NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS

SEP 4 1923
MAILED

TO: M. Truscott

TECHNICAL NOTES

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

No. 155.

REGULATIONS GOVERNING THE ISSUANCE OF CERTIFICATES OF AIRWORTHINESS OF AIRCRAFT IN FRANCE.

From Bulletin de la Navigation Aérienne, March, 1923.

August, 1923.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

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Introduction.

These regulations, approved by the Under Secretary of State for Aeronautics, in a ministerial decree 1124/2A, February 19, 1923, cancels the regulations of August 31, 1920, and supplements the decree of August 14, 1920, fixing the conditions under which certificates of airworthiness may be issued, in conformity with Article 5 of said decree.

FIRST PART

AIRCRAFT HEAVIER THAN AIR

Chapter I.

METHOD OF PROCEDURE FOR OBTAINING CERTIFICATES OF AIRWORTHINESS FOR AIRCRAFT HEAVIER THAN AIR.

A certificate of airworthiness is delivered by the "Service de la Navigation Aérienne" (S.N.Aé.), on presentation of a voucher issued by the "Service Technique de l'Aéronautique" (S.T.Aé.), if

* From Bulletin de la Navigation Aérienne, March, 1923, pp. 611-624.

the aircraft is of a new type, or by the "Service des Fabrications de l'Aéronautique" (S.F.Aé.), if of a type previously accepted and produced in quantity.

In order to obtain a certificate of airworthiness, the parties concerned must proceed as follows:

I. New Aircraft Types.- The constructor of any new type of aircraft must apply to the "Service Technique de l'Aéronautique," 2, rue Jeanne d'Arc, Issy-les-Moulineaux. The S.T.Aé. makes all static tests and checks the characteristics and performances of the aircraft.

Since the construction of a new aircraft type and of the cell for static tests must be inspected and checked by the S.T.Aé., application to the S.T.Aé. must be made before construction is begun. The officials of the S.T.Aé. must be granted every facility for checking and inspecting the work during construction.

When the tests have been completed, the S.T.Aé. reports the result to the S.N.Aé.

The owner of the aircraft may then apply to the S.N.Aé., 2, Boulevard Victor, Paris, for a certificate of airworthiness.

II. Aircraft of an Adopted Type.- The constructor of an aircraft produced in quantity and having the characteristics of a type accepted by the S.T.Aé. should get into touch with the "Service des Fabrications de l'Aéronautique," 2, Boulevard Victor, Paris. The S.F.Aé. undertakes to check the manufacture of the parts in the

factory and to stamp them. It also verifies the similitude between an aircraft of quantity production and its model, a similitude certified by the constructor in a written statement. The inspection carried out by the S.F.Aé. exempts aircraft of accepted type from tests previously undergone by the original specimen. Only aircraft which are exact reproductions of the specimen accepted by the S.T.Aé. are thus exempted.

When the factory inspection is completed, the S.F.Aé. shall draw up a memorandum enumerating the parts checked and the details of the inspection of the aircraft in flying order and shall also give the number of the test card of the engine or engines.* This memorandum shall be sent to the constructor of the aircraft and must be sent by him to the S.N.Aé., 2, Boulevard Victor, Paris, with his application for a certificate of airworthiness.

TECHNICAL DOCUMENTS TO BE SUPPLIED BY CONSTRUCTORS OR OWNERS OF AIRCRAFT, IN ORDER TO OBTAIN A CERTIFICATE OF AIRWORTHINESS FOR AIRCRAFT HEAVIER THAN AIR.

The documents to be furnished are:

New Aircraft Types.- Documents to be supplied to the S.T.Aé.: All those named in the list published by the S.T.Aé. to be furnished for new aircraft types, especially airplanes amd seaplanes.

* NOTE.- The inspection mentioned and carried out by the S.T.Aé. or the S.F.Aé. is simply for the purpose of checking the work. It in no way relieves the manufacturers of responsibility, especially as regards their declaration concerning the identity of the aircraft (if of a new type) with the plans furnished and the test cell, or, if of a known type, concerning their similarity to the model.

I.- Drawings showing:

1st. Equipment (instruments, parachutes, radio, night equipment, etc.);

2nd. Arrangement of tubes and wiring for oil, gasoline, water, electricity and radio;

3rd. Wing sections with dimensions, the polar curve of the cell;

4th. Diagrams showing the position of the center of gravity for flight at 500 meters (1640 feet) in the three following cases:

a) Fully loaded, with fuel;

b) With commercial load, but no fuel;

c) With neither fuel nor commercial load.

II.- A note giving the strength computations with the section of the various parts.

III.- A complete set of working drawings and nomenclature in conformity with regulations in force. These shall be stamped by the S.T.Aé. after they have been checked with the model presented. The S.T.Aé. shall send to the S.F.Aé. a complete set of blueprints for checking the construction when the aircraft is produced in quantity. A set of blueprints shall also be sent to the S.N.Aé. for use in checking eventual repairs.

IV.- A signed declaration certifying that the documents furnished are really those relating to the aircraft presented as a new model and to the corresponding cell for static tests.

Aircraft of an Accepted Type Produced in Quantity.- Documents to be furnished by the constructor to the S.T.Aé.:

1. A declaration giving the characteristics of the aircraft

and certifying that they are the same as those of the original specimen accepted by the S.T.Aé.

Should the constructor or owner request permission to modify his aircraft, a working drawing of such modification must be sent to the S.T.Aé. The drawings thus submitted shall be stamped by the S.T.Aé., which shall then inform the S.F.Aé.

When changes are made, the S.T.Aé. may subject the modified aircraft to the whole or part of the tests previously undergone by the original specimen and shall inform the S.N.Aé. of changes to be made in the characteristics marked on the certificate of airworthiness of the original specimen.

Chapter II.

TECHNICAL REQUIREMENTS TO BE MET BY AN AIRCRAFT HEAVIER THAN AIR, IN ORDER TO OBTAIN A CERTIFICATE OF AIRWORTHINESS.

Privately owned aircraft are divided into:

a) Touring aircraft,

b) Aircraft for races and experimental purposes,

c) Commercial aircraft.

Touring aircraft are privately owned and fitted up for strictly private pleasure trips. They must in no way compete with commercial aircraft and may not carry more than four passengers.

Racing aircraft are those which are specially built and fitted for particular performances of purely sporting interest.

Experimental airplanes are those built exclusively for testing and studying technical innovations which exempt them from the current regulations. These two classes of airplanes are authorized to fly only under condition of observing the restrictions as to route, etc., laid down in each case by the competent authorities.

Other airplanes are considered commercial, whether they carry passengers, mail, or freight.

An aircraft is considered multi-engined if it has at least two engine sets independent of each other (each set comprising engines, propellers, radiators, tanks, and independent fuel and lubricating systems).

An aircraft is also considered multi-engined, if it has at least two independent engines, each one having all the organs necessary for functioning (fuel feed, cooling, ignition, lubrication), so that either one of the engines can be stopped during flight without detriment to the operation of the remaining engine or engines.

The inspections and tests, hereinafter specified, shall be carried out on one of the government airdromes. The altitudes measured during the tests shall be reduced to "standard air" conditions, as used in France at the time of the tests.

During the whole of the tests provided for in these regulations, unless otherwise specified, engines must never exceed the R.P.M. corresponding to their brake horsepower by more than 50, under penalty of having the test canceled. This number is equal to 29/30 of the number of revolutions at the normal horsepower, as defined in

the paragraph on engine tests.

All tests will be made, unless otherwise specified, under full load, with the same engine set or sets, and with the same propeller or propellers.

I. - AIRPLANES

I. - MINIMUM CONDITIONS OF SAFETY, TAKING OFF, LANDING, CEILING.

Touring Airplanes.- A touring airplane carrying full load must be able to take off within 250 meters (820 feet) in a head wind of less than 6 meters (19.7 feet) per second. It must be able to land within 250 meters with full load and with engine shut off. It must be able to glide, with engine shut off, in a head wind of less than 6 meters per second, a distance at least five times its altitude. Lastly, it must be able to climb with full load to an altitude of 1500 meters (4921 feet) within 30 minutes.

Commercial Airplanes.- These are divided into two categories:

1st.- Multi-engined airplanes capable of flying horizontally with one or more engines stopped, under conditions defined below. Airplanes of this category may be employed on all routes.

2nd.- Multi-engined airplanes not included in the first category, and all single-engined airplanes

The airplanes of the second category may be used on certain routes, provided they are of a type accepted by the S.N.Aé.

All commercial airplanes must be able to take off, under full

load, within a distance of 300 meters (984 feet) in a head wind of less than 6 meters (19.7 feet) per second. They must be able to land within 250 meters (820 feet) with full load and engine stopped, and glide, with engine stopped, a distance at least six times the altitude, in a head wind of less than 6 meters per second. Multi-engined commercial airplanes of the first category must be able to reach an altitude of 3500 meters (11483 feet) within 60 minutes and airplanes of the second category an altitude of 4000 meters (13123 feet) within 60 minutes. During this test, the mean angle of climb during the first 500 meters (1640 feet) must be over 5% for airplanes of the first category and over 8% for airplanes of the second category.

Since the full load of the airplane, recorded on the certificate of airworthiness, must not, under any circumstances, be greater than that deduced from the static test, only the official figure will be allowed, even if the airplane should make the climb with a greater load.

Commercial airplanes of the first category must also be able to make a horizontal and rectilinear flight of one hour at an altitude of 1000 meters (3280 feet) with full commercial load and a quarter of the full fuel load, with one engine stopped, if the airplane has two, three, or four independent engines and with two engines stopped, if the airplane has more than four engines.

For the purpose of determining the routes over which the use of a second category airplane may be authorized for multi-engined airplanes of this class, the measurement must be taken of the min-

imum angle of descent from an altitude of 1000 meters (3280 feet) with engine running as slowly as possible, the maximum duration of this test being 15 minutes.

During this test the engines kept running must not exceed their normal power as defined in the paragraph on engine tests.

For navigating and landing, the pilot when near the ground should have a clear field of vision vertically downward and a horizontal field of vision extending from ten meters at most from the airplane to the horizon. On commercial airplanes the passengers and crew in the plane of the propellers must be adequately protected from the effects of possible propeller breakage.

The pilot's cockpit must contain aviation instruments, as stipulated farther on. These instruments shall be arranged in conformity with the instructions given in the current official documents of the S.T.Aé. The controls and other movable metal parts situated within a meter from the compass, must be of non-magnetic metal.

Controls.- When the controls are not in action, the airplane must maintain a rectilinear line of flight in a horizontal plane at the normal R.P.M. of the engine. The controls themselves and the aeronautical qualities of the airplane must be such that a pilot of average strength can fly it without excessive fatigue during the whole of the endurance test, completed on the same day for touring airplanes, or during one of the partial endurance tests for commercial airplanes, or for a test of at least one hour if he is piloting a multi-engined airplane of the first category

with one or more engines stopped under the conditions given above.

If the airplane is to fly for more than four hours at a stretch, it must be provided with dual control, or so arranged that the pilot can be relieved at regular intervals without disturbing either the longitudinal or lateral stability of flight.

On airplanes fitted with dual control, it must never be possible to disconnect both sets of controls at the same time.

All engine controls affecting the stability, altitude, or course of the airplane during flight, shall be operated by the pilot alone, the mechanics having charge only of the auxiliary controls connected with engines.

Radio.- A commercial airplane carrying more than ten persons must be fitted with a radio telegraph sending and receiving station with a range of at least 300 kilometers (186.4 miles) or with a radio telephone station of a type accepted by the government.

Consequently, an airplane constructed for carrying ten persons must make its tests with the radio telegraph or telephone station as stipulated above.

Dating from two years after the adoption of these regulations, all commercial airplanes, of whatever seating capacity, must be fitted with radio apparatus as stipulated above. On airplanes fitted with instruments of either type, all metal parts which may come in contact shall be connected electrically, and the sending instruments which produce sparks must be enclosed in housings made of fine wire gauze.

Engines.- The number of revolutions not to be exceeded by each engine will be indicated by a red arrow on the revolution counter placed in view of the mechanic.

There shall be an ignition switch and a throttle for each engine and there must also be an ignition switch for the entire group of engines and a gasoline cock for each tank under the control of the pilot. Lastly, the engines of commercial airplanes must each have double ignition with two distributors.

The propellers must be placed so that the tip of the blade shall be at least 40 centimeters (15.7 inches) from the ground on commercial airplanes, and 25 centimeters (9.8 inches) on touring airplanes, when the airplane is at rest on the ground, in flying position. There must also be a play of at least 10 centimeters (3.9 inches) between the plane of the propeller blade tips and the other parts of the airplane with which they might come into contact in case of deflection.

When there are radiators, they must be provided with a thermometer, placed within sight of the mechanic, giving the temperature of the water leaving the cylinder heads.

The exhaust manifolds and mufflers must be insulated from the other parts of the airplane by non-conducting, incombustible coverings, or by a layer of air of at least 2 cm (0.79 in). The exhaust manifolds and mufflers must be placed so that no gasoline can possibly fall on them and the mouth of the exhaust pipe must be placed so that the exhaust gases cannot reach any combustible part of the airplane. The carburetor air intakes must open outside the fuse-

lage and be provided with wire gauze or otherwise protected from back firing. Gasoline drains ending outside the fuselage must be provided wherever the air intakes may present low points, either in flight or on the ground.

The carburetors shall be water-tight or provided with an overflow device emptying outside. They must be able to function in any position of flight and under all circumstances.

The ignition wires shall be insulated and installed in such a way that they cannot be affected by the heat from the engines or by accidental discharges of gasoline.

In general, good ventilation must be provided wherever there is liable to be an accumulation of gasoline fumes. There must also be a fire extinguisher of an approved type for each engine, capable of being effectively employed.

II. - DEMONSTRATION OF FLYING QUALITIES.

Each new type of airplane, after a short flying test, shall be subjected to the following tests, which must be made under normal conditions of load, as specified in the first part of these regulations.

a) Take-off and Landing Test.- The take-off and landing distances, as specified above for airplanes of various types, shall be checked. The airplane, resting on the ground, must start without external aid and with its engines running at low speed. The taxying distance shall be measured from this point, where the wheels rest on the ground, to the point where the wheels leave the ground in rising.

In landing, the taxying distance shall be measured from the point at which the wheels first strike the ground to the point where the airplane, after taxying in a straight line, stops of itself without outside help.

b) Ceiling Test.- This test shall comprise:

1st. A climb of at least 1 hr. 15 min. for commercial airplanes and of 45 min. for touring airplanes.

During the climb, it shall be ascertained whether the altitude specified above was reached within 30 min. for touring airplanes and within 60 min. for commercial airplanes. For the latter it must also be verified that the mean angle of climb during the first 500 meters (1640 feet) was over 5% for airplanes of the first category and 8% for those of the second category.

2nd. A series of horizontal flights made at the highest altitude reached and then, during the descent, at every altitude expressed in multiples of one thousand meters, down to an altitude of 1000 meters (3280 feet) with the throttle as wide open as possible without exceeding the prescribed revolution speed.

c) Maneuverability Test.- All airplanes must describe five successive figure eights at an altitude between 500 and 1000 meters above the airdrome, without varying more than 100 meters (328 feet) in altitude. Airplanes having a total load of over 2500 kg (5512 lb) (including fuel) must execute this test within 20 minutes. All other airplanes must complete it within 15 minutes.

In the case of multi-engines airplanes of the first category, two of these figure eights must be made with full commercial load

plus a quarter of the fuel load, with one engine stopped, if the airplane has two, three or four engines, or with two engines stopped, if there are more than four engines.

The maneuverability test will also include a horizontal flight of one hour under the conditions already specified in the paragraph on commercial airplanes, first category.

The above tests shall be made on all new types of airplanes, each test being eliminatory. Should an airplane fail in one of the tests, it may make another attempt, but in that case three consecutive tests must be satisfactorily executed.

d) Endurance Test.- Before being used in actual work, every airplane must pass an endurance test. For this purpose a touring airplane must make a flight of not less than 200 kilometers (124 miles), with one optional landing.

For commercial airplanes the endurance-test shall consist of a trip of 500 kilometers (310 miles) with half-way stop. Both take-offs must be made with full load and no landing shall be made except the half-way stop provided for above and which is necessary for taking on fuel. No repairs shall be made except those which can be executed with the means at hand on the airplane. After the endurance test, an examination shall be made to see that no part is abnormally worn or damaged.

e) Speed and Gliding Tests.- These tests shall be made under the same conditions as the climbing test. The speed test shall be made over a base measured on the ground. The speed thus measured shall serve as a basis for checking the calculations of the design-

ers and all other official calculations.

The speed test shall be immediately followed by a horizontal flight at full throttle at an altitude of 1500 meters (4921 feet). This test shall be followed by a glide which will show whether the mean gliding angle is less than that specified above.

During the speed tests, if the mean R.P.M. of the engine or engines is greater than the R.P.M. at normal brake horsepower, but does not exceed it by more than 50 (above which the test shall be canceled), the performances shall be reduced to what they would have been, if the engine or engines had revolved during the whole of the test at the R.P.M. corresponding to the normal brake horsepower.

III. - CONSTRUCTION AND INSPECTION.

The construction must conform to the general technical requirements of the S.T.Aé. in so far as they are not contrary to the present regulations and excepting modifications authorized by the S.T.Aé.

I. New Airplane Type.- Each new airplane type shall undergo the following static tests:

a) Cell Test.- The cell shall be completely assembled and inverted and inclined so that the chord of the wing will make an angle of 7.5° with the horizontal. The total load in kilograms which the cell must support, without rupture of any of its parts, shall be given by the formula:

$$c = n\ (\pi - P_c) - P_c$$

in which π is the weight of the airplane fully loaded, P_c the weight of the cell and n a coefficient defined by the formula

$$n = 7.5 \frac{S}{T_o} \left(\frac{V}{100}\right)^3$$

S is the lifting area not including the tail planes, expressed in square meters, T_o is the normal engine power expressed in HP, V is the horizontal speed near the ground in km/hr at this normal horsepower. In no case shall the coefficient n be less than 5 or greater than 12.

The total test load shall be calculated on the basis of the weights and performances of the airplane as certified by the constructor.

The load thus calculated shall be distributed as follows:

1st. Uniform distribution along the span.

2nd. Along the chord the load shall be distributed so that the center of gravity of the load of each plane will be at a third of the chord from the leading edge.

After the test flights have been made, it shall be noted whether the value of n, calculated as above, is at least equal to the value deduced from the weights and performances checked by the S.T.Aé. If so, the T_o of the formula shall be taken as the power at which the speed V was made in the horizontal flight test near the ground.

Otherwise, the value of the total weight of the airplane shall be reduced by calculation to another value compatible with the value of n as deduced from the test results.

The stabilizers and elevators must support loads per square meter equal to three-fifths of the load calculated for the wing by the preceding formula, without rupture of their attachments or any of their parts.

b) Fuselage and Landing Gear.- The fuselage shall be calculated to withstand the following test conditions:

The inverted fuselage shall be secured to a stand at the points where the longerons are attached to the cell and, with the rear part overhanging, there shall be uniformly distributed on the stabilizers and elevators a load equal to the larger of the two following quantities:

1st. Load on the stabilizers and elevators calculated as in the preceding paragraph.

2nd. Load equal to five times the weight supported by the tail skid when the fully loaded airplane is resting on level ground.

The landing gear shall be designed to support five times the weight of the airplane.

The fuselage and landing gear tests are compulsory.

II. Standardized Airplane.- After the specimen has passed the tests satisfactorily, each airplane must be an exact reproduction of the original and shall be checked as follows:

The quality of the materials used, the way in which they are used and the method of assembling shall be inspected on each airplane separately. It shall be especially noted as to whether the mechanical characteristics of these materials are up to the standard of those used in the construction of the model which successfully pass-

ed the static tests.

On each airplane there shall be placed, in a conspicuous position, a card giving the following information:

Total weight loaded,

Dead load,

Maximum weight of fuel.

For commercial airplanes this card shall also give the maximum number of passengers to be carried and the maximum load of freight.

IV. -- ENGINES AND PROPELLERS.

No engine shall be mounted on an airplane without having passed a five-hour bench test under the conditions stated farther on.

Moreover, for the specimen of each new series, the following particulars must be given and tests made:

1st. Photograph of engine;

2nd. List of chief characteristics and especially of the volumetric compression ratio;

3rd. Power curve with wide-open throttle on the ground (between N/3 and N, N being the R.P.M. corresponding to the normal power as hereinafter defined);

4th. Curve of fuel efficiency (fuel consumption for various positions of throttle) and low-speed test;

5th. Dimensions;

6th. Weight of engine empty;

7th. Weight of engine in running order;

8th. Checking of distribution adjustment and ignition;

9th. If required, determination of the power equivalent by a negative pressure test;

10th. Measurement of water-pump output, with engine running at normal rate N, under a pressure of 40 centimeters of mercury (algebraic difference of static pressures measured at engine outlet and pump inlet).

After these preliminaries are completed, the engine shall be given a fifty-hour test, divided into periods of not less than five nor more than ten hours.

Conditions for Elementary Tests of New Engine Types and for Tests of Standardized Engines.- All these tests may be made either on a Froude brake, or on a "balance bench," with an ordinary or tractor windmill or with a tractor propeller. Pusher windmills and propellers are prohibited.

If the constructor uses a tractor propeller, he must provide some device for preventing the bench from being affected by the propeller slipstream. The readings given by the balance bench are not corrected for this.

The first half hour of each elementary test shall be run at the rate N and power given by the constructor as the normal R.P.M. and HP. If the fifty-hour endurance test is satisfactory, these figures become official. The remainder of the test is made at nine-tenths of the normal horsepower. To obtain this reduction, the R.P.M. at normal HP may be reduced one-thirtieth unless the reduction can be effected by direct measurement.

These regulations also apply to the five-hour tests required

for standardized engines.

Cancellation of Elementary Tests.- An elementary test is canceled:

1st. If there is any stop during the first half of the test;

2nd. If any stop lasts over an hour;

3rd. If there are two stops during the test.

Cancellation of the Fifty-Hour Test.- The endurance test is canceled:

1st. If a third of the elementary tests have been canceled;

2nd. If either of the following engine parts has been put out of commission: cylinder, connecting rod, reduction gear, camshaft, crankshaft, crankcase, oil pump, scavenging air pump (if there is one) and water radiator if the engine requires one when mounted on the airplane;

3rd. If there are frequent accidents to parts other than those mentioned above;

4th. If the test is not completed within 20 working days.

Care and Repairs of Engine During Test.- During the test, only such operations are allowed as could be made during flight. In particular, the replacement of a spark plug is considered as involving the stoppage of the engine. Any constant leakage of water, however small, involves the immediate stoppage of the engine, whether occurring at a joint or in one of the engine parts. These regulations also apply to the five-hour tests.

Between tests, defective parts may be replaced, so far as permitted by the regulations given above concerning cancellation.

The whole set of spark plugs may be replaced within fifty hours.

Place and Control of Tests.- The tests shall be made in the government laboratories and under the control of government inspectors. During tests, the constructors shall be admitted only during laboratory working hours. The constructor shall provide for the driving of the engine and is responsible therefor.

Propellers.- Propellers used on airplanes in service must meet the specifications of the S.T Aé. in force at the time.

V. - AVIATION INSTRUMENTS AND ACCESSORIES.

Every touring airplane must have, in the pilot's cockpit, at least an altimeter, a speed indicator and a compass.

Every commercial airplane must have, in the pilot's cockpit, a liquid compensating compass, an altigraph, a clock, a speed indicator and a gyroscopic indicator of the position of the airplane in flight.

Furthermore, each engine must be provided with a recording tachometer, so that the person in charge can easily read the indications at any time.

All commercial airplanes designed to make flights of over four hours or to carry more than ten passengers, must be fitted with a navigator's outfit including: a compensating compass, an altimeter, a clock, a drift meter and a chart table with the proper instruments

All the instruments used must be of models approved by the inspection department and shall have luminous graduations in addition to the usual electric illumination.

Every airplane must carry lights and signaling apparatus, as provided in the decree of August 26, 1920. On commercial airplanes for night flying, there must be two distinct and independent methods of keeping up the navigation lights. An airplane must have at least two landing lamps with two methods of illumination. Each lamp must have an opening of 25° giving a mean light of 30 lux at a distance of 50 meters in a plane perpendicular to the axis. As an alternative, each airplane must have a system of flares of similar power and free from danger of fire.

Commercial airplanes, flying normally at an altitude of over 5000 meters (16400 feet) must carry respirators of an approved type equal in number to the number of passengers.

For airplanes flying over the sea, there must also be life-saving apparatus of a model approved by the inspection department and in sufficient quantity to provide for all the passengers.

All closed cabins on commercial airplanes must be provided with a sufficient number of emergency panels which can be opened quickly from inside the cabin, so that the passengers can get out without delay and use the parachutes, in case of an outbreak of fire, a fall into the sea, the capsizing of the airplane, etc.

A first aid kit shall be installed on every commercial airplane and must contain everything required by the regulations of the S.N.Aé.

II. - SEAPLANES.

These may be either seaplanes pure and simple (maritime or

river type), or amphibians, that is, designed to rise from and alight on either land or water.

Like airplanes, seaplanes are divided into touring seaplanes and commercial seaplanes, the latter being again subdivided into two categories.

I. - MINIMUM CONDITIONS OF SAFETY.

Seaplanes must be able to take off with full load from a sea in which the waves are a meter high, and alight safely on a rough sea.

River seaplanes must be able to take off and alight correctly with full load.

Every multi-engined seaplane of the first category, maritime or river type, must also be able to make a horizontal and rectilinear flight at an altitude of 500 meters (1640 feet) with full commercial load plus a quarter of the fuel load, with one engine stopped, if the seaplane does not have more than four independent engines, and with two engines stopped, if there are more than four. The engines kept running must not exceed their normal power during the test. On commercial seaplanes the passengers and crew in the plane of the propellers must be adequately protected from the effects of propeller breakage.

A commercial seaplane must be able to climb, with full load, to an altitude of 2000 meters (6560 feet) within one hour and to make a descent with full load and with engines shut off in a head wind of less than 6 meters per second, with a gliding angle of not

over 18° below the horizontal.

Controls - Engines.- The conditions are the same as for land airplanes. The propellers, carburetor air intakes, and magnetos must be protected from sea spray.

The conditions as regards radio are the same as for airplanes, except that there must be a receiving and sending emergency set for use after alighting.

II. - QUALITIES OF FLIGHT AND FLOTATION.

Before a new seaplane type is accepted for service, it shall go through the same endurance and maneuverability tests as an airplane, but without fixed altitude. It shall also be noted as to whether its floating stability at anchor is satisfactory in a wind of 10 meters (33 feet) per second.

The gliding test shall be made, as indicated above, at an altitude of about 500 meters (1640 feet).

III. - CONSTRUCTION.

The test conditions for cells and fuselages and the construction of engines are the same as those laid down for airplanes. The factors of safety are the same. Hulls and floats must be durable and water-tight. The floats must be divided into fore and aft compartments.

Instruments for Safety of Navigation.- The navigation instruments to be used on seaplanes are the same as for airplanes. For long-distance seaplanes, however, (having to fly more than 200 kil-

ometers (124 miles) from the coast), the navigator's outfit must contain a sextant, a revolution counter, a chart table with drawing requisites and the books necessary for calculating altitude.

The conditions of safety with regard to electric lighting, signaling lights and apparatus, parachutes and engine repair kits, are the same as for airplanes.

In addition, seaplanes must carry an adequate supply of individual life-saving devices of an approved model. Five liters of drinking water per person, or a water still, must also be carried.

SECOND PART

AIRCRAFT LIGHTER THAN AIR

Chapter I.

PROCEDURE TO BE FOLLOWED TO OBTAIN CERTIFICATES OF NAVIGABILITY FOR AIRCRAFT LIGHTER THAN AIR.

The airworthiness certificate is delivered by the "Service de la Navigation Aérienne," on a voucher delivered by the "Service Technique de l'Aéronautique" for an aircraft of standardized type.

The method of procedure for obtaining a certificate of navigability is as follows:

I.- New Aircraft Type:- The constructor of a new type of aircraft must apply to the S.T.Aé., 2, rue Jeanne d'Arc, Issy-les-

Moulineaux, which is charged with verifying the characteristics and performances of the aircraft.

The construction of the specimen must be under the supervision of the S.T.Aé., which must therefore be notified before construction is begun. All facilities for supervision and inspection must be accorded the representatives of the S.T.Aé.

After the tests are completed, the S.T.Aé. shall send to the S.N.Aé. a report on the examination and tests of the aircraft in question.

The owner of the aircraft may then apply to the S.N.Aé., 2, Boulevard Victor, Paris, for a certificate of navigability.

II. Standardized Aircraft.- The constructor of an aircraft standardized by agreement with the S.T.Aé. must get into touch with the "Service des Fabrications de l'Aéronautique." The latter shall attend to the inspection in the factory and stamp the inspected parts. It shall verify the similitude of the aircraft with the specimen, as certified by the constructor in a written statement. Standardized aircraft constructed under the inspection and control of the S.F.Aé. shall be exempt from the special tests already made on the specimen. In order to be thus exempt, the standardized aircraft must be duly certified to be an exact reproduction of the specimen approved by the S.T.Aé.

After the inspection is completed, the S.F.Aé. shall draw up a voucher enumerating the various parts of the aircraft in flying order which have been verified and giving the number of the test

voucher of the engine or engines.* The voucher thus drawn up shall be sent to the constructor. It must be attached to the application for a certificate of navigability made to the S.N.Aé., 2, Boulevard Victor, Paris.

TECHNICAL DOCUMENTS TO BE FURNISHED BY CONSTRUCTORS OR OWNERS OF AIRCRAFT LIGHTER THAN AIR IN APPLYING FOR AN AIRWORTHINESS CERTIFICATE.

The documents to be furnished by the persons concerned are:

New Aircraft Type.- Documents required by the S.T.Aé.

All those enumerated in the current regulations of the S.T.Aé. concerning the plans to be furnished for a new type of aircraft, in particular for aerostation:

a) Free balloons.- Two sets of blueprints;

b) Captive balloons.- Two sets of blueprints;

c) Nonrigid airships.- Two sets of blueprints; plans, diagrams tables and calculations giving stresses of fabrics of the envelope, stresses of the nacelle, stresses of the suspension, stability of the airship;

d) Rigid airships.- Two sets of blueprints; plans, diagrams, tables and calculations giving list of weights, distribution of useful load for various dégrees of inflation of the gas cells, stresses

* NOTE.- The inspection mentioned shall be carried out by the S.T.Aé or the S.F.Aé. simply for the purpose of checking the work. It in no way relieves the manufacturers of responsibility, especially as regards their declaration concerning the identity of the aircraft (if of a new type) with the plans furnished and the test cell or, if of a standard type, concerning the accuracy as regards type.

of longitudinal girders, transverse frames, turnbuckles and of any other parts required by the acceptance commission.

Standardized Aircraft of an Accepted Type.- Documents to be furnished to the S.F.Aé. by the constructor of an aircraft of a standardized type:

A statement giving the characteristics of the aircraft and certifying that these characteristics are in absolute conformity with those of the specimen accepted by the S.T.Aé.

Should the constructor or owner request permission to modify his aircraft, a working drawing of such modification must be sent to the S.T.Aé. The drawings thus submitted shall be stamped by the S.T.Aé., which must inform the S.F.Aé.

When changes are made, the S.T.Aé. may subject the modified aircraft to the whole or part of the tests previously passed by the model aircraft and shall inform the S.N.Aé. of changes to be made in the characteristics noted on the certificate of airworthiness of the specimen.

Chapter II.

TECHNICAL REQUIREMENTS TO BE MET BY AN AIRCRAFT LIGHTER-THAN-AIR IN ORDER TO OBTAIN AN AIRWORTHINESS CERTIFICATE.

I. - FREE BALLOONS.

I. - MINIMUM CONDITIONS OF SAFETY.

The balloon must revolve about a vertical axis terminated at

the lower end by an appendix or a valve. The section and length of the appendix or the size of the valve shall be such that the balloon can rise vertically at a speed of 5 meters (16.4 feet) per second with not more than 2 mm (0.08 in) of water of extra pressure inside the envelope, In a rapid descent the appendix may be steadied from the basket.

In the upper part of the balloon there shall be a valve (operated from the basket) large enough, when the balloon is fully inflated, to allow the escape in ten seconds of a volume of gas equal to 1/200 of the volume of the balloon. In case of snow or frost, this valve must be protected by a cover.

For rapid deflation, the balloon shall be provided with a rip-panel or other similar device. This panel shall be operated by pulling a red cord, accessible from the car, The pull required for ripping shall not be less than 15 nor more than 30 kilograms. The rip-gore must be stitched to the envelope and not merely glued on. It shall follow the line of a meridian above the equator, its length being equal to an arc of the meridian measuring at least 50°.

The balloon shall be provided with an anchor and a drag-rope at least 100 meters (328 feet) long and of a weight equal at least to that given by the formula $P = 0.24\ D^2$.

(P = weight in kg. D = diameter of balloon in meters).

The total weight of the rigging (drag-rope, serpent, bags, anchors) hanging below the car must be at least equal to $0.4\ D^2$.

If the valve is of metal it must be fitted with an electric discharging device.

II. - DEMONSTRATION OF FLYING QUALITIES.

None.

III. - CONSTRUCTION AND CONTROL.

The strength and quality of the materials employed in manufacturing the main parts of free balloons must be tested before using.

The ratio between their breaking load and the load they carry in ascensions shall be taken at 8 for fabrics and 10 for suspensions, nets and rigging. For balloons without nets, this ratio shall be taken at 10 for the fabric.

IV. - INSTRUMENTS REQUIRED FOR SAFE NAVIGATION.

Every free balloon must have at least:

Two altimetric barometers;

One compass and, for night ascensions, a signal light in accordance with Article 7 of the decree of August 26, 1920. This signal light must be of a safety type.

II. - CAPTIVE BALLOONS

I. - MINIMUM CONDITIONS OF SAFETY.

Every captive balloon must have the parts required for its special work and must also be fitted with emergency parts enabling it to function as a free balloon, should the cable break.

The special parts required when functioning as a captive balloon are:

An automatic valve or similar device for preventing a pressure within the envelope greater than that specified below, even for a rate of ascent of 8 meters per second (in case of cable breakage).

For non-spherical captive balloons, an air ballonet, or similar device, allowing the balloon to be kept inflated at all altitudes which the length of its cable permits it to reach.

The emergency parts, for use in case of cable breakage, are:

A hand-operated valve, which may also be the automatic valve.

A rip panel permitting the evacuation, in one second, of a hundredth part of the volume of gas contained in the balloon.

Emergency ballast of a weight equal to $\frac{3}{100}$V (V = volume of balloon in cubic meters). The metal cable holding the balloon must be electrically grounded.

II. - DEMONSTRATION OF QUALITIES OF STABILITY DURING AN ASCENSION.

For every new type of captive balloon, the extreme velocity of the wind at which stability is assured must be verified and the tension of the cable at that velocity measured. It shall also be tested as to whether, in case of cable breakage, the stability of the balloon and the rigging of the basket would allow of navigation.

III. - CONSTRUCTION AND INSPECTION.

The strength and quality of the materials employed in making the main parts of captive balloons shall be tested before using.

The ratio between their breaking loads and the loads to be supported during ascent, under the most unfavorable conditions, shall be at least:

8 for fabrics,

15 for the car suspension,

10 for the traction suspension,

4 for the towing cable.

The maximum pressure which the balloon must not exceed shall be governed by its shape and by the factor of safety specified for the fabric. The maximum velocity of wind in which the balloon may fly shall be governed by the condition of never exceeding this maximum pressure, of never exceeding the limit of stability determined in the ascension test and of not allowing the cable to bear a greater load than that designated above.

IV. - INSTRUMENTS NECESSARY FOR SAFE NAVIGATION.

1 barometric altimeter,

1 compass,

In night ascensions, the safety signal lights prescribed by the decree of August 26, 1920, with wind cones and lights disposed along the cable.

III. - NONRIGID AIRSHIPS

I. - MINIMUM CONDITIONS OF SAFETY.

A nonrigid airship is one in which the form of the hull is maintained by the pressure of the gas with which it is inflated.

Every nonrigid airship must have the following parts:

A gas envelope provided with valves which are both automatic and hand-operated. There must be at least one valve for each compartment with at least two valves for the whole envelope, if it is not divided into compartments. It must be possible to remove and adjust these valves without deflating the envelope. They must open automatically when the pressure exceeds 40% of the maximum pressure measured at the axis and defined in the plans. The total capacity of the gas valves shall be such that, for a vertical ascending speed of 6 meters (20 feet) per second, the pressure in the envelope can never, under any circumstances exceed 60% of the maximum pressure given above. When the gas valves are in the lower part of the envelope, they must have their outlet behind the engines.

One or more air ballonets suitably divided into compartments and having a total volume equal at least to that required for utilizing the total dischargeable weight (ballast and supplies) of the airship. For airships with a volume greater than 4000 cubic meters, there shall be at least two ballonets placed longitudinally so as to enable trimming. Each ballonet shall have at least one valve, operated both automatically and by hand. Air valves shall always open at a lower pressure than gas valves. Their output must be such that a vertical ascending speed of 2 meters (6.5 feet) per second can be reached with an over pressure of not more than 2 mm (0.08 in) of water in the envelope. For airships of more than 1500 cu.m. there shall be two ballonet air-supply devices, one at least being able to function when the propellers are stopped. They

shall enable the airship to descend at a speed of at least 2 m/sec without danger of deformation of the envelope. For airships of less than 1500 cu.m (52973 cu.ft) only one sir-supply device need be authorized, if it is shown that in case of its not functioning the stresses on the envelope and nacelle will not be dangerous. The valves of the gas bag and of the air ballonets must both have double controls, one for opening and the other for closing.

The envelope and the ballonets must have rip-panels. For balloons of over 2000 cu.m (70630 cu.ft) there shall be at least two rip-panels placed longitudinally. The pull required for ripping shall be about 50 kg (110 lbs). The surface ripped open must be large enough to evacuate in one second one hundredth of the gas contained in the envelope.

The airship shall be provided with surfaces for longitudinal stability, steering, and lifting. When the control surfaces are balanced they must return automatically to a neutral position in the wind, when the controls are abandoned. The rudder and elevator control-cables must be easily adjustable and shall be in duplicate at points which are inaccessible during flight.

Besides this, at least one of the rudders must have an emergency control quite independent of the one ordinarily used.

The airship must have at least the following rigging:

Two drag-ropes at least 120 meters (393.7 feet) long. Their strength, expressed in kilograms, shall be deduced from the formula:

$$\text{Strength} = 8.5\ V^{\frac{2}{3}}$$

V being the capacity of the airship expressed in cubic meters. This formula is valid up to a capacity of 20,000 cu.m (706300 cu.ft). Above that capacity, the data given below relative to rigid airships must be taken. Every airship must be provided with a land anchor. For ships intended for oversea flights, a sea anchor must also be provided. The base of the conical sea anchor shall be a circle with a diameter of at least 0.07 D, or an equivalent area (D being the diameter of the airship at its greatest cross-section).

The attachments of the drag-ropes to the envelope must be made so strong that they will not give way before the breaking of the drag-ropes themselves.

Radio.- All airships, except touring airships of less than 4000 cu.m (141360 cu.ft) gas capacity, must be equipped with radio instruments for sending and receiving, with a range of at least 300 kilometers (186 miles).

Engines.- All airships, except those with a gas capacity of less than 2000 cu.m, shall have two independent engines.

The conditions specified for airplane engines apply to airships, with the following modifications:

The propellers shall be placed so that the circle described by the tips of the blades shall be at least 1.2 meters (3.94 feet) from the envelope.

Cars containing engines, tanks, or gasoline pipes must be well ventilated.

It must be possible to stop and start any one of the engines a number of times during the ascent; also to operate with one engine

stopped and the others revolving at two-thirds of their maximum R.P.M. without danger of overheating. The engines must be able to function, even if the airship should assume a slant of 20°.

Precautions against Fire.- The engine mufflers must be at least 1.5 meters (5 feet) from the envelope. Their outer surface must never be allowed to get red-hot. The gas outlets must be covered with wire gauze. The carburetor air intakes must also be thus protected. These intakes must be at some distance from the outlets of the exhaust pipes.

On airships fitted with radio the following precautions shall be taken:

1st. All parts of the radio apparatus, such as sending keys, spark gap, or other parts apt to produce sparks, must be enclosed in fine wire gauze. Wires carrying high-frequency currents must be insulated by at least 10 centimeters of air or of ebonite. Special attention must be paid to the outlet of the antenna through the lower metal parts of the car.

2nd. All the metal parts of the car must be electrically connected. In particular, the gasoline pipes must be electrically connected, throughout their whole length, with the neighboring metal parts. The connections must be made by means of connecting-pieces with wide contact surfaces very tightly joined.

The contacts must be made metal to metal, without interposition of paint or varnish. When the parts contain movable pieces which may, during their movements, become isolated (scoops, winches), these parts must be permanently connected with the general mass by flexi-

ble conductors.

The metal parts of propellers shall be electrically connected with the hub.

3rd. The suspension wires, especially those near the envelope, tanks or possible gasoline pockets, must be specially examined.

All parts which are 15 cm (5.9 in) or more from each other, must be connected by a small copper wire. The contact of this wire with each of the parts must be assured by several tight turns of the wire and by soldering wherever possible.

The ends of suspension wires, brace wires, etc., terminating near the envelope forward of the gas valves, must end at a distance of at least one meter (3.28 feet) from the envelope. Behind the gas valves, this distance is increased to 1.5 meters (5 feet).

4th. Metal parts not directly connected to the car, and consequently subject only to induction (fins, rudders, bracing wires), must end at a distance of at least 20 cm (7.9 in) from the envelope (50 cm (20 in) wherever possible). If the ballonet scoop is metal, it should end one meter from the envelope.

5th. There must be an electric connection by copper wire between the various metal parts of the valve seats and valves.

6th. The controls of valves, rudders, and similar parts, attached to the envelope, shall be interrupted by hemp rope of such a length that, under no circumstances, shall there be less than one meter between the end of the control attached to the car and the end attached to the envelope.

Besides the foregoing precautions, a sending test shall be made at night in the hangar, the antenna being extended and suitably insulated. During this test it must be noted whether any spark is produced between the metal parts of the car and its suspension wires, especially in the vicinity of the gas valves and of the gasoline pipes or tanks.

Lastly, there must always be at least two fire extinguishers for each large compartment, ready for instant use and within immediate reach of the crew.

II. - DEMONSTRATION OF MANEUVERING QUALITIES.

The following points must be checked for each new type of non-rigid airship:

a) The gas pressure required for maintaining the shape of the hull at full engine power with an original load corresponding to a lift of at least 1100 g (2425 lbs);

b) Whether this pressure is lower than or equal to the maximum pressure indicated in the plans;

c) Whether the means of maintaining the ballonet pressure answers to the conditions specified above;

d) Whether the airship is stable and easily maneuvered vertically and horizontally both at high speed and at landing speed;

e) Whether the landing and ground maneuvering gear (hand-lines hand-rails, etc.) work well and are provided in sufficient number; also whether the ballast can be released easily.

Besides the foregoing tests for new types, every airship, of

whatever type, must, before being accepted for service, undergo a test of general good functioning under full power.

III. - CONSTRUCTION AND CONTROL.

The quality of the materials, their manufacture and assembly shall be examined for each airship. The required factors of safety for the materials are as follows:

Fabric	5
Suspension ropes	10
Metal	8
Steel, Duralumin, Piano wire	4
Wood	10

The factor of safety shall be determined by the ratio of the breaking load to the load given by calculation for the most unfavorable practical cases for the parts of the airship considered, whether in flight or in the shed.

For the metal engine supports the factor of safety must be not less than 8. The factor of safety for propellers must be greater than 5.

Constructors must provide the necessary calculations and drawings to prove that the foregoing factors of safety are maintained. In particular, the maximum pressure which the fabrics of the envelope can withstand, shall be determined by the condition that, in no part of the airship, shall the load on the fabric exceed the above factor of safety.

This pressure shall be marked by a red arrow on all the manometers of the airship.

The conditions of construction, relative to airplane engines and their accessories, apply to airship engines in all points not contrary to what follows.

The five-hour bench test, however, which must be passed by all engines before being placed in service, shall be made entirely at the maximum power and R.P.M. stipulated for them.

Furthermore, for every airship of a new type, or for any installation of a new engine on an airship, the two-hour test at fixed point shall be made at full power. It may, however, be limited to one car, if the airship has several cars which are exactly alike.

Instruments required for safe navigation.- Every airship must carry at least:

One compensating compass in each control station and a compensating compass for taking bearings in the navigating station. The compasses must be of a type approved by the S.T.Ae.;

Two altimeters, (one with large graduations for landing);

A clock;

An inclinometer;

A lamp for Morse luminous signals;

A pressure indicator for each compartment contained in the envelope. Each of these indicators shall be on the dual principle, that is, they shall comprise a liquid manometer and a direct-reading needle manometer with two distinct sets of piping for the gas manometers;

A set of spare wrenches and tools for current repairs. Lamps for navigating lights, lamps and signals for use in distress and in mooring, as stipulated in the decree of August 20, 1920. The lamps must be of a safety type.

At least 3% in kilograms of the volume expressed in cubic meters as landing ballast, one-third of which it must be possible to release immediately.

On commercial airships there must be as many parachutes of an approved type as there are persons on board. These parachutes must be easily accessible and their location must be indicated by conspicuously placed cards giving instructions for their use. On airships intended for oversea service there must be as many life-belts of an approved type as there are persons on board. The airship must also carry the instruments, charts and documents necessary for finding her position and an optical signaling device with a range of 20 kilometers (12 miles) when the visibility is 0.9.

Furthermore, every long distance airship shall carry a stock of five liters of fresh water per passenger, in addition to the usual stock of provisions.

IV. - RIGID AIRSHIPS

A rigid airship is considered as one in which the shape of the hull is maintained by a framework sufficiently complete to nullify the pressure on the lower part of the gas cells during navigation.

I. - MINIMUM CONDITIONS OF SAFETY.

Every rigid airship must have the following parts:

Several independent gas cells, each having at least one automatic valve. The capacity of the automatic valves of each cell shall be such that an ascensional speed of 10 meters (33 feet) per second may be attained without the factor of safety of the fabric and frame falling below the figures hereinafter mentioned. The pressure required to open the valves, referred to the axis of the airship, shall not be greater than that which would be given by a column of gas having the height of the axis above the ground when the airship is in the shed.

Besides the automatic valves there shall be several hand-controlled valves which can be operated as required, either separately or in groups of three at most. Their distribution must enable stabilizing maneuvers. The valves must be provided with wide outlet sleeves so that no gas shall remain between the cells and the hull envelope. The interior passages must be well ventilated.

The gas cells and their attachments must be so arranged that there shall be no dangerous tension on the fabric or frame when the cells are partly deflated. The airship must be able to navigate with at least one cell empty.

The airship shall be provided with means of maintaining longitudinal stability, direction and lift. When the control surfaces are balanced, they should return automatically to their normal position in the wind, when the controls are abandoned. If the airship

has more than three cars, there shall be two control positions, one forward and one aft.

The following equipment must be provided:

One anchor;

Two drag-ropes at least 150 meters (492 feet) long, each with a minimum strength of 6 metric tons (13227 lbs);

A sea anchor, the large base of which shall be a circle having a diameter of at least 0.07 D or having an equivalent surface (D being the diameter of the airship), for aircraft intended for over-sea flights.

The attachment of the drag-ropes must be made so that it will not give way before the drag-rope itself. It must allow the drag-ropes to be paid out rapidly, if required. It must also be possible to haul the drag-ropes back on board. Emergency water ballast bags shall be installed fore and aft.

Radio.- All rigid airships shall have a radio outfit (for receiving and sending) with a range of at least 500 kilometers (310 miles) with radio direction-finding apparatus. This outfit must be supplied with power in at least two independent ways.

Engines.- The conditions required are the same as those indicated above for nonrigid airships. In addition, the propellers of the two independent engine sets must be reversible. The engines must be able to operate, even when the airship is inclined 20°.

Fire Precautions.- The precautions relative to nonrigid airships apply also to rigid airships. When the frame of the hull is metal, special precautions must be taken to insure good electric

conductivity. All detached metal parts (valves, controls, propellers, etc.) shall be grounded. Metal floors used by passengers shall be covered with insulating materials.

There must be at least two extinguishers, of a model approved by the inspection department for each engine car and passenger cabin; also one every ten meters in the walk-way.

The gasoline piping must be done so that no gasoline shall be exposed to the open air.

II. - DEMONSTRATION OF FLYING QUALITIES.

For every rigid airship the following points must be verified:

a) That it is stable and responds to the controls in altitude and direction at any power, at landing speed, and in backing;

b) That its landing gear and land maneuvering gear (hand-lines, hand-rails, etc.) are sufficient and function satisfactorily. That the functioning of the ballast bags is dependable, their output sufficient, and that the condition of the ship as regards ballast can be rapidly inspected at any moment;

c) That the whole airship functions satisfactorily at any engine power;

d) That no dangerous spark is produced by the radio (night test in shed).

III. - CONSTRUCTION AND CONTROL.

The factors of safety for the materials used in the construction of rigid airships are the same as those for nonrigid airships.

Constructors must furnish drawings and calculations showing that no part of the framework is subject to a load greater than the safety load in the three following cases:

a) Stabilized airship with useful load,

b) Stabilized airship without useful load,

c) Airship in flight at an angle of 15° to the horizontal.

It shall also be verified as to whether the factors of safety of the different parts of the framework should one cell be deflated, are still greater than two-thirds of the factors of safety stipulated above.

IV. - INSTRUMENTS REQUIRED FOR SAFE NAVIGATION.

There shall be at least the following instruments:

a) For each control station:

A compensated liquid compass,

A compass for taking bearings,

Two altimeters (one with large graduations for landing),

A statoscope (or equivalent),

A clock,

An inclinometer,

A lamp for Morse luminous signals,

b) For each engine car:

A spare set of wrenches and tools.

c) Navigation lights, distress signals and mooring signals, as prescribed by the decree of August 26, 1920. It must be possible to feed these lamps in two independent ways and they must be

of a safety type. As many one-man parachutes as there are persons on board. For airships having to fly more than 100 km over the sea, as many life-belts as persons on board. The charts, instruments and documents required for determining the position of the ship. Also an optical signaling device with a range of 20 kilometers (12 miles) for a visibility of 0.9. A weight (in kilograms) of ballast for landing of at least 3% of the volume of the airship in cubic meters.

The reserve stock of water prescribed for nonrigid airships.

Translated by Paris Office,
National Advisory Committee
for Aeronautics.