



# FLIGHT MANUAL

Written by the manufacturer for hot air balloons

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## Balloon registration

Registration	
Serial no.	
Year of manufacturing	
Hot air balloon Type	
Envelope size	
Manufacturer	 <p>Gewerbegebiet Am Bahnhof 12 54338 Schweich Fon: + 49 6502 930 4 FAX: + 49 6502 930 500 <a href="http://www.schroederballon.de">www.schroederballon.de</a></p>
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This flight manual belongs to the hot air balloon specified above. It is always to be carried onboard. The operational limitations, instructions and processes defined in the manual are thoroughly complied to be with by the pilot. It is not permitted to carry out not specified operations.

The regulations, accident avoidance directives, rules and respective guidelines applicable to the operation of the liquefied petrol gas cylinders and the liquefied gas system are to be complied with in addition to the instructions of this flight manual.

The fuel cylinders must be approved for use in hot air balloons, re-fuelling as well as for road transport in accordance with the "Druckbehälterverordnung" and ADR regulations. The periodical required inspection is to be carried out by an official technical expert.

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### 1. General

#### 1.1. Weighing report

Registration / Serial no.			
Weighing date			
Inspector's signature			
Burner incl. load frame and rods			
Envelope			
Basket			
Minimum Equipment			
Maximale payload			
Maximum Take Off Mass = Empty weight + Payload			

The maximum take-off weight stated in this weight report is authoritative, e.g. for the insurance category.

The maximum weight stated in the inspection report is a theoretically determined value and calculated in the type certification documentation.

The actual take-off weight depends on the empty weight and the basket size.

### 1.2. Data matrix 1200 m<sup>3</sup> – 1899 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	1200-1299				1300 - 1699								1700 - 1899																
Burner	Single- or double burner				Single- or double burner								Single- or double burner																
Deflation system	Parachute or Paraquick				Parachute or Paraquick								Parachute or Paraquick																
Basket size	M/2	I/2			M/2	I/2	II/3	III/4					M/2	II/3	III/4	IV/5													
Empty weight [kg]	100	115			115	130	135	140					130	150	155	160													
Maximum mass [kg]	378				409								535																
Fuel cylinders [qty]	5	4	5	3	5	4	5	3	7	5	4	8	6	5	3	5	4	7	5	4	8	6	5	3	11	8	6	5	4
Occupants [qty]	1	2	1	2	1	2	1	2	1	2	3	1	2	3	4	1	2	1	2	3	1	2	3	4	1	2	3	4	5
max. payload [kg] (occupants & fuel cylinders)	406		316		406		316		406		474		406		406		474		530										
Min. landing mass [kg] incl. fuel reserve	180				230								255																

Table 1-1: Data matrix for envelope volume 1200 m<sup>3</sup> to 1899 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.3. Data matrix 1900 m<sup>3</sup> – 2199 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	1900 - 1999										2000 - 2199																							
Burner	Single- or double burner										Single- or double burner																							
Deflation system	Parachute or Paraquick										Parachute or Paraquick																							
Basket size	M/2	M/3	II/3	III/4	IV/5						M/2	M/3	II / 3	III / 4	IV / 5																			
Empty weight [kg]	135	140	155	160	165						140	145	160	165	170																			
Maximum mass [kg]	599										630																							
Fuel cylinders [qty]	5	4	6	5	4	7	5	4	8	6	5	3	8	6	5	2	5	4	6	5	4	7	5	4	8	6	5	3	11	8	6	5	4	
Occupants [qty]	1	2	1	2	3	1	2	3	1	2	3	4	1	2	3	4	5	1	2	1	2	3	1	2	3	1	2	3	4	1	2	3	4	5
max. payload [kg] (occupants & fuel cylinders)	406		450		406		474		530		406		450		406		474		530															
Min. landing mass [kg] incl. fuel reserve	275										290																							

Table 1-2: Data matrix for envelope volume 1900 m<sup>3</sup> to 2199 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

The M/2 basket can be used for envelopes up to 2200 m<sup>3</sup> include.

The M/3 basket can be used for envelopes up to 2600 m<sup>3</sup> included.

### 1.4. Data matrix 2200 m<sup>3</sup> – 2599 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	2200 - 2399				2400 - 2599			
Burner	Doppelbrenner				Doppelbrenner			
Deflation system	Parachute or PARAQUICK				Parachute or PARAQUICK			
Basket size	M/3	II / 3	III / 4	IV / 5	M/3	III / 4	IV / 5	V / 5 V-A / 5
Empty weight [kg]	150	165	170	175	155	175	180	185
Maximum mass [kg]	690				755			
Fuel cylinders [qty]	6 5 4 7 5 4 8 6 5 3 11 8 6 5 4					6 5 4 8 6 5 3 11 8 6 5 2 8 6 5 2		
Occupants [qty]	1 2 3 1 2 3 1 2 3 4 1 2 3 4 5					1 2 3 1 2 3 4 1 2 3 4 5 1 2 3 4 5		
max. payload [kg] (occupants & fuel cylinders)	450	406	474	530	450	474	530	598
Min. landing mass [kg] incl. fuel reserve	315				340			

Table 1-3: Data matrix for envelope volume 2200 m<sup>3</sup> to 2599 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.5. Data matrix 2600 m<sup>3</sup> – 3099 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	2600 - 2899				2900 - 3099			
Burner	Double burner				Double burner			
Deflation system	Parachute or Parachute & Velcro or PARAQUICK				Parachute or Parachute & Velcro or PARAQUICK			
Basket size	III/4	IV/5	V/5 V-A		III/4	IV/5	V/5 V-A	VI/6
Empty weight [kg]	185	190	195		195	200	205	210
Maximum mass [kg]	820				910			
Fuel cylinders [qty]	8 6 5 3 11 8 6 5 4 11 8 6 5 4					8 6 5 3 11 8 6 5 4 11 8 6 5 4 11 9 8 7 4		
Occupants [qty]	1 2 3 4 1 2 3 4 5 1 2 3 4 5					1 2 3 4 1 2 3 4 5 1 2 3 4 5 2 3 4 5 6		
max. payload [kg] (occupants & fuel cylinders)	474	530	598		474	530	598	700
Min. landing mass [kg] incl. fuel reserve	370				420			

Table 1-4: Data matrix for envelope volume 2600 m<sup>3</sup> to 3099 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.6. Data matrix 3100 m<sup>3</sup> – 3600 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	3100 - 3299											3300 - 3600																		
Burner	Double burner											Double burner																		
Deflation system	Parachute or Parachute & Velcro or PARAQUICK											Parachute or Parachute & Velcro or PARAQUICK																		
Basket size	IV/5		V/5 V-A			VI/6						IV/5		V/5 V-A			VI/6													
Empty weight [kg]	215		220			225						230		235			240													
Maximum mass [kg]	975											1040																		
Fuel cylinders [qty]	11	8	6	5	2	11	8	6	5	4	11	9	8	7	4	11	8	6	5	2	11	8	6	5	4	11	9	8	7	4
Occupants [qty]	1	2	3	4	5	1	2	3	4	5	2	3	4	5	6	1	2	3	4	5	1	2	3	4	5	2	3	4	5	6
max. payload [kg] <small>(occupants &amp; fuel cylinders)</small>	530		598			700						530		598			700													
Min. landing mass [kg] <small>incl. fuel reserve</small>	455											495																		

Table 1-5: Data matrix for envelope volume 3100 m<sup>3</sup> to 3600 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.7. Data matrix 4000 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	4000																								
Burner	Double or triple burner																								
Deflation system	Parachute or Parachute & Velcro or PARAQUICK																								
Basket size	IV/5		V/5 V-A			VI/6						VII/7			VIII/8										
Empty weight [kg]	206 to 249 240 to 271		213 to 256 235 to 266			225 to 268 247 to 278						237 to 280 259 to 290			259 to 340 281 to 360										
Maximum mass [kg]	1260																								
Fuel cylinders [qty]	11	8	6	5	2	11	8	6	5	4	11	9	8	7	4	12	11	9	7	4	14	12	10	9	6
Occupants [qty]	1	2	3	4	5	1	2	3	4	5	2	3	4	5	6	3	4	5	6	7	4	5	6	7	8
max. payload [kg] <small>(occupants &amp; fuel cylinders)</small>	530		598			700						815			975										
Min. landing mass [kg] <small>incl. fuel reserve</small>	600																								

Table 1-6: Data matrix for envelope volume 4000 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.8. Data matrix 4250 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	4250																								
Burner	Double or triple burner																								
Deflation system	Parachute or Parachute & Velcro or PARAQUICK																								
Basket size	IV/5				V/5 V-A				VI/6				VII/7				VIII/8								
Empty weight [kg]	206 to 249 240 to 271				213 to 256 235 to 266				225 to 268 247 to 278				237 to 280 259 to 290				259 to 340 281 to 360								
Maximum mass [kg]	1340																								
Fuel cylinders [qty]	11	8	6	5	2	11	8	6	5	4	11	9	8	7	4	12	11	9	7	4	14	12	10	9	6
Occupants [qty]	1	2	3	4	5	1	2	3	4	5	2	3	4	5	6	3	4	5	6	7	4	5	6	7	8
max. payload [kg] (occupants & fuel cylinders)	530				598				700				815				975								
Min. landing mass [kg] incl. fuel reserve	640																								

Table 1-7: Data matrix for envelope volume 4250 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.9. Data matrix 4500 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	4500																				
Burner	Double or triple burner																				
Deflation system	Parachute or Parachute & Velcro or PARAQUICK																				
Basket size	VI/6				VII/7				VIII/8				VIII/9								
Empty weight [kg]	240 to 280 260 to 290				251 to 290 273 to 300				273 to 350 295 to 370				279 to 370 301 to 380								
Maximum mass [kg]	1410																				
Fuel cylinders [qty]	11	9	8	7	4	12	11	9	7	4	14	12	10	9	6	15	14	12	11	9	6
Occupants [qty]	2	3	4	5	6	3	4	5	6	7	4	5	6	7	8	4	5	6	7	8	9
max. payload [kg] (occupants & fuel cylinders)	700				815				975				1065								
Min. landing mass [kg] incl. fuel reserve	670																				

Table 1-8: Data matrix for envelope volume 4500 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.10. Data matrix 5000 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	5000																	
Burner	Double or triple burner																	
Deflation system	Parachute oder Parachute & Velcro or PARAQUICK																	
Basket size	VII/7					VIII/8						VIII/9						
Empty weight [kg]	284 to 360					306 to 395						312 to 415						
Maximum mass [kg]	1575																	
Fuel cylinders [qty]	12	11	9	7	4	14	12	10	9	6	15	14	12	11	9	6		
Occupants [qty]	2	3	4	5	6	3	4	5	6	7	4	5	6	7	8	9		
max. payload [kg] (occupants & fuel cylinders)	815					975						1065						
Min. landing mass [kg] incl. fuel reserve	780																	

Table 1-9: Data matrix for envelope volume 5000 m<sup>3</sup>

### 1.11. Data matrix 6000 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	6000																						
Burner	Triple or quad burner																						
Deflation system	Parachute oder Parachute & Velcro or PARAQUICK																						
Basket size	VII/7					VIII/8						VIII/9					IX/11						
Empty weight [kg]	292 to 370					298 to 410						320 to 430					369 to 440						
Maximum mass [kg]	1890																						
Fuel cylinders [qty]	12	11	9	7	4	14	12	10	9	6	15	14	12	11	9	6	17	15	14	12	9	8	6
Occupants [qty]	3	4	5	6	7	4	5	6	7	8	6	7	8	9	10	11	5	6	7	8	9	10	11
max. payload [kg] (occupants & fuel cylinders)	815					975						1065					1200						
Min. landing mass [kg] incl. fuel reserve	930																						

Table 1-10: Data matrix for envelope volume 6000 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.12. Data matrix 7000 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	7000																														
Burner	Triple or quad burner																														
Deflation system	Parachute oder Parachute & Velcro or PARAQUICK																														
Basket size	VIII/9					IX/11					X/13					X/15															
Empty weight [kg]	410 to 470					390 to 460					570 to 690					570 to 690															
Maximum mass [kg]	2205																														
Fuel cylinders [qty]	15	14	12	11	9	6	17	15	14	12	9	8	6	18	17	16	15	13	12	10	6	19	17	16	14	13	11	10	8	7	5
Occupants [qty]	4	5	6	7	8	9	5	6	7	8	9	10	11	6	7	8	9	10	11	12	13	6	7	8	9	10	11	12	13	14	15
max. payload [kg] (occupants & fuel cylinders)	1065					1200					1430																				
Min. landing mass [kg] incl. fuel reserve	1060										1070																				

Table 1-11: Data matrix for envelope volume 7000 m<sup>3</sup>

The basket payload can only be used up until the maximum weight has been reached.

### 1.13. Data matrix 8500 m<sup>3</sup>

The minimum crew for all baskets is 1 Person.

Volume [m <sup>3</sup> ]	8500																								
Burner	Triple or quad burner																								
Deflation system	Parachute oder Parachute & Velcro or PARAQUICK																								
Basket size	IX/11					X/13					X/15														
Empty weight [kg]	390 to 460					570 to 650					570 to 650														
Maximum mass [kg]	2205																								
Fuel cylinders [qty]	17	15	14	12	9	8	6	18	17	16	15	13	12	10	6	19	17	16	14	13	11	10	8	7	5
Occupants [qty]	5	6	7	8	9	10	11	6	7	8	9	10	11	12	13	6	7	8	9	10	11	12	13	14	15
max. payload [kg] (occupants & fuel cylinders)	1200					1430																			
Min. landing mass [kg] incl. fuel reserve	1300																								

Table 1-12: Data matrix for envelope volume 8500 m<sup>3</sup>

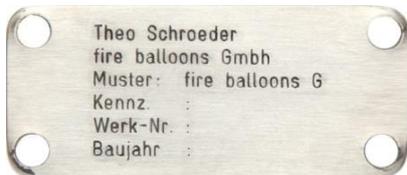
The basket payload can only be used up until the maximum weight has been reached.

### 1.14. Type plates of the components

The main identification plate of the balloon is riveted onto the middle of panel 1, gore 18 of the envelope. It is made from fireproof stainless steel. The most important data engraved are the manufacturer's serial number, registration, year of construction. This plate is valid for the complete aircraft. On the secondary component plates can be seen which components belong to this balloon:



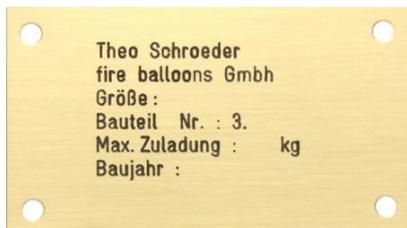
Picture 1-2: Crownring



Picture 1-3: Envelope type plate



Picture 1-4: Burner type plate



Picture 1-5: Basket type plate



Picture 1-6: Cylinder type plate

#### Crown ring

The component identification plate of the envelope is engraved in the crown ring. It specifies envelope size, year of construction, manufacturer's serial number and manufacturer.

#### Envelope

The main type plate of the balloon is riveted the middle of panel 1, gore 18 of the envelope. It declares Manufacturer, Type, registration of the balloon, serial number of the envelope and the year of manufacturing.

#### Burner

The burner type plate specifies Manufacturer, burner type, serial number and the year of manufacturing.

#### Basket

The basket type plate describes the basket type, serial number, maximum payload, and year of construction. In older plates you can also find the registration of the balloon.

#### Fuel cylinder

Fuel cylinder type plates are, depending on the year of manufacture, equipped with different information. A minimum contains serial number, manufacturer, volume, testing pressure, Seal of the authorized expert, year of manufacture and weight.

#### Flight instruments

Flight instruments are fitted with type plates showing serial numbers manufacturer and type.

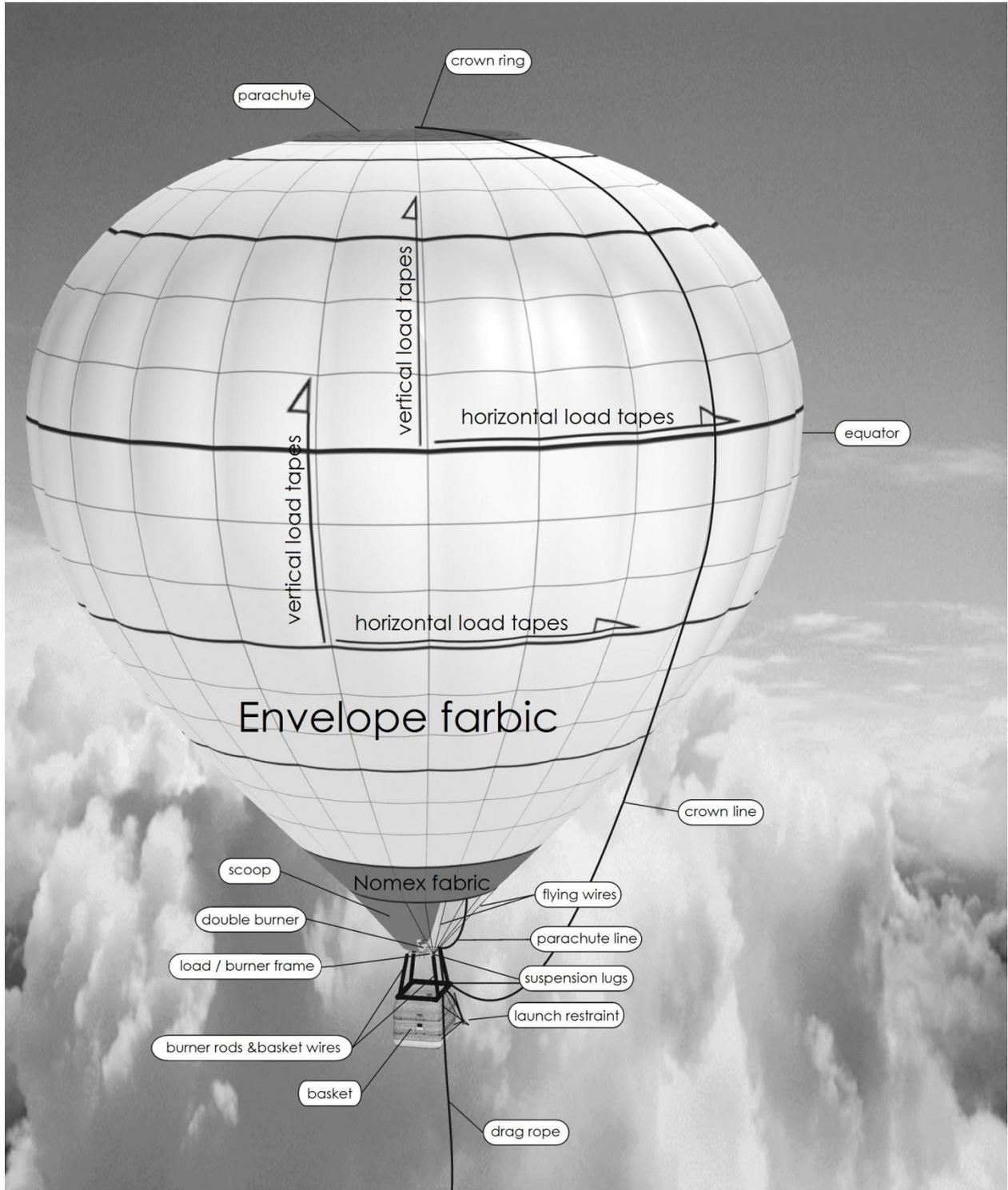
All parts fitted to the envelope (main component) must be specified in the inspection documentation. Alternatively used component must also be mentioned in the annual / 100 hour inspection report. All equipment not presented for the inspection must not be used until inspected.



## 2. Technical description (components of the balloon)

The balloon consists of many parts which are described in the current Chapter 2.

### 2.1. Balloon structure



Picture 2-1: Structure of the balloon



## 2.2. Envelope

The envelope is used to contain the heated air and to provide the resulting lifting force. The requested requirements of the envelope are air-tightness, high tensile strength and low weight. Furthermore, the fabric should resist mould and mildew as long as possible. The envelope fabric is made of high tensile nylon weave with a polyurethane or silicone coating. In general, the coating is applied to the inside of the fabric except for silver or gold fabrics. Due to the fine pores of the weave, the coating can penetrate all the way through the fabric's weave and completely encloses the thread.

At the beginning, the tensile strength of a 5 cm wide strip is approx. 65 daN (65 kp) for standard fabrics. The upper envelope edge and the parachute edge are made of an optional fabric of higher tensile strength, the Thermogrip fabric. The edge of the parachute or Paraquick reaches into the envelope and gets in touch with the hotter air of the balloons inner air. All other fabric is approx. 20°C cooler than the inside of the envelope due to the heat dissipation through the fabric. A "cool" barrier layer that surrounds the inner hot air core results from the dissipation.

Optionally, larger areas of the balloon can be equipped with the stronger Thermogrip fabric. The Thermogrip fabric withstands higher temperatures, more hours of UV radiation and moisture but its weight is the disadvantage.

### **The greatest dangers for the envelope fabric are exceeded temperature, UV radiation as well as moisture.**

The inner pressure starts at the bottom envelope mouth aperture at 0 N/m<sup>2</sup> and increases steadily upwards up to approx. 50 N/m<sup>2</sup> (approximately 5 mm hydrostatic head) depending on balloon height and the difference of inner and outer temperature.

The Envelope is sewn together with 24 or 16 vertical gores and up to 25 horizontal panels in height. The edges of the gores are sewn together onto vertical load tapes. After every third horizontal panel there is a load tape sewn onto the double lap seam of the panels. These rip stoppers are installed in order to stop big growing tears in the fabric. This prevents large holes in the envelope and great lift loss when damaged during flight. Counting the gores and rows of the balloon you can see the envelope is made of some hundred single fabric panels. The lower part of the envelope and the scoop are made of heat-resistant Nomex® fabric.



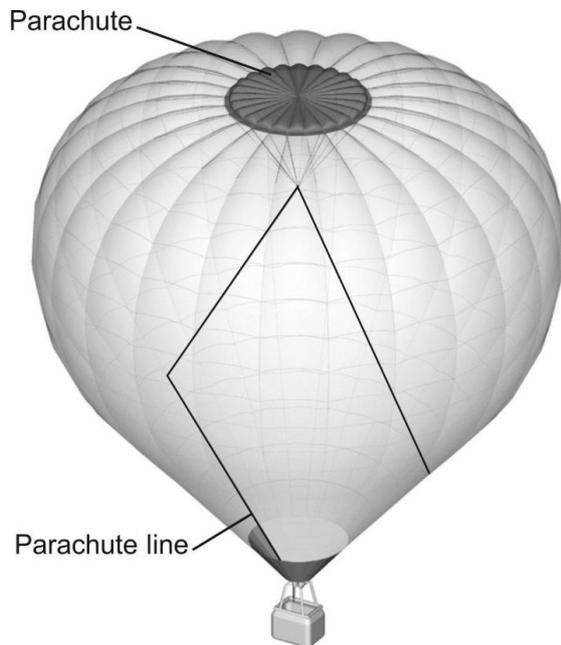
Picture 2-2: Fabric rolls



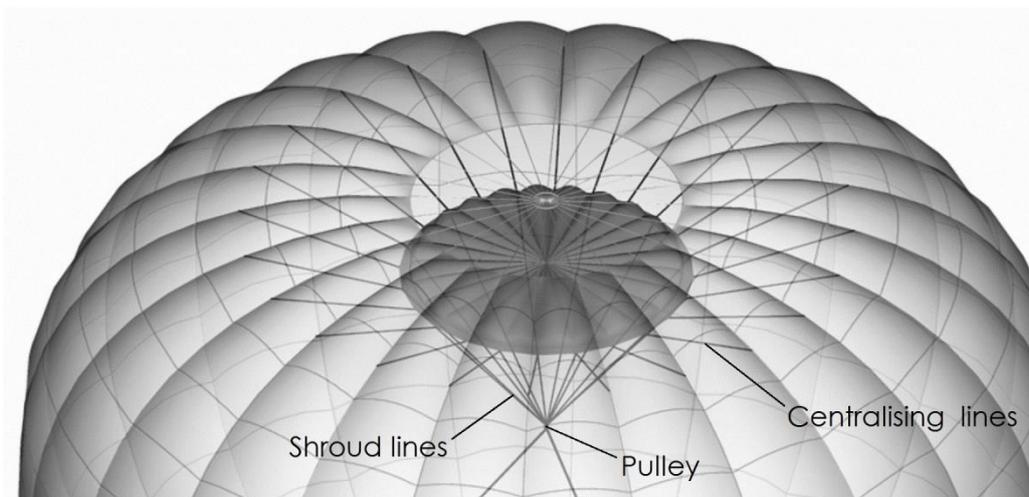
## 2.2.1. Parachute

The Parachute is the commonly used deflation system for hot air balloons nowadays. The parachute is the main valve of the balloon and used to release hot air from the envelope. It is centred in the inside with centre lines going from its edge to the envelope. The centre lines are made of fibres that show only little contraction due to heat and moisture in order to keep the parachute in the right position and the lines loose enough to make sure that the envelope can be closed right by the parachute. The parachute closes the top when hot inflated by the pressure of the hot air. Before inflation the parachute is attached to the envelope with velcros in order to keep it in position and closed.

There are Shroud lines attached to the parachute edge going down to a centralised point where they are attached to a pulley. The Parachute operating line is redirected by this pulley. It starts at a load tape in the lower part of the envelope where it is fixed with a loop, runs through the shroud pulley to the opposite side of the fixation all the way down in the envelope where a second pulley redirects the line for the pilot through the load frame into the basket. Pulling this red parachute line, makes the parachute move downwards. This enables the warm air to exit the envelope in a controlled manner. The balloon loses lift and loses height. The pressure causes the parachute to go back up again after letting go of the line. This closes the envelope again. During the landing, the Parachute must be pulled so that a rapid deflation causes the balloon to lose enough lift to make it stop as quick as possible.



Picture 2-3: Parachute



Picture 2-4: Parachute system

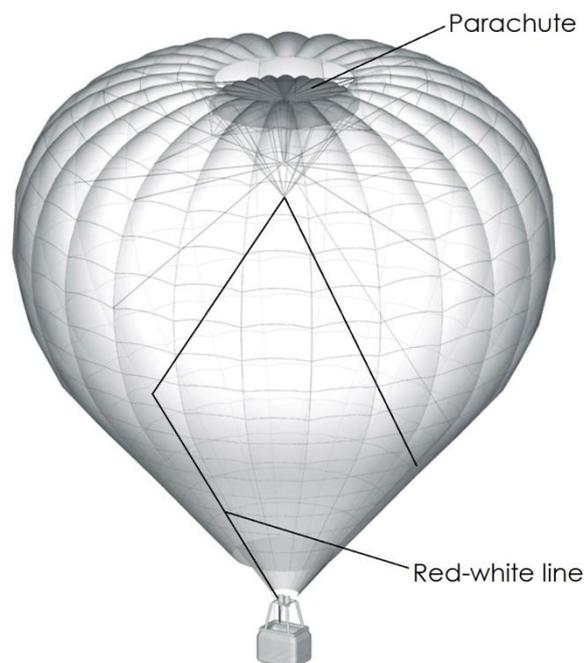


## 2.2.2. Paraquick – fast deflation

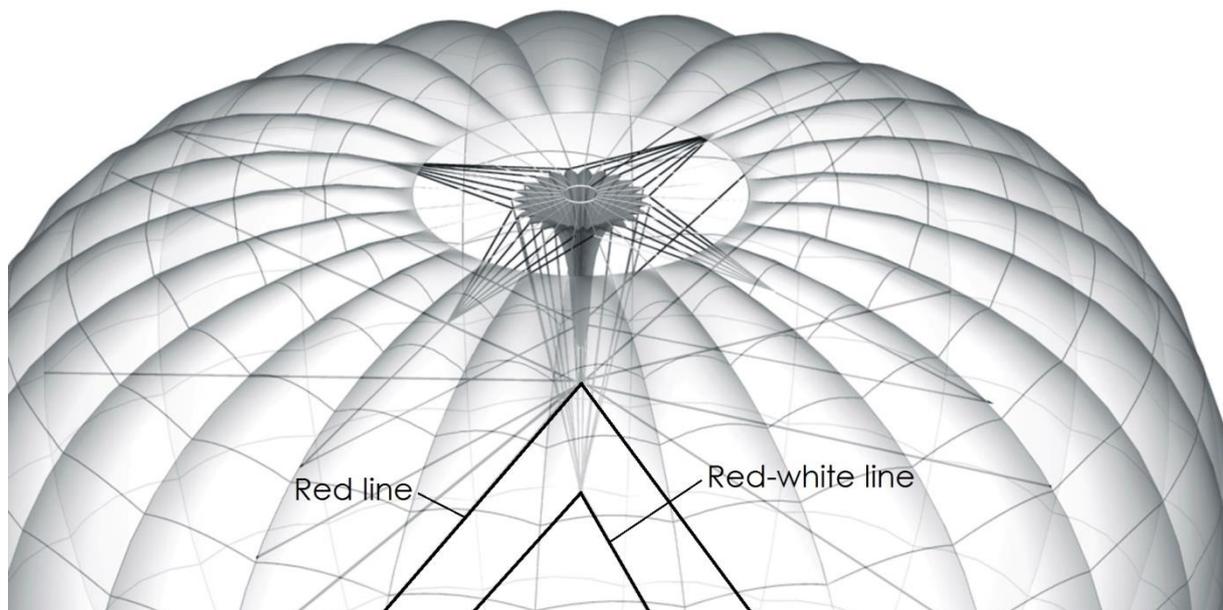
(Smart-Vent system, licensed by Kavanagh)

This valve shows two functions combined into one system:

- a. **Controlled ventilation during flight and final landing at calm winds on the ground using the red-white line.** This part of the system has the same functionality as the standard parachute. The Paraquick is automatically centered and fitted air tight by the system of lines, so that the paraquick is always centred, even in gusty conditions.
- b. **Fast deflation for the final landing by operating of the red line.** This line must only be operated for the final landing. The envelope deflates very fast with this part of the Paraquick system. If the Parachute needs to be closed again, the red – white line must be operated in order to pull the Paraquick back into position and seal the valve.



Picture 2-5: Red - white line for Paraquick



Picture 2-6: Paraquick Detailansicht



There is an automatic line clamping device installed to the burner frame to avoid unintentional operation. During flight, the mechanism is locked so that the red line can't be pulled down to open the Paraquick system.

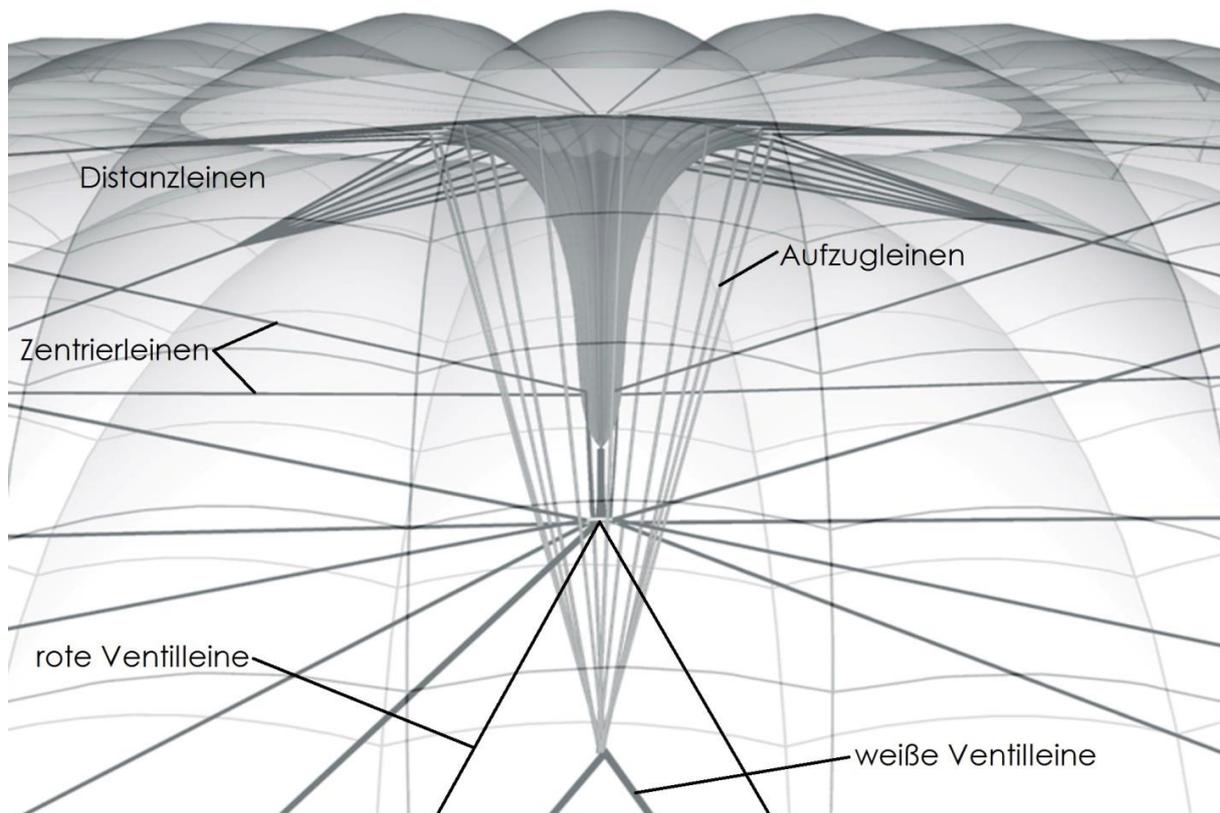
To avoid tensile forces in the red line caused by the deformation of the balloon, the line can slide through the automatic clamp as mentioned before. Directly before landing, the lever of the clamp must be released, so that the line can be operated when needed. To avoid inadvertent opening, the movement of the line downwards is blocked.

For the pilot it is very important to get familiar with the way of operating the system. Every pilot must operate the Parachute- as well as the Paraquick line a few times with the balloon still on the ground. For the "system training" it is important that the envelope is heated up again after every single operation. Otherwise the envelope might collapse very quickly and will drop onto the burner.

If the envelope should accidentally collapse, all burner valves must be closed immediately, pilot light included, and the burner must be covered with the fire blanket in order to avoid contact of the envelope with the burner coils.

**Important notice:**

**Generally, the red line of the Paraquick must not be operated during flight, except for the final landing.**



Picture 2-7: Paraquick system



## 2.2.3. Operation notice to Paraquick system



1. Prior to the rigging of the balloon, attach the fast deflation locking mechanism to the burner frame, connect the hook of the line and close the lever of the securing mechanism. Fit Paraquick line.
2. Visual check that the lines are not twisted inside the envelope.
3. It is paramount to pull the white line until all Velcro(r) taps are open prior to take-off.
4. Use only the white line for venting during flight (except at the final landing).

Picture2-8: Paraquick

5. The lever of the fast deflation securing fully opened before the landing. The red shortly above ground to avoid a hard open the Paraquick system 10 m above rate of descent (e.g. 2 m/s).

The pilot has to find the correct controlled



clamp locked

mechanism must be line must only be pulled the ground with a high

operation by practice.

Picture 2-9: Paraquick clamp open

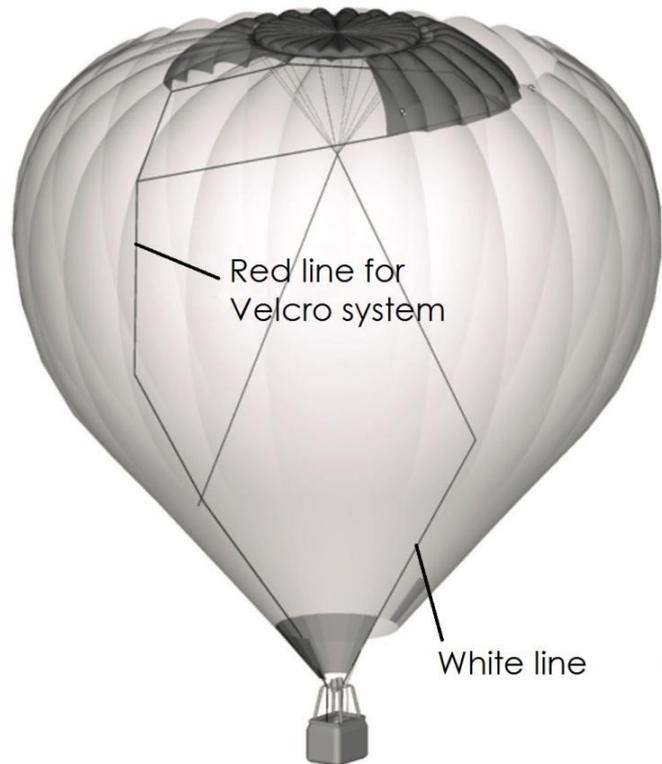
### Important notice:

**The ballon with rapid deflation system must not be left to an unfamiliar pilot without training.**



## 2.2.4. Parachute – Velcro™ – System

The velcro system is an old system that was used for big balloons before the Paraquick system came up. It is effective though requires more effort in its use than the Paraquick. Therefore it was more and more replaced by the Paraquick system. A parachute as described before is installed in the centre. This parachute has a smaller diameter than today's standard Parachute. Using the parachute, venting is possible without excessive force. Even landing at calm winds is no problem. For rapid deflation a rip panel is installed 13 panels wide around the parachute which is fixed to the envelope with Velcro tapes before the start. The rip panel is secured by three locks. In order to unlock the locks, the red line must be pulled. The locks release the rip panel from the envelope and open the top of the envelope. The opening can be opened by pulling the red line all the way until all Velcros are released all over the 13 gores.



Picture 2-10: Velcro rip panel system

The rip panel

**Once the panel is opened it cannot be closed again during flight. It must only be used for landing, preferably at strong winds.**

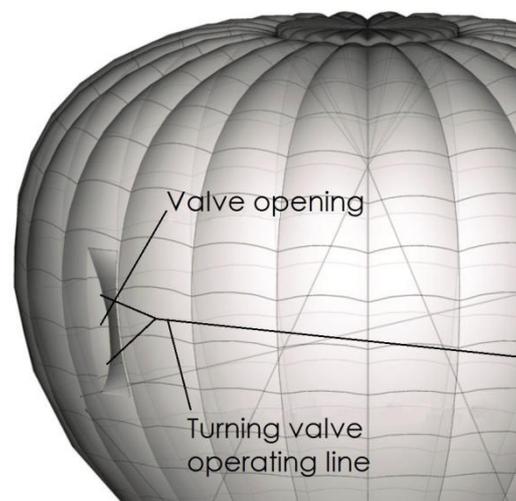
The lines have different colours in order to differentiate the function. **The Parachute line is red-white or white** and the line of **the rip panel is red** for all FDS system.

## 2.2.5. Turning valve

One or two turning valves are installed in equator height to be able to rotate the balloon around its own axis. When operating the turning valve line, warm air escapes tangentially and therefore produces a momentum initiating the rotation. Main aim at bigger balloons is to enable the landing always to be with the long side of the basket. Often, two counter-operating vents are installed so that a left or a right rotation can be made. To distinguish the two directions, the operating lines are colour coded.

**Right rotation: blue line / black line**

**Left rotation: green line.**



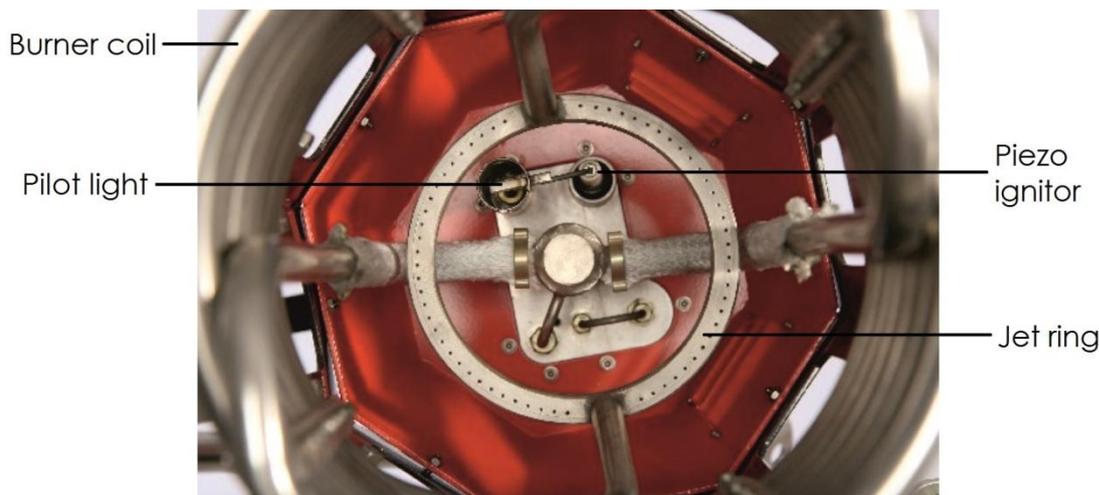
Picture 2-11: Turning valve



### 2.3. Heating system

The heating system assembly consists of many miscellaneous parts. Its function is to heat up the air mass inside the envelope in order to control the rate of climb or descent. The components of the assembly are the burner, hoses and fuel cylinders. This chapter describes these components in detail.

#### 2.3.1. Burner



Picture 2-12: Burner view from above inside

The burner is an atmospheric gas burner for liquefied propane. Propane builds up a pressure through vaporization inside the pressure vessels (fuel cylinders). At normal temperatures the pressure inside a cylinder is approx 6 bars. This pressure drives the liquid propane through the open liquid take off of the cylinder and the hose of the burner into the valve block of the burner. By opening the main blast valve, the liquefied gas is flows through the valves into the coil of the burner.

The liquefied gas can start vaporizing in the pipes of the coil and leaves the coils through the holes of the jet ring. The discharged gas, partly vaporized and liquefied, is ignited by the lit pilot light and heats up the coils because the vaporization needs lots of energy.

The burners are depending on the size of the envelope designed as single, double triple or quad burners.

The correlation between the burner configuration and the envelope size can be taken from the data matrices in Chapter 1.

**Every single burner of a balloon is fed separately. There is one fuel cylinder connected to each burner. Single burners contain a second system. There is also two cylinders attached to it.**

The power of a single burner is sufficient for all emergencies of the balloon. All fuel lines and other functional elements are redundant. The safety level is not reduced at all!

The health of pilots, occupants and animals are spared by the new, low noise emitting burner generation of Theo Schroeder fire balloons. The reduction of noise is definitely audible and some pilots believe that the reduction of noise is also a reduction of power. That can only be declared as a subjective perception.

The annoying, sooty condensate water dripping down from the coils onto passengers and crew belong to the past.



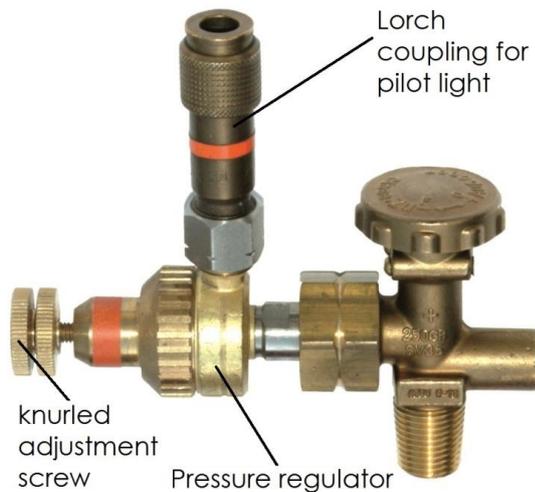
## 2.3.2. Pilot light

The ignition of the main flame of each burner is by a pilot light working by the Bunsen-principle. It is fed from the vapour phase of the fuel cylinder (vapour pressure cushion) by a proven system. The size of the flame is maintained stable and continuously strong independent of the gas pressure via a pressure regulator.

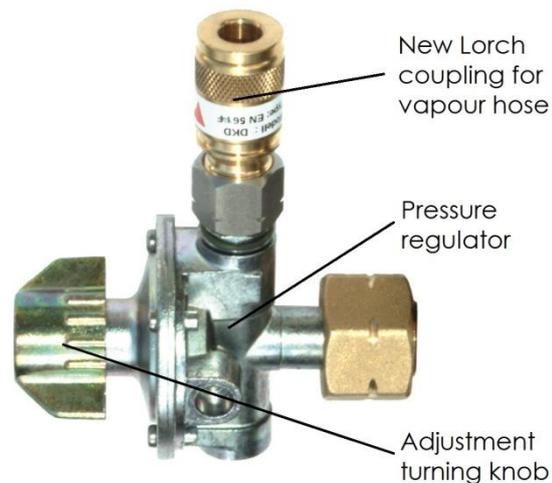
The size of the flame can be adjusted using a knurled screw and fixed by a counter nut.

The ignition of the pilot lights is done by piezo-electric igniter integrated in the burner (see picture, operating controls FB 6 page 2-10)

This is a reliable system with decades of trouble free operation in all heights and temperatures.



Picture 2-13: Pilot light regulator; Lorch



Picture 2-14: Pilot light regulator; Schroeder fire balloons

## 2.3.3. Fuel lines

The vaporous fuel as well as the liquid fuel is transported through rubber hose lines from the fuel cylinder to the burner. The hoses are armoured with a stainless steel braid and have a high burst pressure and tensile strength. The burst pressure is more than fifty times higher than the maximum operating pressure. The hose couplings on both ends are pressed in a specified process in the factory and can be delivered with different connection adapters. All hoses are routed to the burner along the burner support rods inside the leather cushions.

## 2.3.4. Load-/ burner frame

The load- or burner frame is made of stainless steel. It is square shaped and available in two sizes depending on the basket size. The Sizes are 730 mm and 1030 axle to axle. It consists of the load frame and the cardan frame that holds the burner. These two frames allow a slewing of the burner in almost every direction when wind conditions cause the envelope to constantly change position.

The two frames are available with either hydraulic or mechanical height adjustment for double burner. For triple or quad burner there is only the mechanical height adjustment available due to static issues. The hydraulic height adjustment is continuous adjustable.

The burner and frame are supported by Nylon rods that find their position in burner sockets of the basket and burner frame.



### 2.3.5. T-piece Manifolds (see also Appendix A)

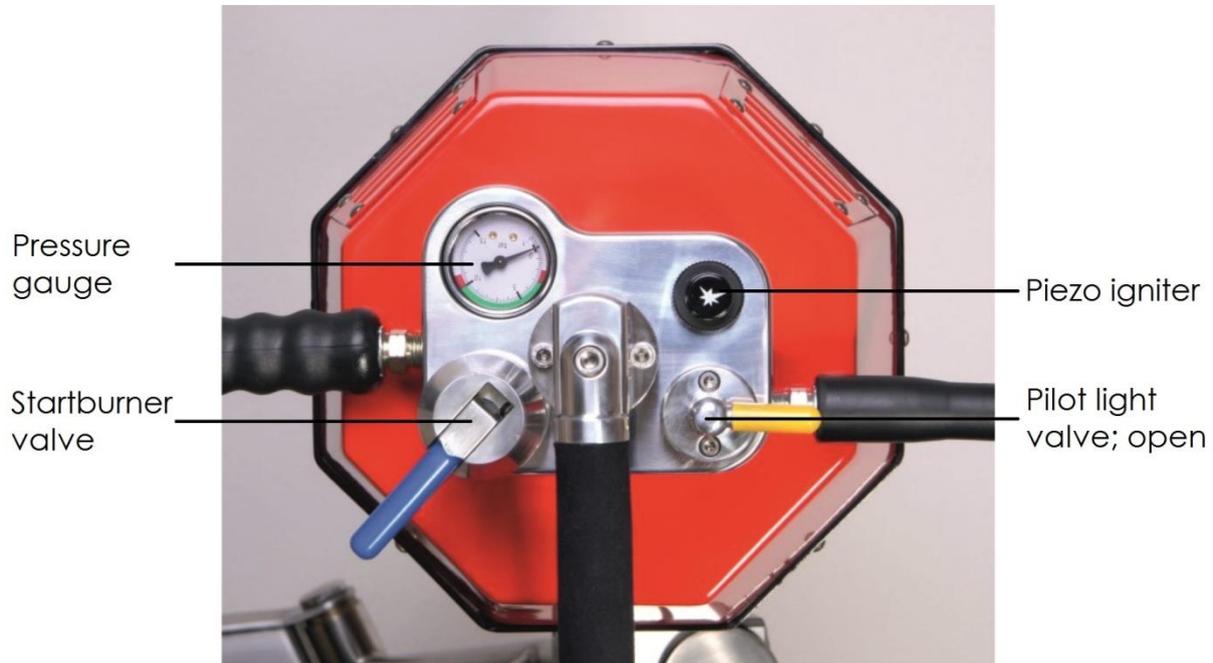
Fuel line manifolds are used to connect two or three fuel cylinders with the burner. Master fuel cylinders as well as slave fuel cylinders can be connected. It is very important to meet the following condition:

1. All parts of the fuel system must be original Schroeder fire balloons parts.
2. There must only be one fuel cylinder opened at a time! Never open two cylinders at the same time connected to one T-piece Manifold! In case two cylinders are opened at one T-Manifold, overfilling of one of the two can occur. Liquefied gas can flow from the cylinder with higher pressure into the cylinder with lower pressure. The safety volume of the cylinder will vanish if gas flows into a filled cylinder and represent a great danger.
3. If less fuel cylinders are used, the not connected couplings must be secured using original blanking fittings. This is necessary to avoid gas leaking if the non-return valve of a coupling should fail.
4. The hoses are to be routed and fastened below the basket top frame in a way that they do not project into the passenger area and therefore minimising the danger of hose rupture during a hard landing.
5. The SCHROEDER fire balloons operation information plate must be glued to every fuel cylinder.
6. The manufacturers serial number of the balloons must be embossed into the t-piece (see also Appendix A, schematic drawing fuel line manifold).



## 2.3.6. Operating instructions FB 6 burner (see also Appendix A)

Operating Instruments:



Picture 2-15: Operating controls FB 6

The FB 6 is a burner which has an enormous power especially in the lower pressure range and which is very quiet. For inflation, the burner should be installed in that way that the piezo-igniters are positioned at the bottom when the basket is lying. Then, the take-off valve (symbol "start") is at the top right during inflation; at the top left is the cow burner valve (cow symbol) at the second burner.

As with any other burner, the best precondition for a problem-free inflation is an envelope fully filled with cold air. For that, the fabric must be dragged wide apart at the bottom so that the folds do not prevent a complete expansion of the envelope.

The main burner has a wider flame in the lying position, caused by the newly applied burner technology. With this system with its many advantages, the inflation must be carried out a bit different than with conventional burners.

At the begin of the heating phase of the inflation, the evaporation coil is still cold and too much liquefied gas enters the combustion area in the multiple jet burners. To avoid this, the following method should be adopted:

1. The blue take-off valve is at the top for better operation.
2. Never open only the take-off valve over a longer period of time without operation of the associated blast valve. The coils could start to glow which may cause damage.
3. Never inflate downhill, as the end of the dip tube is then situated in the vapour phase, or using half empty fuel cylinders. The coils will start to glow as they can be no longer cooled by the liquefied gas. The flame becomes short and blue. The burner becomes noisy and loses power. If a downhill inflation cannot be avoided, one helper must lift the burner with the basket lightly for the dip tube end to be in the liquid phase.

**2.3.7. 3 Phases of hot inflation with FB 6 and FB 7 burner** (see also Appendix A)**Phase I**

First, burn patiently in short intervals of 5 to 10 seconds (depending on envelope size and fuel pressure) using the blue take-off valve and by making pauses, allow the envelope to expand fully with the inflation fan running.

**Phase II**

Open the Startburner valve fully and keep open for longer periods of time but at the same time, open and close the blast valve of the same burner. That means that the blue Startburner valve remains open for a period of time of e.g. 10 to 30 seconds (depending on fuel pressure and envelope size), but at the same time period, the blast valve is operated in short intervals a few seconds. By adding the blast valve, more liquid fuel flows through the coil so that it is cooled sufficiently.

**Phase III**

Now the burner is heated so well that the flame becomes narrower. The last heating phase can be done using only the blast valve.

After a little practice, the pilot will recognize when the burner is sufficiently heated up and phase III starts.

During the following flight it is noticeable that the power of both burners is a little bit different at the beginning. This is due to the inflation process and is normal.

Only the blast valves are used during flight. Attention is to be paid that the valves are opened wide enough as otherwise significant condensation could develop in the valve caused by the expansion. This makes the O-rings less elastic. Furthermore an after burning develops as the very cold remaining liquefied gas only evaporates very slowly. If it is desired to fly very controlled and precise, it is better to operate the valve in shorter intervals or at least half open rather than continuously only a small bit opened. At sudden power demand both blast valves can be operated with one hand. When the pilot decided to land, the pilot light must be extinguished shortly before touch down to minimize the risk of ignition in case of a fuel leak.



### 2.3.8. Instructions for solenoid valves (see also Appendix A)

Optionally, Schroeder fire balloons offers the possibility to operate the burner electrically via remote control. Therefore, a solenoid valve is installed parallel to the blast valve, the solenoid valve is to be shut off from the fuel flow by a shut-off valve, the burner is then operated manually using the blast valve.

The valve is opened by switching-on when pressing the button on the remote control. Without electrical power the solenoid valves are shut. To enable a fault free operation the accumulators must be fully charged before start of flight. If during flight no sufficient electrical power is available the solenoid valve cannot be opened anymore. The burner must now be operated manually using the main blast valve.

If, for any reason, the solenoid valve cannot be shut, the shut-off valve of the respective burner is to be shut. The burner can then be operated by using the main blast valve. When pressing both buttons of the remote control, both burners can be operated simultaneously.

### 2.3.9. Winterpower mode FB V burner (see also Appendix A)

Optionally a Winterpower valve is installed in both burners of the FB V. The Winterpower installation can be activated at low fuel pressures (symbol "snowman"). This results not only in a liquid fuel flow through the evaporation coil but also through the small jet ring of the whisper burner. The power increases significantly because of that. Caused by the high velocity of the liquid fuel exiting the jets surrounding air is swept along, suction develops. The "induction effect" of the main burner has a very stabilizing effect on the flame especially at low fuel pressures and also the noise level is decreased by further 3 dB. Nitrogen need only be used at extreme low fuel pressures and in not calm weather conditions. This of course is also depends on the balloon size. As ever, the basic principle remains that it is most advantageous to fly with warmed fuel as higher fuel pressures exist and the seals remain more elastic because of the attemperation.

#### **Notice:**

After landing, the Winterpower valve has to be shut (to position 0) to ensure that no flame can continue to burn. It must not be flown with the winter-power valve in an intermediate position.



## 2.4. Fuel cylinders

### 2.4.1. General

The heating system is supplied from fuel cylinders filled with propane according to DIN 5 1622 but with a maximum of 20% of butane. The fuel pressure depends on the fuel temperature and the butane concentration. Standard lightweight stainless steel cylinders type Schroeder fire balloons VA 50 and VA 70 are used. Alternatively, also fuel cylinder listed in the tables on page 2-28 can be used, providing that they have been inspected at a part or annual inspection. To avoid accidents, it is highly recommended to gain as much knowledge as possible about liquid fuel through technical literature. Also the brochure "The safe handling of liquid fuel" issued by the DFSV (German Balloon Federation) and the DAeC (German Aero Club)



2-16: Schroeder fuel cylinders

are very recommendable. The accident prevention instructions and the regulations for the operation of pressure vessels and liquefied gas installations picture are to be met.

### 2.4.2. Constellation of VA 50 and VA 70

The VA 50 and VA 70 are available in the following constellations:

VA 50	Empty weight incl. fittings [kg]	Weight when filled (80%) [kg]	Capacity [kg]	Nitrogen pressurisation
Slave cylinder	ca. 14,5	ca. 35,7	ca. 21,2	0,7 MPa (7 bar)
Master cylinder	ca. 14,9	ca 36,1	ca. 21,2	0,7 MPa (7 bar)*
VA 70	Empty weight incl. fittings [kg]	Weight when filled (80%) [kg]	Capacity [kg]	Nitrogen pressurisation
Slave cylinder	ca. 18	ca. 48	ca. 30	0,7 MPa (7 bar)
Master cylinder	ca. 18,3	ca 48,3	ca. 30	0,7 MPa (7 bar)*

Table 2-1: Schroeder fire balloons cylinders

Master cylinders are equipped with a pressure regulator for the pilot light.

\*Nitrogen pressurized Master cylinders are no save fuel cylinders for pilot lights. Pilot light might extinguish.



## 2.5. Fuel cylinder equipment

The Fuel cylinders are equipped with different parts. Each part will be explained in the next paragraphs.

### 2.5.1. Protective cover

The **protective cover** is not only for the protection of the occupants against injuries but also for the protection of the fuel cylinders against damages on the surface. The cylinder must not be used without these covers. Furthermore, the padding shall protect from too high fuel temperatures in summer and from too rapid cooling in winter. A very effective shock protection is the **padding of the cylinder top guard ring**, which Schroeder fire balloons introduced first as standard. Because of that, the danger of injury is reduced at hard landings.



Picture 2-17: Protective cover

### 2.5.2. PRV

A **pressure relief valve**, integrated into the vapour withdrawal valve at fireballoons fuel cylinders, shall avoid the cylinders to burst. At these fuel cylinders, the pressure relief val (safety valve) opens at approximate 3.5 MPa (35 bar) according to the German regulations. This limit is partly lower at fuel cylinders other manufacturers. The opening pressure is printed on every valve. In order to release as little dangerous heating energy as possible into the open when the safety device responds, the pressure relief valve leads always in the vapour phase and not in the liquid phase. This, of course, only applied if the cylinders stand upright. At reaching the set limit pressure, a spring is compressed and the stealing cone give the way free to the open. At slow pressure increase, e. g. an overfilled cylinder in the sun, the valve opens only partly and relieves only as much gas until the pressure is compensated and then closes again. Often the seal is then not absolutely tight and the valve must be replaced by a new one.



Picture 2-18: PRV

The situation is especially critical, if the safety valve opens because of flame engulfment as the fire is further fed by the strong gas jet



### 2.5.3. Bleed valve

**The bleed valve** indicates the maximum level of liquid during re-fuelling by the visible escape of liquefied gas. The re-fuelling process must be stopped at this point immediately. The fixed liquid level device consists of a shut-off valve with a liquid level tube soldered on, which length depends on the respective cylinder type. It is to ensure that the cylinder is filled up to a maximum of 80 % of liquefied gas. The shut-off valves should be re-tightened again after all fuel cylinders are filled. The bleed valve should be opened as little as required so that only little amount of gas can escape if a pressure pump is present at re-fuelling.



Picture

2-19: Bleed valve

**Furthermore, it is referred to the other relevant filling instructions. A bleed valve with a transparent drain hose can be used to lead the escaping further away from the fuel cylinder. Precaution is to be taken, that the drain hose is routed in wind direction away from the cylinder. In Switzerland, this re-fuelling in the basket is already approved. There, the end of the hose must be as far away from the basket so that no fuel can flow back through the basket walls.**

(Bold paragraph is valid in Switzerland only)

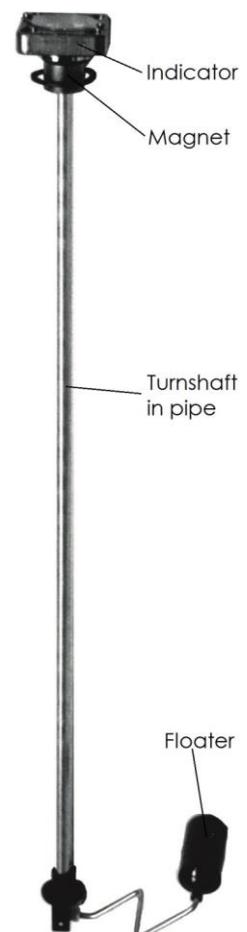
### 2.5.4. Contents gauge

**The contents gauge** consists of a floater, which transmits a rotation movement via a gear to a shaft, a magnet attached to the shaft and an indication unit. This visible part is completely disconnected from the lower part so that there is no danger of leaks. The dial only moves by the transmitted force of the magnet. Only the remaining quantities of fuel can be indicated due to the construction of the system.

At Schroeder fire balloons, **the pilot light** is fed from the vapour phase. All Schroeder fire balloons fuel cylinders are fitted with a **vapour withdrawal valve**, even if a pressure regulator is not necessarily fitted to feed the pilot light (only at master cylinders). Although it is possible to open the valve but a type-approved blanking piece, instead of the pressure regulator, prevents gas escaping. A short, bent withdrawal pipe is fitted to the vapour withdrawal valve, which ends at upper fuel cylinder rim. Using Schroeder fire balloons fuel cylinder during inflation, the vapour withdrawal valve has to lay on the top so that no liquid fuel can enter the pressure regulator for the pilot light (danger of icing and danger of pilot light failure after take-off). This can also happen when the basket is facing downhill during inflation. The drilled holes in the cylinder top guard must face down when using Worthington aluminium fuel cylinders.

If it happens that hoar frost builds up on the pressure regulator, then the regulator must be warmed by hand before take-off.

In the factory the regulator is set to the required operating pressure, but can be re-adjusted using the knurled screw and locked using the counter nut.



Picture 2-20: Content gauge



Is the pressure set too high (loud, hard flame noise), the quality of ignition and combustion decreases. A possible source of fault, which leads to pilot light failure, is that the hose connector is not properly connected. The plug opens the non-return valve but is only loosely connected to the socket. When touching inadvertently during flight, the pin is displaced slightly and the non-return valve blocks off the fuel supply. The pilot often does not recognize the fault as the plug is connected to the socket.

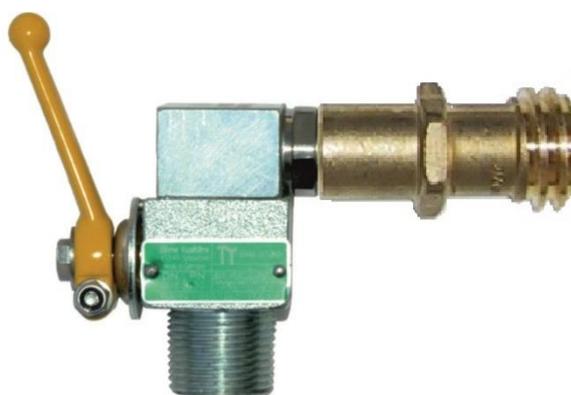
**For safety after connecting the plug, always pull on the hose to ensure the connection is correctly locked.**

## 2.5.5. Liquid Ball valve

The main burner is fed via a liquid withdrawal valve. There are needle valves opened and closed by a hand wheel as well as ball valves closed by a simple lever action. Currently Schroeder fire balloons installs only these ball valves, as they provide higher safety because of more robust materials and faster operability, especially in emergency situations. Furthermore, the pilot can see immediately whether a fuel cylinder is open or closed. Schroeder fire balloons recommends to replace the still existing Ceodeux valves for liquid withdrawal (vapour withdrawal valves are not affected) made from brass with steel ball valves because of safety reasons. A stainless steel tube (dip tube) is fitted to the withdrawal valve, which reaches to the centre of the bottom of the fuel cylinder. Hence the position of the liquid withdrawal valve is of no significance for liquid withdrawal during inflation. It is important though that inflation is not done with a half filled fuel cylinder as the dip tube takes in partly gaseous fuel. This causes the gas to cool and the pressure to drop. Only a small part of the required amount of fuel then reaches the burner jets as gaseous fuel requires a far greater volume and so no power will be achieved. Besides, the coils become hot and amplify the phenomenon even more. A noisy, short flame develops with which the balloon can hardly be inflated.



Picture 2-21: Ball valve TEMA



Picture 2-22: Ball valve REGO

The same effect develops, when the basket lies downhill on sloping ground. The end of the liquid fuel supply tube is then in the vapour space. If an inflation in this position cannot be avoided, the burner, together with a helper, must to be lifted a bit on the burner support rods. A type plate belongs to every fuel cylinder. According to the pressure vessel directive only those things can be filled which are stated on the type plate. Among other things, the fuel capacity and the inspection date are stated.

At all fuel cylinders from Schroeder fire balloons (VA 50 and VA 70), it is stated as standard for some time now that they may be pressurised with nitrogen with 0.7 MPa (7bar). Older cylinders can be retro-fitted with adhesive stickers available from Schroeder fire balloons.

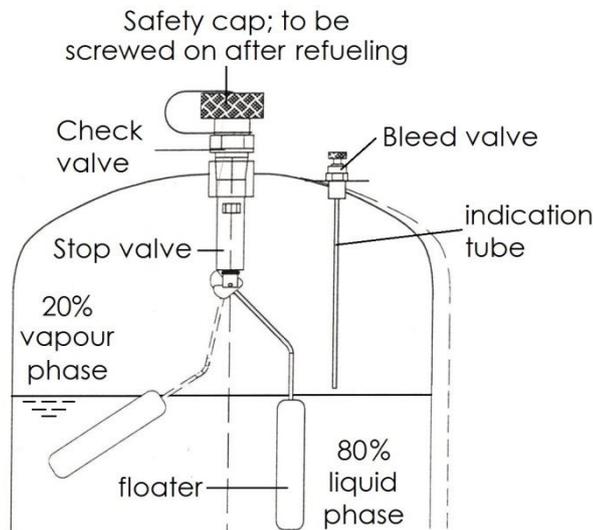


## 2.6. Fuel cylinder handling instructions

Handling with liquefied petrol gas is very dangerous. These instructions must be followed strictly in order to prevent accidents and injuries. Do always obey the regulations of safe working with liquefied gas. Do always wear suitable gloves working with liquefied gas! Do always consider and respect the regulation of ex-zone. The operation of electronic devices within the fueling area is prohibited

### 2.6.1. Automatic re-fuel stop

An automatic re-fuel stop can be an advantage with big fuel cylinders and big baskets, where a removal of the fuel cylinders for re-fuelling is difficult. The automatic re-fuel stop avoids that propane exits into the basket during re-fuelling in the basket. Precondition is using a pump for re-fuelling. The pump pressure should be relatively high so that the cylinder can be filled up to the capacity limit even with the pressure building up in summer.



Picture 2-23: Automatic fueling stop

**The re-fuelling of fuel cylinders inside the basket is only possible with the automatic liquid level stop and compliance with the following requirements.**

During re-fuelling no person and no source of ignition (e. g. burner with piezo-ignitors) must be inside the basket.

The venting of the hose between re-fuel stop and shut-off valve (e. g. re-fuel pistol) must be at least one meter away from basket or trailer respectively so that no remaining gas can escape into the basket when disconnecting the re-fuel adapter.

The bleed valve must only be opened for approximately two seconds to check the fill level after the re-fuelling process is finished.

If re-fuelling is carried out inside the basket, the bleed valve must not be opened during the re-fuelling process (except for short opening, approx. two seconds, to check the fill level).

### 2.6.2. Re-fuelling process:

Unscrew the safety cap and screw on the re-fuel adapter. Open fill pistol in the fuel supply line. When reaching the 80% fill limit, the floater of the fill stop shuts so that no further gas can flow in. Close the fill-pistol, disconnect the re-fuel adapter and screw on the safety cap. To check the re-fuelling process, open the bleed valve for a short period of time. No liquid fuel should exit but

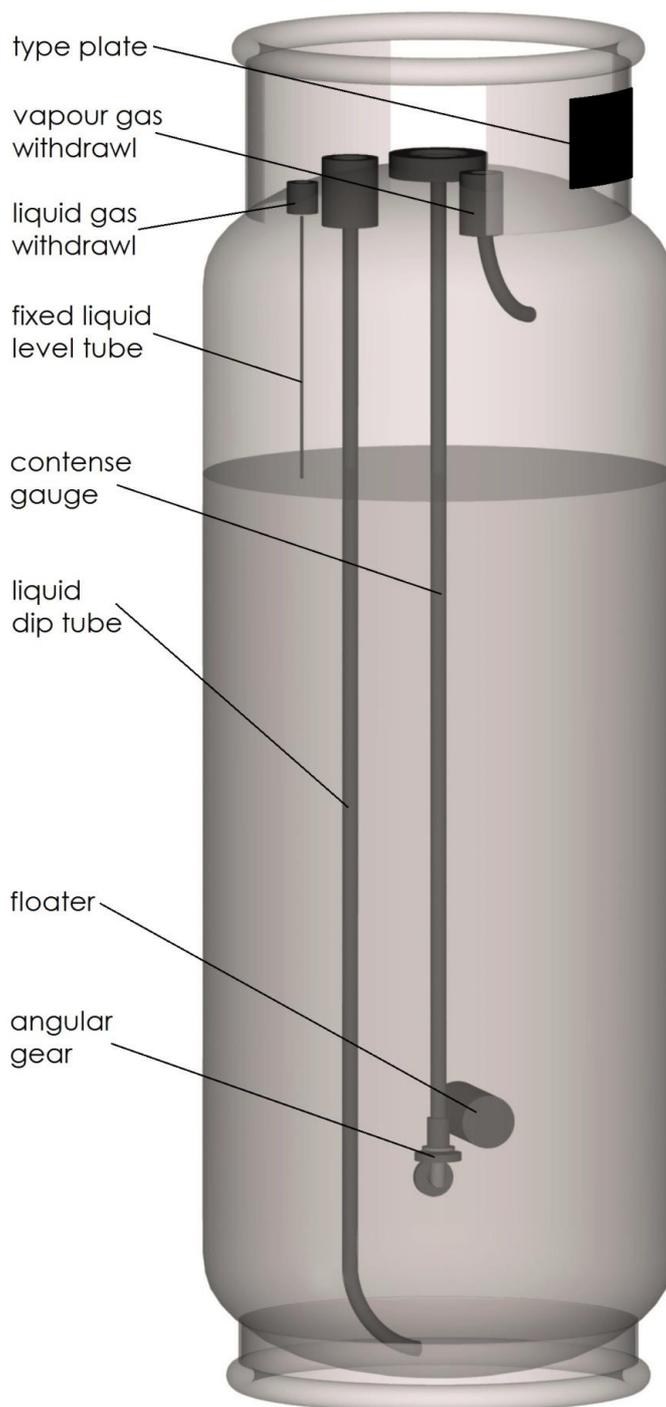


only gaseous propane. If liquefied propane escapes then the automatic refuel-stop is faulty. The fuel cylinder must be removed and inspected.

As the fuel cylinder is then over-filled the excess fuel is to be burnt off using the burner in sufficient safety distance from the re-fuelling station.

When using the automatic re-fuel stop according to above description the fuel cylinders need not be weighed after re-fuelling.

### 2.6.3. Schematic view of Schroeder fire balloons fuel cylinders



Picture 2-24: Schematic view VA 50 / 70



## 2.6.4. Re-fueling systems

Most fuel cylinders are re-fuelled using compact re-fuelling stations consisting of a storage tank, an explosion-safe pump and a filling unit. Apart from the usual regulations it is absolute paramount that only trained and knowledgeable persons re-fuel gas cylinders. It has been shown in many accidents that exactly then a heavy accident happened when only once a non-trained person re-fuelled.

**Not enough attention is also brought to the fact that gas can easily be ignited by static charge depending on humidity in the air and clothing.**

## 2.6.5. Technical information to the fueling system

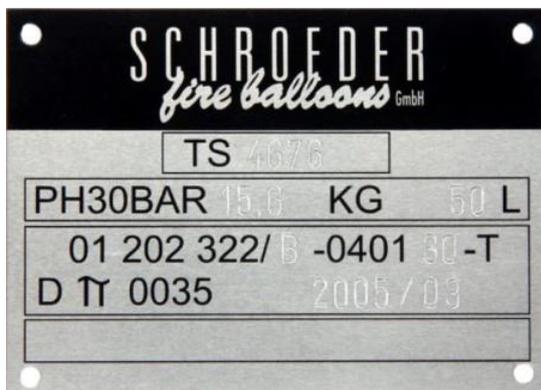
The fuel pressure and therefore the burner power depending on the fuel temperature. Approximate values for propane are:

Fuel temperature [° C]	-15	0	15	30
Fuel pressure [MPa]	0,20 (2 bar)	0,36 (3,6 bar)	0,60 (6 bar)	0,90 (9 bar)

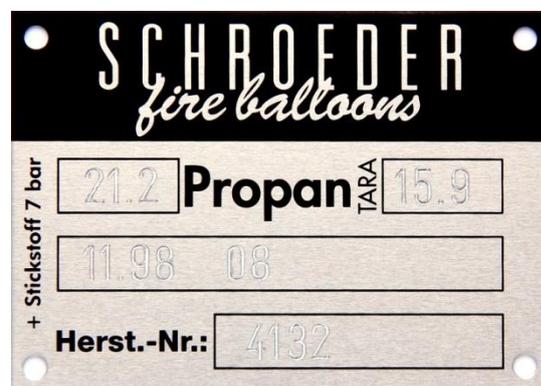
Table 2-2: Fuel pressure

## 2.6.6. Artificial fuel pressure increase

With the introduction of the burner FB 6 an artificial fuel pressure increase is in most cases no longer required. Although the noise of the flame is so quiet at low fuel pressure that the subjective impression of lower occurs but in reality the heating power of the Fb 6 is significantly higher than its predecessors. Although it can be of advantage in certain cases to increase fuel pressure. This depends on many factors and is to be decided on a case to case basis by the pilot. At calm weather conditions small balloons up to a size of 3000 m³ can still be flown at approx.. 0,4 MPa (4 bar) without pressure increase. At more unsettled weather a pressure increase can be recommendable for e. g. two fuel cylinders used for take-off and landing. Of course the heating periods are longer at a pressure of 0,3 MPa (3 bar) than at 0,7 MPa (7 bar), but the burner FB 6 does not overheat at longer heating periods. For commercially operated big balloons, a pressure of at least 0,5 MPa (5 bar) is recommendable, although fuel cylinders with a pressure of 0,7 MPa (7 bar) used for landing mean an increase of safety.



Picture 2-25: Re evaluation type plate



Picture 2-26: Type plate before 2004

In the ideal case, the fuel is elevated to a higher temperature (e. g. by storing in slightly heated rooms) to achieve a pressure increase. At this the regulations for storing liquefied gas must be met



(well ventilated). In no case store in a room below ground, as leaks due to defects on seals must be expected. A catastrophe could be triggered off if the lights are switched on. The fuel cylinders should be checked for leaks by listening for hissing noises (with the ear near the fittings) before storage in an enclosed location. It should not be relied on the non-return valve as they may start leaking. Always close the valves properly. Leakages may also happen, if a valve or a ball valve is opened inadvertently and then closed without venting it afterwards. The amount of liquefied gas trapped in the valve chamber expands that much at temperature increase so that the seal of the non-return valve is pushed out of its position. Care has to be taken that the pressure does not increase too much if the fuel cylinders are warmed up in a water bath. The water bath should not be warmer than 30 ° C.

Slightly warmed fuel has an advantageous effect on the rubber seals of the couplings and in the burner valves. Although pressurizing using methane is practiced, officially it is not permitted in Germany. According to investigations of the BAM (German federal material research institute) and the PTA (German federal metrology institute) this is due to the pressure characteristics at temperature increase.

The addition of nitrogen up to 0,7 MPa (7 bar) has been officially approved in 1997 for Schroeder fire balloons fuel cylinders VA 50 and VA 70. Precondition is the additional notice on the type plate. To avoid nasty surprises, a few things have to be taken into consideration at this procedure. One needs to know, that a flame is significantly bigger and stronger when nitrogen of up to 0,7 MPa (7 bar) has been added to cold gas than with fuel of a pressure of 0,7 MPa (7 bar) caused by temperature. This is because cold fuel evaporates less in the evaporation coil and causes therefore less pressure loss. The fuel flow increases. During inflation, one has to be careful with the first flame blasts when using fuel cylinders pressurized with nitrogen.

The burner blasts should not be too long at flights at high altitude above 6000 m when it has been pressurized with nitrogen as the flame becomes longer and contains not enough oxygen, so that the fuel consumption might increase. Although the pressure but steadies itself relatively good at a medium level until the cylinder is nearly empty. This is caused by the fact that, depending on boundary conditions, nitrogen dissolves more or less in propane and therefore is longer available. It is absolutely recommendable to mark the pressurized fuel cylinders well visible and permanently e. g. by taping the rim of cylinder with colored insulation tape which can be removed at any time.

All pilots also using these fuel cylinders must be instructed. **Fuel cylinders pressurized with nitrogen must not be used for the operation of pilot lights.** After the winter period, the fuel cylinders pressurized with nitrogen must be emptied.



## 2.6.7. Instructions for pressurizing fuel cylinders with Nitrogen

The remaining pressure in the nitrogen cylinder (50l) must be between 1,5 MPa and 20 MPa (15-200 bar).

1. Screw on pressure regulator and tighten with spanner.
2. Connect hose coupling with propane cylinder.
3. Open cylinder valve of propane cylinder.
4. Open main valve on nitrogen cylinder.
5. Open shut-off valve on the pressure regulator (round knurled screw).
6. Close shut-off valves again, the order does not matter, if no flow noises can be heard anymore (after approx. 20 seconds)!
7. The pressure is set in the factory to 0,7 MPa (7 bar) and is fixed to that value.



Picture 2-27: Nitrogen pressurization set

### Notes:

**Only full fuel cylinders must be used for the flight. All cylinders are to be safely secured using the approved (use original Schroeder fire balloons part) cylinder straps. No fuel cylinders must be transported outside the basket. If an inflation cylinder is used for inflation, which is taken out prior to take-off, is to be secured in the basket in any case.**

**The flight preparation is to be made in that way that a fuel reserve for a minimum of 30 minutes is still available when landing.**



## 2.7. Basket and equipment



Picture 2-28: Open basket

The basket is used to contain the occupants, fuel cylinders and other things. Traditionally and for safety reasons the basket walls are woven from cane, willow or similar material. The basket floor is made from very robust plywood boards glued together. The strength of the boards depends on the size of the basket. The frame, constructed as a sliding edge, as well as the runners are also made from very robust boards glued together. The weave is embedded in the frame and glued together. At the top end of the weave is a metal frame also accommodating the burner support rods. The basket wires made from stainless steel run vertically through underneath the basket floor. They are each made from a single piece without any connections.



Picture 2-29: Double T basket

Thimbles, secured by swaging done with the Nico-Press process, are made at the end of the wires to accommodate the carabiners. Holes are made in the basket weave for cylinder straps and step wholes. The lower part of the wickerwork is protected by a robust hide. For impact protection, the upper surrounding metal frame is padded with a thick and effective cushion material covered with natural leather.

The minimum basket height is 1 m, for commercial balloons 1,10 m (measured inside). Baskets for more than 6 persons must contain at least one partition wall.

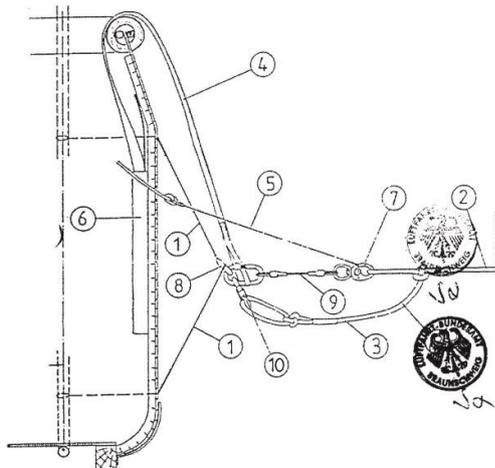
### 2.7.1. Launch restraint

The quick release is a very helpful device. It saves the ground crew on the basket at winds on the ground higher than 5 knots. It should always be used even at calmer winds as one cannot be safe against suddenly occurring gusts. When the basket takes off the ground the pilot releases the release mechanism. Sufficient climbing force exists when the basket floats approx. 2 m above ground with a quick-release rope of 5 m length. A rated breaking point is fitted to the later rope for the basket not to be damaged when overstressed.

The safety device (3) must only be disconnected from the karabiner immediately before the release of the safety hook (snap shackle). Its aim is to avoid that the balloon releases itself during inflation if the coupling is opened inadvertently.

This fire balloon's system has the enormous advantage that the occupants cannot be injured by the coupling snapping back at release. Drag rope (4) and take-off rope (2) must not be used for tethered take-offs (tethered take-off as a type of operation is not permitted in Germany).

**Caution! The drag rope (4) is only for recovery of the balloon above ground unsuitable for landing**

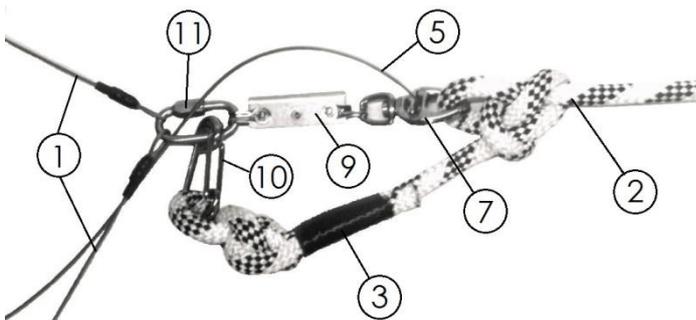


1. Launch restraint attachment wire
2. Take-off rope approx. 5m long
3. Safety bypass
4. Drag rope approx. 45m long
5. Launch restraint release wire
6. Bag for drag rope
7. Safety shackle (snap shackle)
8. Launch restraint junction
9. Weak link load 850 daN (850 Kp)
10. Bypass attachment karabiner
11. Quick link

Pictur 2-30 Schroeder fire balloons launch restrain

## 2.7.2. Launch restraint operation instructions

### Phase I - Inflation procedure

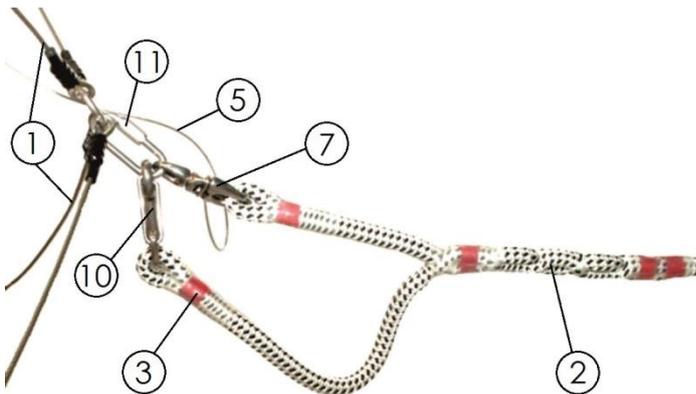


Rigging of the launch restraint during inflation.

The bypass connection (10, 3) prevents uncontrolled take off in case of weak link failure or inadvertent release.

(Numbering see Picture 2-30)

Picture 2-31: Rigging of the launch restraint



Rigging of the balloon without weak link during inflation.

(Numbering see Picture 2-30)

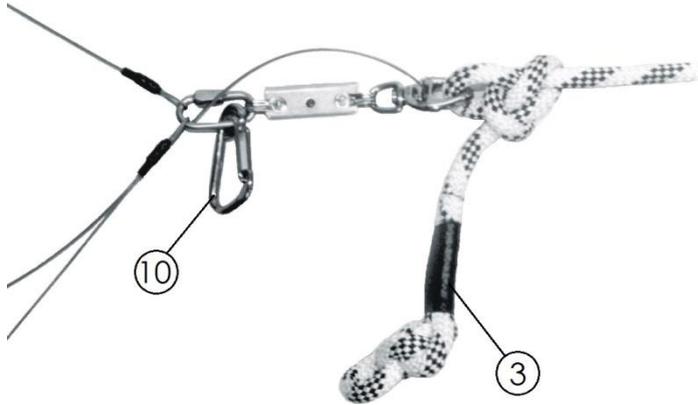
Picture 2-32: Rigging without weak link



Picture 2-33: Launch restraint rope with pulling damper



## Phase II – Before the start

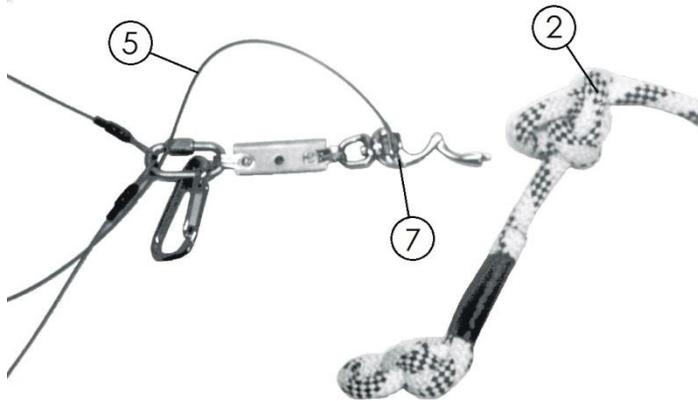


Directly after everything is ready for take off and the balloon is "light", the Bypass rope (3) is released from the Karabiner (10).

(Numbering see Picture 2-30)

Picture 2-34: Launch restraint just before start.

## Phase III – After take off



Right after the balloon has taken off, the release wire (5) that activates the snap shackle (7) must be pulled by the pilot in order to release the launch restraint rope from the basket. The angle between restraint rope and the ground must not exceed an angle of 60°.

(Numbering see Picture 2-28)

Picture 2-35: Launch restraint after take off



### 2.7.3. Load frame connection

On each corner of the burner frame is a wire lug. These wire lugs are to accommodate the carabiners, which provide the connection between the envelope wires and the basket wires and direct the load into the burner frame at the same time.

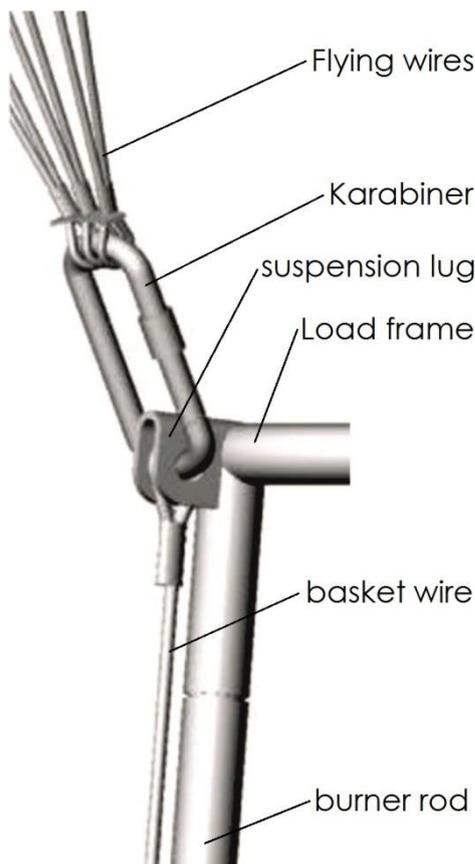
There are different constructions of the burner frames and the wire lugs depending on basket size. Also the breaking load of the carabiners to be used depends on the basket size.

The values are to be taken from the following tables.

#### **Suspension lug type A**

The basket wire is inserted in the latch of the wire lug. The carabiner is then moved through the lug hole and the thimble of the basket wire.

**Always secure the carabiner by locking the safety screw.**



Basket size	Carabiner designation	Breaking load / carabiner
I/2	SCHROEDER F.B.	min. 25 kN
M/2	SCHROEDER F.B.	min. 25 kN
M/3	SCHROEDER F.B.	min. 25 kN
II/3	SCHROEDER F.B.	min. 25 kN
III/4	SCHROEDER F.B.	min. 25 kN
IV/5	SCHROEDER F.B.	min. 25 kN
V/5	SCHROEDER F.B.	min. 25 kN
VI/6	SCHROEDER F.B.	min. 25 kN

Table 2-3: Carabiner sizes

Picture 2-36: Envelope rigging basket



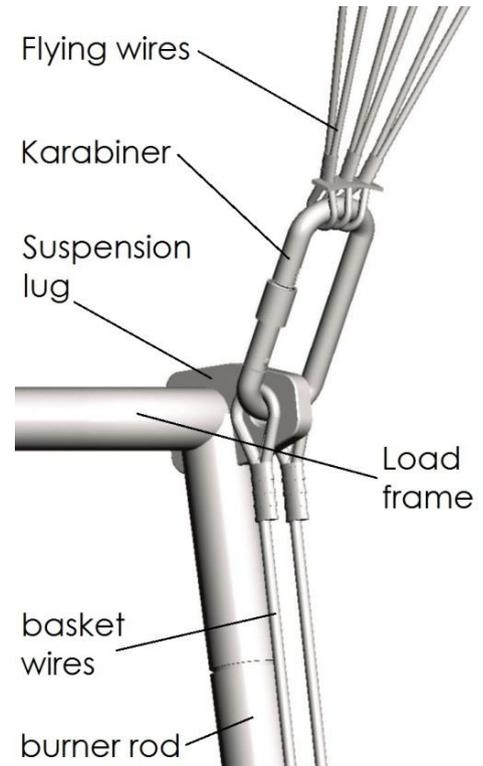
### Suspension lug type B

Hold both basket wires on to the latch of the lug. Move the carabiner through the hole of the latch and the thimbles of the basket wires.

**Always secure the carabiner by locking the safety screw.**

Basket size	Carabiner designation	Breaking load / carabiner
VII/7	Schroeder fire balloons	min. 28 kN
VIII/8	Schroeder fire balloons	min. 32 kN
VIII/9	Schroeder fire balloons	min. 32 kN
IX/11	Schroeder fire balloons	min. 45 kN

Table 2-4: Carabiner sizes basket VII/7 to IX/11



Picture 2-37: Envelope rigging

### Suspension lug type C

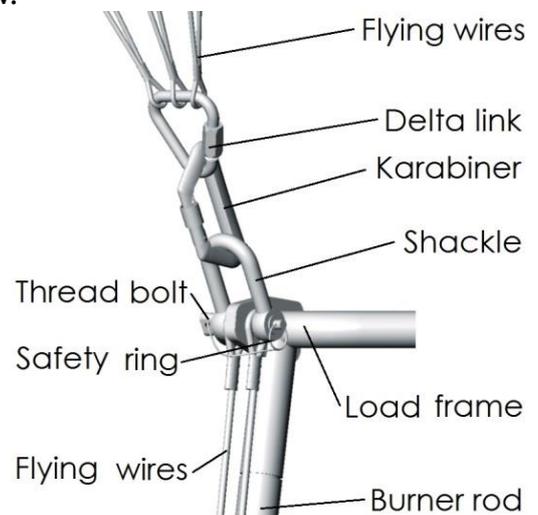
Both of the basket wires are connected to the wire lug via a screw shackle. The delta screw link is connected to the envelope wires. The carabiner connects the screw shackle with the delta screw link.

**The delta screw link must not be opened! The bolt of the screw shackle must be secured with the safety ring.**

**Always secure the carabiner by locking the safety screw.**

Basket size	Carabiner designation	Breaking load / carabiner
X/13	Stubai Super 5000	Min. 50 kN
X/15	Stubai Super 5000	Min. 50 kN

Table 2-5: Carabiner sizes basket X/13 and X/15



Picture2-38: Envelope rigging



#### 2.7.4. Cushion floor

Optionally a very effective and robust padded floor mat can be delivered for all basket sizes. It is hardly inflammable and significantly dampens shocks at hard landings. Furthermore no fuel cylinder can jump that high anymore at a hard touchdown that occupants get the foot below the bottom rim of the fuel cylinder and get injured. This mat is mandatory in M/2 and M/3 baskets.

#### 2.7.5. Minimum equipment

a) For flights during the day according to visual flight rules, the following minimum equipment is required:

1. Altimeter\*
2. Variometer\*
3. Fire extinguisher, 2 kg, according to DIN EN 3
4. Compass
5. Envelope thermometer\*
6. Pressure gauge for each burner
7. First aid kit, DIN 13164 or 13157
8. Cutting knife
9. One alternative ignition source (e. g. storm matches)
10. One pair of fire resistant gloves

\* - combined in e.g. one flight instrument (see appendix B)

Furthermore for baskets with more than 10 occupants:

1. A second first-aid-kit
2. Second pair of fire resistant gloves
3. fire blanket according to DIN 14155

is required when commercially licensed.

b) Additionally for night flights, the required balloon illumination with a sufficient energy source, a strong battery lamp (minimum one), torch for reading the instruments and the map.



### 2.7.6. Applicable equipment with Schroeder fire balloons baskets

Following components are approved with the type fire balloons G.

#### Baskets:

The measures are outer measure in cm. Length and width may vary but the respective ground area is the same.

Basket size	length x width [cm]
I/2	107x95
M/2	115x90
M/3	130 x 100
II/3	125x100
III/4	130x115
IV/5	145x115
V/5 und V-A	155x120
VI/6	175x125
VII/7	215x145 / 180x140
VIII/8	245x145 / 215x140
VIII/9	260x145 / 235x140
IX/11	275x150 / 250x170
X/13	300x170 / 275x175
X/15	300x170 / 275x175

Table 2-6: Basket measures

#### Burners:

Optima I, Optima II, Optima IV, FB V, FB 6 and FB 7

#### Fuel cylinders:

All upright standing, by the dimensions suitable and for hot air balloons approved and inspected fuel cylinders are allowed equipment for Schroeder fire balloons hot air balloons.



## 2.8. Inflation fan

Although the inflation fan is not directly part of the aircraft, it needs also to be considered from a safety point of view to avoid accidents during the take-off phase. It is important that the fan is always in good technical condition. Broken mesh wires or fixings must be repaired professionally. Due to the high rotation speed of the rotor blade, loose parts can be catapulted far away and endanger particularly the eyes of persons standing next to it. Also the fan blade must be free of damages. Missing bits cause imbalance by which the fan can dismantle itself during operation. Furthermore the gaps between the mesh wired must not be too wired so that no finger can be injured. An instructed person must stay allow no other unauthorised persons near it.



Picture 2–39: Inflation fan

**Accident example:** A cord on the sleeve of a child is pulled into the fan. As a result the child loses a finger.



## 2.9. GPS

GPS devices are not part of the balloon, but the correct use of those navigation aids can be a help as well as an increase in safety. This applies especially to flights in the Alps, races and flights above difficult landing terrain. Also, the device can detect wind direction and velocity in high altitudes better and faster than the human eye at extreme calm wind. But the GPS can only then be of help during difficult flights, if the operation at normal flights and on the ground respectively is trained in a way that one will not be distracted unnecessarily. As a balloon pilot one should know that one obtains inexact direction and speed values during climb and descent.

**GPS devices may be used under VFR conditions. But they are no replacement for the classic flight preparation and the required navigation material.**

### 2.9.1. Instruments approved for Schroeder fire balloons hot air balloons

The following instruments are also approved for operation in balloons of the type fireballoons G in addition to the devices described in Appendix B:

1. OPTOVARIO, made by Schroeder fire balloons
2. ATOVARIO, made by Schroeder fire balloons
3. Flytec 3040-M
4. Flytec 6040
5. Ball 655
6. Winter
7. VARIOTEL, made by Schroeder fire balloons

The valid operating instructions are the operating instructions of the respective instrument. Therefore these are part of this operating manual.

Intentionally left blank

### 3. Operational limitations

The empty weight consists of envelope, basket, burner and load frame. The maximum permitted total weight calculated for the respective envelope size, 3000 m<sup>3</sup> - 910 kg, is designated as maximum weight. The actual maximum permitted total weight is usually lower as the payload is limited for each basket size (see weight report in Chapter 1, page 1-1).

This maximum weight calculated for each balloon individually consists of the following: envelope, burner with frame and support rods, basket, minimum equipment payload (occupants, fuel cylinders, other).

The maximum weights are listed in the tables on the pages 1-2 to 1-7 of this manual.

#### 3.1. Envelope inside temperature

Often the same thing is meant with envelope fabric temperature and hot air temperature. With the devices listed in Appendix B, the air temperature is measured and not the envelope fabric temperature. Although this sounds not logical, we recommend to measure the hot air temperature as this process has an experience of 30 The system has proved to be reliable. The fabric temperature is approx. 20 to 30 ° C lower than the hot air temperature due to the cooling from outside. A further advantage is that the indicated temperature is approximately equivalent to the calculated value of the capacity.

Experience has shown that the porosity and strength of the envelope fabric are noticeably poorer at a higher hot air temperature than 110 ° C. The longer the excess of 110 ° C the higher the fatigue of the envelope fabric.

For fire balloons envelopes, the maximum operating temperature is set to 110 ° C.

#### 3.2. Maximum rate of climb

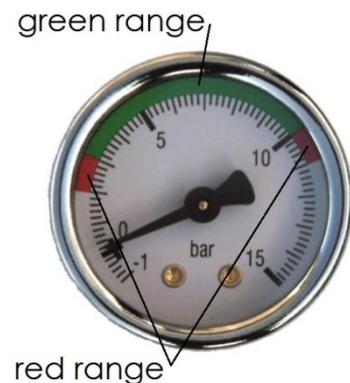
**The maximum rate of climb and descent for Type fire balloons G is 5 m/s or 1000 ft/min. For Type fire balloons G/M (Mistral) the maximum rate for climb and descent is 7,5 m/s or 1500 ft/min**

The Parachute must not be opened longer than 5 seconds to initiate descent, except for landing. For manoeuvring, it is fully sufficient to open just a larger gap.

#### 3.3. Fuel pressure

Maximum permitted operating pressure: 1 MPa (10 bar) equivalent to 30 ° C. Minimum operating pressure: 0.3 MPa (3 bar) equivalent to -5 ° C commercial propane or propane-butane-mixture according to DIN 51 622. The amount of butane must only be that high that the fuel pressure is within above limits during flight.

The pressure should always be in the green range from 0,3-1 MPa (3-10 bar).



Picture 3-1: Pressure ranges

### 3.4. Wind speed

The balloon flight is to be cancelled when the ground wind speed at the take-off site exceeds 15 knots or gusts occur with a velocity of more than 10 knots above average wind velocity or when on excess during landing is probable. Of course the maximum velocity stated in the permission for take-off is authoritative.

The values stated above are absolute maximum values. The pilot should set the maximum limit to 10 knots for take-off and landing at usual sports flights and commercial balloon flights (beginners even less). The statistics of accidents shows that the very most of the heavy accidents happen at landing speeds above 10 knots. Inexperienced passengers often have difficulties already at a landing speed of 10 knots even if they have been instructed beforehand. The maximum limit of 15 knots has been set for e. g. competitions at which experience pilots take-off in small balloons alone or with competition-experienced occupants (co-pilots or observers).

### 3.5. Thermal activity, gusts

Special caution is required in weather with thermal activity. If possible, inexperienced pilots should not take-off in thermal activity. It must not be taken-off, if the gusts exceed more than 10 knots above the ambient air. This also applies to alpine flights at which it must never be climbed or descended into an air layer with abruptly changing wind velocity and direction. Strong wind shearing and rotors are the more to be expected as the wind velocity increases and the closer the balloon flies towards a mountain ridge. These situations occur in wind direction (lee) especially behind obstacles. To be able to carry out these flights safely, as much theoretical knowledge using literature and practical experience with other pilots must be gathered as possible.

### 3.6. Loading

Balloons can be flown from 1 to 15 occupants depending on the size of the basket. The maximum number of occupants depends furthermore on the number of fuel cylinders carried. All combinations are listed in the table "data matrix" (The allocation of the baskets to the envelope sizes is listed at the beginning of the flight manual).

#### **DETERMINATION OF THE MAXIMUM LOADING**

There are two methods to use the loading chart for the planning of a flight (for loading chart see page 3-4).

#### **Method a)**

Assuming that the temperature decreases according to ISA, which means  $0.65\text{ }^{\circ}\text{C}$  per 100 m. In this case proceed as shown in the following example (loading chart).

Balloon size 30/24 3000 m<sup>2</sup>

Take-off altitude 200 m

Ambient temperature TA =  $+16\text{ }^{\circ}\text{C}$  in 200 m

Which maximum loading capacity does exist in 2800 m altitude at an envelope temperature of  $100\text{ }^{\circ}\text{C}$  ?

- (A) At ambient temperature + 16 C straight up vertically to the line 200 m.
- (B) From point (B) to the line 2800 m parallel to the ISA-lines.
- (C) From point (C) to horizontally to the line of balloon size 3000 m<sup>2</sup>.
- (D) The loading capacity is 750 kg.

### Method b)

The temperature at the altitude in which one wants to fly is known. This is especially of advantage if it is a very high altitude. The temperature can be obtained from the weather service. This method is more exact in high altitudes as the temperature decrease is often significantly lower than 0.65 C per 100 m. The higher the flight altitude the higher the inaccuracy, especially in hazy weather the temperature is falling less than according to ISA or by approach of a warm air mass at altitude. According to method a) the table would show a higher than the actual load capacity.

### Example:

Ballon size: 3000 m<sup>3</sup> take-off altitude: 200 m ambient temperature: +17 C in 200 m ambient temperature +8 C in 2800 m obtained from weather service, caused by inversion. Intersection 2800 m – line with ambient temperature +8 determined, horizontally to the left until the vertical line of the balloons size 3000 m<sup>3</sup>: loading capacity = 680 kg.

The error in this case according to method a) would be 70 kg. Regardless of the table the envelope thermometer is to be observed.

**The maximum continuous operation should not be above 100 C, the maximum temperature is 110 C.**

### ISA conditions means:

Temperatures of +15 C at an air pressure of 1013.2 hPa at sea level. The temperature decrease is according to ISA 0.65 C per 100 m altitude difference. In reality the temperature decrease is usually less.

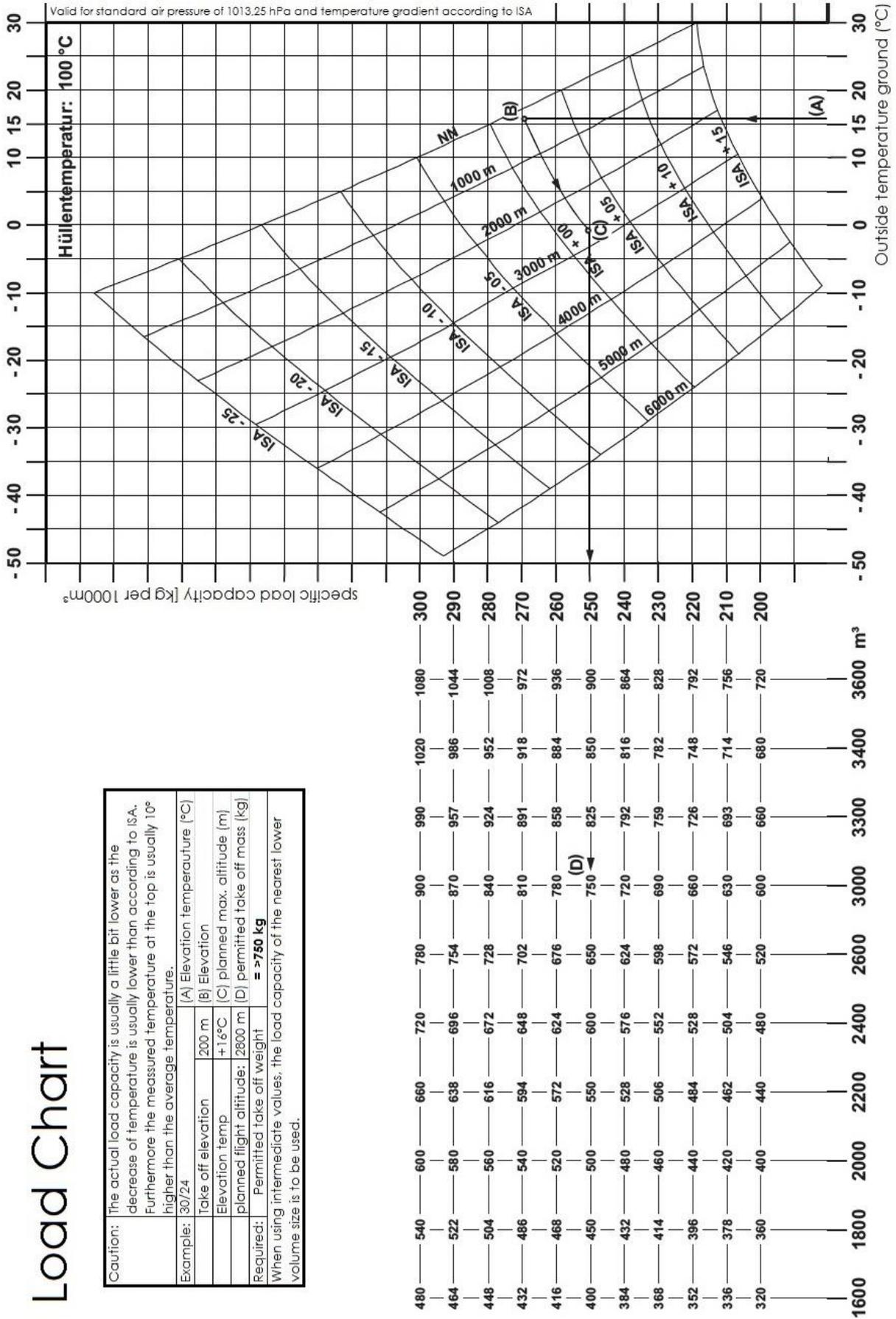
Apart from the maximum take-off weight, the minimum landing weight is also important. Already when calculating the loading attention is to be paid that the minimum landing weight stated in the data matrices of the manual must not be fallen short of.

The pilot must understand that a flight, at which this weight is hardly exceeded, can always be problematic especially in thermal activity, wind shear and other turbulences. A balloon loaded too lightly deforms more rapidly at wind shear than a heavier loaded balloon due to the low inner pressure. Warm air is pushed out of the envelope by each deformation so that loading capacity is lost and the balloon starts to descent.

In turbulent wind, it is difficult to keep an under-loaded balloon at a constant altitude. Not sufficiently loaded baskets also generate a respectively lower braking effect during landing so that the drag strip becomes longer. The parachute sealing pressure is also decreased so that the closing speed when operating the parachute is diminished.

Therefore, the total weight of the balloon during landing including everything must never be lower than the value stated as minimum landing weight in the data matrix (see data matrices in Chapter 1, pages 1-2 to 1-7).

### 3.7. Load Chart 3000 m<sup>3</sup>



**Caution:** The actual load capacity is usually a little bit lower as the decrease of temperature is usually lower than according to ISA. Furthermore the measured temperature at the top is usually 10° higher than the average temperature.

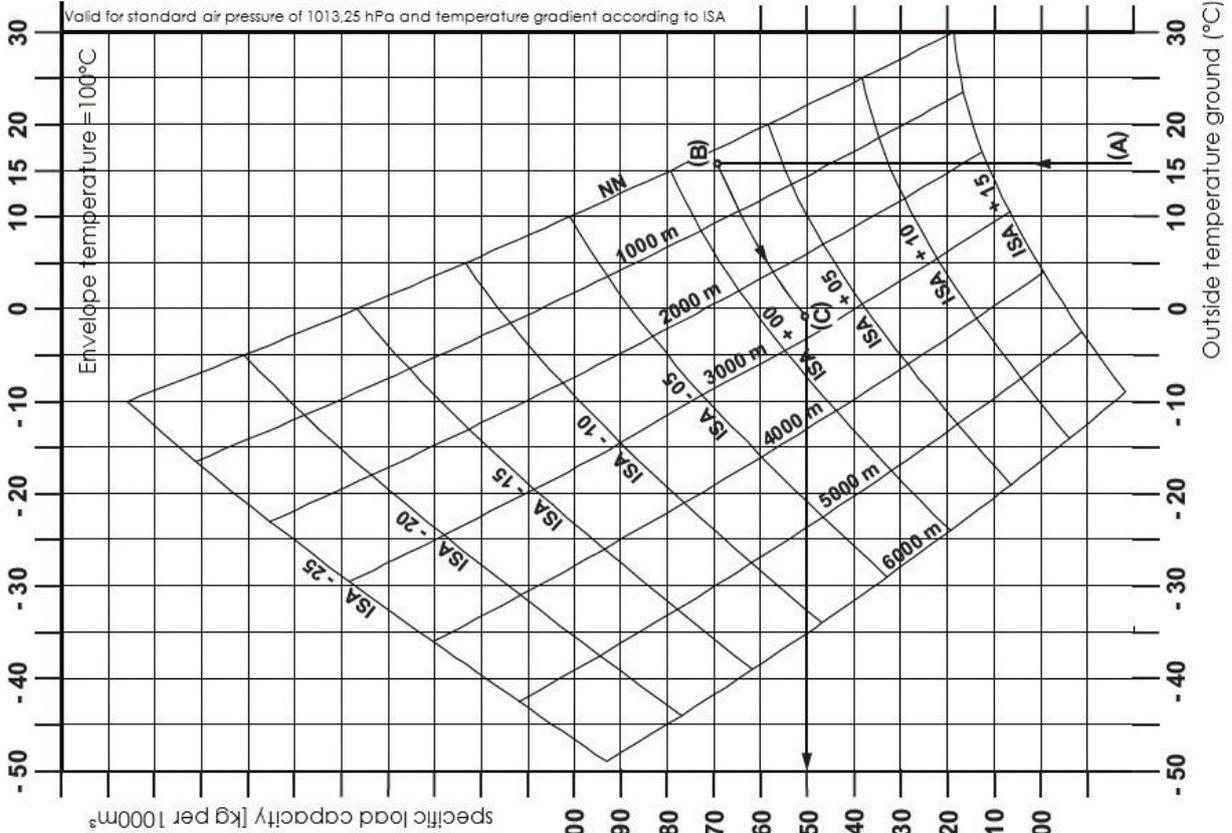
**Example:** 30/24

Take off elevation	2000 m
Elevation temp	+1s°C
planned flight altitude:	2800 m
Required: Permitted take off weight	= 750 kg

(A) Elevation temperature [°C]  
 (B) Elevation  
 (C) planned max. altitude (m)  
 (D) permitted take off mass (kg)

When using intermediate values, the load capacity of the nearest lower volume size is to be used.

## 3.8. Load Chart 6000m<sup>3</sup>



# Load Chart

**Caution:** The actual load capacity is usually a little bit lower as the decrease of temperature is usually lower than according to ISA. Furthermore the measured temperature at the top is usually 10° higher than the average temperature.

**Example:** 60/24

Take off elevation	200 m
Elevation temp	+1.6°C
Planned flight altitude:	2800 m
Required:	Permitted take off weight = <b>&gt;1500 kg</b>

When using intermediate values, the load capacity of the nearest lower volume size is to be used.

1200	1275	1350	1500	1800	2100	2550
1160	1233	1305	1450	1740	2030	2465
1120	1190	1260	1400	1680	1960	2380
1080	1148	1215	1350	1620	1890	2295
1040	1105	1170	1300	1560	1820	2210
1000	1063	1125	1250	1500	1750	2125
960	1020	1080	1200	1440	1680	2040
920	978	1035	1150	1380	1610	1955
880	935	990	1100	1320	1540	1870
840	893	945	1050	1260	1470	1785
800	850	900	1000	1200	1400	1700
4000	4250	4500	5000	6000	7000	8500 m <sup>3</sup>

### 3.9. Limitation for the commissioning into operation

There must be no damages to the envelope whatsoever.

**Exception:**

**A maximum of three tears up to a length of 5 cm each in the bottom three panel rows. It must not be taken-off if the rip is not straight but angled. Furthermore the damage must be not closer to a horizontal tape or load tape than 5 cm.**

Extreme caution is to be taken especially at alpine flights and thermal activity if the envelope already has a relatively great number of hours of operation and it can be assumed that the tear strength is significantly reduced.

Loading bearing wires of envelope and basket must be free of damage; a maximum of 8 strands of each wire may be broken. No wire must be glowing by effects of the flame so no too great damage must be recognisable on the burner frame. The lower basket floor must be neither cracked nor broken. It must not be taken-off if a tear in the basket floor of more than 25 cm length is visible on one side. It must not be taken-off if the floor is broken in one place (tear on both sides longer than 15 cm). In case of doubt always consult the relevant balloon inspector. The balloon is not airworthy if the lower basket frame is broken.

The balloon must only be operated in the weather conditions described in the manual.

The pilot and owner must comply with the certification and insurance regulations officially required.

**The following modes of operation are approved:**

1. Flight under Visual Flight Rules during the day with minimum equipment according to flight manual.
2. Flight during the night with the minimum equipment listed in the flight manual.
3. Dropping of parachutist.

The balloon must not be modified. No parts must be exchanged with another balloon even if they are approved for another balloon. A number of baskets and burners may be approved for one envelope if that is stated in the inspection certificate.

The balloon must not be operated after expiry of the annual inspection period (to the last day of the inspection month).

The balloon must never come into contact with power lines (danger of death, danger of total destruction). Load bearing steel wires, which came into contact with a power line, must be replaced. Often damage to the wire by electric shock under the basket floor or in the weave is not noticeable.

### 3.10. Restrictions for using other manufacturers components

**Basket, burner and burner frame should be from one manufacturer at combinations of Schroeder fire balloons envelopes with foreign components.**

For further details see corresponding flight manual supplements.

### 3.11. Restrictions for commercial passenger transport

1. The balloon must at least have two burners and fuel systems completely separated from each other.
  2. The height of the basket rim must be at least 1.10 m.
  3. The basket must be partitioned if certified for more than six occupants. The envelope must be fitted with at least one turning valve to be able to land the basket with its widest side if the ratio between length and width of the basket is greater than 1 : 1.3 and/or the maximum permitted number of occupants is greater than six.
  4. The balloon must be subject to an inspection every 100 hours by an inspector of category III or an equally authorised person. In addition, a tear test (grab-test, see maintenance manual) must be carried out once the envelope exceeds 200 operating hours.
1. minimum equipment (for commercial operation):
    - altimeter \*
    - variometer \*
    - radio 117.975 to 137.000 MHz
    - fire extinguisher 2 kg according to DIN EN 3
    - compass
    - envelope thermometer \*
    - pressure gauge for each burner
    - first aid kit according to DIN 13164 or 13157
    - one pair of fire resistant gloves
    - one cutting knife
    - one alternative source of ignition
    - one fire blanket according to DIN 14155
    - necessary extracts from manufacturer's manual and checklists

\* - combined e.g. in one flight instruments (see Appendix B)

for baskets from 11 occupants:

- a second first aid kit and a second pair of fire resistant gloves

### 3.12. Fuel consumption

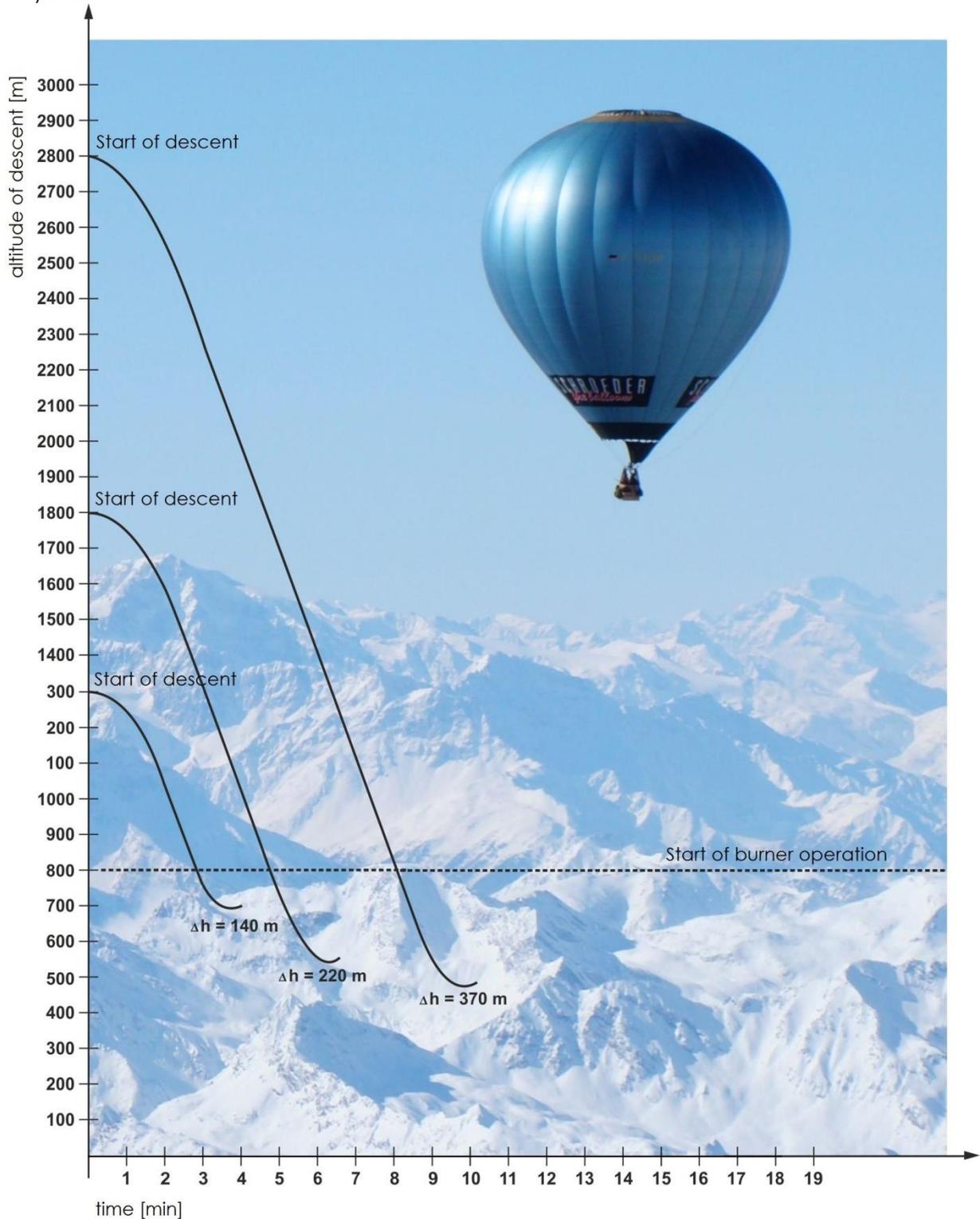
The fuel consumption depends on the size of the balloon, loading, flight altitude, frequency of change of altitude as well as operation of the parachute and turning valve and external temperature.

It is between 25 and 30 kg per hour at new balloons of approx. 3000 m<sup>3</sup>. The balloon must not be operated any longer, if the consumption is so high that it can not be flown for at least one hour with the available fuel supply and then still have a reserve of 30 minutes. Also, if the burning periods become unreasonably long and therefore the safety of overcoming an obstacle is not guaranteed anymore, the manufacturer or the relevant Maintenance Organisations must be consulted. Possibly the fabric has become porous. But it may also be that the parachute leakage has worsened by shrinkage or stretch of the distancing lines.

The following four diagrams describe the reaction of the balloon during cold descent and catching the balloon by starting to heat until the descent equals 0 m/s rate of climb/descent.

### 3.13. Reaction of a 2500 m<sup>3</sup> balloon

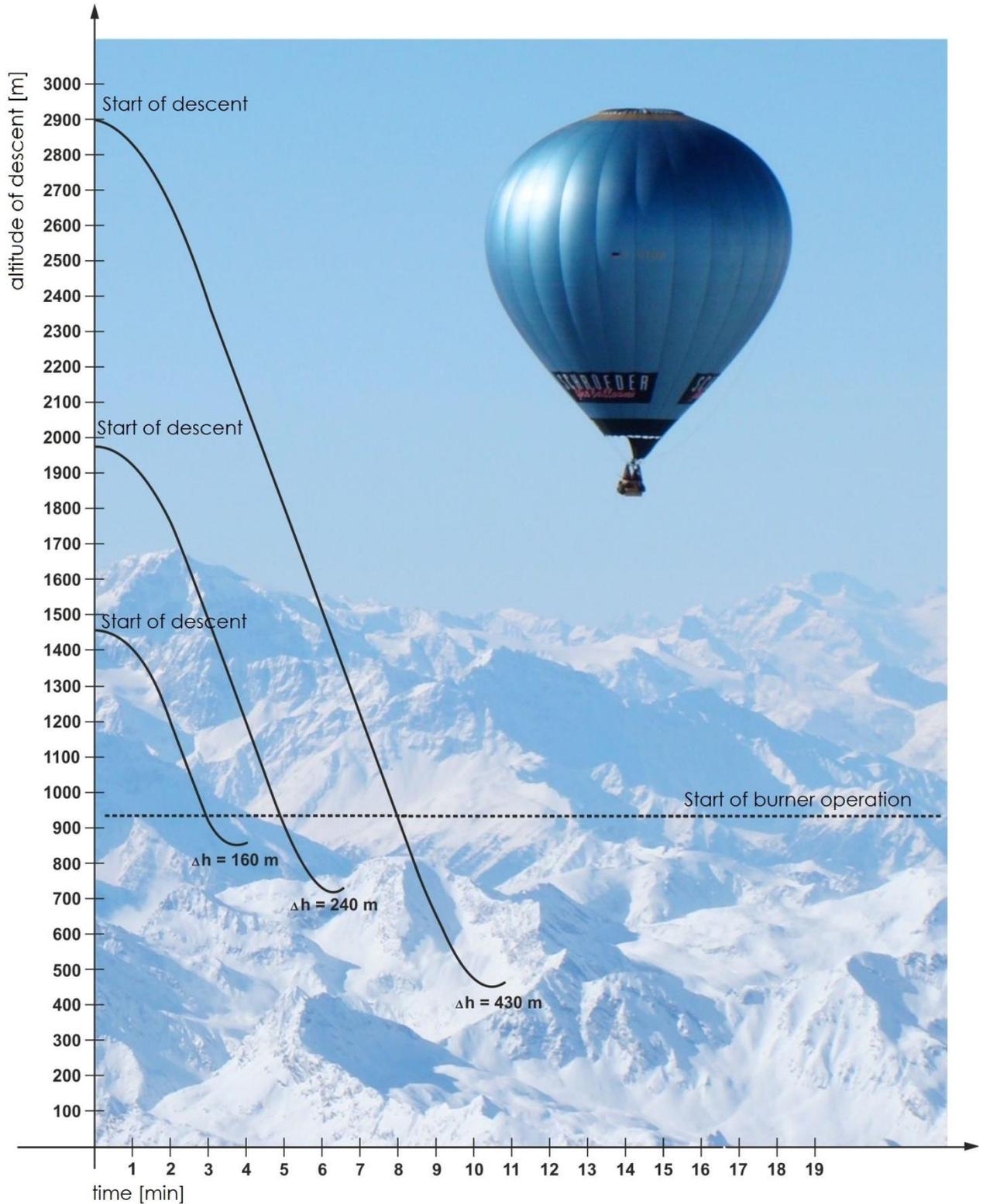
Envelope size 2500 m<sup>3</sup>; least fuel pressure 0,3 MPa (3 bar); FB 6 double; ISA condition, 4 occupants, 4 cylinders



Picture 3-1: Cold descent 2500m<sup>3</sup>

## 3.14. Reaction of a 3000 m<sup>3</sup> balloon

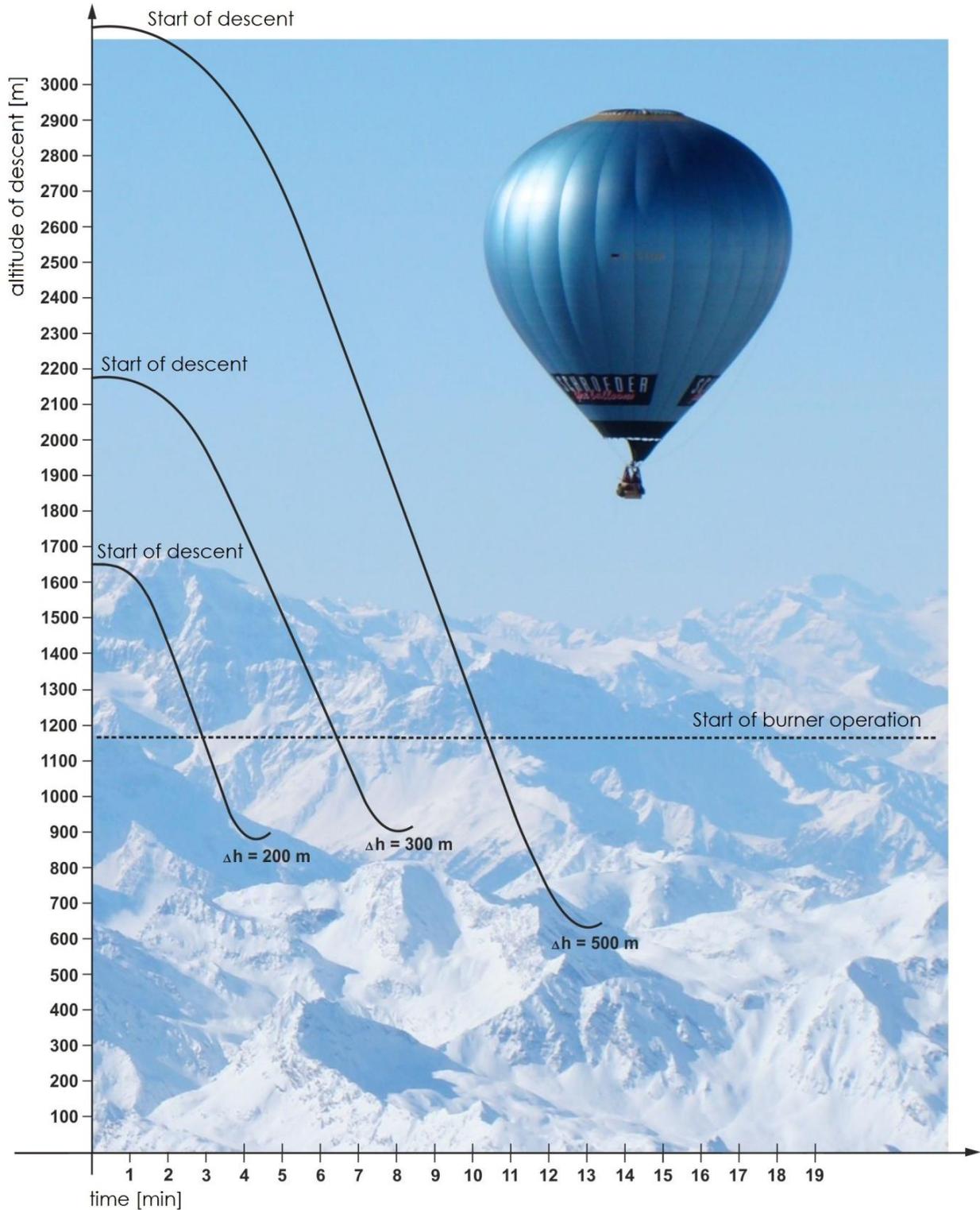
Envelope size 3000 m<sup>3</sup>; least fuel pressure 0,3 MPa (3 bar); FB 6 double; ISA condition, 4 occupants, 4 cylinders



Picture 3-2: Cold descent 3000m<sup>3</sup>

### 3.15. Reaction of a 4500 m<sup>3</sup> balloon

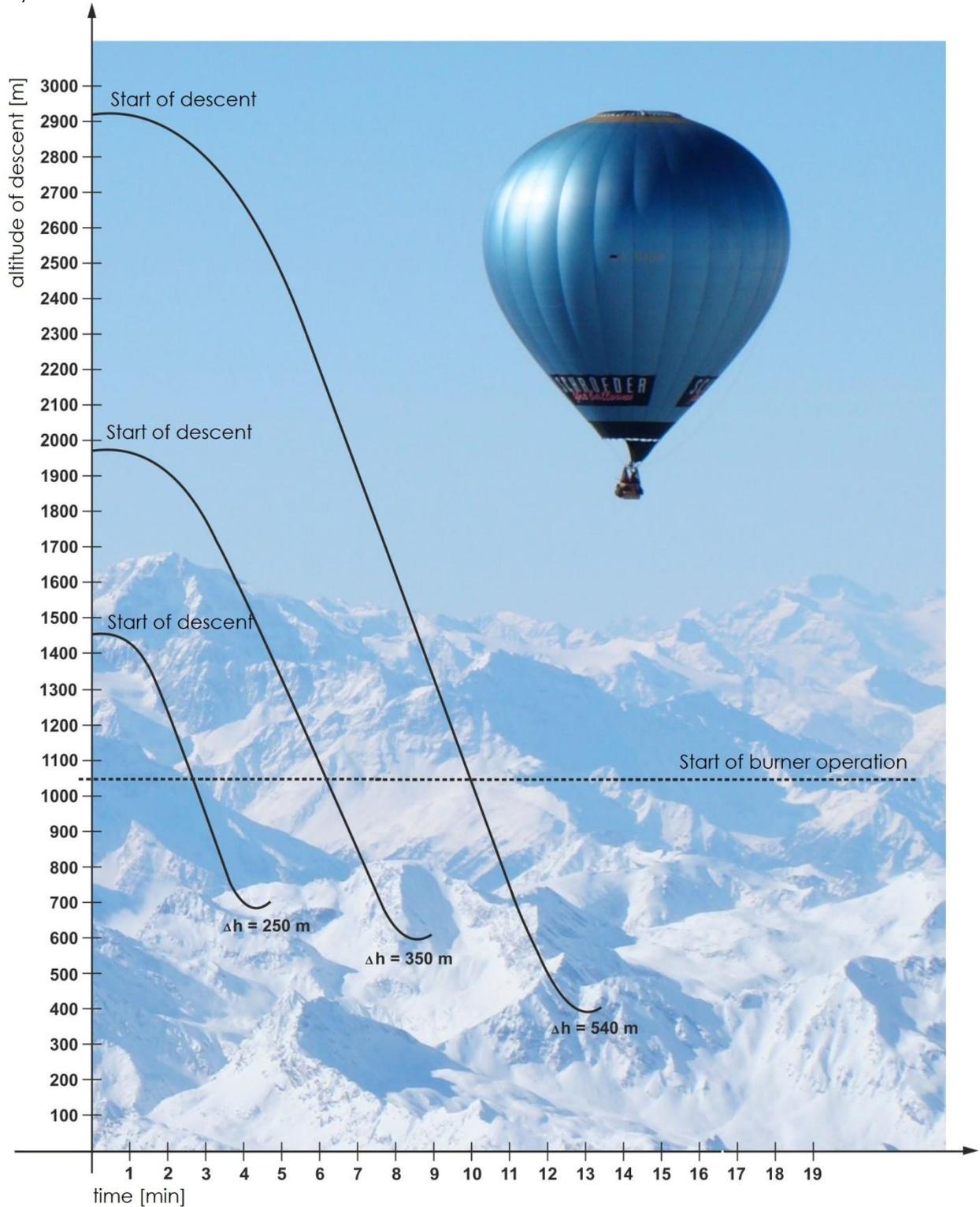
Envelope size 4500 m<sup>3</sup>; least fuel pressure 0,3 MPa (3 bar); FB 6 double; ISA condition, 4 occupants, 4 cylinders



Picture 3-3: Cold descent 4500m<sup>3</sup>

### 3.16. Reaction of a 8500 m<sup>3</sup> balloon

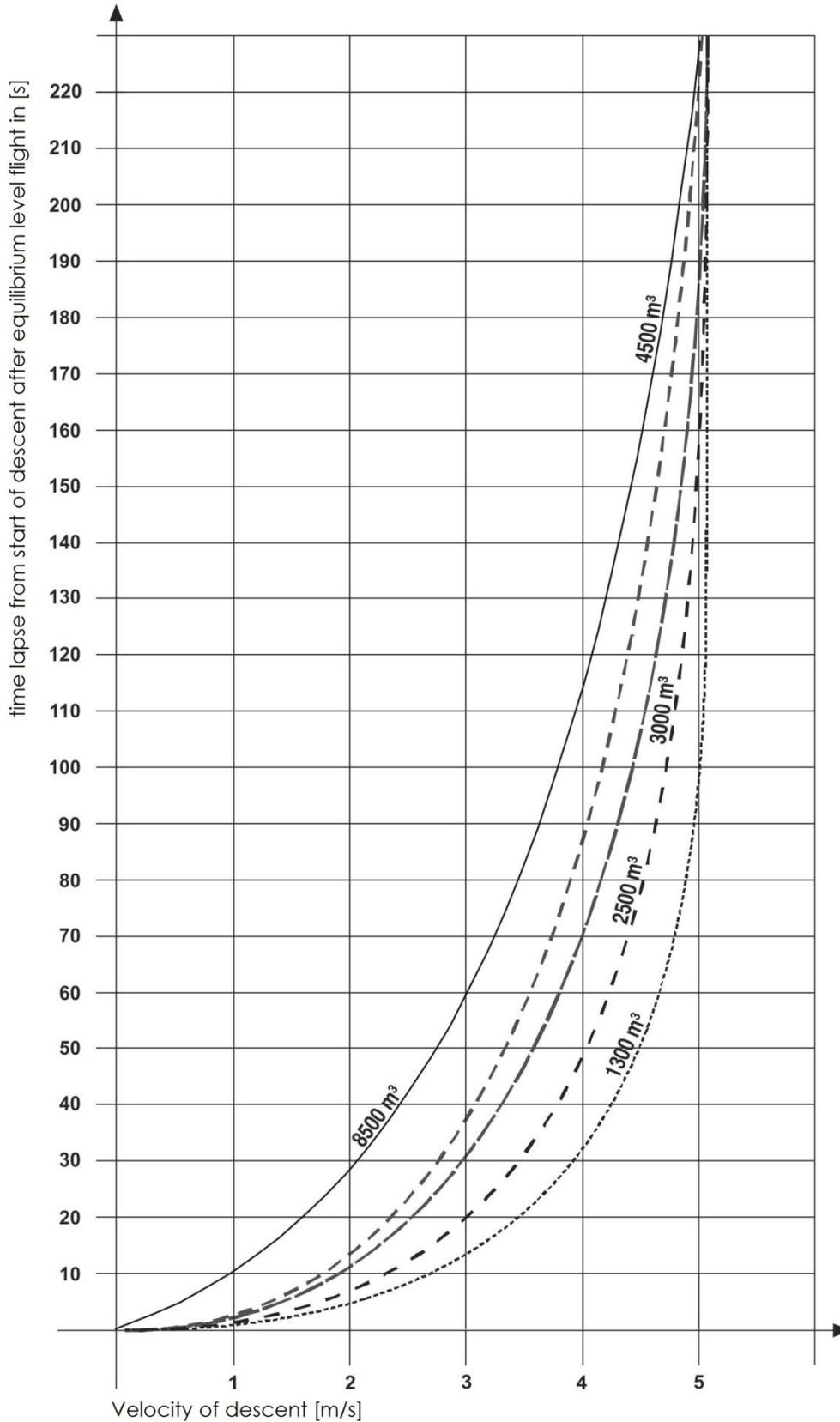
Envelope size 8500 m<sup>3</sup>; least fuel pressure 0,3 MPa (3 bar); FB 6 double; ISA condition, 13 occupants, 6 cylinders



Picture 3-4: Cold descent 8500m<sup>3</sup>

## Approximate reaction during descent from equilibrium level flight

(Valid up to approx. 10 000 ft at medium loading and intact envelope coating)



Picture 3-5: Descent reaction from equilibrium

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### 4. Emergency procedures

There are certain situations during takeoff flight and landing procedure that need detailed clarification. The next Chapter describes several situation that might occur. With the knowledge of these situations in advance, it is easier to react in an emergency condition.

#### 4.1. Overcoming obstacles at low level flights

When an obstacle emerges the pilot must be able to decide quickly and safely whether the obstacle can be overflown or it has to be landed beforehand. Regarding high power lines, radio towers or mountain ridges it must be considered that the wind velocity can increase strongly with increasing flight altitude. Often radio towers have anchoring wires of 45 to the ground. Radio transmitters can cause damages to occupants and the balloon depending on the transmitting power.

**In any case, the pilot must carry out his decision once made consequently.**

It must be landed beforehand, even if an envelope damage by trees or similar is expected, if there are doubts whether an obstacle can be overflown safely. If necessary, the parachute is opened to initiate quick descent. At this, the stability of the envelope must be observed. Often one to two operations of 5 seconds each are sufficient. As soon as the balloon descents with approx. 2 m/s after the operation of the parachute, it is already to be heated with short blasts to keep the balloon filled. With this procedure, the descent can be continued to 5 m/s. If there is enough time during an emergency landing, the rate of descent shall be reduced before touchdown. A touchdown with 5 m/s is approx. six times harder than with 2 m/s.

If an emergency landing into trees cannot be avoided, the pilot lights must be shut down by closing the valves on the burner prior to contact with the trees so that torn off hoses can cause no fire. A climb into power lines may end fatally. Also, if the basket is caught on an anchoring wire of a material aerial cable railway or of a tower, this causes great damages as the total balloon mass of 2 to 3 tons con not be stopped easily in short distance.

I an obstacle is to be overflown quickly, the acceleration up to the necessary rote of climb must be initiated by using all burners obeying the envelope temperature and the maximum rate of climb.

If a contact with a power line cannot be avoided despite all measures, it must be tried to initiate descent in any case immediately, if necessary by strong operation of the valve.

The most dangerous point of contact is the basket as there is the danger that the fuel cylinders explode when arcing shortly before contact, the occupants should crouch into the basket and not touch the burner. The best chances to remain injury-free exist at the contact of the power lines with the envelope. The pilot must point out correct behavior to its occupants before each hard landing. The occupants must hold on to the handles in the basket and must remain in the basket under all conditions.

Is the decision for landing made, two guide lines are to be obeyed:

1. It is easier to maintain or to increase the horizontal climbing and descending movement of a balloon rather than to reverse the direction of the movement.
2. At stable horizontal level flight, the balloon reacts quicker in direction descent than in direction climb.

#### **Caution:**

**If there is the danger that the balloon is crashing against a tree, it is important that the rip lines do not tangle up in branches. Instruct the basket occupants to crouch in the basket, hold tight properly and to try to remain if the basket under any circumstances.**

After over-flying the obstacle, a careful operation of the maneuver valve may be required to counter-act the increased lift.

### 4.2. Burner failure

The more knowledge one has gathered about the fuel system the easier it is to react correctly at burner failure. The reaction should be quick but without panic. One has to distinguish between pilot light failure and main burner failure. The more critical situation is the main burner failure.

### 4.3. Pilot light failure

**Pilot light failure can have to following causes:**

1. The hose connector came loose in the lock although it is still connected to the socket. Pull on the hose and check the connection, if necessary re-connect properly. Then re-light the pilot light using the piezo-ignitor or open the other burner, which still has a working pilot light, and at the same time open the main burner for a short period of time. The fire jumps over to the extinguished pilot flame.
2. Both hose connections came loose at the same time as the connection was not properly locked (unlikely, but it happened in the past). Lock plug properly in the connection and re-light the pilot light with the piezo on the burner. If unsuccessful, ignite with storm matches or spare piezo.
3. Dirt particles blocking the jet of the pilot light. There is the possibility that the flame extinguishes or burns weaker. At failure of only one pilot light, try to re-light the pilot light by short, partly opening of both main flames. It is unlikely that both flames fail at the same time because of dirt particles. If one pilot light burns weaker than during take-off, a higher pressure can then be set using the knurled screw of the pressure regulator (tighten counter nut!) The cause must be rectified before the next flight.
4. Maybe the vapour phase valve of the fuel cylinder or burner has been closed inadvertently.
5. Has the supplying fuel cylinder been pressurised with nitrogen? In this case the flame may have burnt in the beginning but extinguishes later. Connect to another fuel cylinder, if available, if the other checks 1 to 4 have already been unsuccessful and there is still enough safety altitude.
6. The pressure regulator is iced up because liquid fuel has got into it during inflation or because two cylinders connected via a fuel hose manifold have been opened at the same time and hence the master cylinder is now completely filled. Continue flight with the other still functioning pilot light and connect to other fuel cylinder, if available. If not, ask passengers to warm the iced regulator by hand.

The check is done in a few seconds if all these possibilities are known to the pilot. If it is even then not possible to re-ignite a pilot light and the other one works without problems, land at the next opportunity.

If both pilot lights cannot be get going again, a main burner flame must be lit. For that different possibilities exist.

We recommend the use of storm matches. It is best to open the cow burner and to partly open the connected fuel cylinder valve. Light the match and place it close to the burner coil directly above the burner can coming from the side.

The thus lit cow burner can now be used as a pilot light for the other burner. Land as soon/quick as possible. Be aware that partial opening of valves causes a strong cooling of the seals and a certain danger of leakages exists.

#### 4.4. Main flame failure

**A failure of the main flame is critical, it must be acted courageously. There may be a number of causes for the blockage:**

1. Cylinder valves have been closed inadvertently.
2. The fuel cylinder is empty although the contents gauge indicates something else. Connect the hose to another fuel cylinder after closing the cylinder valve. If this fails with all cylinders and the other burner still works without problems, land as soon as possible. Is the fuel cylinder connected to the failed burner not empty (detectable by opening of the strap buckles and lifting the cylinder), it is likely that the blockage is caused by a defective blast valve needle or a piece of ice in the blast valve.
3. Ice can also develop because of the cold due to evaporation, if the external or gas temperature is above 0 C. Is the blockage caused by ice, then there is now still a good chance if acted correctly: Release the upper cylinder strap and tilt the fuel cylinder 45°. Only then open the cow burner or the take-off burner (at FB 6). A further intake of water must be avoided by tilting. This situation rarely happens, but has already been experienced by various pilots.

#### **4.5. Emergency landing**

The following points should absolutely be obeyed if an emergency landing cannot be avoided.

##### **Instruction of passengers**

1. Instruct passengers so they are prepared for a hard landing.
2. The passengers should grab the handles and stand on their place with their knees slightly bent and pressed together. In no case passengers must bend over the cylinders with the head as this posture cannot be maintained during impact with up to 5 m/s and therefore danger of injury exists.
3. The passengers must be especially reminded that the basket will tip due to the impact of the first touchdown and the forward speed. Because of that, there is the possibility that occupants are thrown out of the basket. Hence to give instruction not only to hold tight but to hold tight with all force until the basket comes to a complete stop.
4. If e. g. cameras, video recorders or other not fastened things are carried, it will be regarded as necessary already before take-off to allocate a bag which is permanently connected to the basket and in which these things can be stowed away before landing.
5. The passengers must not leave the basket without permission from the pilot even after a hard touchdown.

##### **Shut off the burner**

1. Close quick shut-off valves of the pilot lights.
2. Close fuel valves on the fuel cylinders.
3. Vent fuel lines.

##### **Deflation of the envelope**

1. The pilot keeps the rip line in one hand during touchdown to be able to open the parachute immediately and, if fitted, the rip panel if there is ground wind after touchdown.
2. Irrespective of that, the pilot must hold on to the basket handles during touch down. As the balloon envelope expands lengthwise after touch down due to the inertia, there is the danger that the rip line is pulled out of the pilot's hand.

##### **Hence it is recommended:**

Hold line in one hand and also hold tight to the burner frame or handles with both hands at the same time during touchdown.

The touchdown speed may be as high as approx.. 5 m/s depending on loading.

#### **4.6. Fire on ground**

A fire before take-off can start for various reasons. Here are some possibilities from experience: A basket lies on the ground for the take-off preparations. The pilot opens the main valves on the fuel cylinders and does not notice that by mistake the cow burner valves not completely closed. The gas flow noise cannot be heard because of the inflation fan noise. At the later ignition of the pilot lights a very heavy detonation happens and a fire develops. This case happened in similar fashion a number of times.

At another take-off a pilot sets all the straw alight laying around in a field. The complete balloon burns down and aluminum cylinders might explode.

During inflation a pilot is not looking behind into the lying basket and inadvertently opens a fuel cylinder not connected. A fire develops if by accident the non-return valve does not shut properly again.

Fires can also develop in case of faulty seals in burner valves and hose couplings.

If a pilot uses an inflation cylinder which is not strapped to the aircraft, gusts might move the basket and cause damages or break of fuel lines. With a very high probability this will cause fire, fatal injuries and much damage.

Venting of non-burnt fuel at the take-off site can cause a fire by sparks from a running fan or other sources of ignition.

### **Measures:**

A fuel fire caused by leakages is always easier to fight than a fire caused e.g. by a broken hose. If possible, close fuel cylinder valve to stop the fuel supply, otherwise try to extinguish the fire with the fire extinguisher or the fire blanket.

**Never extinguish against the wind. If the fire fighting tries are unsuccessful for one minute, the try to stop the fire should be abandoned because of danger of a explosion. If aluminium cylinders are onboard, all people within a 100 m perimeter of the fire must leave within 1 minute. With Schroeder fire balloons stainless steel fuel cylinders, the fire fighting attempts should be stopped if the fire is not extinguished after three minutes.**

### **4.7. Fire in the air**

**First general rule is to react immediately and courageously. Inactivity because of paralysing fear surely leads to a catastrophe.**

- Shut down fuel cylinder immediately.
- Operate fire extinguisher or use fire blanket.
- After the fire has been extinguished, re-ignite the pilot light using the piezo-ignitor and fly with the intact burner.
- Land as soon as possible.
- If the burner cannot be operated, prepare for a hard landing.

The fires in the basket during flight up to now have nearly all been caused by leaks of valves or couplings.

**At a rupture of a part in the liquid phase, there is only a chance of survival, if it can be succeeded to shut the cylinder valves close. In any case, this should be tried immediately, even if heavy burns on hands are to be expected.**

**Always wear gloves when handling liquefied gas!**

(Re-fuelling of fuel cylinders, test of fuel cylinders and burner before take-off, hot inflation, flight and venting)

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### 5. Operation procedures

The next Chapter describes how to operate Schroeder fire balloons equipment and what needs needs to be payed attention to or needs to be obeyed in order to have a save transport, start flight, and landing.

#### 5.1. Launch site

The ground should be free of sharp and pointy objects to treat the envelope with care. If take-off on a rough concrete floor is required, it is recommended to first blow air into the envelope and only then drag out the remaining fabric carefully.

The sufficient distance to obstacle is also important. At ground winds of 10 knots, the balloon must already be able to over-fly an obstacle 200 m away with a safe clearance after 40 seconds.

There is the possibility to take off from wind-sheltered and un-sheltered sites.

Un-sheltered places have the advantage that an unsuitable weather condition is easier recognised. Besides, the wind is in fact stronger compared to sheltered sites but more constant in direction and strength. Many pilots are today of the opinion that one should renounce a balloon flight with ones guests if a take-off from an un-sheltered place is not possible. On the other hand, a sheltered place in the evening can provide a convenience during take-off. Later the wind often will become calmer during landing. A take-off out a sheltered site required increase caution when climbing into the fast wind as, depending on the strength of the wind, air is displaced out of the envelope, which necessitates a measured heating. A slope blown at by the wind (ascending in direction of the wind) usually has a disadvantageous effect on the take-off as the ground winds are stronger there than in the plane.

#### 5.2. Weather conditions

Before each flight, information about the current weather and the weather during the flight period must be obtained. Especially in gust conditions, thunderstorm probability, strength of the ground wind and its direction as well as winds in high altitude in and above the planned flight altitude, thermal activity, layers and cloud bases are important. Especially when cold fronts are approaching, the pilot should ask for strength and the chronological sequence as shortly before take-off as possible, as a weather instructor does often not know the problematic nature of flying balloons.

**Cold fronts** approaching during flight have the unpleasant characteristic to cause a vivid ground wind, which cannot be noticed in altitude. The heavier cold air approaches rapidly on ground level. The descent into this sometimes thin, fast and gusty ground layer often with a different wind direction often surprises pilots during the landing.

Due to the sudden change of velocity and direction of the wind, air is displaced out of the envelope, which increases the descent. This phenomenon is then often referred to as "falling gust" among pilots, but in reality it is caused by above circumstances.

Utmost caution is required if there is talk of a thundery weather situation but no CBs have yet developed in the vicinity. **In no case must be taken-off in the vicinity of predicted thunderstorms or even when a thunderstorm warning has been issued for the area of flight. The pilot has to decide by himself whether he wants to take-off or not, if thunder activity is forecasted further away.** Shortly before take-off, a weather information as precise as possible must then be obtained again. The flight must be renounced in those weather conditions, of large urban areas or forests are in flight direction. The pilot must be on the look out all the time for suitable landing sites and also observe the sky even against flight direction in those unstable weather conditions. Also to high flight

altitudes are not advantageous for a landing to be carried out quickly. Sudden changes of wind direction may happen when thunderstorms are approaching. Thunderstorms generated by warm air mass often not only announce themselves a long time before but can also develop suddenly in close vicinity.

### 5.3. Rigging and inflation of the balloon

This section is not only for the correct assembly of all parts but also for the inspection of all parts before take-off. It is recommended to have always a checklist so that nothing will be forgotten especially for less experienced pilots. For special missions, e. g. flights in the alps, a checklist is unavoidable. In no case, one should alter or shorten one's proven routine because of outside pressure e. g. lack of time, present camera teams or sponsors. Something important is quickly forgotten.

#### Step 1.

Stand the basket upright, launch restraint opposite of wind direction. Only fasten full fuel cylinders using cylinder straps. Use only inspected original straps for the respective fuel cylinder type so that the multiple of the own weight will be held safely during a hard landing (because of the larger cylinder body diameter the straps for the fuel cylinders VA 70 are longer than the straps for the smaller fuel cylinders VA 50). Full cylinders can be checked stands upright. When the basket lies on the ground turn the cylinders to which the vapour phase pilot lights are connected that way that pilot flame valves are on top. This is valid for Schroeder fire balloons fuel cylinders. It is therefore avoided that liquid fuel enters the pilot light device (danger of icing). For Worthington fuel cylinders, the two drilled holes in the cylinder rim have to lay at the bottom.

#### Step 2.

##### Check of the heating system

- Fuel cylinders: Secured on the designated places inside the basket using designated straps.
- Liquid phase hose connections: O-Rings without visible damage, spray with silicone now and then. Check correct connections of TEMA-couplings by a short pull on the hose. Tighten REGO-screw connections so that no leakage can occur.
- Vapour phase connections: Connection must lock noticeable. In all cases and always check correct locking by a short pull on the hose! (Frequent source of fault which can lead to a real problem during flight -> pilot light failure see Chapter 4.3, page 4-2).
- Hoses: Without visible damage
- Pressure gauge: Without damage
- Burner: Without damage

Now the cylinder pressure and burner test is to be carried out. Spectators to be outside of the area of danger. Ignite pilot lights with Piezo igniter.

Connect all cylinders one after the other, check pressure (0.3 - 1 MPa) and ignite main burner. After the test close first the cylinder valve, then burn off the fuel to empty the hose so that no icing occurs when the hose is disconnected. If no fault has been noticed, connect the first two cylinders and close all valves including the pilot light. Especially, close the turn lever valves on the burner (ball valves), also cow burner valves. If an additional inflation cylinder is to be used, then it must lay in front in the centre of the basket and in all cases must be properly secured (danger of injury in sudden gust conditions).

#### Step 3.

Meanwhile the pilot carried out the cylinder pressure and burner test, his instructed helpers have unloaded the envelope and moved it to a few meters in front of the basket in wind direction. The basket is laid down and further steps follow:

1. Attach take-off aid as described in section 'take-off aid' (page 2-23).
2. Drag the bottom part of the envelope out of the envelope bag so that the marking on the inside of the envelope edge (I) is in the centre on the ground. The dragon on the Nomex(r) is then in the centre on top. First connect the two lower wire sets to the left and right of the centre marking to the two lower carabiners on the burner frame. The wires must not be twisted. Then connect the two upper wire sets. Secure all carabiners with the locking nut.

Frequent source of faults: A number of helpers carry out the connection together. Everybody believes the other has carried out the check.

### **The pilot is solely responsible!**

#### Step 4.

There are a number of methods to spread the envelope:

Is the ground soft and free of obstacles, the envelope can be spread apart by pulling left and right starting from the two markings at the bottom of the envelope. For that the whole length of the envelope has to be first stretched out in the direction of the wind. After spreading it apart, cold air is blown into the envelope by the inflation fan so that the Parachute or the other deflation system can be installed in its place. With the other method, the fan is used immediately after the envelope is connected and two helpers then drag the bag in direction of flight. The balloon then starts to inflate so that more helpers can spread the envelope totally apart. This method is advantageous on bad ground (concrete, stubble field). The better and less creasy the envelope is spread on the ground the easier and better will be the hot inflation. Layout the entire crown line in wind direction.

#### Step 5.

Attach the safety hooks of the Parachute respectively Rip line and Turning valves to the basket respectively burner frame!

#### Step 6.

Attach the deflation system respectively turning valve.

##### a) Parachute:

First pull the Parachute line towards the top envelope aperture so that there is no load on the line during inflation. In the upper part push the Velcro(r) taps together (obey colours!). The correct installation can be checked by following the distancing lines. Obey by doing that, that all lines are free and not entangled with each other. To attach the Parachute, hot air has to be blown into the envelope first.

##### b) Paraquick – fast deflation:

Proceed as for Parachute. There are however more lines and pulleys, their free run is checked during attachment.

## c) Parachute - Velcro(r) tape - Combination (rip panel)

Attach the centrally positioned Parachute as described above. The closing and checking of the rip panel requires some practice and should not be left to the helpers (except instructed personnel). The pilot is responsible for the check. Two persons together grab hold of one Velcro(r) tape between two load tapes and pull it tight. The Velcro(r) tapes are then pushed together first only on the two load tape joints and then the middle between the load tapes. Also the then smaller distances are halved again. Only at the end is the Velcro(r) tape pushed together continuously and tightly over the whole width of the gore. Continue in that way with the remaining sections. The Velcro(r) tape of the rip panel must be at least as long as the Velcro(r) tape at the upper part of the envelope otherwise there is the danger of unintentional opening in the air. Finally close the safety locks tight by noticeable and audible locking. Secure the red line as far back as possible as otherwise the upper lock opens due to tension when the envelope floats upright.

## d) Turning valve

Check that the lines are not tangled up.

## Step 7.

## Envelope check:

Only step inside the envelope with soft shoes or no shoes. There is the danger of tearing and damaging the fabric coating when a helper stand on the fabric under tension in gust conditions or especially on hard ground or on a stubble field. With a standard Parachute entering the envelope is most times not required. Ugly stains happen on wet ground when the envelope is entered.

## Checks:

**Free run of all lines**, secure position of all safety hooks on the basket, pulleys free and moveable, no rips in the envelope caused by inflation or last landing, no burn damage on lines and steel wires, correct position of the Parachute attachment on the envelope load tape (knots without faults), carabiner locked accommodating the operating lines of the Parachute, careful routine thumb test (tear test) especially on older balloons in the upper part of the envelope fabric, are the carabiners on the burner frame secured.

## Step 8.

After the checks have been carried out, the other necessary bits are fixed inside the basket: Instruments, radio, maps, balloon bag with safety matches, knife, compass, fire resistant gloves.

Earlier the basket has been already fitted with first-aid-kit and fire extinguisher (2 kg) and with a fire blanket for commercial balloon flights (for minimum equipment see page 2-27, 51 and LuftBO [regulations on operation of aircraft]).

Spare O-Rings packed in a light- and air-tight bag should also be part of the equipment. By now GPS device are very popular in ballooning whereby spare batteries should always be at hand. Also light paper-like materials or shaving foam are part of good equipment in order to be informed about lower wind currents especially when landing. A small pair pliers should also not go amiss.

### Step 9.

Instructing the passengers can happen at this point or earlier. This depends on the weather, the set procedure in commercially operating ballooning companies and other things. It is important that the instructions are understood by every individual. The following points are to be pointed out among other things:

All instructions from the pilot are to be followed, smoking is not permitted in the basket and near the balloon, entering and exiting the basket only on explicit instruction from the pilot, no object to be thrown out, no hoses or lines to be touched, objects brought along are to be securely stowed away before landing.

Careful with glasses, cameras and video recorders, bring power lines to the attention of the pilot, when landing hold on to the handles with both hands as tight as possible and not release before the basket came to a complete stop, slightly bent knees, leave arms and hands in the basket and away from the basket rim. Instruct again before landing as novices are not aware of the acting forces. The more powerful the ground wind the more urgent and clearer the instructions must be. Many passengers understand by 'holding tight' to put their hands onto the handles. The accident investigations also show that the main misunderstandings are here. The passenger also needs to know that often just the second or third impact is the worst and need to be instructed to be aware of a possible tipping of the basket during a drag landing. As the pilot must take into account that he will be distracted during the landing in gust conditions, he should carry out the landing instruction of the passengers well in advance.

### Step 10.

Inflation procedure: Two helpers keep the envelope mouth open as square as possible, a further helper remains with the fan. One instructed person is usually sufficient to hold the crown line. Obey that the helpers wear gloves and covering clothes.

**The first general rule should be to fill the envelope with cold air as much as possible. Only then start to heat the envelope.**

There are experienced pilots who master this simple rule worse than well trained newcomers. It then happens that the envelope moves upwards like a banana and is forcefully treated with the burner so long until it is finally filled. During that the fabric suffers heavily from zonal overheating (due to the too small distance between flame and fabric material).

Correct is to operate the burner only when the inflation fan cannot fill the envelope any further. **If there are still large fabric folds on the ground not filled, the envelope should be spread further apart two helpers.** Then give the inflation fan a little bit more time to blow in a further few 100 m<sup>3</sup>. Then operate a single burner with short blasts to warm the air inside only so far to carry the fabric. The envelope becomes tighter and tighter, whereby the inflation fan is still running. Only then the envelope is turned with short heating phases.

The helper on the crown line, who carries gloves and must **not sling the rope around his arm**, gives the envelope so much slack at the beginning of the heating that it is able to unfold. The crown ring must therefore not be held close to the ground but approx. 5 to 6 m above ground. At further heating the helper then lets the envelope slowly raise by holding the rope under continuous tension as good as possible. Often 3 to 4 helpers can be seen on the crown line holding the balloon down with all force and then releasing suddenly. The then accelerated mass comes of course into swinging and makes the inflation process difficult.

Is the balloon fitted with a FB 6 burner, the pre-heating is done using the special, blue take-off valve as this flame is narrower and smaller. **Please, in all cases obey the section “operation information for burner FB 6”.** After a little practise, one will like to inflate using this procedure. The pilot is wearing both gloves at least during the whole inflation process.

Step 11.

### Pre take-off checks:

- Fuel cylinders:  
Except take-off consumption, a fuel cylinder possibly used for inflation is to be removed. It will be replaced with a full fuel cylinder.
- Lines:  
Attached to the basket or burner frame, not entangled. **Functional check of the Parachute to detach the Velcro(r) taps.** Operational check of both lines of the Paraquick!!  
(Open the rapid deflation only for a short period of time and close again immediately so that the envelope does not fall into the burner). Safety locks closed at rip panel balloon.
- Crown line:  
Attached to the basket with the Velro(r) fixing, not knotted to the burner frame, give only little slack to avoid contact with trees and if necessary fasten again further up with the Velro(r) tap of the cushion for the burner support rod.
- Minimum equipment and supplementary equipment:  
Existent (according to legal requirements).
- Radio:  
contact with ground control or air traffic control is established.
- Payload (check before laying the basket down):  
maximum permitted number of occupants not exceed depending on the number of cylinders as well as the load calculation, maximum permitted payload not exceeded (see type plate and data matrices).
- Altimeter (check before laying the basket down):  
set to QNH or site elevation if known.
- Documents:  
Certificate of Airworthiness, Certificate of Registration, valid inspection certificate, flight manual, pilot's license, insurance document, ICAO-maps and other maps.
- Passengers and helpers:  
instructed.
- Fuel pressure:  
**0.3 – 1 MPa (3 – 10 bar)** (see section operation parameters page 3-1).
- Pilot light:  
Regulator on the cylinder iced up? In that case warm the respective valve by hand before take-off.
- Valve operation:  
Parachute valve operation must never be forgotten. This is the las possibility to check the free run of the pulleys before take-off.

### 5.4. Take-off

It is recommendable, essential at certain conditions of the weather and the take-off site, to launch one or a few pilot balloons shortly before take-off and to observe them as long as possible. Generally, the take-off aid is always to be used. Use only the equipment approved for the respective balloon! This procedure is compulsory at many officials.

The pilot must know the reaction of his balloon in the cases where the take-off aid cannot be used. The stronger the wind on the ground and the faster one wants to climb the more the balloon must be held downwards. In no case however, the stress must not be too high so that a danger can arise from that. The smaller the balloon the smaller the maximum permitted loading. At a 1300 m<sup>3</sup> balloon, the loading by helpers should not be more than 80 kg, at a 2200 m<sup>3</sup> balloon maximum 100 kg, at 3000 m<sup>3</sup> maximum 130 kg. During this, the contact to the ground with the feet should be maintained in any case as otherwise one could easily get caught on basket loops or valve lines. At sudden off-loading of those loads at a rate of climb of 3 m/s already establish itself. A significantly stronger off-loading can cause the Parachute to open in the most extreme situation due to the dynamic pressure. At calm wind on the ground a significantly lower loading is sufficient for a safe take-off.

The loading forces mentioned above can be considered as good guidance for e.g. a take-off out of a wind shelter into a current of 10 knots as long as the pilot has ensured that the lift is sufficient for a safe take-off and nobody of the ground crew has been caught somewhere, the balloon can be released and climb after the unmistakably command "Let go of everything".

At calm wind it may be climbed fast or slow as desired. At a wind velocity of around 10 knots the rate of climb is to be adjusted according to obstacles ahead and to the distance of the wind shadow edge.

At this wind, the rate of climb should be around 2 to 2.5 m/s up into the undisturbed current. Possible decrease of the rate of climb due to increased displacement of air out of the envelope (wind shear) or decrease of the aerodynamic virtual lift (false lift) is to be counteracted by immediate operation of the burner.

If during take-off a compensating temperature of 100 C already has been achieved (so that the balloon would just float), a safety cushion of 10 C remains. With that the balloon can climb with approx.. 2.5 m/s. To fly over an obstacle 100 m tall, a time of at least 1.5 minutes is to be considered. Depending on the strength of the gust conditions or wind shear, this time increases partly significantly.

**Heavy, even fatal accidents already happened because of equivocal orders from pilots respectively insufficient instructions of the helpers. Clear instructions and loud orders!**

**It is already too late after two to three seconds to jump off, if the balloon breaks free and a helper hangs on the basket rim or carrying handle as the hand is trapped.**

## 5.5. Correct use of the Schroeder fire balloons launch restraint

Here serious errors are often made by many pilots. Some light or heavy accident happened has been caused by that. The only correct use of the take-off aid is as follows:

Fasten the approximately 5 m long original rope with the original hook to the car. Do not tie to the trailer. Connect the rope including the safety device to the basket by avoiding twisting of the ropes.

Reduced strength must be considered for older anchoring ropes. Is the pilot in the basket and the balloon ready for take-off, the pilot releases the safety hook (snap shackle). At further heating, the balloon climbs up to two to three above ground and the release mechanism is not yet to be released.

Accidents have proven that often a small thermal bubble or gust activity lifts the balloon by faking of false climbing force without the envelope air being already sufficiently heated.

In reality often a few burner blasts are missing to produce the right temperature and therefore the required climbing force. In gust conditions, the basket is often vigorously moved up and down a number of times. Is the mechanism released at this virtual climbing force the basket usually hits the ground. Only if the altitude can be maintained over a period of seconds, the release mechanism can be pulled and the flight can begin.



Picture 5-1: Use of launch restraint



Picture 5-2: Launch rope attachment

### 5.6. Flight operation

It is advisable first to empty a cylinder with connection to the pilot light down to 15 %. After that, disconnect the main hose from this cylinder and connect it to a slave cylinder and ensure function. The second cylinder with connection to the pilot light should then again be emptied down to 15 %. So that two cylinders with full pressure are available for the landing phase. It's a fact that the fuel pressure decreases due to evaporation caused by the pilot light supply. At slave cylinders the pressure reduces little until the end

The re-connection of a liquid fuel hose with TEMA coupling is done as follows:

- close the valve of the fuel cylinder
- open the burner valve to vent the hose
- close the burner valve
- connect hose to the new fuel cylinder
- open the cylinder valve and test operate the burner connected to the new cylinder

#### **Caution!**

**At connections with sleeve nuts (e.g. REGO), it is to obey especially in winter that the nuts are tightened firmly. When leaks occur, gas escapes and causes an immediate cooling of the rubber seal due to evaporation, which in turn causes the seal to become hard and ineffective.**

#### **Caution!**

**If this case occurs, close the cylinder valve immediately and tighten the sleeve nut with a pair of pliers ready to use. If this case has occurred, it is recommended to replace both rubber seals in the REGO-cylinder valve and to lubricate with silicone spray.**

After take-off and reaching the minimum safety altitude, the pilot may of course enjoy the flight. As this is the main aim of his efforts after all. At this he must never be distracted so that he makes mistakes. Especially during flights at low altitude, a power line is easily overlooked in the greatest of euphoria be it because of gross negligence or because of blinding by the low sun. Although one should talk to his passengers but only as long as it does not mean a distraction. Contact with power lines happen because of negligence during flight or because of stronger winds on the ground and wind shear near the ground during landing. In general the direction of view of the pilot is in direction of flight, whereby of course it has to be looked also behind and to the sides e.g. for observation of weather developments. A passenger continuously talking about his last holiday should be politely reminded in the interest of the other passengers that one should concentrate now on the balloon flight. The pilot has one's hands full especially in difficult weather and navigation conditions. He shall give explanations to the passengers, answer his retriever, talk to the air traffic control, observe possibly developing winds on the ground (smoke, trees), check his fuel reserve, re-connect hoses and route them so that they do not project into the passenger space, observe changes of direction of wind by paper scraps, look out for possible landing sites and possibly approaching weather front or formations of thunderstorms and also enjoy the flight! This will become significantly increasingly difficult in bigger baskets. One should train his retriever well in ones own and also in the interest of balloonist colleagues. He should only talk on the radio about the things that are directly connected to the balloon flight and should not talk for hours on end. Also he must not be given every single country lane by the pilot. When many balloons are flying, the tranquillity and experience of all listeners is spoilt if heavy chatterboxes are around. This can often be seen at events.

**5.6.1. Landing site selection**

- free of power lines, buildings and animals
- The landing site should be accessible to vehicles if possible
- the faster the wind on the ground possibly the longer is the required landing site.
- Is the landing site suitable for a possible landing abort?
- Do not land towards obstacles

**5.6.2. Instruction of passengers**

- Hold tight with both hands and bend knees slightly
- Give notice that the basket might tip over at a drag landing
- Do not position head above cylinders to avoid injuries during touch down
- The passengers should also look out for obstacles especially power lines (The urgency of this instruction should be adjusted to the prevailing weather and ground conditions)
- The passengers must not leave until instructed to do so by the pilot.

**5.6.3. Descent for landing**

For descending towards the selected landing site, let the balloons cool and initiate the descent. The rate of descent is controlled by short burner operation, sufficient distance to possible obstacles should always be maintained at the same time.

The rate of descent also depends on the wind speed.

At calm weather a low rate of descent may be chosen, whereas at stronger winds one should be prepared for a harder landing. Whereby the basket can tip over and can also drag over the ground. This is less dangerous if the passengers obey the instructions of the pilot. The rate of descent is also controlled by operation of the burner and the valve system of the envelope.

The landing side of the basket is turned across to flight direction by short operation of the turning vent of the envelope, if fitted. Shut pilot light and cylinder valves immediately before touchdown. The rip line is operated by the pilot who also holds tight during touchdown.

**5.6.4. Landing**

Prior to the landing the pilot convinces himself that the landing site is free of power lines. Great distance is to be maintained especially to power lines when thermal activity is existent and when there are stronger winds on the ground, especially when the ground is not even. Due to the later, vortices can occur near the ground, which can cause loss of altitude. A change of direction on the ground can be detected by continuous dropping of paper scraps of shaving foam and therefore flying into power lines can be avoided.

Preparations before descent

- check whether there is sufficient fuel reserve in the connected cylinders
- stow away loose objects e.g. binoculars etc in bags
- instruct passengers
- check Parachute line for free run.

Depending on landing area and strength of wind, descent is to be more or less fast. As an average, a rate of descent of 2 m/s is an optimum. At a short landing site and stronger wind current, descent has to be respectively quicker although a rate of 2 m/s at touch down should not be exceeded.

If sufficient landing space is available at higher wind velocities, the following method may be adopted: Approach the ground with average rate of descent and initiate horizontal flight in one to five metres above ground and open Parachute completely. Hold tight to the rip line. At the same time, the pilot holds tight with his hands on the basket during touchdown.

In this case only open the Parachute immediately after the first touchdown. Hold on to the rip line.

Has the balloon come to a complete stop and enough air escaped out of the envelope, the passengers may leave the basket. One of the passengers takes the crown line and pulls it in wind direction.

At calmer wind it sometimes happens that the balloon comes to a halt over ground unsuitable for landing (e.g. water, vineyard or plantations). Helpers, if available, or passengers carefully climbed out of the basket, can manoeuvre the balloon to a more suitable landing site using the drag rope.

### **In any case check for power lines!**

A Parachute opened too much often causes considerable damage to the envelope when it then falls on top of the burner.

Then check again whether the cylinder valves are closed. Vent the fuel lines as follows:

Ignite pilot lights, burn off fuel in the main hoses while fuel cylinder valves are closed. Then shut-off pilot lights, disconnect all connections and fit protective caps. Do not vent off cold liquefied gas because of the risk of fire and detonation as only the coils are cooled anyway a little bit but not the coil support brackets. Furthermore this is penalised with a number of penalty points at official competitions.

### **Caution!**

#### **The pilot must never leave the basket if passengers are still on board.**

Even at calm and harmless weather heavy accidents already happened for which the pilot has been made liable. Besides accidents with heavy consequences occur after a beautiful and calm flight, If an inexperienced, not correctly instructed passenger trips with his foot tip on the basket rim while climbing out an thus dislocates the knee joint.

### **5.6.5. Deflation and de-rigging of the balloon**

The method used may depend on the prevailing ground. Is the ground clean and without obstacles, the air in the envelope is first pushed from the bottom towards the Parachute by a few helpers after the basket has been laid on its side. The Parachute aperture is held open by another helper. Then, if the envelope is emptied to a great extent, the remaining air is squeezed out from the bottom towards the top and the envelope is folded to a narrow hose.

The better this process is carried out the easier will be the packing into the envelope bag.

With the method used most often the envelope can then be packed bit by bit into the bag from the Parachute towards the bottom, after the crown line has been folded together. Two helpers hold the envelope bag open, a further helper puts the envelope bit by bit in the bag while being dragged towards the basket. The envelope wires, manoeuvring lines as well as temperature measuring cable are disconnected from the basket and properly stowed away. The envelope wires are attached to the Velcro (r) straps on the scoop.

The wires are put in loops into the envelope without being coiled up over the arm. This leads to twists and kinks in the wire which is especially a disadvantage for Parachute and rip lines.

Another method to fold the envelope together is also applicable:

After it has been folded together to a hose, it is rolled together by two people starting from the crown ring. The roll then becoming bigger and bigger must not be pushed but rolled tightly together as it becomes otherwise un-shapely and big or falls apart sideways.

The envelope should be packed together as quickly as possible to avoid that it lays for too long on meadows, often contaminated with artificial fertilisers and also to protect it against further UV-exposure.

In no case disconnect the envelope after landing and leave it unattended. A sudden gust could carry it away.

The pilot in charge should always be aware of the fact that he landed on some ones property. From the point of view of a farmer view working on a field, it looks especially provocative when helpers and spectators trample on his field during the 'balloon christening' and behave inconsiderate. Thereby every balloonist sets the basis for the next restrictions by authorities. The retriever must also be instructed in order to know on which property he is allowed to drive and when he must ask the proprietor first. Crop damage, even insignificant ones, must be reported, even if it is sometimes difficult to trace the proprietor or leaseholder. Retriever and pilot should also avoid crop damage by spectators.

### **5.6.6. Control of the balloon**

Within a certain range a balloon can be steered towards a certain direction. This depends on the change of wind direction between ground and flight altitude. At low air pressure distribution, the pilot can also make use of temperature-related local winds. This is more, the more a valley is carved in, the steeper the angle of attack of the valley and the more the sun radiation. The straightness of a section of the valley even amplifies this effect. At such situations, the ground wind flows usually downhill until the late hours before noon (mountain wind) and reverses after that in the opposite

Therefore theoretical instructions about controlling a balloon are no replacement for practical experience. The following notes may be of use for the pilot.

### Altitude

First, consider that always some time elapses between the operation of the burner or valve and the actual reaction of the balloon due to the inertia of its mass. The reaction time is of course different for every balloon mass but the pilot will be familiar with the behaviour of the balloon already after a short period of flight time.

The flight altitude of the balloon can actively be influenced by:

- the burner
- the manoeuvring valve.

### Operation of the burner

The balloon can be controlled best by short burner blasts. Numerous short burner blasts allow a more precise control than longer burn operations with irregular intervals. This should be used to one's advantage during the landing process.

### Operation of the manoeuvring valve

The Parachute valve can be used to increase the heat loss. It's opening causes either a faster rate of descent or a slower rate of climb. The manoeuvre valve should be used as little as possible as the fuel consumption increases significantly otherwise. The valve should be used only near the ground and before landing respectively. Every pilot must learn by practise how the reaction of the balloon to valve operation is.

Especially for pilots under training it is advised to count the seconds while he holds the valve open. This provides an immediate possibility of comparison of the different reactions when opening the valve and makes their assessment easier. These exercises should not be carried out to close the ground, but best in an altitude above 50 m. It is safer for manoeuvring to open the parachute only a little bit but for a few seconds longer, the descent will then start not too abruptly.

An eye is always to be kept on the altimeter. Also the envelope is to be observed, especially the lower part. An extremely long operation of the Parachute is risky as the envelope will become instable in the area of the lower aperture. Also, the parachute must not be opened so long that a rate of descent of 5 m/s is reached but is to be closed at approx. 2 m/s as the rate of descent increases after that even with closed valve.

Short and regular heating is advantageous for an affordable fuel consumption and to treat the envelope with care. A continuous up and down is also disadvantageous for the fuel consumption. The pilot must know the inertia of his balloon, which varies according to loading, size and external temperature.

Near the ground, the rate of climb or descent can be judged by observation of trees or the landscape. In higher altitude, the check can only be made by observation of the altimeter. The re-heating should always be carried out, before the balloon starts to descent. During flight, the wind drift in the lower layers can be observed by dropping small paper scraps so that the further flight course can be planned. Also the observation of flags, smoke, corn fields and water surfaces is important for the determination of direction.

### **Fuel reserves**

The balloon pilot knows by experience that often something unexpected happens during the landing phase no matter how harmless the weather and the landing site appear. To initiate an early landing means a reduction of risk. Generally, the poorer the weather and the landing site the more fuel reserve is to be allocated, as in this case only few landing possibilities are available.

### **Directional control**

The directional control of a balloon is often a matter of coincidence, but is still often possible by skilful exploitation of the change of direction between the different wind layers. Prior to flight, approximate details about the wind directions in various altitudes can be obtained from the weather service. A more exact assessment can be made after launching pilot balloons and observation with the compass. This requires some experience as only at the beginning the indicated course is also equivalent to the wind direction. The pilot can bring the balloon possibly on a desired course or in direction of a chosen point by changing its altitude.

After takeoff the different directions and wind velocities are experienced by step-by-step climbing. If the pilot knows the direction and velocity over altitude, he can make use of this to determine his destination or his arrival time.

Apart from the prevailing winds, local wind conditions can also be used to direct the balloon. A local effect occurring quite often is a valley wind, which can flow against the direction of the main prevailing wind. Local wind effects can be identified by observation of smoke from chimneys and open windows.

### 5.7. Influence of weather disturbances on the balloon

#### Wind shear

Depending on strength, they deform more or less the balloon envelope so that warm air is pushed out of the balloon and the Archimedean lifting force is reduced. At occurring wind shear, which can be detected by a sudden wind in the basket, the balloon should immediately be heated as needed so that the balloon does not start to descent. These winds usually occur close to the ground, especially behind mountain ridges. (Rotors) In this case, the basic principle applies:

**The faster the wind and the more jagged the mountain ridge, the higher it should be over flown.**

The wind shear is to be assessed when descending into a valley running across the flight direction. At speedy wind, one should try to descent at approx. 1/3 of the valley width. Shortly before the middle of the valley, one should be again a bit lower than ridge height. At deep valleys, usually one can descent vertically after reaching this point even at stronger altitude wind.

#### Thermal activity

Generally one should avoid a flight in thermal activity. One learns in the meteorology classes when the probability for thermal activity is given. The ground and the wind are to be observed carefully, land at the first signs of thermal activity. If one should still come unexpectedly into strong thermal activity, it must be acted with caution.

The temperature should be maintained and increased during the climbing phase in the thermal bubble. Not the fast climb in a thermal bubble, which can be a few hundred metres in diameter, is dangerous but the dynamic downwind reaching down to the ground next to the thermal bubble. It must be reacted immediately with burner operation at sudden occurrence of strong descent, if necessary with double burner, especially when power lines are nearby. When these wind conditions occur, the flame and the envelope should be observed when the burner is used to counter the effect.

#### Caution!

##### Observe the thermometer continuously.

After such a defence, one can surely assume that the balloon will start to climb rapidly after pulling out. Should this thermal activity occur in the late afternoon, this situation can easily be avoided by increasing the flight altitude and to wait for the thermal activity to disperse. This requires of course the necessary fuel reserve.

When the thermal activity occurs in the morning it is recommended to land as soon as possible, in fact sufficiently far away from power lines. The approximate strength of the thermal activity can be obtained from the weather service. The situation is serious when more than 2.5 m/s is specified.

If possible, it should be landed before dispersion of the ground inversion and the related strong picking up of the wind.

#### Precipitation

The envelope absorbs a considerable amount of rain water despite the coating due to the large surface area, furthermore the envelope will be cooled more. The load calculation carried out before beginning of the flight is not valid anymore in rain. It is known that many envelopes have been overheated and hence heavily damaged during flights in rain.

Especially with older and porous balloons, the absorbed water can take the mass of a number of people.

A further danger threatens the heating system due to the rain. When the rain increases, water enters the inside of the envelope via the Parachute-area due to the low gradient through the adhering area. The water then flows along the envelope fabric and envelope wires on to the burner and can cause the pilot lights to extinguish.

**Extreme caution is required. Every suitable landing site is to be used. Therefore, land immediately at arising precipitation.**

### **Calm wind**

A careful flight planning is especially important at calm wind. For instance, is a large forest area in direction of flight at clam wind, it must be decided early enough whether it is necessary to land beforehand. At flights on the late afternoon it must be expected that the wind decreases with decreasing sun activity. The landing should be calculated in a way that more than 30 minutes flight reserve is available.

### **Current vortices**

Current vortices usually occur near the ground and push the balloon downwards. They are usually on the lee side of a hill, a forest, other large obstacles as well as in the middle of a forest or of another uneven landscape. The strength of the wind pressure affecting the envelope is in proportion to the wind velocity and elevation of the obstacle. The pilot should pre-judge the possible effect of the vortex and operate the burner early enough to counteract the vortex.

### **Valley wind, gusts**

Basically, valley winds and gusts represent a confrontation between the prevailing wind current and a local effect. Usually the balloon is affected as far as the wind pressure can displace a part of the envelope and a loss of hot air at the open bottom envelope edge (in conjunction with loss of climbing force) with the result of a loss of altitude. Furthermore the burner flame may be distorted sideways, so that the pilot must make full use of the gimballed suspension of the burner to avoid burning the envelope and to fill the balloon within a short period of time again.

**Caution! Observe thermometer continuously.**

### **Low external temperatures**

These cause a drop in propane pressure and therefore a decrease of heating power. Furthermore the inert mass increases with air density. The reaction time becomes longer. It is therefore recommended to increase the fuel pressure in the cylinders depending on balloon size, wind conditions (and burner type). One possibility to increase the fuel pressure is to warm the fuel cylinders by storing, after checking for leaks, in warmed, well ventilated rooms (no cellars). This has the advantage that all seals remain warm and elastic and so a leakage will be unlikely by a multiple.

If a warming is not possible, nitrogen can be added (see artificial fuel pressure increase page 2-19).

### **Wind velocity**

A balloon flight is to be cancelled when the wind velocity on the ground exceeds 15 knots at the take-off site, gusts occur with velocities of more than 10 knots above the average wind velocity or an excess during landing is probable. It must also not be taken-off not even out of an ever so deep and sheltered valley in those wind conditions (see wind velocity, page 3-2).

Exceptions are in the responsibility of the pilot e.g. at competitions where only the pilot and experienced occupants are onboard. Though such a situation is even a risk for experienced persons. The upper limit should be 10 knots for standard passenger flights as out of experience even novices may have problems. Inexperienced pilots and also experienced ones, who are mainly interested in the sport, take off only up to 8 knots at the take-off site. The limitations from the authorities are to be obeyed, which often limit the wind velocity on the ground to 10 knots, in addition to the limitation from the manufacturer.

### **5.8. Dropping Parachutists**

Dropping of parachutists must only be carried out under following pre-conditions:

To reach a designated drop area, a suitable take-off site according to wind direction and velocity is to be selected.

The baskets must have a minimum gap between the burner support rods so that the parachutist can leave the basket without touching the burner support rods. Therefore only the baskets from size IV/5 and upwards must be used to drop parachutists.

Equipment must not be installed on the in- and outside of the basket wall on the basket side of the exit and furthermore not on the burner support rods on this side.

The loading plan must be carefully obeyed when planning the take-off. Obey the minimum landing weight! Because of the drop altitude, the legal safety regulations as well as the local limitations are to be obeyed.

The wind speed on the ground must be no higher than 8 knots and in drop altitude no higher than 15 knots because of the lower inner pressure of the envelope. The drop side is always the wide side turned towards the direction of the wind.

The pilot has to discuss the best point and altitude of drop with the parachutist. The rate of descent of the balloon shall be approx. 1.5 m/s at the point of drop. The parachutist sits with time in hand on the basket rim with view towards the drop point and waits for the signal from the pilot. Only the pilot responsible gives the signal for exit.

Variometer and altimeter must be checked thoroughly prior to take-off for correct functioning and setting to the air pressure.

The fact that the balloons of the type fire balloons G are approved to drop, does of course not automatically constitute the permission for this procedure. Permission from the relevant local authority must be existent.

### 5.9. Refuelling and transport of pressure vessels for hot air balloons

Excerpt from the Nachrichten fuer Luftfahrer (NfL) (News for Aviators):

A heavy accident during re-fuelling of pressure vessels for hot air balloons not long ago provides the LBA with the occasion to point out the following fact again:

1. Pressure vessels are part of the hot air balloon and are in this characteristic approved according to the airworthiness requirements for hot air balloons. Instructions for re-fuelling are contained in the associated operating instructions. Further than that, the pressure vessel directive (DruckBehV) and the Technical Regulations for Pressurised Gases (TRG), which both are valid independently of aviation regulations, are to be applied to the re-fuelling process.
2. It is furthermore pointed out, that, according to the pressure vessel directive, the pressure vessels can only then be filled and, according to the directive about the transport of dangerous goods on the road (GGVS), transported if they have been marked with a stamp of an appointed expert in accordance with the stated regulations. This applies independent of the LBA-approval of the pressure vessels at the type approval of hot air balloons.

This notice is to be carried as appendix to every operation's manual of a hot air balloon.

Braunschweig, February 1994

II 1 13-602.2/40/94

The director of the Luftfahrt-Bundesamt (German federal civil aviation authority):

Koplin

The change of the notification "Filling of pressure vessels for hot air balloons": NfL II-33/95 bullet 2. underlined sentence in the original version "TÜV-stamp" was to be replaced with the underlined text.

NfL II-33/95 Brunswick, the 02. Mar 1995

II 1-602.2/40/95

The director of the Luftfahrt-Bundesamt (German federal civil aviation authority):

Horst

### CAUTION

Exercising air sports contains dangers to live and limb and may even lead to death. No instrument and no aircraft is perfect. It may happen in rare cases that a flight instrument fails or indicates faulty values. The pilot (the aviator in charge) is always totally alone responsible for a safe execution of all flights.

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