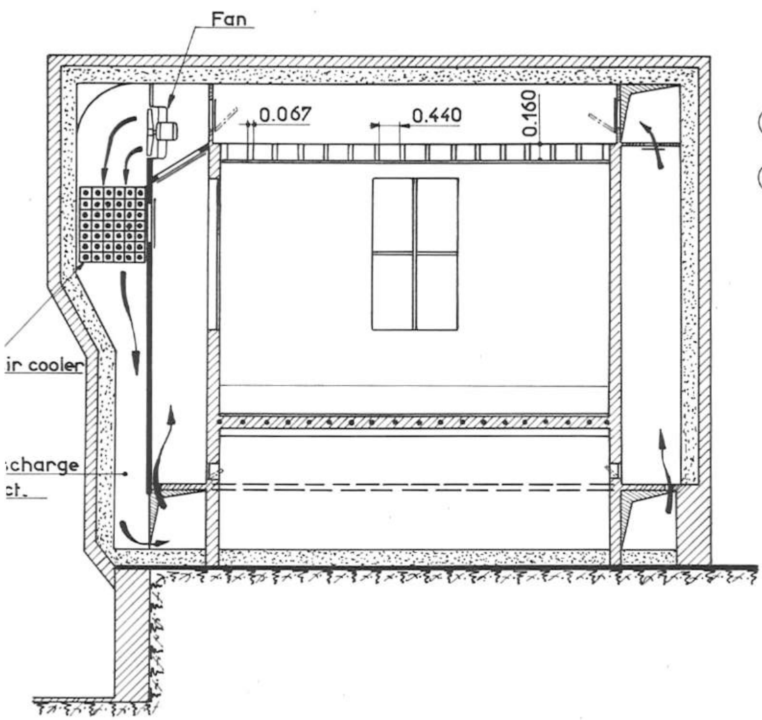
The test room is 4.62 m x 3.53 m x 2.95 height. It is construc
in accordance with current building practice, having two windows and
entrance. Page 30 shows the materials used for the overall constructi
and gives the main dimensions.

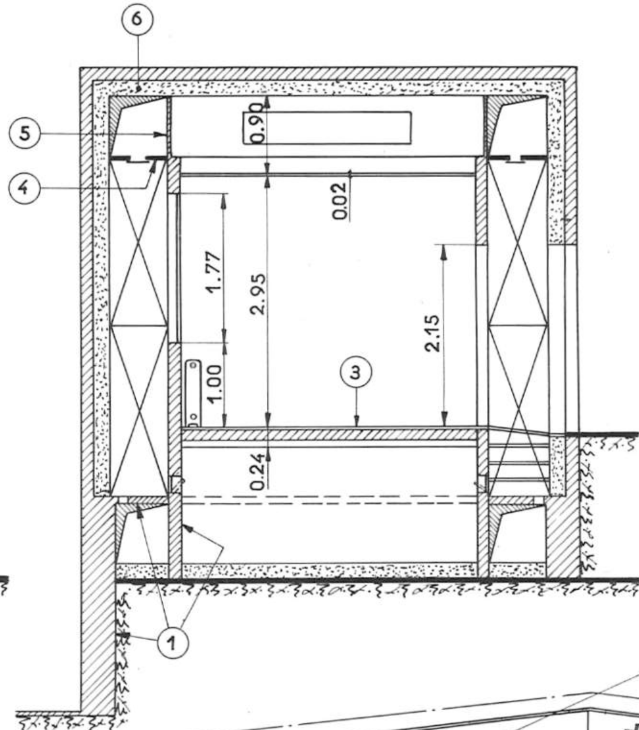
Page 31 shows the inside of the test room.

The thermal transmittance of the four walls is approximately
2.5 kcal/hr/m^2/°C. Of course, the door and the windows can be repla
by corresponding elements having the same transmittance as the surro
walls. The wall transmittance can be reduced, if so desired, by additi
insulating panels.

The unit under test is usually installed under the window facing
door, 50mm from the wall. Flexible flow and return pipes connect the
to be tested to the hot water or steam generator.

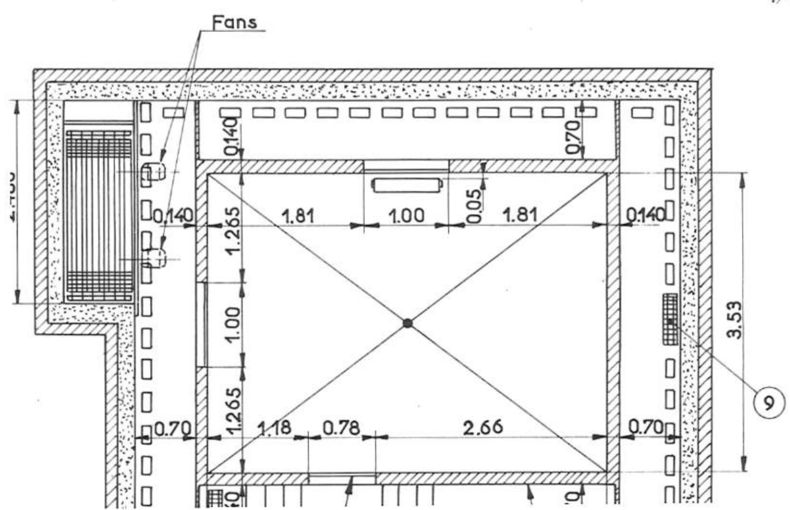
For the hot water tests, precision mercury thermometers and
thermocouples are disposed in special pockets fixed to the radiator inl
and outlet, to measure and record actual mean values of water temper

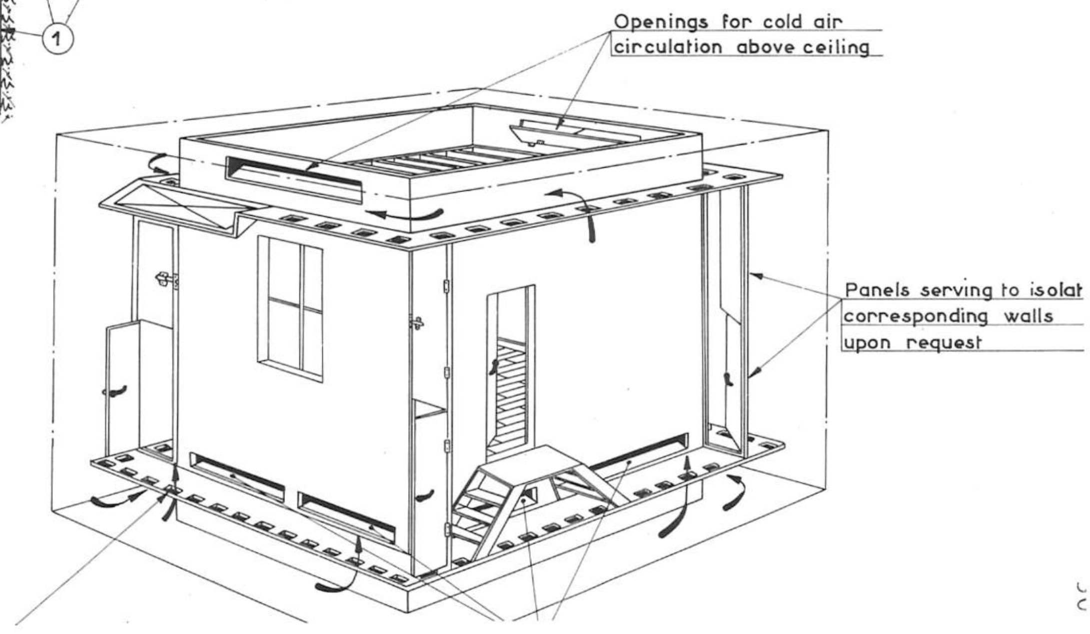


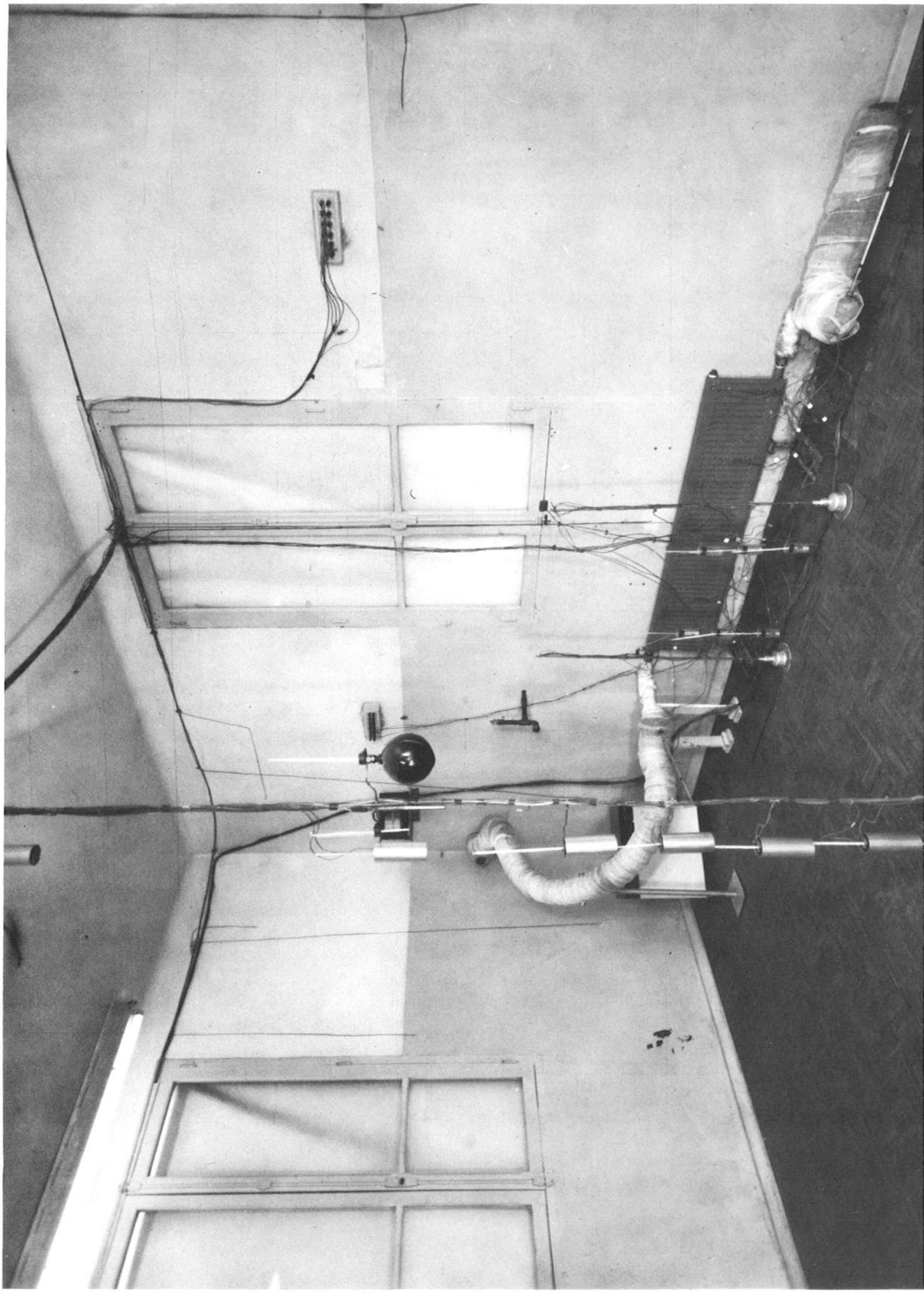


CONSTRUCTION

1. Concrete
2. 0.11m thick brick_1 coat cement on outside face15mmth
   _1 coat plaster on insi le face15mmthi
3. Impregnated wood flooring laid over concrete.
4. Insulated partitions with controllable openings.
5. Insulated partitions.
6. Cork board insulation lining.
7. Wooden access door.
8. Insulated wooden access door.
9. Electrical heater with thermostatically controlled







Air temperatures are taken at the centre of the room, at 5 le (0.01 - 0.75 - 1.50 - 2.20 and 2.90m), using mercury thermometer thermocouples.

Wall temperatures are also taken and additional thermocoupl can be installed at any other desired point (air inlet of convectors, f instance).

A globe thermometer and an electrically heated eupatheoscop are used for some specific studies.

- Controlled temperature enclosure -

The test room has been erected in the centre of a larger roo is thoroughly insulated on the outside walls. The space between the (and inner rooms is divided into 6 independent compartments. An air circuit allows cooling of any of the lateral compartments to a consta controlled temperature. This can be seen from page 30.

The air cooling circuit consists of two electrical fans which circulate the air through a cooler, delivering the air to the supply du low level from where it is distributed in the side compartments by a number of openings. The air then passes in the return duct by openi located at the upper part of the side compartments.

The space behind the floor and the ceiling of the test room ca supplied with cooled air by means of traps which allow circulation o Thermostats installed in the lateral compartments maintain the air t rature constant within $\pm$ 1/4°C. One mercury thermometer and one resistance thermometer measure and record this temperature. The tube cooler is supplied with chilled brine from a tank located in the instrument room, the brine being cooled by a two-unit refrigerating

The two compressors are controlled by a thermostat in the b thus enabling the brine temperature to be regulated. Control of the a temperature in the enclosure is obtained by thermostats located in tl various compartments and operating on the air circulating fan and circulating pump.

A defroster is located on the side of the cooler.

Thermostatically controlled electrical heaters are also insta in some compartments in order to ensure that the temperatures insid outside the room are maintained the same, when the appropriate wa not being cooled.

- Instrument room -

The instrument room comprises the 600-litre brine tank, refrigerating plant, brine circulating pump, the electrically operate hot water / steam generator unit, complete with measuring and cont instruments.

Pages 34 and 35 show the schematic installation for steam ar hot water tests.

The output supplied to the electrical boiler is regulated withi ± 1% by means of a 3-phase electronic voltage regulator of 20 KVA r output. The output delivered by the 4 heating elements in the boiler varied continuously from 0 to 12 KW by means of a 3-phase auto-tra

Air temperatures measured in the test room and in the enclo are recorded on a multi-direction Leeds & Northrups recorder. Any temperatures desired are recorded on a multi-direction Philips rec or measured when necessary, with a high accuracy potentiometer.

- Method of test -

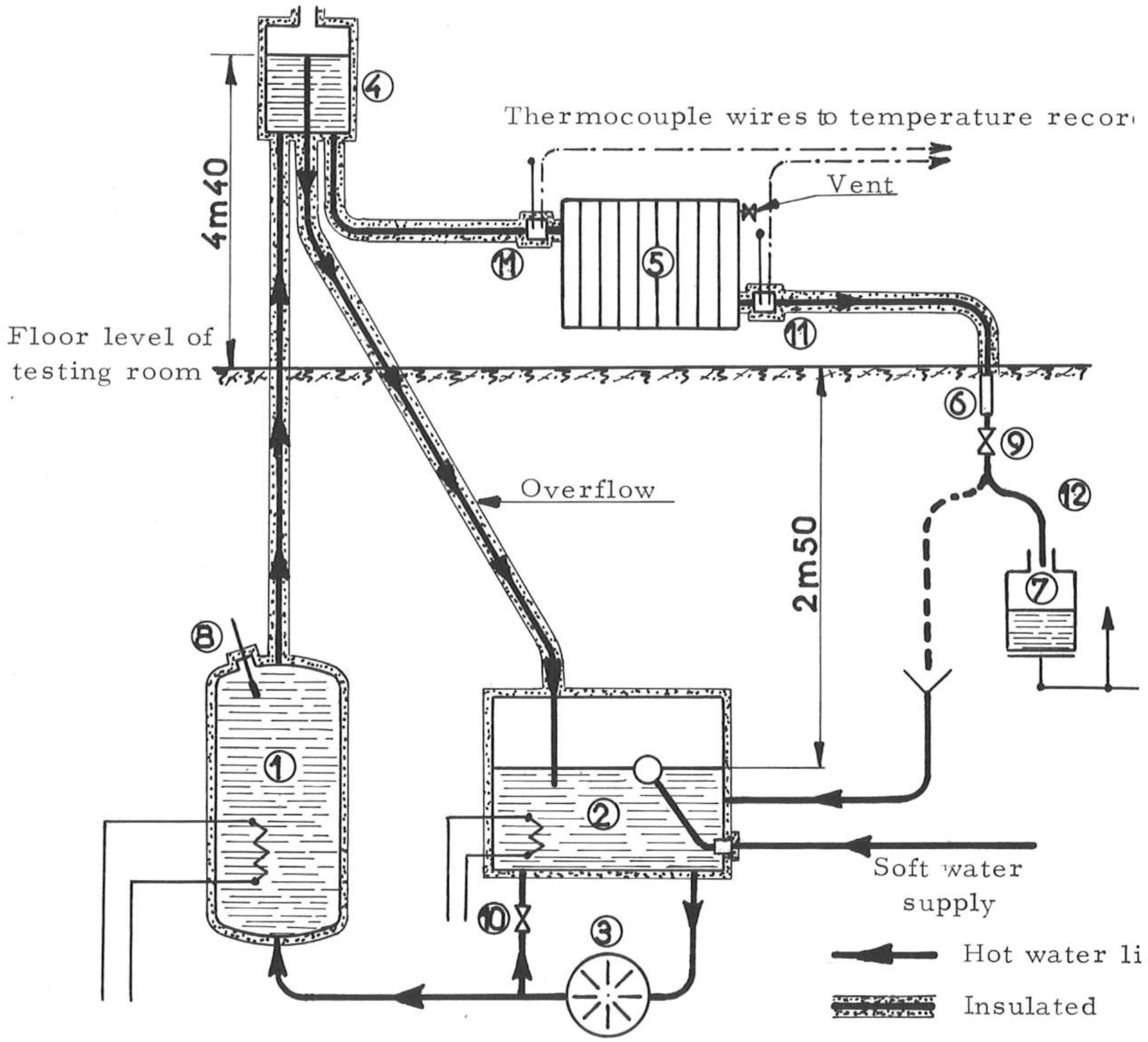
The methods described thereafter, are those most commonly used for the measurement of outputs from radiators and convectors.

The appliance is normally selected for delivering not less th 800 kcal/hr and not more than 2,000 kcal/hr when operating with flu having a mean temperature of 80°C and with the ambient air tempera at 18°C.

Depending upon the contemplated water flow rate through the the electrical method or the weight method are used for testing hot v appliances.

Generally , tests are made with only the two walls having win cooled, thus simulating a corner room. Once stable conditions of te rature are reached, the temperature in the outer compartments is s adjusted as to obtain in the test room, an air temperature of 18°C ± 1.50m above the floor at the centre of the test room. This point is u taken as a reference for the measurement of the ambient air temper reference adopted conventionally to check the operation in situ of he installations.

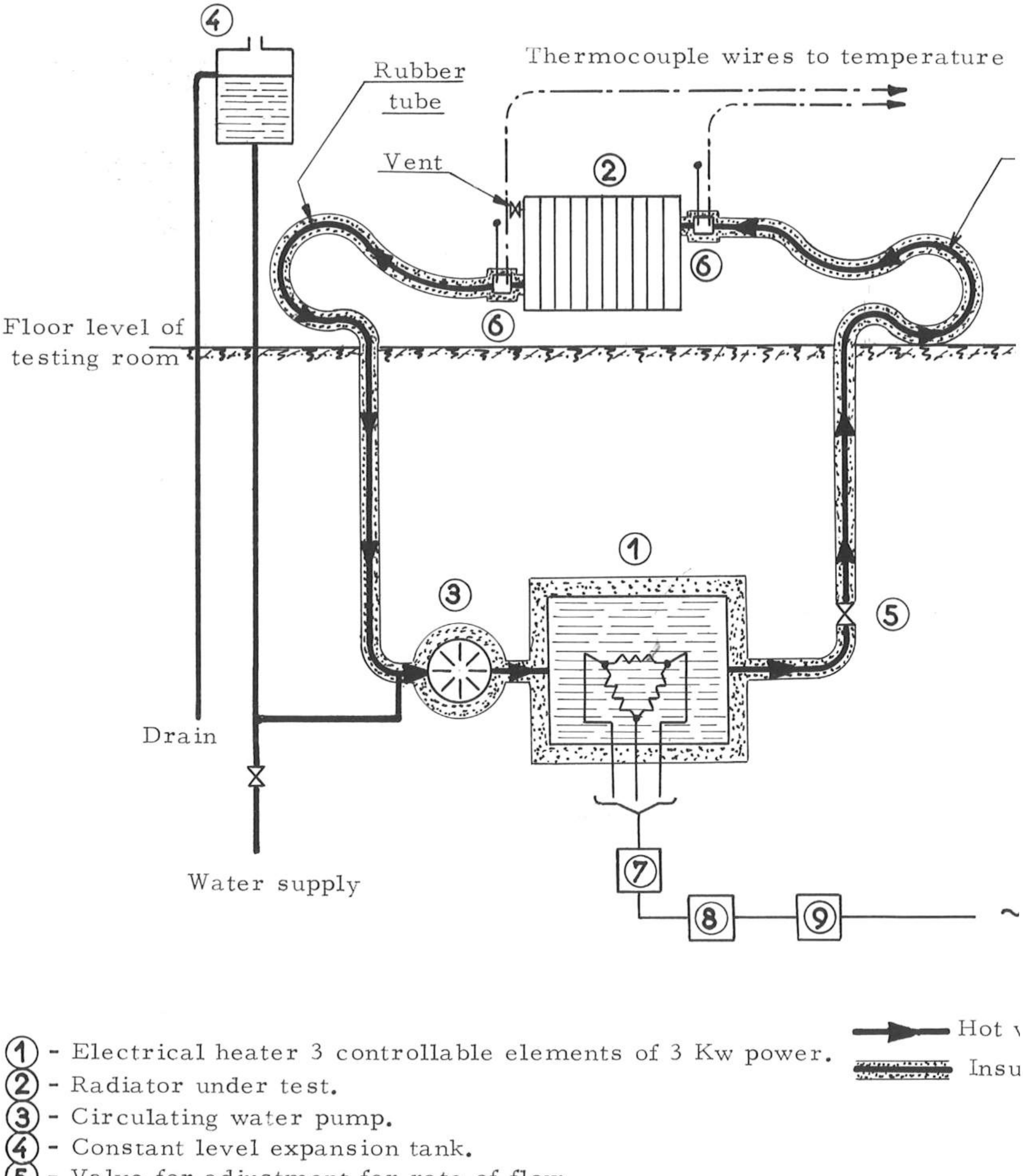
Prior to the test, great care is taken to eliminate any air tra in the heating unit, and for this purpose, the heating unit is slightly on one end and provided with adequate vents.



①-Electrical boiler heated by 4 controllable elements of a maximum power of 3 Kw.
②-Water supply tank with auxiliary heater 6 Kw for starting installation.
③-Circulating water pump.
④-Constant level expansion tank.
⑤-Radiator under test.
⑥-Flowmeter enabling quick adjustment of the rate of flow.
⑦-Scales to measure the exact rate of flow.
⑧-Mercury thermometer boiler temperature control

⑨ -Valve for adjustment of ra water flow.
⑩ -By-pass to adjust rate of through the boiler.
⑪ -Mercury thermometers to flow and return water tem thermocouples for controll temperature stability.
⑫ -Return water to measuring during tests otherwise to tank.

INSTALLATION FOR HOT WATER TESTS



1 - Electrical heater 3 controllable elements of 3 Kw power.
2 - Radiator under test.
3 - Circulating water pump.
4 - Constant level expansion tank.
5 - Valve for adjustment for rate of flow.
6 - Mercury thermometers and thermocouples to measure inlet and outlet temperatures.
7 - Wattmeter for measurement of output.
8 - Voltage variator for adjustment of output.
9 - Regulator.

TEST ARRANGEMENT USING THE ELECTRICAL METHOD

- Weight Method -

When using hot water, the rate of flow is normally adjusted so a to obtain through the unit a temperature drop of approximately 15°C for an average water temperature of 80°C. This flow rate is kept constant for other values of the average water temperature. This drop has been allowed for straight forward heat emission tests as a compromise to obtain reasonable accuracy in the measurements.

Temperature drop is measured by means of two mercury precis thermometers and two chrome-alumel thermocouples located in special pockets fixed to the radiator inlet and outlet. The pockets are designed give a turbulent water flow, thus preventing errors due to an irregular temperature, particularly at radiator outlet. This point is of importanc since, if the water flowing at the point of measurement is not properly mixed, substantial errors can be obtained.

When using low pressure steam, several separators are dispose before the radiator inlet in order to prevent errors due to the introducti of condensate in the radiator. This was adopted in preference to superheating the steam because of the difficulty of adjusting the degree of superheat for radiators of widely different outputs.

In both hot water and steam tests, the radiator output is equal to the enthalpy difference between inlet and outlet of the heating fluid used test, i.e.,

$$Q = r.c. \qquad \text{hot water}$$

$$Q = r.L. \qquad \text{steam}$$

where :

Q = emission in kcal/hr
r = rate of water flow or condensate kg/hr
Δ = water temperature drop (°C) between inlet and outlet water
L = latent heat of vaporization in the particular conditions of test
c = specific heat of water (kcal/°C/kg)

The rate of water flow or condensate r is determined by weighi the quantity of water leaving the radiator, 5 to 6 kg water being normall collected for each test.

By convention, the heat emission obtained experimentally is exp as a function of the difference dt between the mean value (t_m) of the he fluid temperature inside the heating appliance, and the value of the ambi air temperature at the above mentioned reference point (t_i) :-

$$dt = t_m - t_i$$

The mean fluid temperature t_m is usually taken as being the half sum of inlet and outlet water temperature (arithm. meanvalue) fc hot water operation, the vaporizing temperature corresponding to th steam pressure inside the radiator, for steam operation.

In order to determine the performance of a heating appliance, tests are carried out for different values of t_m and the heat emissic values Q are usually plotted against the different dt values using t relationship :-

$$Q = a\ dt^n$$

The exponent n is a characteristic of the heating appliance design.

- Electrical Method -

The electric heating test equipment comprises a small contai with immersion heaters, an adjustable output transformer and a circ pump.

The electrical supply is stabilized to ± 1%. The rating of the appliance is obtained by the formula :-

$$Q = 0.86\ (P_t - P_n)$$

Q = output in kcal/hr
P_t = total watt-hours per hour during test
P_n = total watt-hours per hour during no-load test

The performance of the heating appliance is expressed as explained above.

This method is used each time the difference Δ between the inlet and outlet temperatures of the water flowing through the heating appliance is less than 10°C, i.e., when the possible error introduced by the weight method is likely to exceed the possible error inherent t the electrical method.

MISCELLANEOUS FACILITIES

- Drafting Office -

This office serves to prepare Technical Reports and Design Specifications including detailed manufacturing drawings. It is equip with all the facilities for printing and reproducing.

- Workshop -

Arrangements for the manufacturing of full scale prototype units are usually undertaken by one of the Ideal-Standard Companies, by an external contractor. However, a well equipped workshop is av in the Laboratory in order to permit modifications to be carried out r apidly, as this may be indicated by the results of test work.

- Fuel Storage -

Fuel storage facilities exist in order to maintain reserves of different calibrations of solid fuel, and for different grades of liquid

Manufactured gas is available by pipe-line from the "Gaz de I distribution system, whilst natural gas from different countries is a moment available from cylinders. It is planned to install a gas holde order to make possible the preparation of reserves of gases of diffe compositions.

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