

# TECHNICAL CONSIDERATIONS ON THE SEVILLE-CUBA FLIGHT, "CUATRO VIENTOS", JUNE 1933

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- Introduction
- Preparing the flight
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## MAIN GRAND RAIDS ACROSS THE NORTH ATLANTIC OCEAN

- Vicecmdr. Read, with Curtiss NC4 from Newfoundland to Azores, Lisbon and Plymouth, May 1919
- Alcock and Brown, aboard a Vickers Vimy, first non-stop between America and Europe, June 1919
- Lindbergh, on a Ryan Special, first solo flight from New York to Paris, May 1927
- Von Hünefeld, Koehl, Spinder and Fitzmaurice, with Junkers W33L, first East-West from Berlin to Ireland and to Labrador, April 1928
- Costes and Bellonte, in a Bréguet XIX Super TR, Paris to New York, 1930
- Amelia Earhart, in Lockheed Vega, flew the second solo (first for a woman) from America to Europe, May 1932

## MAIN GRAND RAIDS BY SPANISH PIONEERS

- Franco, Ruiz de Alda, Durán and Rada, on Dornier Wal hydroplane, from Palos to Buenos Aires, January 1926
- Gallarza, Martínez Estévez and Lóriga, on Bréguet XIX, from Madrid to Manila, April-May 1926.
- Atlantida squadron, on Dornier Wal hydroplanes, Seville to Bata (Eq. Guinea), December 1926.
- Jiménez and Iglesias, with Bréguet XIX Super TR, Seville to Bahia (Brazil), March 1929

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EL CAPITAN BARBERAN



EL TENIENTE COLLAR



THE CREWMEN

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BREGUET XIX FLYING

TABLE 1. MAIN DATA OF BRÉGUET XIX AIRPLANES

|                           | B XIX common | B XIX CV  |
|---------------------------|--------------|-----------|
| Engine                    | Elizalde A4  | HS 12 Nb  |
| Maximum power (CV)        | 450          | 650       |
| Wingspan (m)              | 14.83        | 18.30     |
| Length (m)                | 9.51         | 10.70     |
| Wing area ( $m^2$ )       | 50           | 59.97     |
| MTOW (kg)                 | 2300         | 6375      |
| Empty weight (kg)         | 1387         | 1900      |
| Wing loading ( $kg/m^2$ ) | 46           | 106.4     |
| Fuel capacity (l)         | 440          | 5325      |
| Oil capacity (l)          | -            | 250       |
| Maximum speed (km/h)      | 214          | 230       |
| Cruise speed (km/h)       | 175          | 190       |
| Range (km)                | 800          | Est. 8500 |

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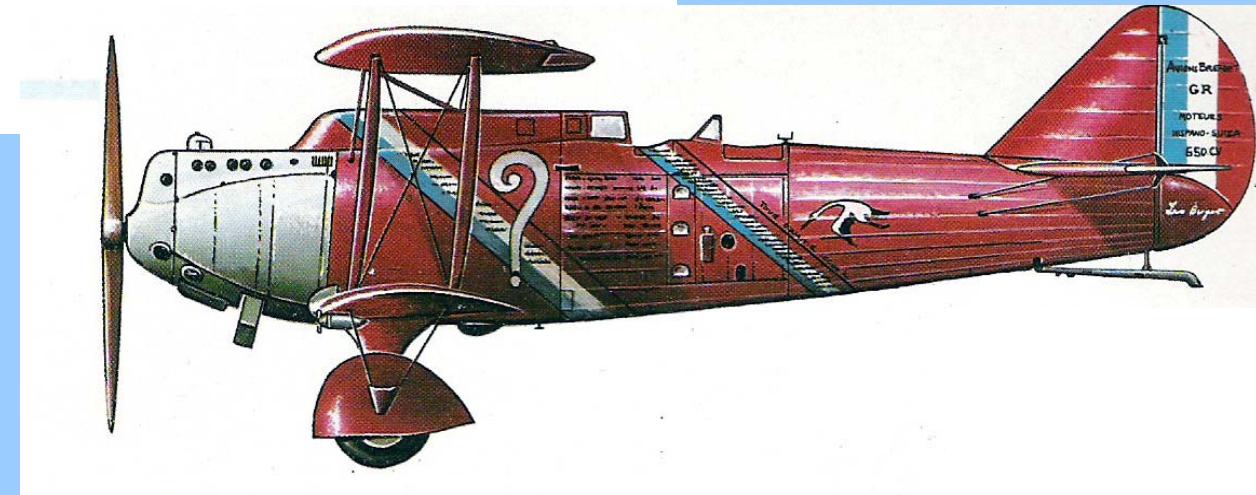
The “Cuatro Vientos” Seville-Cuba flight, 1933



BREGUET XIX TR “CUATRO VIENTOS”

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The “Cuatro Vientos” Seville-Cuba flight, 1933



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The “Cuatro Vientos” Seville-Cuba flight, 1933



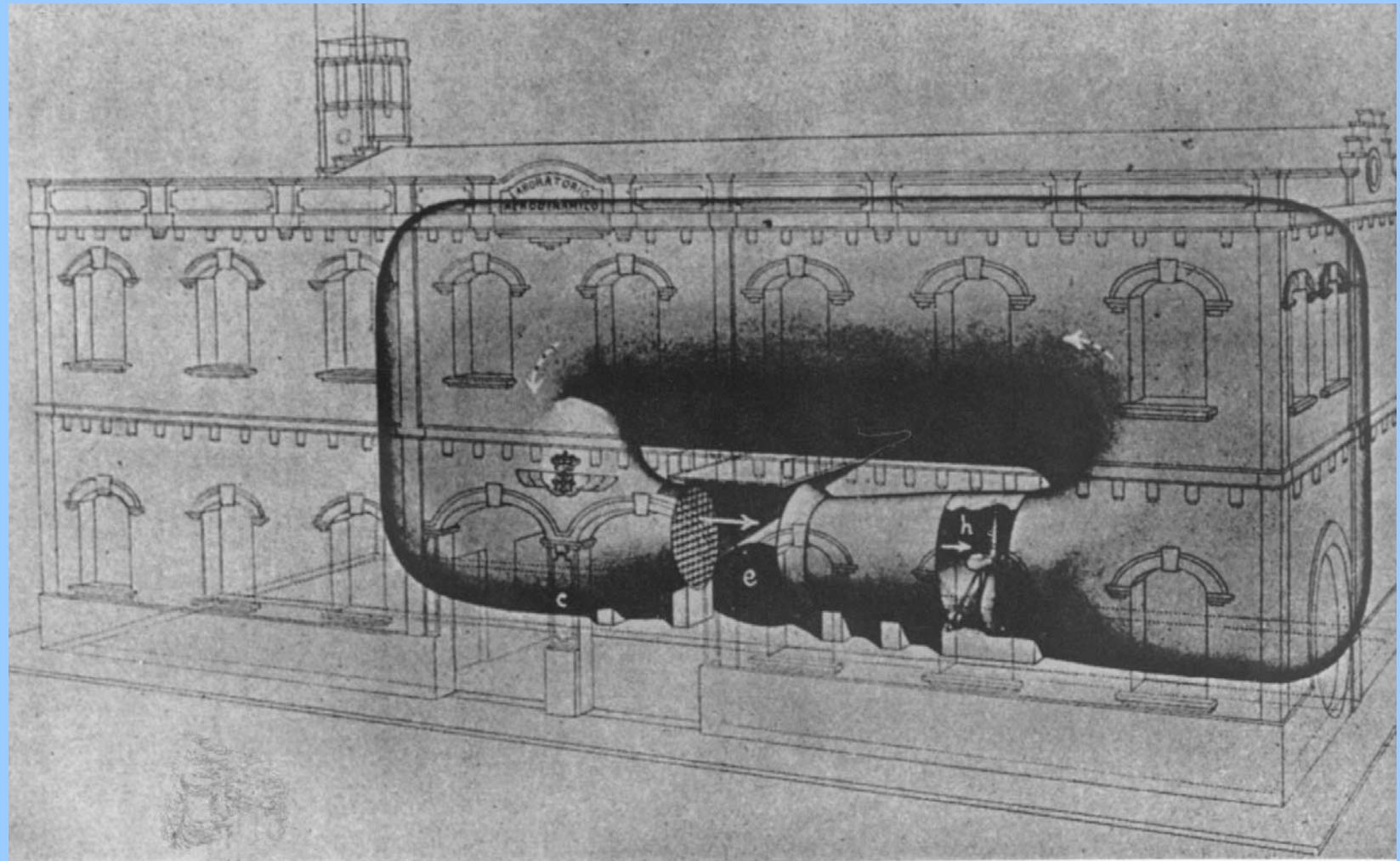
CUATRO VIENTOS, 20s

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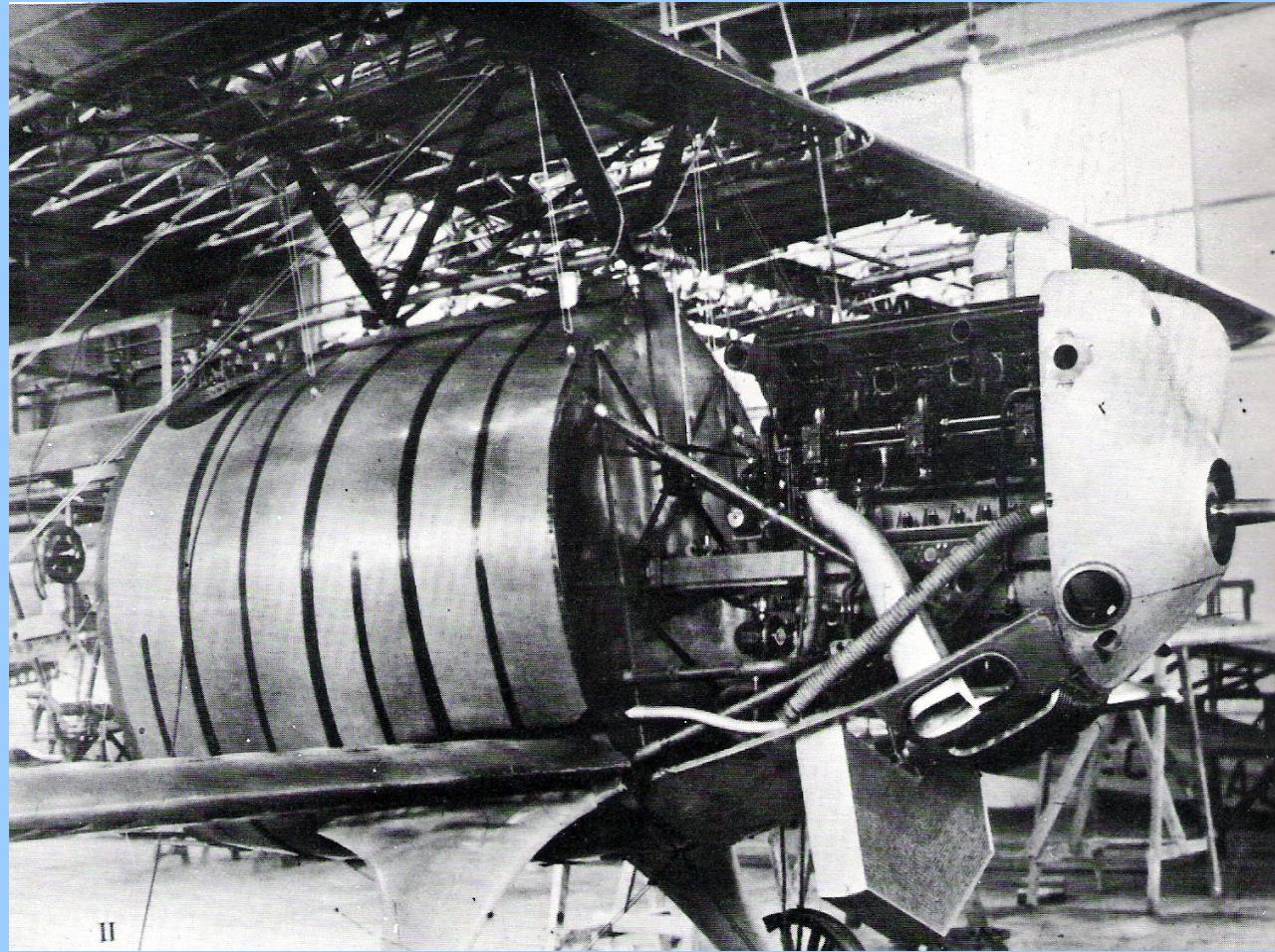
The “Cuatro Vientos” Seville-Cuba flight, 1933



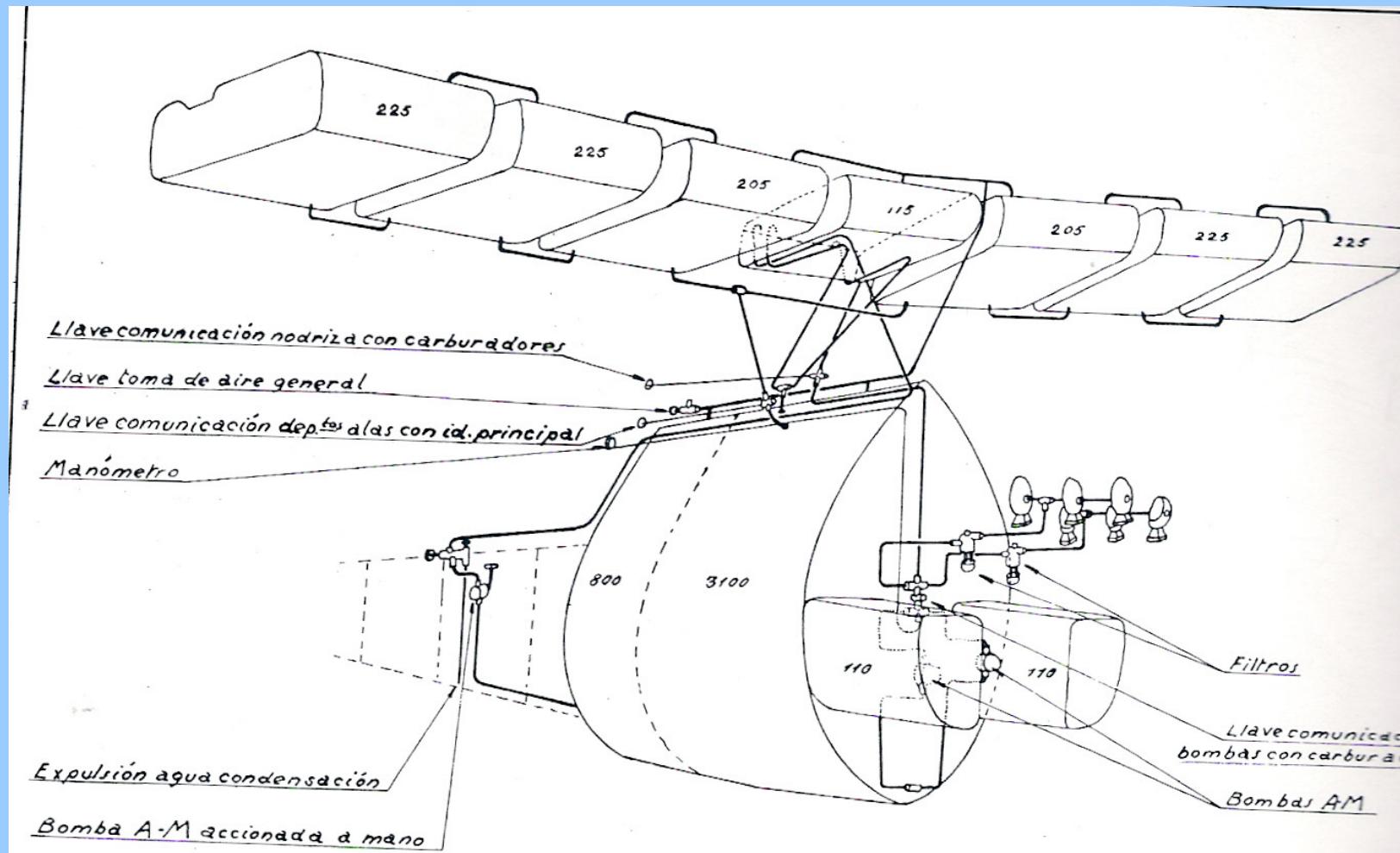
THE SCHOOL OF AERONAUTICAL ENGINEERING



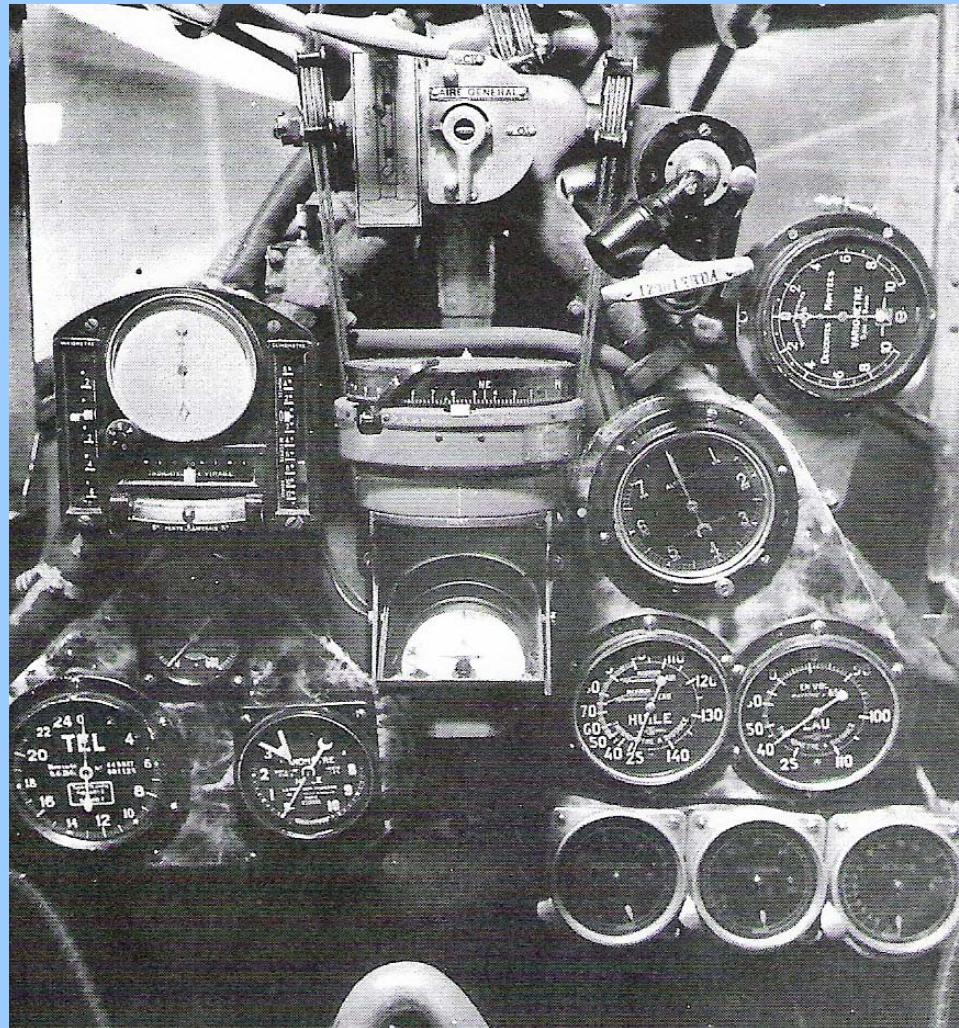
WIND TUNNEL (2nd LARGEST Re IN THE WORLD)



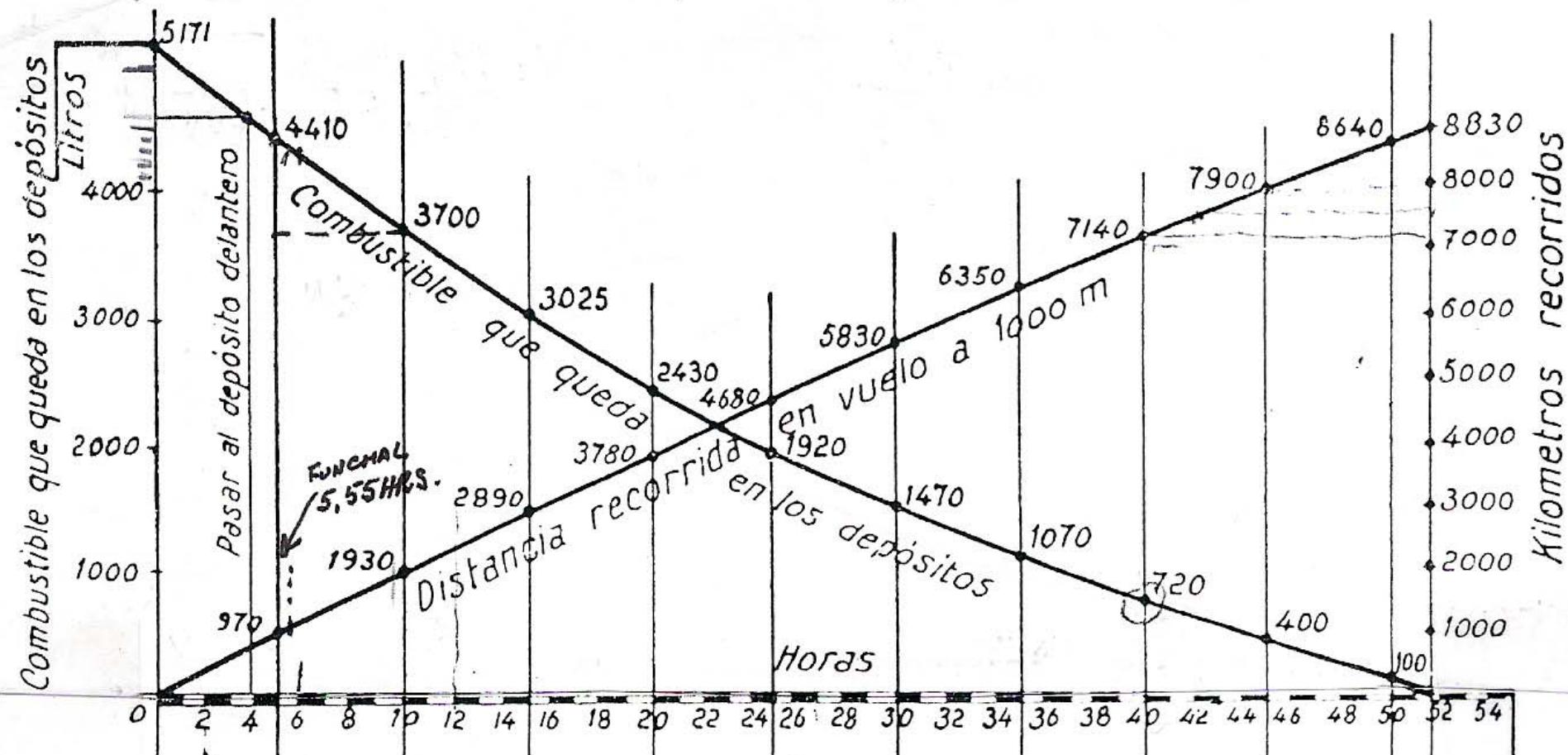
CONSTRUCTION DETAIL



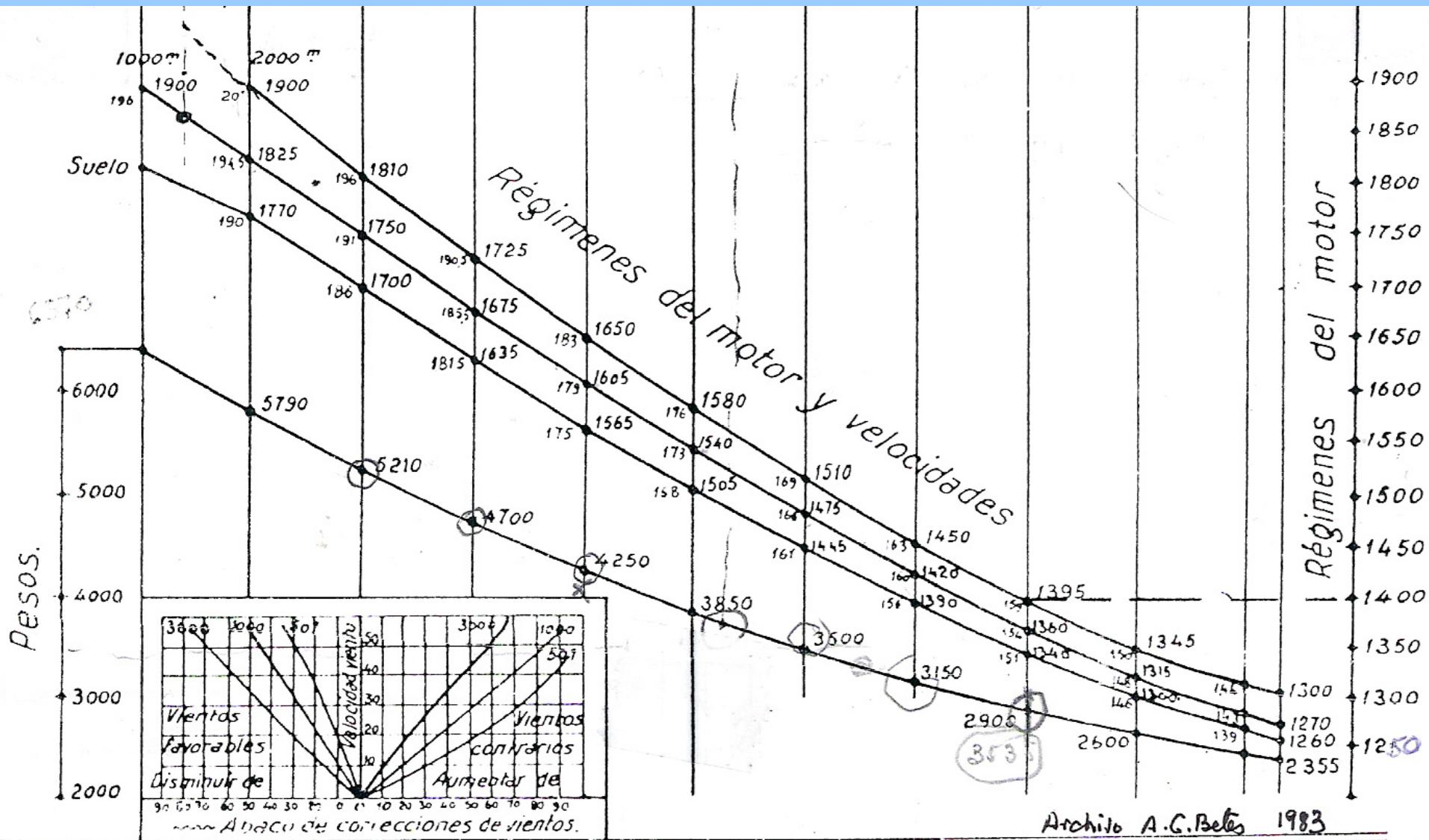
## FUEL SYSTEM



INSTRUMENT PANEL



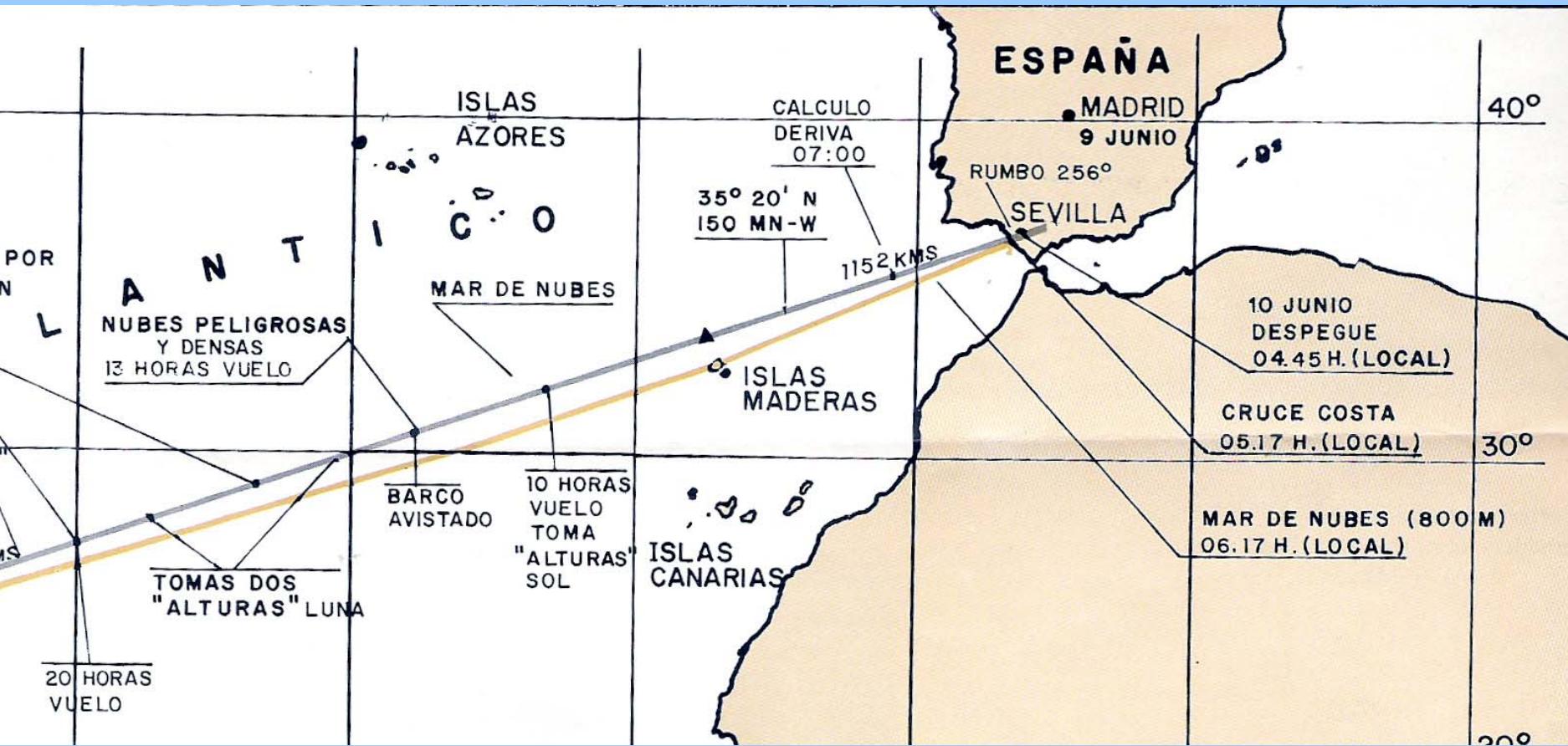
FORESEEN FLYING CONDITIONS (1)



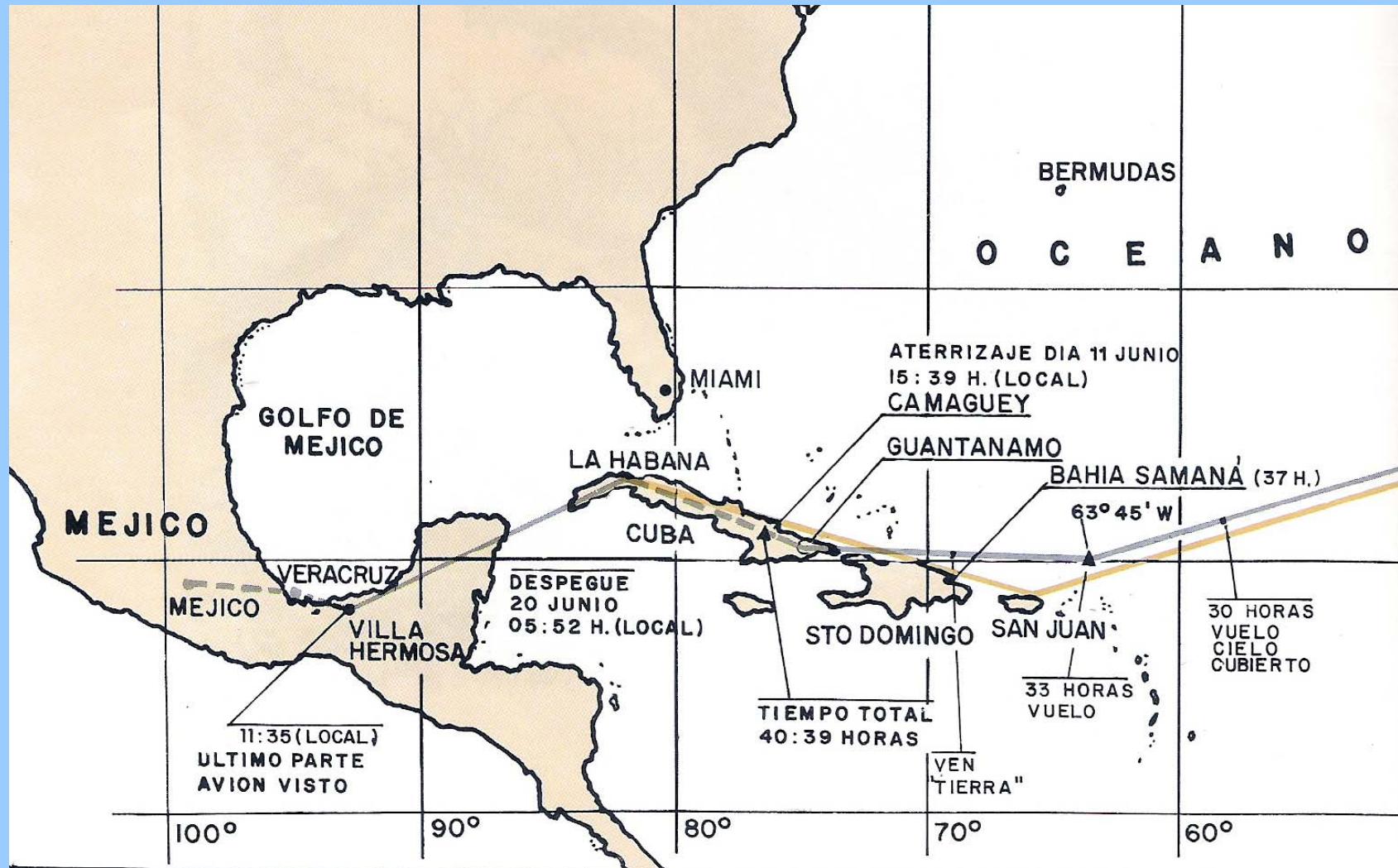
FORESEEN FLYING CONDITIONS (2)

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FIRST FLYING HOURS



LAST FLYING HOURS

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ARRIVAL AT HAVANA

## ESTIMATING AERODYNAMICS AND PERFORMANCES

- Most technical data are lost; except the global ones, that were kept and archived in public news media.
- Airfoil type and other characteristics unknown.
- A detailed search by Dr. Gonzalez-Betes in 2003 allowed to identify the airfoil as Hailbronn 3.
- “Cuatro Vientos” airplane’s aerodynamics and performances are estimated with type 0 methods (conceptual design level).

## ESTIMATING THE DRAG POLAR

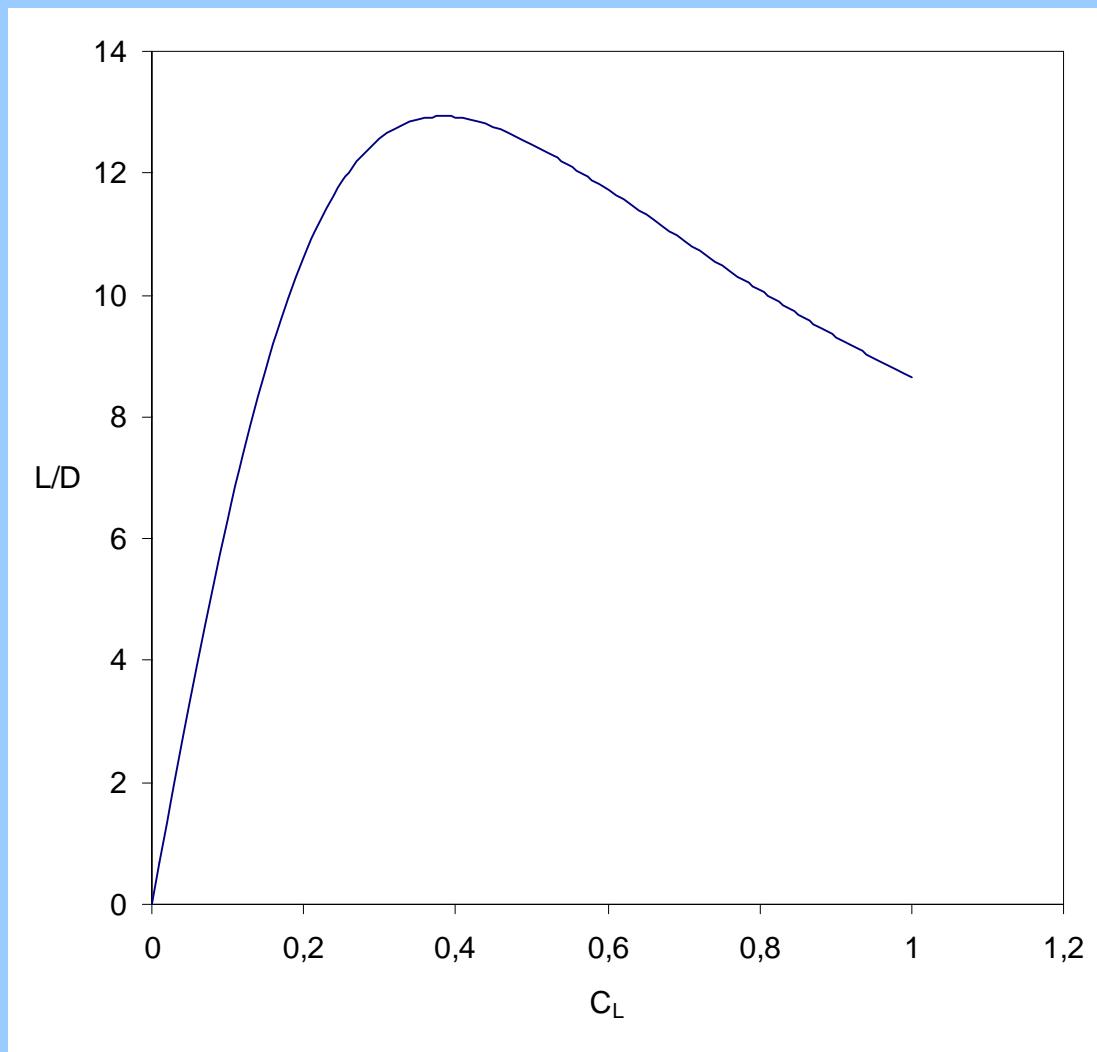
$$C_D = C_{D0} + K C_L^2 \quad (1)$$

$$C_{D0} = (C_{fw} F_{fw} S_{wetw}/S + C_{fB} F_{fB} S_{wetB}/S) I_f + C_{fe} F_{fe} S_{wete}/S + C_{Dmis} S_{mis}/S \quad (2)$$

$$K = S (1+\delta)/[\pi e (\lambda b_1)^2] \quad (3)$$

$$C_D = 0.0148 + 0.101 C_L^2 \quad (4)$$

$$(L/D)_{max}=12.9 \quad (5)$$



DRAG POLAR

## INTEGRAL PERFORMANCES

$$W = L = \frac{1}{2} \rho V^2 S C_L \quad (5)$$

$$T = D = \frac{1}{2} \rho V^2 S C_D \quad (6)$$

$$\frac{dm}{dt} = - c_P P \quad (7)$$

$$T V = \eta_h \eta_m P \quad (8)$$

$$x = \int_0^t V dt = \int_{m_f}^{m_i} \frac{V dm}{c_P P} = \int_{m_f}^{m_i} \frac{\eta_h \eta_m}{c_P T} dm \quad (9)$$

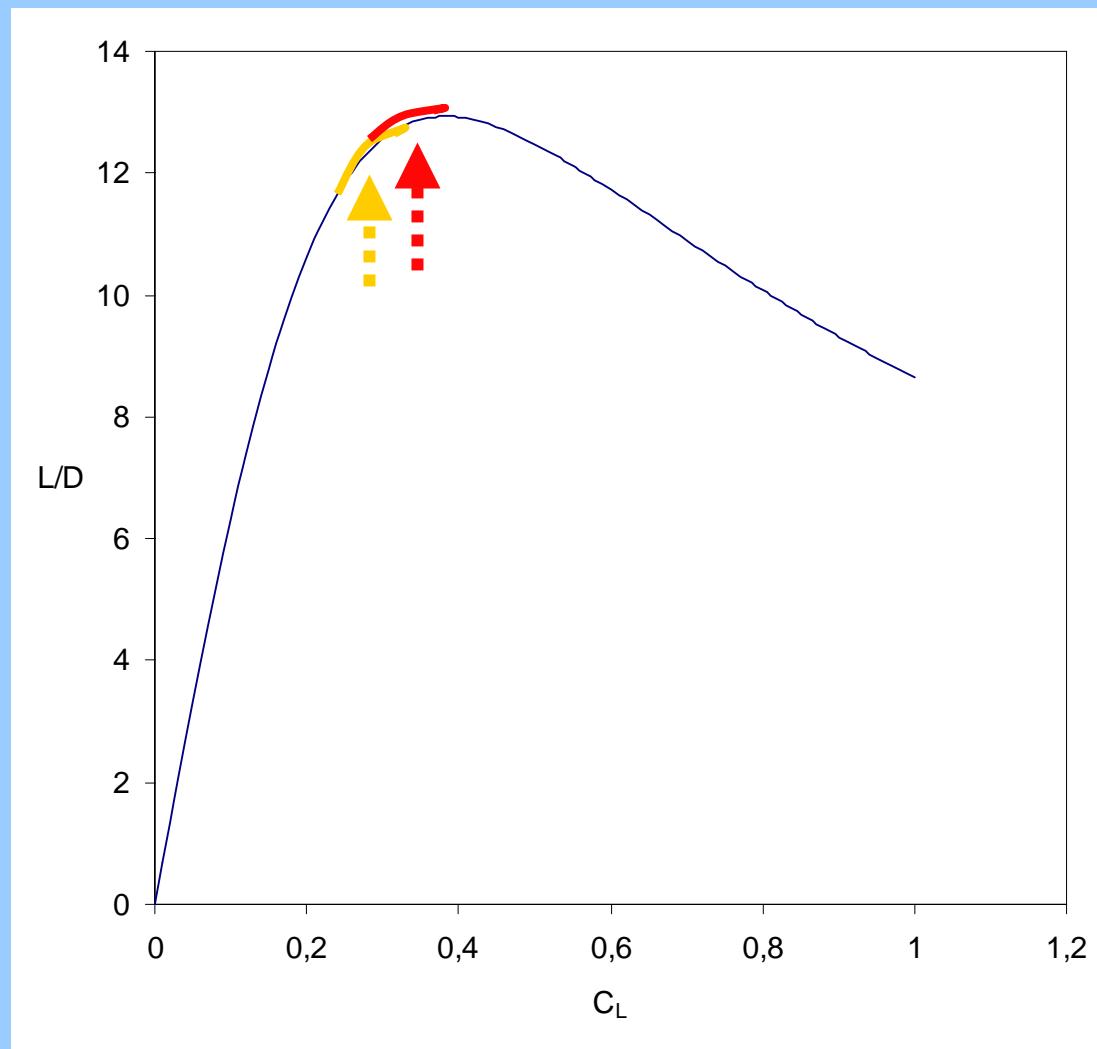
$$R = \int_{W_f}^{W_i} \frac{\eta_h \eta_m}{g c_P} \frac{L}{D} \frac{dW}{W} \quad (10)$$

TABLE 2. EVOLUTION OF SELECTED VARIABLES IN THE REPRODUCED FLIGHT OF THE “CUATRO VIENTOS”

| T (h) | W <sub>i</sub> (kg) | V (km/h) | C <sub>L</sub> | L/D  | P <sub>req</sub> (CV) | R (km) |
|-------|---------------------|----------|----------------|------|-----------------------|--------|
| 0     | 6320                | 198      | 0.58           | 11.9 | 617                   | 0      |
| 5     | 5559                | 191      | 0.62           | 11.6 | 543                   | 968    |
| 15    | 4361                | 187      | 0.51           | 12.4 | 396                   | 2848   |
| 30    | 3042                | 180      | 0.40           | 12.9 | 263                   | 5614   |
| 39    | 2429                | 173      | 0.36           | 12.9 | 210                   | 7235   |
| 40.7  | 2324                |          |                |      |                       | 7530   |

TABLE 3. EVOLUTION OF WEIGHT AND SPEED AS PRESCRIBED IN 1933 AND OBTAINED IN PRESENT ESTIMATION

| T (h) | W <sub>est</sub> (kg) | W <sub>pres</sub> (kg) | V <sub>est</sub> (km/h) | V <sub>pres</sub> (km/h) |
|-------|-----------------------|------------------------|-------------------------|--------------------------|
| 0     | 6320                  | 6320                   | 198                     | 196                      |
| 5     | 5559                  | 5790                   | 198                     | 194                      |
| 10    | 4926                  | 5210                   | 192                     | 190                      |
| 15    | 4361                  | 4700                   | 187                     | 185                      |
| 20    | 3872                  | 4250                   | 184                     | 180                      |
| 25    | 3441                  | 3850                   | 184                     | 177                      |
| 30    | 3042                  | 3500                   | 180                     | 170                      |
| 35    | 2690                  | 3150                   | 180                     | 167                      |
| 40    | 2367                  | 2900                   | 173                     | 158                      |
| 40.7  | 2324                  | 2858                   | 170                     | 155                      |



FORESEEN AND ACTUAL L/D

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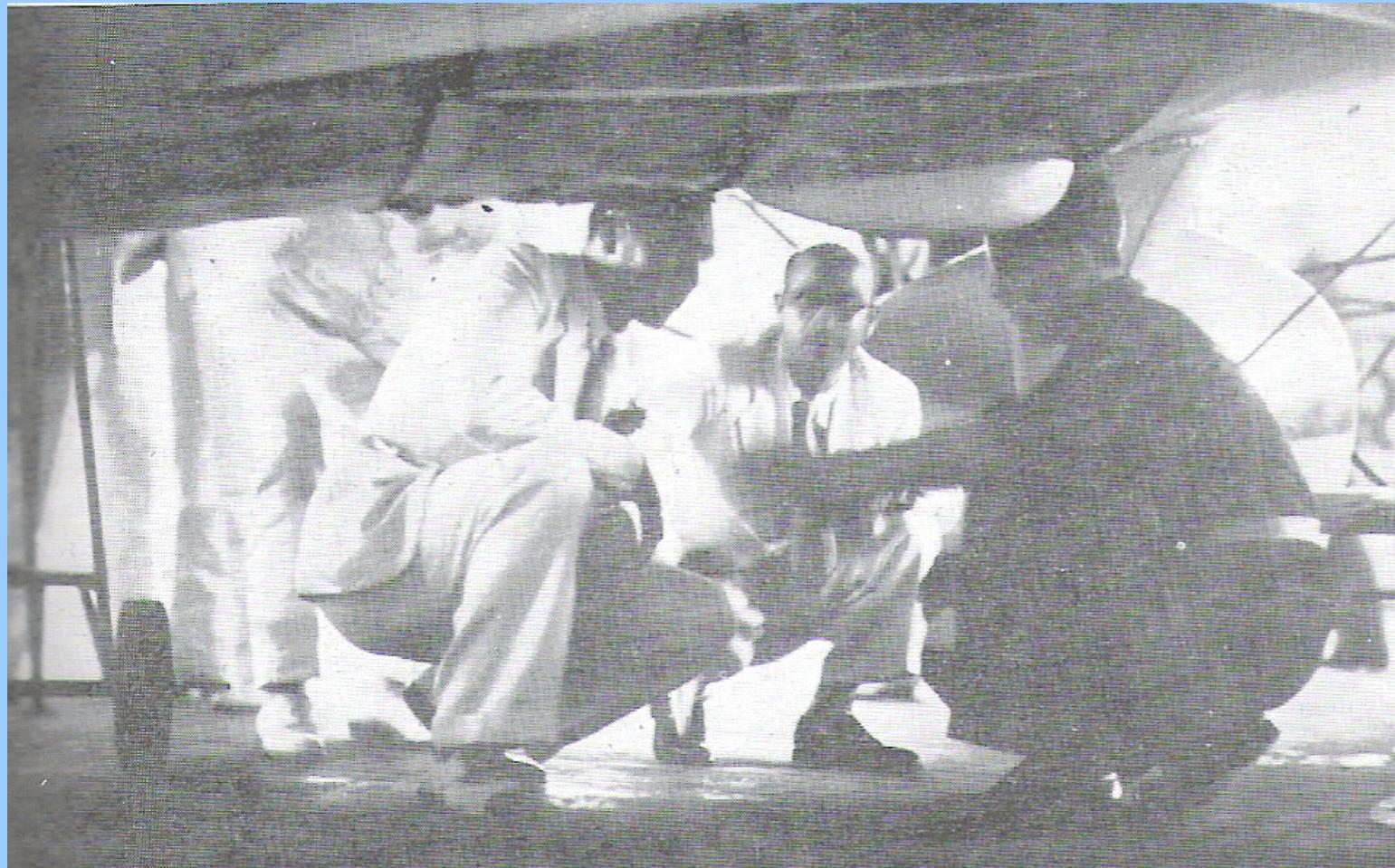
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BECOMING LEGEND ...

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FUEL TANK LEAKAGE

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The “Cuatro Vientos” Seville-Cuba flight, 1933

EL CAPITAN BARBERAN



EL TENIENTE COLLAR



## FINAL CONSIDERATIONS

- Current prediction methods are accurate enough as to allow the reproduction of pioneer flights, even when most technical data are lost or unknown.
- Grand raids and other similar flights greatly contributed to the advancement of aviation. We are, therefore, indebted to the men that prepared and carried out these flights.
- The present paper is a tribute to the effort done by Barberán, Collar and others for the “Cuatro Vientos” endeavour, sadly finished over the Gulf of Mexico on June 1933.