DETAILED STRUCTURE WEIGHT AND PERFORMANCE CALCULATION FOR ETERNAUS – "EXPLORER H2"

$Ø_{máx}$ =	16,9 m (D)
C=	100 m (L)
Relação L/D=	5,917
V_{real}/V_{cil}=	0,694
S_{real}/S_{cil}=	0,746
$S_{trans.\ máx}$=	224,3 m²
S_{ext}= 5.757 x 0,746	4.295 m²
V_d= 22.400 x 0,694	15.567 m³
$E_{máx}$=	20.230 Kg

Aerodynamics & friction loss (velocity)

W= Cw.F.σ/2 .vel²
W= $Cwv^{2/3}$ x $V^{2/3}$ x σ/2 x vel²
l/d = Length of the body/biggest body diameter
$Cwv^{2/3}$real= 0,017834
σ= 0,1275

F= Spantquerschnitt
(V = volume of the Airship)
(slender-slim factor)
(Hindenburg_Dubbel pg 271)
(Dubbel pg 246)

W= 0,017834 x $(15.567)^{2/3}$ x 0,1275/2 x vel²
W= 0,017834 x 623,45 x 0,1275 /2 x vel²
W= 0,71279 x vel² = força em kg
Pot_{real} = W x vel./75 = 0,71279 x vel^3/75 = 0,009504 x vel³

<u>0,009504.vel³ = Displacement factor for Explorer</u>

If we would consider the aerodynamic penetration formula (used for cars, planes etc.):

W= Cw x F x $\sqrt[3]{V}$/2g x vel² Cw= 0,35 e F= 224,3 m²=S transv.Max

$W = 0,35 \times 224,3 \times 1/16 \times vel^2$

$W = 4,907.vel^2 = (Kg)$

$Pot = W \times vel/75 = 4,907 \times vel^3/75 = 0,06543.v^3$

0,06543.v³ = displacement factor if using aerodynamic penetration formula

0,06543 / 0,009504 = 6,884 times bigger

PS = 0,009504 x vel³

At velocities of: 50 km/h = 13,88 m/s	PS=25 CV
At velocities of: 70 km/h = 19,44 m/s	PS=70 CV
At velocities of: 100 km/h = 27,77 m/s	PS=203 CV
At velocities of: 140 km/h = 38,88 m/s	PS=560 CV
At velocities of: 210 km/h = 58,33 m/s	PS=1886 CV

For the maximum velocity of 210 km/h, required power of 1886 CV

Pot=W/75. v ³

W= 1.886 x 75 / 58,33 = 2.425 kg

Determination of the structural central tube for a turbine force of 2.425 kg

For an internal pressure of 2,0 kg / cm ², required transversal surface = 1.212 cm²

$S = \Pi x Ø^2 /4$

$Ø = (S \times 4/\Pi)^{½}$

$Ø = (1.212 \times 4/3,1416)^{½} = 39 \text{ cm} \approx 400\text{mm}$

40 x 2 kg/cm² = 80 kg 40 kg in 1 cm = 4,0 kg/mm

With a 0,4 mm aluminum sheet we will have 4,0/0,4 = 10 kg/mm²

Determination of the cave rings

(½ of the Ø of central tube) Ø= 200 mm (20 cm)

20 x 2 kg/cm ² = 40 kg 20 kg in 1 cm = 2,0 kg/mm

With a **0,2 mm** aluminum sheet we will have 10 kg/mm²

Determination of the external cover

A_L = 0,4mm duralumin (ALLOY 2090-T83 SHEET density 2,6 kg/dm3)

Density = 2,6 kg/dm^3 = 2,6 kg /m^2 /mm

Superficial density = 2,6 x 0,4mm kg/m^2 = 1,04 kg/m^2

Sigma rupture al.= 83 kg/mm^2

Resist = 65 kg/mm

Sigma solicitante =3,55 kg/mm or 420 mmCA

S_{ext} (external surface) = 4.295 m^2 x 1,04 **= 4.470 kg** total weight

Weight of the central tube

$S_{ext\ tubo\ central}$ = (0,4 x π x 100 ≈ 126 m^2) x 1,04 kg/m^2=**131 kg**

Weight of the circular caves

Ø = 200 7x caves $Ø_m$ = 15m

W_{Caves} = 30 m² x 7 = 210 m² x 0,52 = **150 kg**

$W_{Spectra\ cables}$ (3mm) 4,2 g/m ≈ 11.500 m x 4,2 ≈ **50 kg**

$W_{of\ the\ 8\ PE\ balloons}$ = 6.087 m² ≈ **608 kg**

$W_{Preliminar\ structure}$ = 4.470 + 131 + 150 + 50 + 608 ≈ **5.410 kg**

Weight of the hydrogen:

Volume=15.567 m^3 x 0,1 kg/m^3 = 1.557 kg + (5% overpressure 420 mmca)

Weight of Hydrogen = **1.634 kg**

Aluminum profiles 0,3 kg/m Ø medium=10m P=30m

W =12 kg/rings x 40 = **480 kg**

Weight Total (sum) = 5.410kg + 1.634 kg +480 kg **≈ 7.525 kg**

$E_{máx}$ = 20.230kg

.: $E_{máx} - W_{total}$ = 20.230 – 7.525 **= 12.706 kg**

With a payload of 6.000 kg, we will have 6.706 kg for fuel and accessories.

Relationship between weight and thrust = 7.525/20.230 = **0,37**