Flight Manual

Written by the manufacturer for hot air balloons

Theo Schroeder fire balloons GmbH

Gewerbegebiet Am Bahnhof 12
D – 54338 Schweich
Deutschland

Phone +49 6502 930-4
Fax +49 6502 930-500

mail@schroederballon.de
www.schroederballon.de

EASA Type certificate datasheet no.: EASA.BA.016 and EASA.BA.010
EASA approval as production organization: DE.21G.0038
EASA approval as design organization ADOAP: EASA.AP038
EASA approval as Continuing Airworthiness Organization: DE.CAO.0065

Schweich, November 8th 2023
Date

Signature

Balloon registration

Registration	
Serial no.	
Year of manufacturing	
Hot air balloon Type	
Envelope size	
Manufacturer	Gewerbegebiet Am Bahnhof 12 54338 Schweich Fon: + 49 6502 930 4 FAX: + 49 6502 930 500 www.schroederballon.de
Edition	Ed. 2016

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 "Druckbehälterverordung" and ADR regulations. The required periodical inspection is to be carried out by an official technical expert.
The Hot Air Balloon may only be operated according to the determined limitations and provisions of the EASA approved Flight Manual.

The Hot Air Balloon mentioned on page II with the registration

D-Oxxx

is described in this Flight Manual and its applicable appendices. The Hot Air Balloon envelope is quipped with the below mentioned components for controlling means. The description of operations, normal and emergency procedures, limitations of the equipment and systems, are defined in the corresponding chapters of this flight manual.

Deflation System: Smart Vent

Number of turning vents: none

Table of content

Balloon registration **II**
Table of content **IV**
Records of Amendements **VIII**
Table of valid pages **IX**
1. General **1-1**
1.1. Weighing report 1-1
1.2. Data matices for combinations of Schroeder equipment 1-2
1.2.1. Data matrix 1200 m³ – 1899 m³ 1-2
1.2.2. Data matrix 1900 m³ – 2199 m³ 1-2
1.2.3. Data matrix 2200 m³ – 2599 m³ 1-2
1.2.4. Data matrix 2600 m³ – 2899 m³ 1-3
1.2.5. Data matrix 2900 m³ – 3099 m³ 1-3
1.2.6. Data matrix 3100 m³ – 3299 m³ 1-3
1.2.7. Data matrix 3300 m³ – 3600 m³ 1-4
1.2.8. Data matrix 4000 m³ 1-4
1.2.9. Data matrix 4250 m³ 1-4
1.2.10. Data matrix 4500 m³ 1-5
1.2.11. Data matrix 5000 m³ 1-5
1.2.12. Data matrix 6000 m³ 1-5
1.2.13. Data matrix 7000 m³ 1-6
1.2.14. Data matrix 8500 m³ 1-6
1.2.15. Data matrix 10500 m³ 1-6
1.2.16. Data matrix 12500 m³ 1-6
1.3. Type plates of the components 1-7
2. Technical description (components of the balloon) **2-1**
2.1. Balloon structure 2-1
2.2. Envelope 2-2
2.2.1. Deflation systems 2-3
2.2.1.1. Parachute system 2-3
2.2.1.2. Para Vent 2-3
2.2.1.3. Easy Vent 2-4
2.2.1.4. Lite Vent - fast deflation system 2-4
2.2.1.5. Paraquick - fast deflation system 2-5
2.2.1.6. Smart Vent - fast deflation system 2-6
2.2.2. Turning valve 2-7
2.3. Heating system 2-8
2.3.1. Burner 2-8
2.3.2. Pilot light 2-9
2.3.3. Fuel lines 2-9
2.3.4. Load-/ burner frame 2-9
2.3.5. T-piece Manifolds (see also Appendix A) 2-10
2.3.6. Operating instructions FB 6 burner (see also Appendix A) 2-11
2.3.7. 3 Phases of hot inflation with FB 6 and FB 7 burner 2-12
2.3.8. Instructions for solenoid valves (see also Appendix A) 2-13
2.3.9. Winterpower mode FB V burner (see also Appendix A) 2-13
2.4. Fuel cylinders 2-14

2.4.1. General 2-14
2.4.2. Constellation of VA 50 and VA 70 2-14
2.5. Fuel cylinder equipment 2-15
2.5.1. Protective cover 2-15
2.5.2. PRV 2-15
2.5.3. Bleed valve 2-16
2.5.4. Contents gauge 2-16
2.5.5. Liquid Ball valve 2-17
2.6. Fuel cylinder handling instructions 2-18
2.6.1. Automatic re-fuel stop 2-18
2.6.2. Re-fuelling process: 2-18
2.6.3. Schematic view of Schroeder fire balloons fuel cylinders 2-19
2.6.4. Re-fueling systems 2-20
2.6.5. Technical information to the fueling system 2-20
2.6.6. Artificial fuel pressure increase 2-20
2.6.7. Instructions for pressurizing fuel cylinders with Nitrogen 2-22
2.7. Basket and equipment 2-23
2.7.1. Launch restraint 2-24
2.7.2. Launch restraint operation instructions 2-25
2.7.3. Load frame connection 2-27
2.7.4. Cushion floor 2-29
2.7.5. Approved instruments for fire balloons 2-29
2.7.6. Minimum equipment 2-29
2.8. Inflation fan 2-30
2.9. GPS 2-30
2.10. Applicable equipment with fire balloons G envelopes 2-31

3. Operational limitations 3-1
3.1. Envelope inside temperature 3-1
3.2. Maximum rate of climb and descent 3-1
3.3. Fuel pressure 3-1
3.4. Wind speed 3-2
3.5. Thermal lift and gusts 3-2
3.6. Loading 3-2
3.7. Load Chart 3-4
3.8. Load table 3-5
3.9. Limitation for the commissioning into operation 3-6
3.10. Restrictions for using other manufacturers components 3-6
3.11. Restrictions for commercial passenger transport 3-7
3.12. Fuel consumption 3-7
3.13. Reaction of a 2500 m³ balloon 3-8
3.14. Reaction of a 3000 m³ balloon 3-9
3.15. Reaction of a 4500 m³ balloon 3-10
3.16. Reaction of a 8500 m³ balloon 3-11
3.17. Reaction of a 12500 m³ balloon 3-12

4. Emergency procedures **4-1**
4.1. Overcoming obstacles at low level flights 4-1
4.2. Burner failure 4-2
4.3. Pilot light failure 4-2
4.4. Main flame failure 4-3
4.5. Emergency landing 4-3
4.6. Fire on ground 4-4
4.7. Fire in the air 4-5

5. Operation procedures **5-1**
5.1. Launch site 5-1
5.2. Weather conditions 5-1
5.3. Rigging and inflation of the balloon 5-2
5.4. Take-off 5-8
5.5. Correct use of the Schroeder fire balloons launch restraint 5-9
5.6. Flight operation 5-10
5.6.1. Landing site selection 5-11
5.6.2. Instruction of passengers 5-11
5.6.3. Descent for landing 5-11
5.6.4. Landing 5-11
5.6.5. Deflation and de-rigging of the balloon 5-13
5.6.6. Control of the balloon 5-13
5.7. Influence of weather disturbances on the balloon 5-16
5.8. Dropping Parachutists 5-18
5.9. Refuelling and transport of pressure vessels for hot air balloons 5-19
5.10. Ground handling and transport of burner 5-20

Appendices

Appendix A	Drawings to burners FB V, FB 6
Appendix A1	Burner FB 7
Appendix A2	Liquid pilot light
Appendix B	Flight instruments
Appendix C.1	Utilization of Cameron Balloons Ltd. bottom ends
Appendix E.1	Occupant restraint
Appendix F.1	Utilization of Cameron Balloons Ltd. bottom ends
Appendix G.1	Utilization of Lindstrand Hot Air Balloons Ltd. bottom ends
Appendix H.1	Utilization of Aerostar International. bottom ends
Appendix I.1	Utilization of Balóny Kubicek bottom ends
Appendix J.1	Tethered flight
Appendix J.2	Quick release for burner frames
Appendix K.1	Operating manual for add-on envelopes and special shapes
Appendix L.1	Seats, doors and removable partition walls for baskets
Appendix L.2	Operation instructions for Panorama basket

Records of Amendements

No	Description	pages	Edition date/ Approval no.
0	New Theo Schroeder fire balloons Flight Manual	all	July 2016
1	Basket size M/3 TM EASA.BA.016.57	VIII; 1-2; 2-27; 2-29, 2-31	February 2017 10061339
2	Basket size IV/5, V/5 and V-A for envelopes up to 4250m³; TM EASA.BA.016-59	VIII; 1-4	September 2017 10063077
3	Operational and installation instructions for the occupant restraint system in Schroeder fire balloons baskets	VII, VIII App. E.1	April 2018 10065243
4	FM Appendix K.1; Operating manual for add-on envelopes and special shapes	VII, VIII App. K.1	August 2018 10066357
5	FM Appendix L.1; Operating manual for baskets with doors, seats and removable partition walls	VII, VIII, 1-5; 1-6; 2-28; 2-31	December 2018 10067957
6	Introduction of new fast deflation systems Smart Vent; Para Vent; Easy Vent; adjustment of boundary conditions	III; IV; VIII; 1-2 to 1-6; 2-3 to 2-7; 2-13; 2-29; 4-3; 5-3; 5-4; 5-6; 5-11	May 2019 10070119
7	Increase of basket loads; New basket size M/5; Pilot light for landing	1-2 to 1-6; 2-27; 2-31; 5-11	August 2019 10070802
8	Appendix A2; Liquid pilot light Appendix F.1 Rev02	VII, VIII	May 2020 10073341
9	Appendices J.2 and L.2; Panorama basket and Quick release system for burner frames; Instrument Flytec Balloon 4	VII; VIII; 2-26; 2-27; 2-29; 2-31	June 2020 10073560
10	New equipment: Envelopes with a volume of 10500 and 12500 m³; baskets XI/19; XII/23 and XIII/27; new burner frame; Polyester envelope fabric	IV; VIII; IX; 1-4 to 1-7; 2-2; 2-4; 2-5; 2-28 to 2-31; 3-1; 3-2; 3-4 to 3-7; 3-12; 3-13; 4-3; 5-5; 5-6	July 2021 10076830 10073828
11	Change of damage tolerances; change of basket payload of basket III/4 and IV/5; FB 7 as double burner up to 6000 m³	VIII, IX, 1-2 to 1-5; 3-6	July 2023 10082318
12	Chapter E12 Ground transport and storage of the burner	V 20	November 2023 10082932

Table 0-1: Records of Amendements

Table of valid pages

chapter	page	dated
Cover	I	July 2023
	II	May 2019
	III	May 2019
	IV	May 2019
	V	May 2019
	VI	May 2020
	VII	June 2020
	VIII	July 2023
	IX	July 2023
	X	July 2016
1	1-1	July 2016
	1-2	July 2023
	1-3	July 2023
	1-4	July 2023
	1-5	July 2023
	1-6	July 2021
	1-7	July 2021
2	2-1	July 2016
	2-2	July 2021
	2-3	May 2019
	2-4	July 2021
	2-5	July 2021
	2-6	May 2019
	2-7	May 2019
	2-8	July 2016
	2-9	July 2016
	2-10	July 2016
	2-11	July 2016
	2-12	July 2016
	2-13	May 2019
	2-14	July 2016
	2-15	July 2016
	2-16	July 2016
	2-17	July 2016
	2-18	July 2016
	2-19	July 2016
	2-20	July 2016
	2-21	July 2016
	2-22	July 2016
	2-23	July 2016
	2-24	July 2016
	2-25	July 2016
	2-26	June 2020
	2-27	June 2020
	2-28	July 2021

chapter	page	dated
	2-29	July 2021
	2-30	July 2016
	2-31	July 2021
3	3-1	July 2021
	3-2	July 2021
	3-3	July 2016
	3-4	July 2021
	3-5	July 2021
	3-6	July 2023
	3-7	July 2021
	3-8	July 2016
	3-9	July 2016
	3-10	July 2016
	3-11	July 2016
	3-12	July 2021
	3-13	July 2021
4	4-1	July 2016
	4-2	July 2016
	4-3	July 2021
	4-4	July 2016
	4-5	July 2016
5	5-1	July 2016
	5-2	July 2016
	5-3	May 2019
	5-4	May 2019
	5-5	July 2021
	5-6	July 2021
	5-7	July 2016
	5-8	July 2016
	5-9	July 2016
	5-10	July 2016
	5-11	Aug 2019
	5-12	July 2016
	5-13	July 2016
	5-14	July 2016
	5-15	July 2016
	5-16	July 2016
	5-17	July 2016
	5-18	July 2016
	5-19	July 2016
	5-20	Nov. 2023

Table 0-2: Table of valid pages

Intentionally left blank

1. General

1.1. Weighing report

Registration / Serial no.			
Weighing date			
Inspector´s signature			
Burner incl. load frame and rods [kg]			
Envelope [kg]			
Basket [kg]			
Minimum Equipment [kg]			
Maximum payload [kg]			
Empty weight [kg]			
Maximmum 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 matices for combinations of Schroeder equipment

The basket payload can only be used up until the maximum weight has been reached.
The minimum crew for all baskets is 1 Person.

1.2.1. Data matrix 1200 m³ – 1899 m³

Volume [m³]	1200-1299				1300 - 1699											1700 - 1899																
Burner	Einzel- oder Doppelbrenner				Single- or double burner											Single- or double burner																
Deflation system	Parachute; Easy Vent; Para Vent				Parachute; Easy Vent; Para Vent											Parachute; Easy Vent; Para Vent																
Basket size	M/2		I/2		M/2		I/2		II/3			III/4				M/2		M/3			II/3			III/4				IV/5				
Empty weight [kg]	100		115		115		130		135			140				130		135			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	6	5	4	7	5	4	8	6	5	3	11	8	6	5	2
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	1	2	3	4	1	2	3	4	5
max. payload [kg] (occupants & fuel cylinders)	406		316		406		316		406			550				406		450			406			550				650				
Min. landing mass [kg] incl. fuel reserve	180				230											255																

Table 1-1: Data matrix for envelope volume 1200 m³ to 1899 m³

1.2.2. Data matrix 1900 m³ – 2199 m³

Volume [m³]	1900 - 1999																	2000 - 2199																
Burner	Single- or double burner																	Single- or double burner																
Deflation system	Parachute; Easy Vent; Para Vent																	Parachute; Easy Vent; Para Vent																
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	11	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			550				650					406		450			406			550				650				
Min. landing mass [kg] incl. fuel reserve	275																	290																

Table 1-2: Data matrix for envelope volume 1900 m³ to 2199 m³
The M/2 basket can be used for envelopes up to 2200 m³ include.

1.2.3. Data matrix 2200 m³ – 2599 m³

Volume [m³]	2200 - 2399															2400 - 2599																					
Burner	Single- or double burner															Single- or double burner																					
Deflation system	Parachute; Easy Vent; Para Vent															Parachute; Easy Vent; Para Vent																					
Basket size	M/3			II / 3			III / 4				IV / 5					M/3			III / 4				IV / 5					M/5					V/5 V-A				
Empty weight [kg]	150			165			170				175					155			175				180					170					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	11	8	6	5	2	11	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	1	2	3	4	5
max. payload [kg] (occupants & fuel cylinders)	450			406			550				650					450			550				650					700					700				
Min. landing mass [kg] incl. fuel reserve	315															340																					

Table 1-3: Data matrix for envelope volume 2200 m³ to 2599 m³
The M/3 basket can be used for envelopes up to 2600 m³ included

1.2.4. Data matrix 2600 m^3 – 2899 m^3

Volume [m^3]	**2600 - 2899**																		
Burner	Double burner																		
Deflation system	Parachute; Easy Vent; Para Vent; Paraquick, Smart Vent																		
Basket size	III/4				IV/5					M/5					V/5 und V-A				
Empty weight [kg]	185				190					180					195				
Maximum mass [kg]	820																		
Fuel cylinders [qty]	8	6	5	3	11	8	6	5	2	11	8	6	5	4	11	8	6	5	4
Occupants [qty]	1	2	3	4	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
max. payload [kg] (occupants & fuel cylinders)	550				650					700					700				
Min. landing mass [kg] incl. fuel reserve	370																		

Table 1-4: Data matrix for envelope volume 2600 m^3 to 2899 m^3
The M/3 basket can be used for envelopes up to 2600 m^3 included

1.2.5. Data matrix 2900 m^3 – 3099 m^3

Volume [m^3]	**2900 - 3099**																							
Burner	Double burner																							
Deflation system	Parachute; Paraquick; Smart Vent																							
Basket size	III/4				IV/5					M/5					V/5 und V-A					VI/6				
Empty weight [kg]	195				200					190					205					210				
Maximum mass [kg]	910																							
Fuel cylinders [qty]	8	6	5	3	11	8	6	5	2	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	5	2	3	4	5	6
max. payload [kg] (occupants & fuel cylinders)	550				650					700					700					800				
Min. landing mass [kg] incl. fuel reserve	420																							

Table 1-5: Data matrix for envelope volume 2900 m^3 to 3099 m^3

1.2.6. Data matrix 3100 m^3 – 3299 m^3

Volume [m^3]	**3100 - 3299**																			
Burner	Double burner																			
Deflation system	Parachute; Paraquick; Smart Vent																			
Basket size	IV/5					M/5					V/5 und V-A					VI/6				
Empty weight [kg]	215					205					220					225				
Maximum mass [kg]	975																			
Fuel cylinders [qty]	11	8	6	5	2	11	8	6	5	4	11	8	6	5	4	11	9	8	7	4
Occupants [qty]	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	2	3	4	5	6
max. payload [kg] (occupants & fuel cylinders)	650					700					700					800				
Min. landing mass [kg] incl. fuel reserve	455																			

Table 1-6: Data matrix for envelope volume 3100 m^3 to 3299 m^3

1.2.7. Data matrix 3300 m³ – 3600 m³

Volume [m³]	**3300 - 3600**																			
Burner	Double burner																			
Deflation system	Parachute; Paraquick; Smart Vent																			
Basket size	IV/5					M/5					V/5 und V-A					VI/6				
Empty weight [kg]	230					205					235					240				
Maximum mass [kg]	1040																			
Fuel cylinders [qty]	11	8	6	5	2	11	8	6	5	4	11	8	6	5	4	11	9	8	7	4
Occupants [qty]	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	2	3	4	5	6
max. payload [kg] (occupants & fuel cylinders)	650					700					700					800				
Min. landing mass [kg] incl. fuel reserve	495																			

Table 1-7: Data matrix for envelope volume 3300 m³ to 3600 m³

1.2.8. Data matrix 4000 m³

Volume [m³]	**4000**																													
Burner	Double– or triple burner																													
Deflation system	Parachute; Paraquick; Smart Vent																													
Basket size	IV/5					M/5					V/5 und V-A					VI/6					VII/7					VIII/8				
Empty weight [kg]	206 bis 249					198 bis 241					213 bis 256					225 bis 268					237 bis 280					259 bis 340				
	240 bis 271					220 bis 251					235 bis 266					247 bis 278					259 bis 290					281 bis 360				
Maximum mass [kg]	1260																													
Fuel cylinders [qty]	11	8	6	5	2	11	8	6	5	4	11	8	6	5	4	11	9	8	7	4	12	11	9	7	6	14	12	10	9	6
Occupants [qty]	1	2	3	4	5	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)	650					700					700					800					815					975				
Min. landing mass [kg]	600																													

Table 1-8: Data matrix for envelope volume 4000 m³

1.2.9. Data matrix 4250 m³

Volume [m³]	**4250**																													
Burner	Double or triple burner																													
Deflation system	Parachute; Paraquick; Smart Vent																													
Basket size	IV/5					M/5					V/5 und V-A					VI/6					VII/7					VIII/8				
Empty weight [kg]	206 bis 249					198 bis 241					213 bis 256					225 bis 268					237 bis 280					259 bis 340				
	240 bis 271					220 bis 251					235 bis 266					247 bis 278					259 bis 290					281 bis 360				
Maximum mass [kg]	1340																													
Fuel cylinders [qty]	11	8	6	5	2	11	8	6	5	4	11	8	6	5	4	11	9	8	7	4	12	11	9	7	6	14	12	10	9	6
Occupants [qty]	1	2	3	4	5	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)	650					700					700					800					815					975				
Min. landing mass [kg]	640																													

Table 1-9: Data matrix for envelope volume 4250 m³

Basket size XIII/9 can also be used with 4250 m³ envelopes; for loading see matrix of 4500 m³ envelopes

1.2.10. Data matrix 4500 m³

Volumen [m³]	4500																				
Brenner	Double or triple burner																				
mögliche Entleerungssysteme	Paraquick; Smart Vent																				
Korbgröße	VI/6					VII/7					VIII/8					VIII/9					
Leermasse ca. [kg	240 bis 290					251 bis 300					273 bis 370					279 bis 380					
Höchstmasse [kg]	1410																				
Gasbehälter [Anzahl]	11	9	8	7	4	12	11	9	7	6	14	12	10	9	6	15	14	12	11	9	6
Max. Insassen [Anzahl]	2	3	4	5	6	3	4	5	6	7	4	5	6	7	8	4	5	6	7	8	9
Max. Zuladung [kg] (Insassen & Gasbehälter)	800					815					975					1065					
Mindestlandemasse [kg] einschl. Gasreserve	670																				

Table 1-10: Data matrix for envelope volume 4500 m³

1.2.11. Data matrix 5000 m³

Volumen [m³]	5000																						
Burner	Double FB 7 - or triple burner																						
Deflation system	Paraquick; Smart Vent																						
Basket size	VII/7					VIII/8					VIII/9						IX/10						
Empty weight [kg]	284 bis 360					306 bis 395					312 bis 415						330 bis 440						
Maximum mass [kg]	1575																						
Fuel cylinders [qty]	12	11	9	7	6	14	12	10	9	6	15	14	12	11	9	6	15	14	12	11	9	6	5
Occupants [qty]	3	4	5	6	7	4	5	6	7	8	4	5	6	7	8	9	4	5	6	7	8	9	10
max. payload [kg] (occupants & fuel cylinders)	815					975					1065						1065						
Min. landing mass [kg] incl. fuel reserve	780																						

Table 1-11: Data matrix for envelope volume 5000 m³

1.2.12. Data matrix 6000 m³

Volumen [m³]	6000																												
Burner	Double FB 7; triple- or quad burner																												
Deflation system	Paraquick; Smart Vent																												
Basket size	VII/7					VIII/8					VIII/9						IX/10							IX/11						
Empty weight [kg]	292 bis 370					298 bis 410					320 bis 430						345 bis 455							369 bis 440						
Maximum mass [kg]	1890																												
Fuel cylinders [qty]	12	11	9	7	6	14	12	10	9	6	15	14	12	11	9	6	15	14	12	11	9	6	5	17	15	14	12	9	8	6
Occupants [qty]	3	4	5	6	7	4	5	6	7	8	4	5	6	7	8	9	4	5	6	7	8	9	10	5	6	7	8	9	10	11
max. payload [kg] (occupants & fuel cylinders)	815					975					1065						1065							1200						
Min. landing mass [kg] incl. fuel reserve	930																												

Table 1-12: Data matrix for envelope volume 6000 m³

For all balloons, the basket payload can only be utilized up to the maximum mass of the balloon. The baskets X/13 and X/15 can also be used with 6000 m³ envelopes. For loading see matrix of 7000 m³ envelopes. The maximum take off weight of the envelope must not be exceeded.

1.2.13. Data matrix 7000 m³

Volumen [m³]	**7000**																																						
Burner	Triple or quad burner																																						
Deflation system	Paraquick; Smart Vent																																						
Basket size	VIII/9						IX/10							IX/11							X/13								X/15										
Empty weight [kg]	410 bis 470						345 bis 455							390 bis 460							570 bis 690								570 bis 690										
Maximum mass [kg]	2205																																						
Fuel cylinders [qty]	15	14	12	11	9	6	15	14	12	11	9	6	5	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	4	5	6	7	8	9	10	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						1065							1200							1700								1700										
Min. landing mass [kg] incl. fuel reserve	1060																																						

Table 1-13: Data matrix for envelope volume 7000 m³

1.2.14. Data matrix 8500 m³

Volume [m³]	**8500**																								
Burner	Triple or quad burner																								
Deflation system	Paraquick; Smart Vent; Lite Vent																								
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							1700																	
Min. landing mass [kg] incl. fuel reserve	1300																								

Table 1-14: Data matrix for envelope volume 8500 m³

1.2.15. Data matrix 10500 m³

Volume [m³]	**10500**																	
Burner	Quad burner																	
Deflation system	Smart Vent; Lite Vent																	
Basket size	XII/19						XII/23						XIII/27					
Empty weight [kg]	390 bis 460						570 bis 650						570 bis 650					
Maximum mass [kg]	3400																	
Fuel cylinders [qty]	14	12	10	8	6	4	14	12	10	8	6	4	14	12	10	8	6	4
Occupants [qty]	14	15	16	17	18	19	18	19	20	21	22	23	22	23	24	25	26	27
max. payload [kg] (occupants & fuel cylinders)	2400						2800						3200					
Min. landing mass [kg] incl. fuel reserve	1600																	

Table 1-15: Data matrix for envelope volume 10500 m³

1.2.16. Data matrix 12500 m³

Volumen [m³]	**12500**																	
Burner	Quad burner																	
Deflation system	Smart Vent; Lite Vent																	
Basket size	XII/19						XII/23						XIII/27					
Empty weight [kg]	390 bis 460						570 bis 650						570 bis 650					
Maximum mass [kg]	4000																	
Fuel cylinders [qty]	14	12	10	8	6	4	14	12	10	8	6	4	14	12	10	8	6	4
Occupants [qty]	14	15	16	17	18	19	18	19	20	21	22	23	22	23	24	25	26	27
max. payload [kg] (occupants & fuel cylinders)	2400						2800						3200					
Min. landing mass [kg] incl. fuel reserve	1900																	

Table 1-16: Data matrix for envelope volume 12500 m³

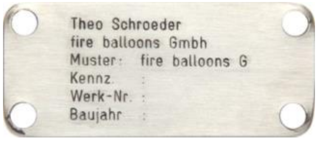
The number of passengers for the envelopes 10500 m³ and 12500 m³ inside a passenger compartment must be reduced by one, if one or max. two fuel cylinders are installed inside the compartment. For all balloons, the basket payload can only be utilized up to the maximum mass of the balloon.

1.3. 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

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. From 2021 the engraving of the crown ring is omitted.



Picture 1-3: Envelope type plate

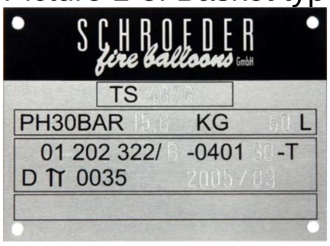
Envelope
The main type plate of the balloon is riveted the middle of panel 1, gore 18 of the envelope. It declares Manufacturer, Type, registration of the balloon, serial number of the envelope and the year of manufacturing.

Picture 1-4: Burner type plate

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

Picture 1-5: Basket type plate

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.



Picture 1-6: Cylinder type plate

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.

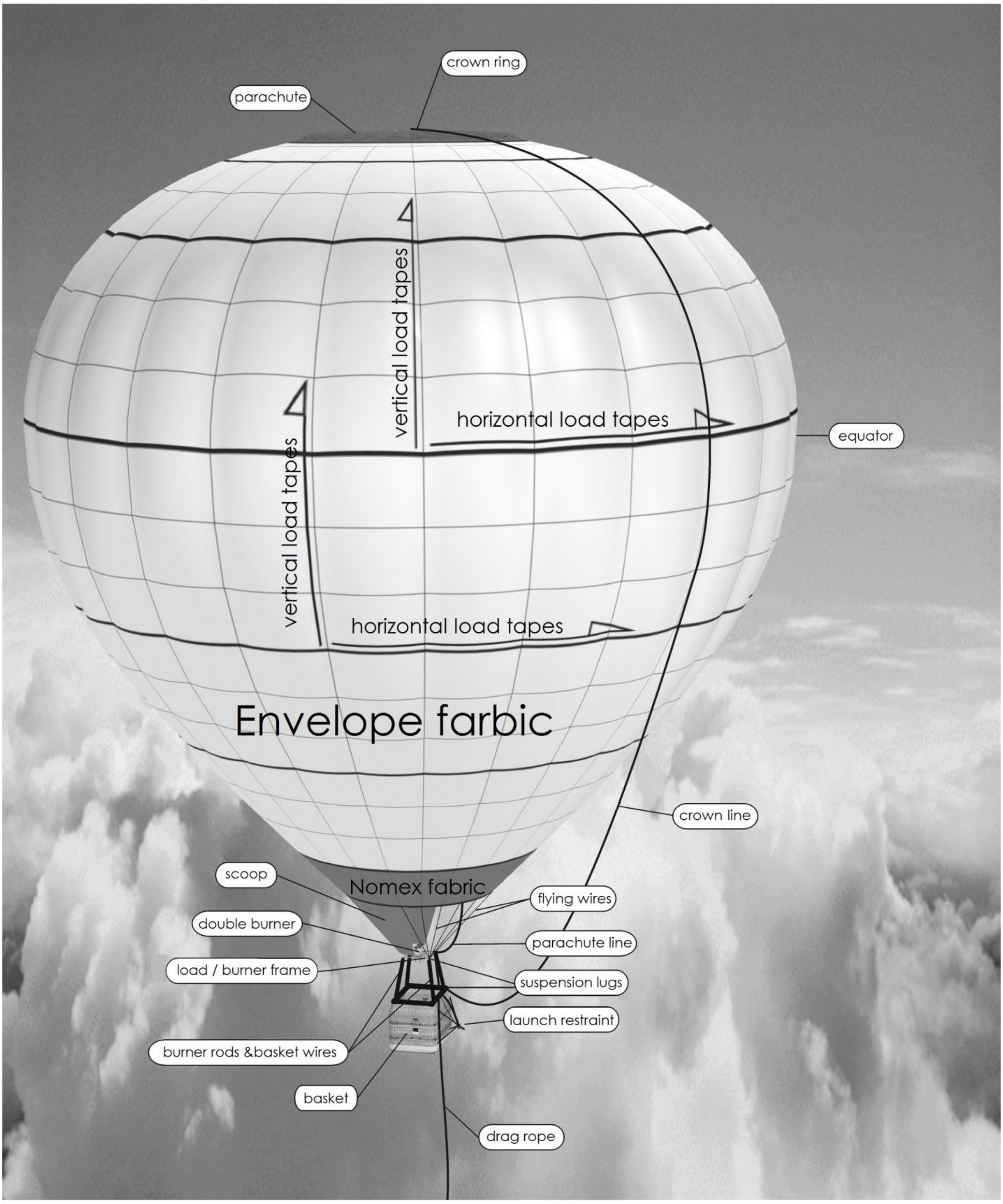
Flight instruments
Flight instruments are fitted with type plates showing serial numbers manufacturer and type.

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 untill 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 Polyester- or 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.

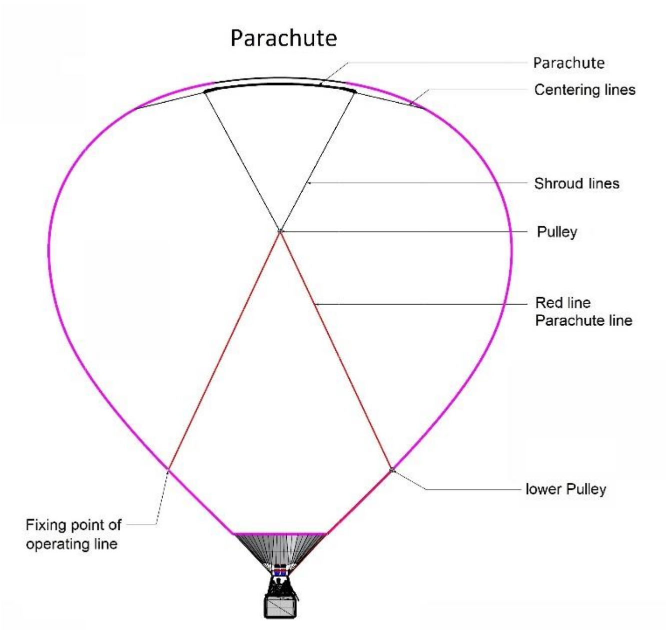
The inner pressure starts at the bottom envelope mouth aperture at 0 N/m² and increases steadily upwards up to approx. 92 N/m² (approximately 9 mm hydrostatic pressure) depending on balloon´s height and the difference of inner and outer temperature.
The Envelope is sewn together with 28, 24 or 16 vertical 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 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. Deflation systems

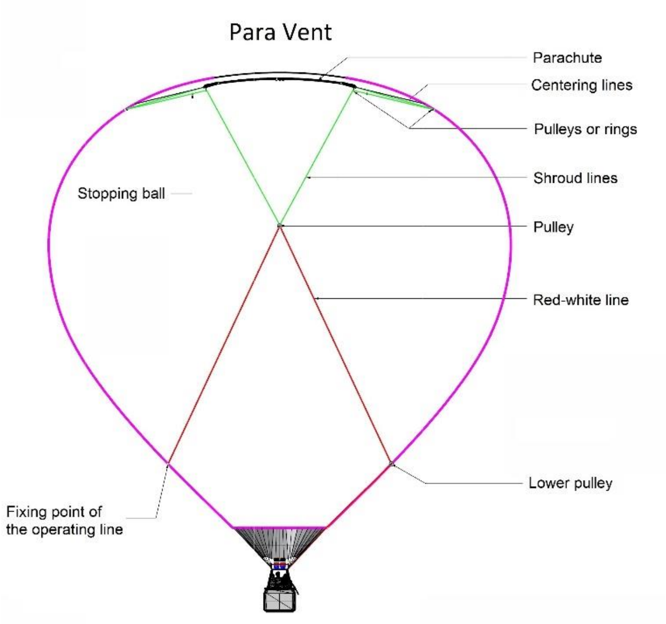
The following sections describe the deflations systems used for Schroeder fire balloons envelopes. Page III declares the vents installed.

2.2.1.1. Parachute system



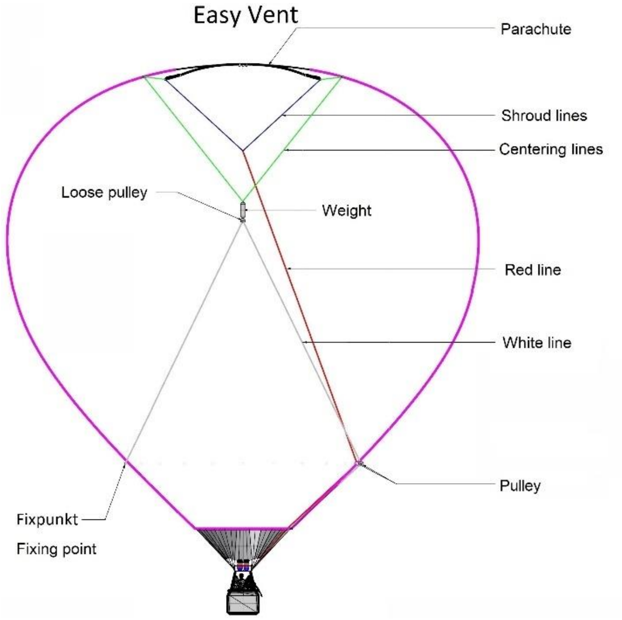
The envelope of the Parachutesystem is an equipped with a sealing device in the upper area named Parachute. The Parachute is attached to the envelope inside the balloon with centering lines. A red operating line, the Parachute line, is connected to the Parachute by shroud lines and reaches down to the pilot into the basket. It´s function is to move the Parachute along the vertical axis to open the valve. The valve closes automatically after releasing the Parachute line if the inner pressure of the balloon is sufficient. A controled release of hot air during flight can be conducted by opening the valve. The landing procedure can be initiated by pulling the line near the ground. A line is attached to the parachute for retrieving the parachute from the inside of the envelope during inflation.

2.2.1.2. Para Vent



The Para Vent is a slight modification of the Parachute system. The sealing device in the upper area is also named Parachute. The Parachute is attached to the envelope inside the balloon. A red-white operating line, the Parachute line, is connected to the Parachute by shroud lines and reaches down to the pilot into the basket. It´s function is to move the Parachute along the vertical axis to open the valve. The valve closes automatically after releasing the Parachute line if the inner pressure of the balloon is sufficient. A controled release of hot air during flight can be conducted by opening the valve. The landing procedure can be initiated by pulling the line near the ground. A line is attached to the parachute for retrieving the parachute from the inside of the envelope during inflation.

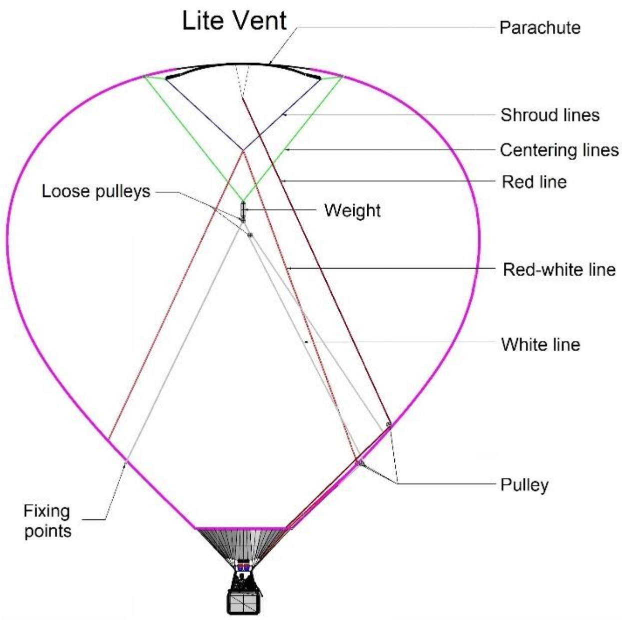
2.2.1.3. Easy Vent



The Easy Vent is based on the Parachute system. It is though equipped with a red-white Parachute line and an additional white line for resealing the valve. The Parachute of the Easy Vent is attached to the load tapes above it. The red-white line is used for releasing hot air during flight and initiating the landing porocedure similar to the red line of the Parachute system. The valve closes automatically after releasing the Parachute line. The white line is equipped with a weight. This weight permanently pulls the parachute radially in its "closed" position. In case the Parachute opens during flights with very high climbing rates, the parachute can be closed again by pulling the white line. A controled release of hot air during flight can be acchieved by pulling the red-white line. This will move the edges of the Parachute downwards into the centre so that the Parachute will look bell-shaped.

2.2.1.4. Lite Vent - fast deflation system

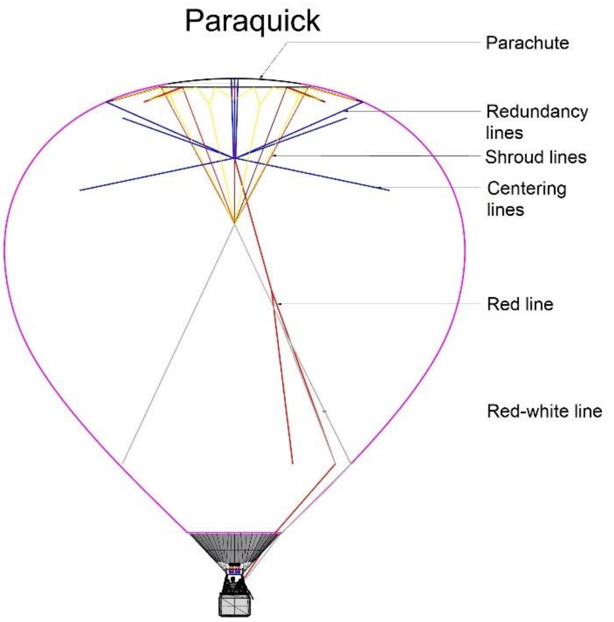
The Lite Vent is a fast deflation system equipped with three operating lines (white, red-white and white) and is used for high volume envelopes.



Function A;
Fast deflation; red line:
By pulling the red line, the Parachute is being pulled with its centre downwards like an umbrella. A doughnut formed opening appears quickly which rapidly releases a lot of hot air fast deflation). It does not close by itself. This fast deflation system is suitable for fast landings. The necessary weight on the ground that is need for slowing down the balloon is available in a short matter of time. By pulling the white line the parachute can be moved into the primarily position to close the fast deflation valve again. The fast deflation valve is only to be used for the final landing in a height of maximum 2 m above ground. The envelope´s inner pressure will decrease quickly and may cause the envelope to collapse.
A retrieving line is attached to the outer centre of the Parachute. It can be used to pull the Parachute out of the envelope during cold inflation.

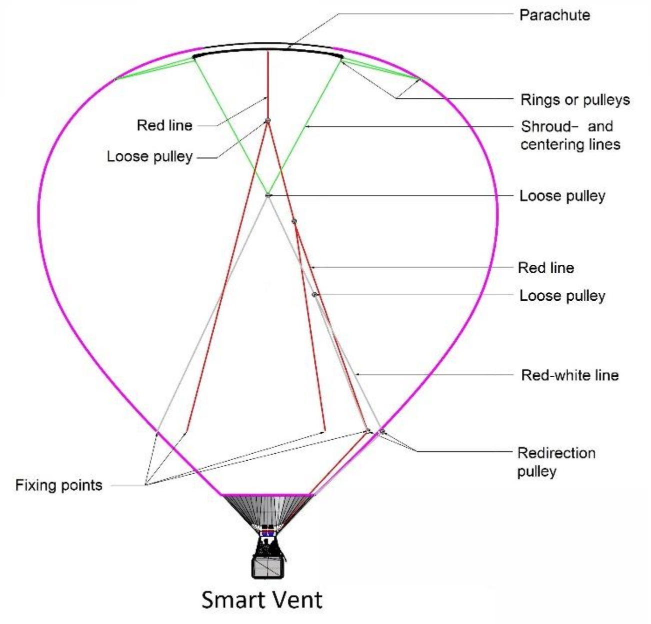
Function B:
Parachute function; red white line:
The red-white line is for a controlled release of hot air during flight and for initiating the landing in slow winds near the ground. The function is comparable to the function of the Parachute system. When pulling the red-white line, the Parachute is pulled downwards along the vertical axis. A gap between the circumference of the Parachute and the edge of the envelope opens. Hot air will be released through this gap.

2.2.1.5. Paraquick - fast deflation system



The Paraquick system is equipped with two different functions and corresponding operating lines in different colors.
Function A:
Fast deflation; red line:
By pulling the red line, the Parachute is being pulled with its centre downwards like an umbrella. A doughnut formed opening appears quickly which rapidly releases a lot of hot air. This opening does not close by itself. This fast deflation system is suitable for fast landings. The necessary weight on the ground that is need for slowing down the balloon is available in a short matter of time.
Function B:
Parachute function; red white line:
The red-white line is for a controlled release of hot air during flight and for initiating the landing in slow winds near the ground. The function is comparable to the function of the Parachute system. When pulling the red-white line, the Parachute is pulled downwards along the vertical axis. A gap between the circumference of the Parachute and the edge of the envelope opens. Hot air will be released through this gap. The red-white line must also be operated for closing the opened fast deflation again (operated red line (function A)). The Parachute will be pulled into position and closed again. Once the fast deflation system is opened, the internal envelope pressure decreases rapidly. A decrease of pressure may cause the envelope to collapse. A retrieving line is attached to the centre of the Parachute. This line is used to pull the parachute out of the envelope during inflation.
In order to avoid inadvertent operation, it is possible to install a locking device to the red line that is fixed to the burner frame. The device is locked during flight so that the red line cannot be operated. Shortly before landing the device can be disarmed. The red line is free for operation. This safety system is optional.

2.2.1.6. Smart Vent - fast deflation system



The Smart Vent is like the Paraquick system a fast deflation system equipped with two different functions and corresponding operating lines in different colors. The functions are directly comparable with the functions of the Paraquick system. Merely the color of one line is not the same.

Function A;

Fast deflation; red line:

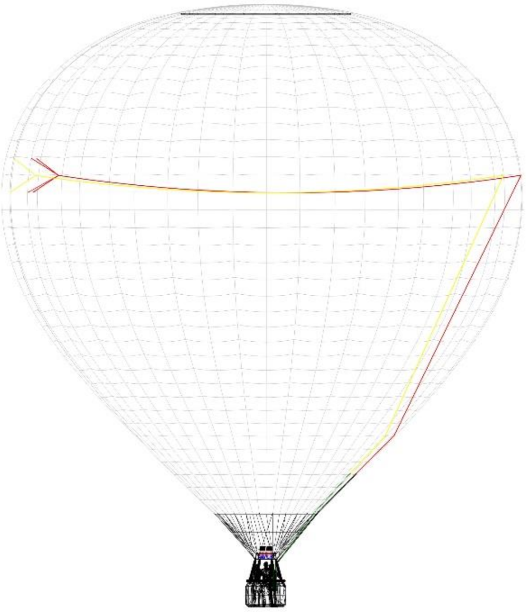
By pulling the red line, the Parachute is being pulled with its centre downwards like an umbrella. A doughnut formed opening appears quickly which rapidly releases a lot of hot air. This opening does not close by itself. This fast deflation system is suitable for fast landings. The necessary weight on the ground that is need for slowing down the balloon is available in a short matter of time.

Function B:

Parachute function; red white line:

The red-white line is for a controlled release of hot air during flight and for initiating the landing in slow winds near the ground. The function is comparable to the function of the Parachute system. When pulling the red-white line, the Parachute is pulled downwards along the vertical axis. A gap between the circumference of the Parachute and the edge of the envelope opens. Hot air will be released through this gap. The red-white line must also be operated for closing the opened fast deflation again (operated red line (function A)). The Parachute will be pulled into position and closed again. Once the fast deflation system is opened, the internal envelope pressure decreases rapidly. A decrease of pressure may cause the envelope to collapse. A retrieving line is attached to the centre of the Parachute. This line is used to pull the parachute out of the envelope during inflation.

2.2.2. Turning valve



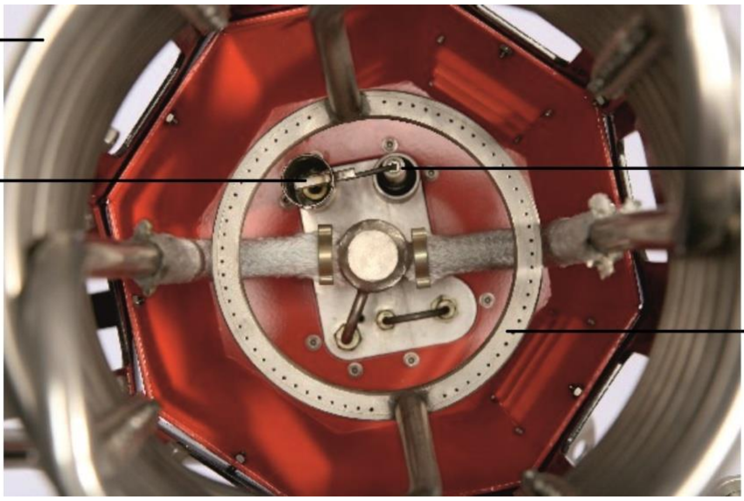
Right rotation: **green line**
Left rotation: **black line.**

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. The main objective for bigger balloons is to be able to turn the balloon with the wide side of the basket as frontside for landing. Often, two counter-operating vents are installed so that a left or a right rotation can be initiated. The operating lines are installed in different colors to determine which way to turn. The envelope loses hot air when operating the turning vents. The lifting capacity decreases using the vents. This effect must be considered when flying low above ground due to the caused descending of the balloon. The loss of lifting capacity depends on the duration of the vent operation.

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.

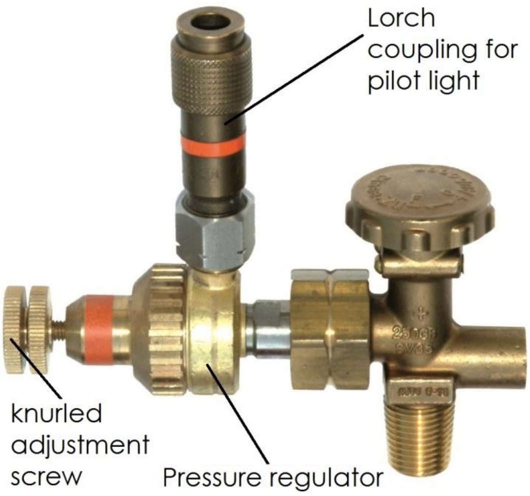
The power of a single burner is sufficient for all emergencies of the balloon. All fuel lines and other functional elements are redundant. The safety level is not reduced at all!

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.

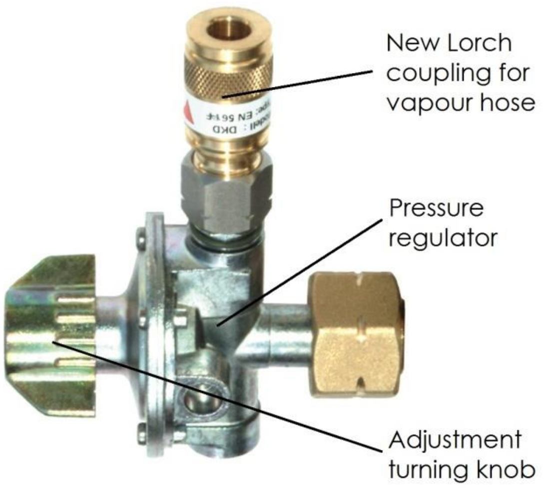
The annoying, sooty condensate water dripping down from the coils onto passengers and crew belong to the past.

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 fire



Picture 2-14: Pilot light regulator; Schroeder 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 tomes 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 dur 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.

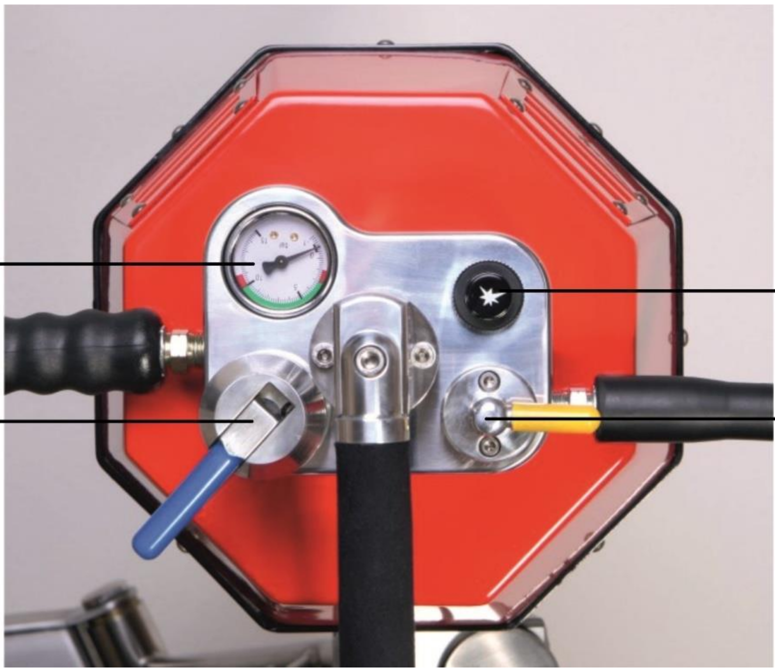
2.3.5. T-piece Manifolds (see also Appendix A)

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-Minafold, 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 fflows 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-ignitors 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 looses 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 is confident that the burners are not needed for landing, the pilot should extinguish the pilot light 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) 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.

Picture 2-16: Schroeder fuel cylinders

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 diffrent parts. Each part will be explained in the next paragraphs.

2.5.1. Protective cover

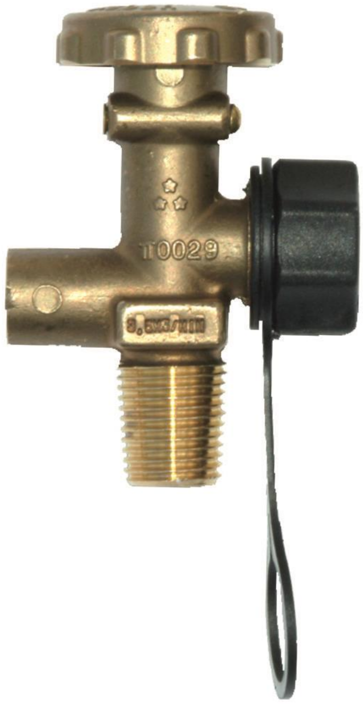
The protective cover is not only for the protection of the occupants against injuries but also for the protection of the fuel cylinders against damages on the surface. The cylinder must not be used without these covers. Furthermore, the padding shall protect from too high fuel temperatures in summer 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.

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



Picture 2-18: PRV

2.5.3. Bleed valve

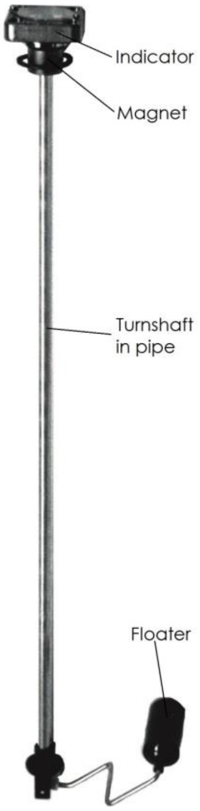
The bleed valve indicates the maximum level of liquid during re-fuelling by the visible escape of liquefied gas. The re-fuelling process must be stopped at this point immediately. The fixed liquid level device consists of a shut-off valve with a liquid level tube soldered on, which length depends on 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-fuellinq 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.

Picture 2-20: Content gauge

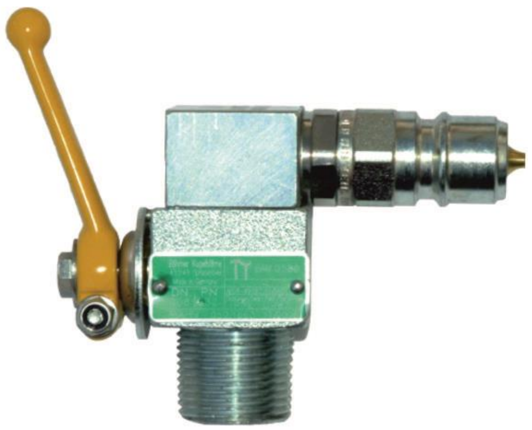
In the factory the regulator is set to the required operating pressure but can be re-adjusted using the knurled screw and locked using the counter nut.

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

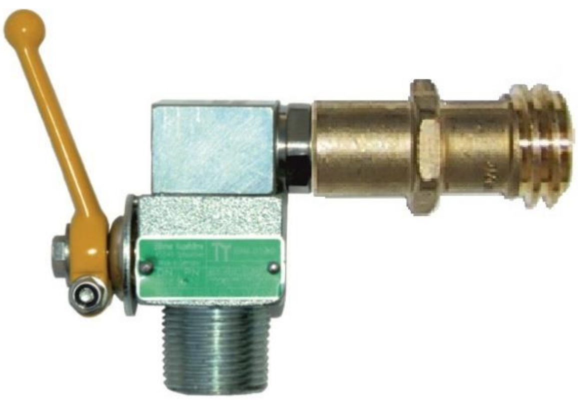
displaced slightly and the non-return valve blocks off the fuel supply. The pilot often does not recognize the fault as the plug is connected to the socket.
For safety after connecting the plug, always pull on the hose to ensure the connection is correctly locked.

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 replacing 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

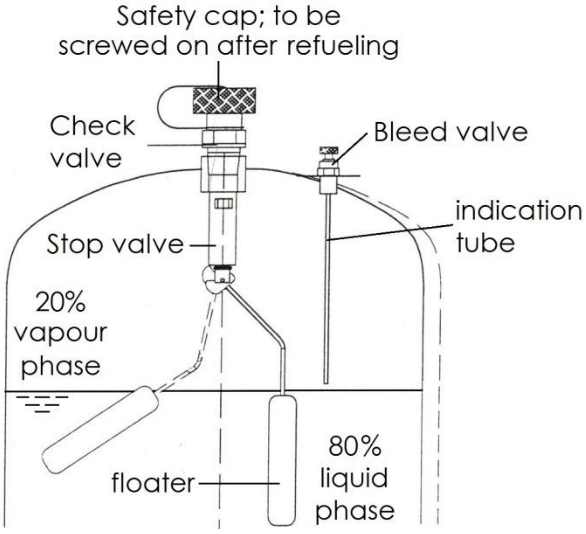
The same effect develops when the basket lies downhill on sloping ground. The end of the liquid fuel supply tube is then in the vapour space. If an inflation in this position cannot be avoided, the burner, together with a helper, must be lifted a bit on the burner support rods. A type plate belongs to 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 retrofitted 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 fuelling 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.

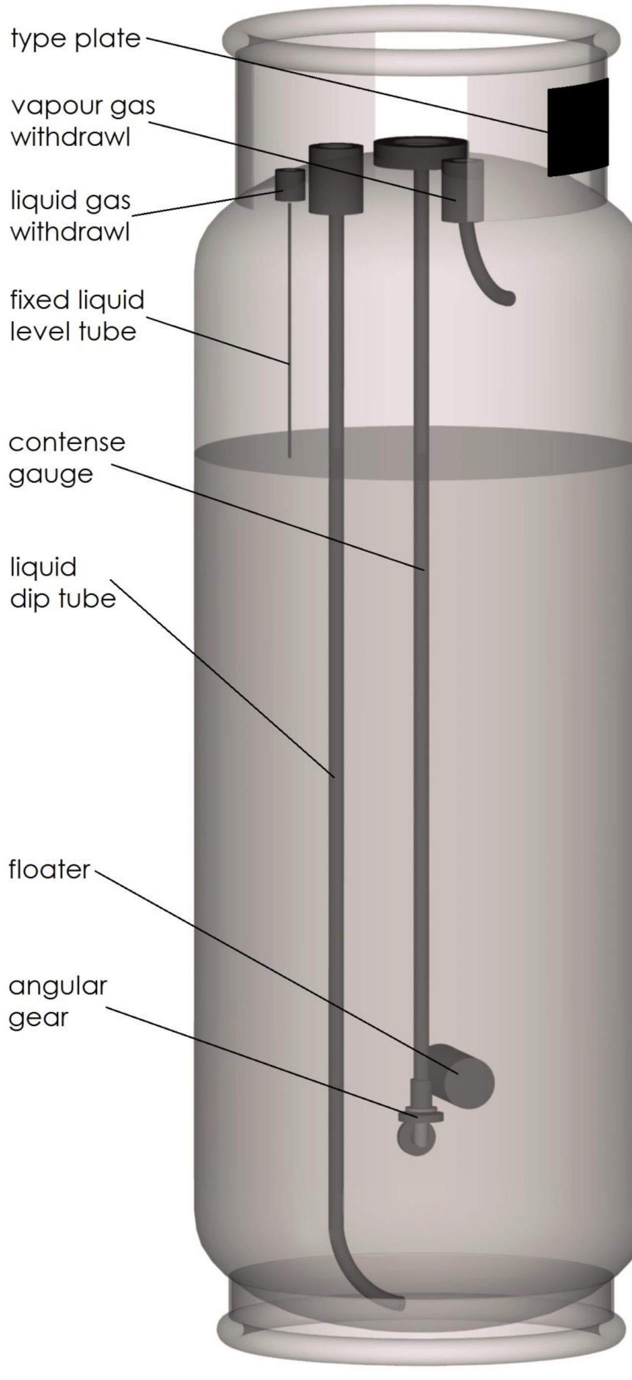
During re-fuelling no person and no source of ignition (e. g. burner with piezo-ignitors) must be inside the basket.
The venting of the hose between re-fuel stop and shut-off valve (e. g. re-fuel pistol) must be at least one meter away from basket or trailer respectively so that no remaining gas can 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

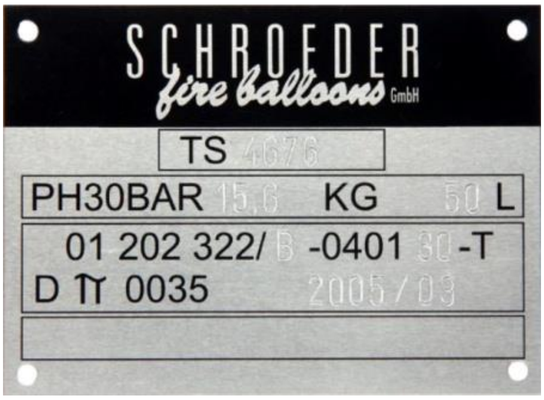
The fuel pressure and therefore the burner power depending on the fuel temperature. Approximate values for propane are:

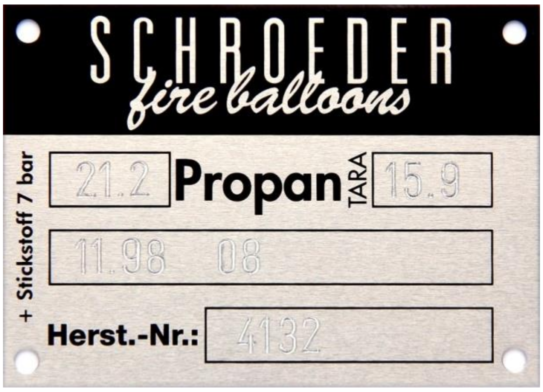
Fuel temperature [° C]	-15	0	15	30
Fuel pressure [MPa]	0,20 (2 bar)	0,36 (3,6 bar)	0,60 (6 bar)	0,90 (9 bar)

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 platePicture 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 carful 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).

Screw on pressure regulator and tighten with spanner.
Connect hose coupling with propane cylinder.
Open cylinder valve of propane cylinder.
Open main valve on nitrogen cylinder.
Open shut-off valve on the pressure regulator (round knurled screw).
Close shut-off valves again, the order does not matter, if no flow noises can be heard anymore (after approx. 20 seconds)!
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.

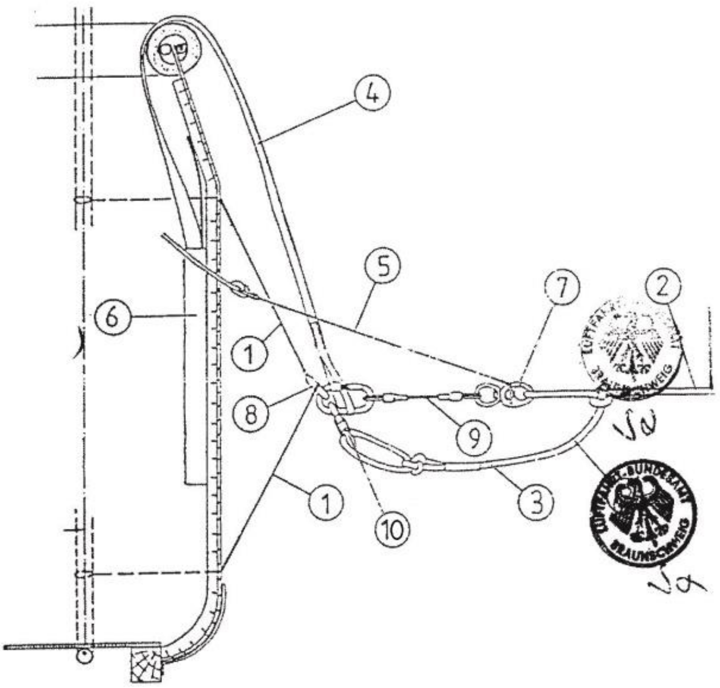
Picture 2-29: Double T basket

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 1,10 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

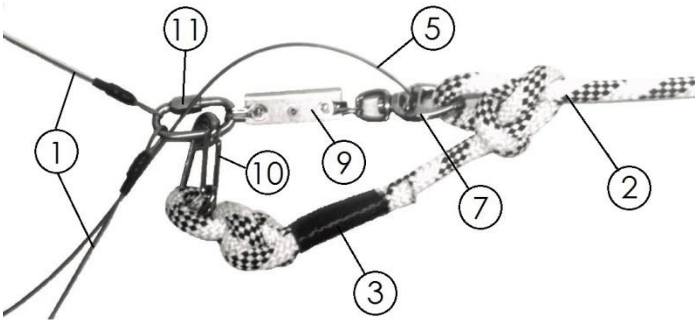


1. Launch restraint attachment wire
2. Take-off rope approx. 5m long
3. Safety bypass
4. Drag rope approx. 45m long
5. Launch restraint release wire
6. Bag for drag rope
7. Safety shackle (snap shackle)
8. Launch restraint junction
9. Weak link load 850 daN (850 Kp)
10. Bypass attachment karabiner
11.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

Picture 2-30 Schroeder fire balloons launch restrain

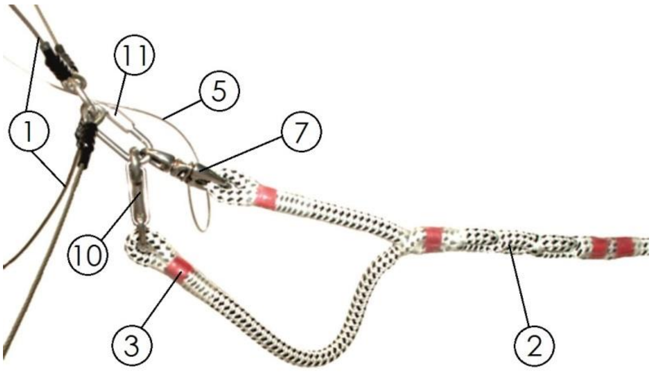
2.7.2. Launch restraint operation instructions

Phase I - Inflation procedure



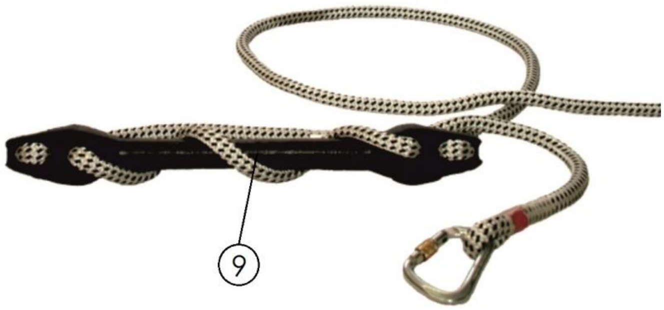
Picture 2-31: Rigging of the launch restraint

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.



Picture 2-32: Rigging without weak link

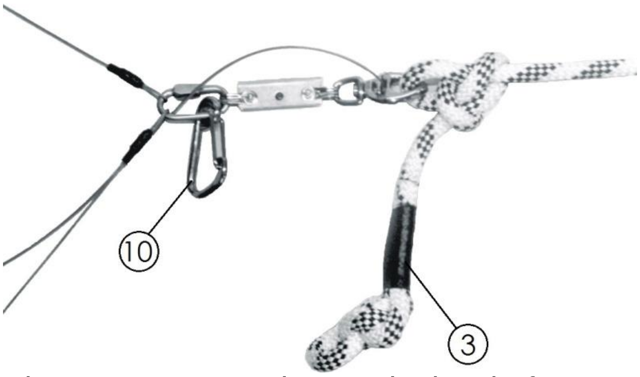
Rigging of the balloon without weak link during inflation.



Picture 2-33: Launch restraint rope with pulling damper

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

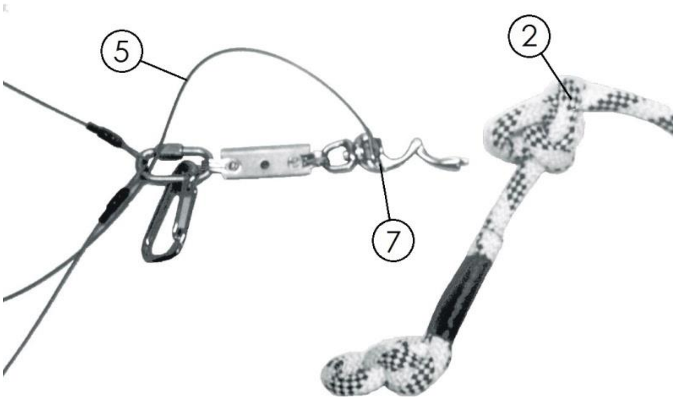
Phase II – Before the start



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

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°.

Picture 2-35: Launch restraint after take off

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

The launch restraint can be attached to the burner frame. Envelopes up to and including 3400 m³ can also attach the launch restraint to the envelope karabiners. Flight manual appendix J.2 declares more details to this.

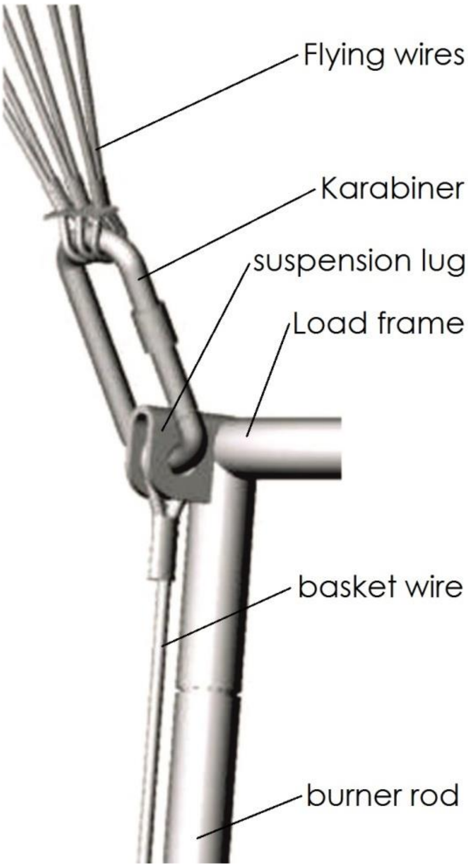
2.7.3. Load frame connection

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
VI/P	SCHROEDER F.B.	min. 25 kN

Table 2-3: Carabiner sizes

Picture 2-36: Envelope rigging basket

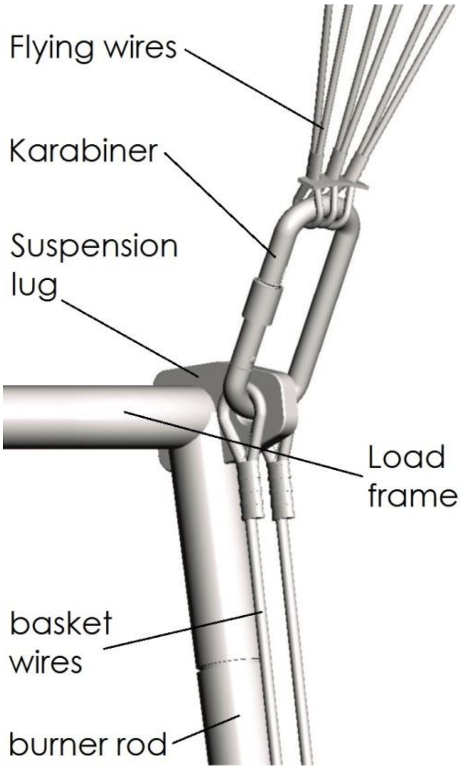
Suspension lug type B

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 / karabiner
VII/7	Schroeder fire balloons	min. 28 kN
VIII/8	Schroeder fire balloons	min. 32 kN
VIII/9	Schroeder fire balloons	min. 32 kN
X/10	Schroeder fire balloons	min. 32 kN
IX/11	Schroeder fire balloons	min. 45 kN
XI/19	Schroeder fire balloons	min. 40 kN
XII/23	Schroeder fire balloons	min. 40 kN
XIII/27	Schroeder fire balloons	min. 40 kN

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



Picture 2-37: Envelope rigging

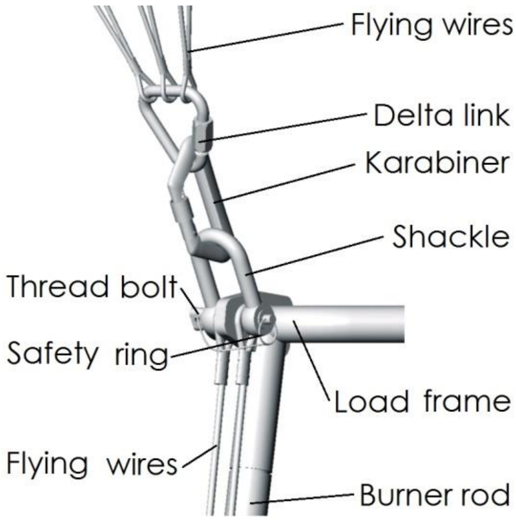
Suspension lug type C

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. Approved instruments for fire balloons

The flight manual appendix B describes instruments for Schroeder fire balloons hot air balloons. In addition to these, the following instruments can also be used in Schroeder balloons

1) OPTOVARIO, Fabrikat fire balloons
2) ALTOVARIO, Fabrikat fire balloons
3) Flytec 3040-M
4) Ball 655
5) Winter
6) VARIOTEL, Fabrikat fire balloons
7) Flytec 6040
8) Digitool DBI3
9) Flytec Balloon 4

The current manuals of the utilized instruments are applicable. The applicable manual is part of the balloon's flight manual.

2.7.6. Minimum equipment

a) For flights during the day according to visual flight rules, the minimum equipment is defined in Balloon air operations (Part BOP Subpart BAS) of the EASA Ballon rule book. Deviant national requirements must be obeyed additionally. For D-registred balloons the following additional equipment according to § 4 of the 4. DV to the LuftBO is required. A simple temperature flag can be installed closed to the fabric where the temperature sensor is usually installed if a constant measuring of temperature is not mandatory. The flag must inform to the pilot, that the recommended maximum fabric temperature was reached.
   1. An EASA approved Radio with a range from 117.975 to 137.000 MHz
   2. Altimeter*
   3. Variometer*
   4. Fire extinguisher, 2 kg, according to DIN EN 3
   5. Compass
   6. Envelope thermometer*
   7. Pressure gauge for each burner
   8. First aid kit, DIN 13164 or 13157
   9. Cutting knife
   10. One alternative ignition source (e. g. storm matches)
   11. One pair of fire resistant gloves

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

For baskets with more than 11 occupants and commercial operation the following additional equipment is mandatory:

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

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.

2.8. 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 finder can be injured. An instructed person must stay allow no other unauthorised persons near it.

Picture 2–39: Inflation fan

Example of accidents: 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 in 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.

2.10. Applicable equipment with fire balloons G envelopes

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	107 x 95
M/2	115 x 90
M/3	130 x 100
II/3	125 x 100
III/4	130 x 115
IV/5	145 x 115
V/5 und V/A	155 x 120
M/5	155 x 120
VI/6	175 x 125
VI/P	180 x 140
VII/7	215 x 145 / 180 x 140
VIII/8	245 x 145 / 215 x 140
VIII/9	260 x 145 / 235 x 140
IX/10	230 x 165
IX/11	275 x 150 / 250 x 170
X/13	300 x 170 / 275 x 175
XI/19	365 x 165 - 380 x 180
XII/23	425 x 165 - 440 x 180
XIII/27	485 x 165 - 500 x 180

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.

Type	VA 50	VA 70	Worthington	V 20	V 30
Empty mass (kg)	15	18	14	14	18
Gas content (kg)	21	30	18	20	30
Total mass (kg)	36	48	32	34	48
Applicable baskets	alle	alle	alle	alle	alle

Manufacturer of the V20 and V30 is Lindstrand balloons Ltd.
All vertical installable EASA approved fuel cylinders for hot air balloons are approved for utilization in fire balloons G baskets. The weight of the fuel cylinders is limited to 70 kg.

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^3 - 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.

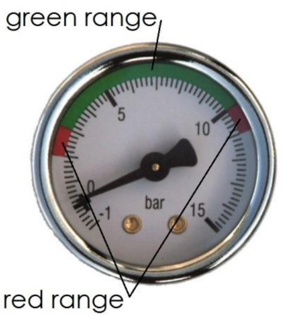
3.1. Envelope inside temperature

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 measuring the hot air temperature as this process has an experience of 30 years. 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 fabric operating temperature is set to 110 ° C.

3.2. Maximum rate of climb and descent

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 of the Parachute-System, the Para Vent-System and the Easy Vent-System must not be opened more than a little gap during flight for initiating the ballon to descent. The Parachute must not be opened longer than 5 seconds to initiate descent, except for landing. To initiate the landing procedure, the Parachute can be opened more than 5 seconds and more than just a gap. The parachute should remain in the open position until the basket has fully stopped on the ground.
The fast deflation systems Lite Vent, Paraquick and Smart Vent must only be operated below 2 m above ground.

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 lift and gusts

Special caution is required in weather with thermal activity. If possible, inexperience 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 27 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 ° C per 100 m. In this case proceed as shown in the following example (loading chart).
Balloon size 30/24 3000 m²
Take-off altitude 200 m
Ambient temperature TA = +16 ° C in 200 m
Which maximum loading capacity does exist in 2800 m altitude at an envelope temperature of 100 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 m².
(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 worm air mass at altitude. According to method a) the table would show a higher than the actual load capacity.
Example:
Ballon size: 3000 m³ 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 m³: 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 1013,25 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

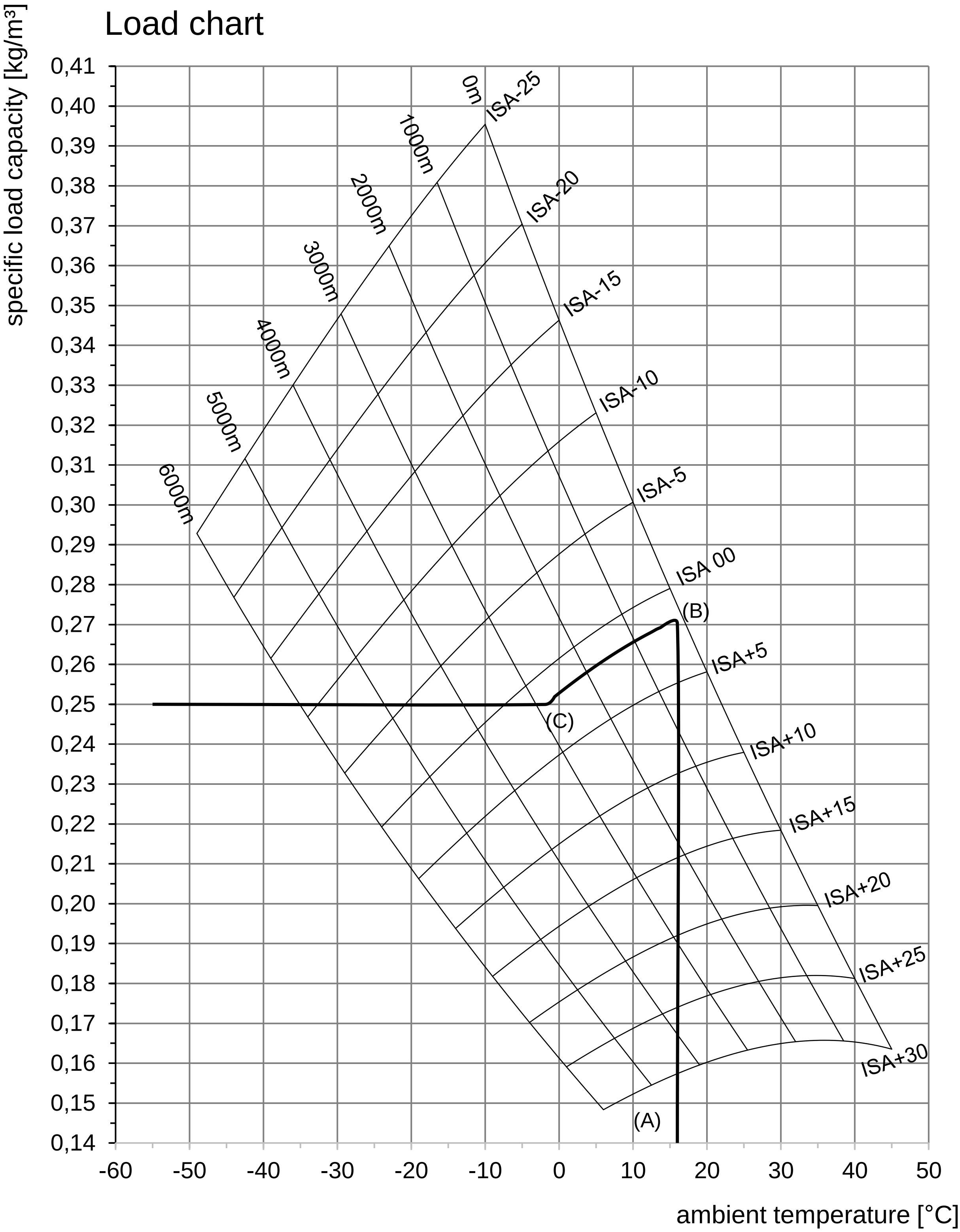


Chart to determine the specific load capacity for a balloon flight.
With the determined specific load capacity of this chart the maximum take of weight (MTOW) can calculated as described before or determined with the following load table.

3.8. Load table

MTOW [kg]																					spec. load capacity in kg/m³
		535																			0,34
		528																	3400		0,33
378		512		630	690	755	820		1040			1260	1340	1410	1575	1890	2205		3360	4000	0,32
372		496		620	682	744	806	910	1023	1040		1240	1318	1395	1550	1860	2170		3255	3875	0,31
360	409	480	535	600	660	720	780	900	990	1020		1200	1275	1350	1500	1800	2100		3150	3750	0,3
348	406	464	522	580	638	696	754	870	957	986	1040	1160	1233	1305	1450	1740	2030		3045	3625	0,29
336	392	448	504	560	616	672	728	840	924	952	1008	1120	1190	1260	1400	1680	1960		2940	3500	0,28
324	378	432	486	540	594	648	702	810	891	918	972	1080	1148	1215	1350	1620	1890		2835	3375	0,27
312	364	416	468	520	572	624	676	780	858	884	936	1040	1105	1170	1300	1560	1820	2205	2730	3250	0,26
300	350	400	450	500	550	600	650	750	825	850	900	1000	1063	1125	1250	1500	1750	2125	2625	3125	0,25
288	336	384	432	480	528	576	624	720	792	816	864	960	1020	1080	1200	1440	1680	2040	2520	3000	0,24
276	322	368	414	460	506	552	598	690	759	782	828	920	978	1035	1150	1380	1610	1955	2415	2875	0,23
264	308	352	396	440	484	528	572	660	726	748	792	880	935	990	1100	1320	1540	1870	2310	2750	0,22
252	294	336	378	420	462	504	546	630	693	714	756	840	893	945	1050	1260	1470	1785	2205	2625	0,21
240	280	320	360	400	440	480	520	600	660	680	720	800	850	900	1000	1200	1400	1700	2100	2500	0,2
228	266	304	342	380	418	456	494	570	627	646	684	760	808	855	950	1140	1330	1615	1995	2375	0,19
216	252	288	324	360	396	432	468	540	594	612	648	720	765	810	900	1080	1260	1530	1890	2250	0,18
204	238	272	306	340	374	408	442	510	561	578	612	680	723	765	850	1020	1190	1445	1785	2125	0,17
192	224	256	288	320	352	384	416	480	528	544	576	640	680	720	800	960	1120	1360	1680	2000	0,16
180	210	240	270	300	330	360	390	450	495	510	540	600	638	675	750	900	1050	1275	1575	1875	0,15
168	196	224	252	280	308	336	364	420	462	476	504	560	595	630	700	840	980	1190	1470	1750	0,14
1200	1400	1600	1800	2000	2200	2400	2600	3000	3300	3400	3600	4000	4250	4500	5000	6000	7000	8500	10500	12500	
envelope volume [m³]																					

Load capacity table

3.9. Limitation for the commissioning into operation

Damages to the crown ring, the horizontal or vertical load tapes are not allowed.
The following damages are tolerable for a balloon launch:

1. Below the first horizontal load tape of the envelope fabric; Damages in this area are free of tolerances, but must be repaired during the next airworthiness review.
2. Above the first horizontal load tape to the equator; Five damaged areas with a maximum size of 50 x 50 mm are permitted. These must be repaired before next flight. In addition a maximum of 12 holes or cuts with an extent of 20 mm are permitted
3. Above the equator; A maximum of 10 areas with an extension of 50 mm and a maximum of 3 per panel are permitted.
4. Flying wires; A maximum of 5 strands of a wire may be broken. In the event of heat related coloration, the flexibility must be checked according to the maintenance manual procedure and accordingly exchanged at the next airworthiness review if necessary.
5. Basket wires; A maximum of 3 strands of a wire end may be damaged.
6. Carabiner; Signs of wear with a depth of appr. 1 mm, a light rust film and lateral play at the end of the gate of 2 mm in both directions is acceptable.
7. Lower basket frame made of wood; One longitudinal crack, which must be repaired at the next review, is acceptable. A broken frame is not acceptable.
8. Lower basket frame made of stainless steel; Slight deformation is acceptable. The frame must not be broken, cracks must be repaired at the next airworthiness review.
9. Braid; Damages with an extension up to 50 mm and a max. of 4 broken verticals are acceptable.
10. Upper basket frame; Slight deformation is acceptable. The frame must not be broken.
11. Control lines; The sheating of control lines may be damaged if the damaged area does not get in contact with pulleys during operation.
12. Basket floor; Cracks up to 25 cm if only visible from one side or cracks up to 15 cm visible from both sides are acceptable.

Extreme caution is to be taken at alpine flights and thermal activity if it can be assumed that the tear strength is significantly reduced. 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 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 date.
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

All utilized equipment must be airworthy. The equipment must comply with the manufacturer's requirements and must be combined accordingly. The conditions of combining fire balloons envelopes with other manufacturers bottom ends is described in the corresponding appendix of this flight manual. The combination must be EASA approved.

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 airworthiness inspector according to part 66 of EU 1321/2014 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.
5. minimum equipment (for commercial operation): The minimum equipment for flights during the day (Visual Flight Rules) are defined in the Balloon air operations (Part BOP; Subpart BAS) of the EASA Balloon rule book. The balloon must be equipped with additional equipment if registered in Germany. § 4 of the 4. DVO to the LuftBO defines mandatory equipment as stated below. For balloons not registered in Germany it is sufficient to install a melting link or bimetal temperature flag inside the balloon if a constant temperature measuring is not mandatory. The melting link or bimetal can be attached to the Velcro where the temperature sensor is usually installed. It should be installed as close as possible to the fabric. The flag informs the pilot about reaching the recommended maximum envelope temperature by falling.
   - variometer * - altimeter *
   - one alternative source of ignition - radio 117.975 to 137.000 MHz
   - fire extinguisher 2 kg according to DIN EN 3 - compass
   - pressure gauge for each burner - one cutting knife
   - one fire blanket according to DIN 14155 - one pair of fire resistant gloves
   - first aid kit according to DIN 13164 or 13157 - envelope thermometer *
   - necessary extracts from manufacturer's manual and checklists

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

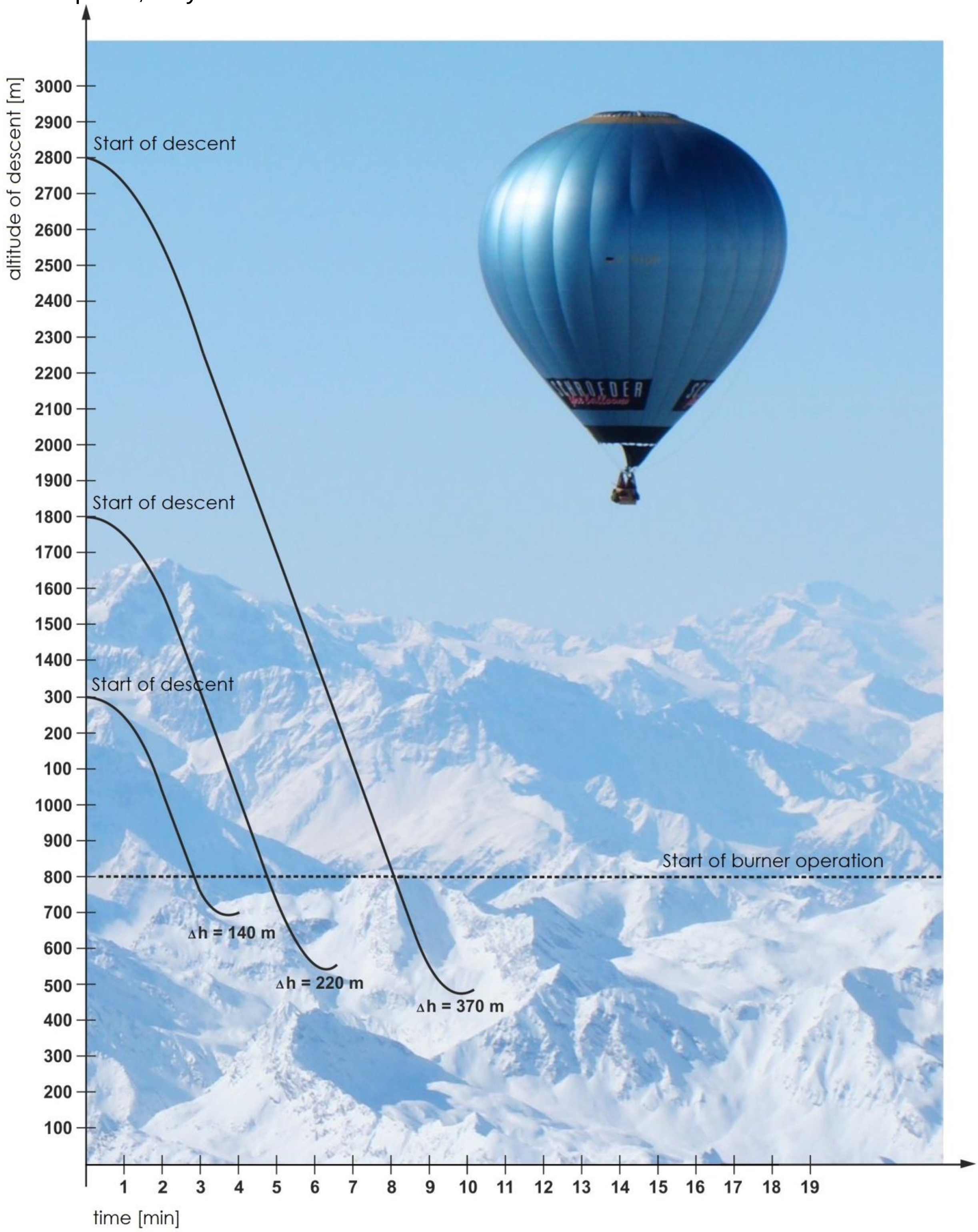
for baskets from 11 occupants: a second first aid kit and a second pair of fire resistant gloves is mandatory

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^3. 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 m³ balloon

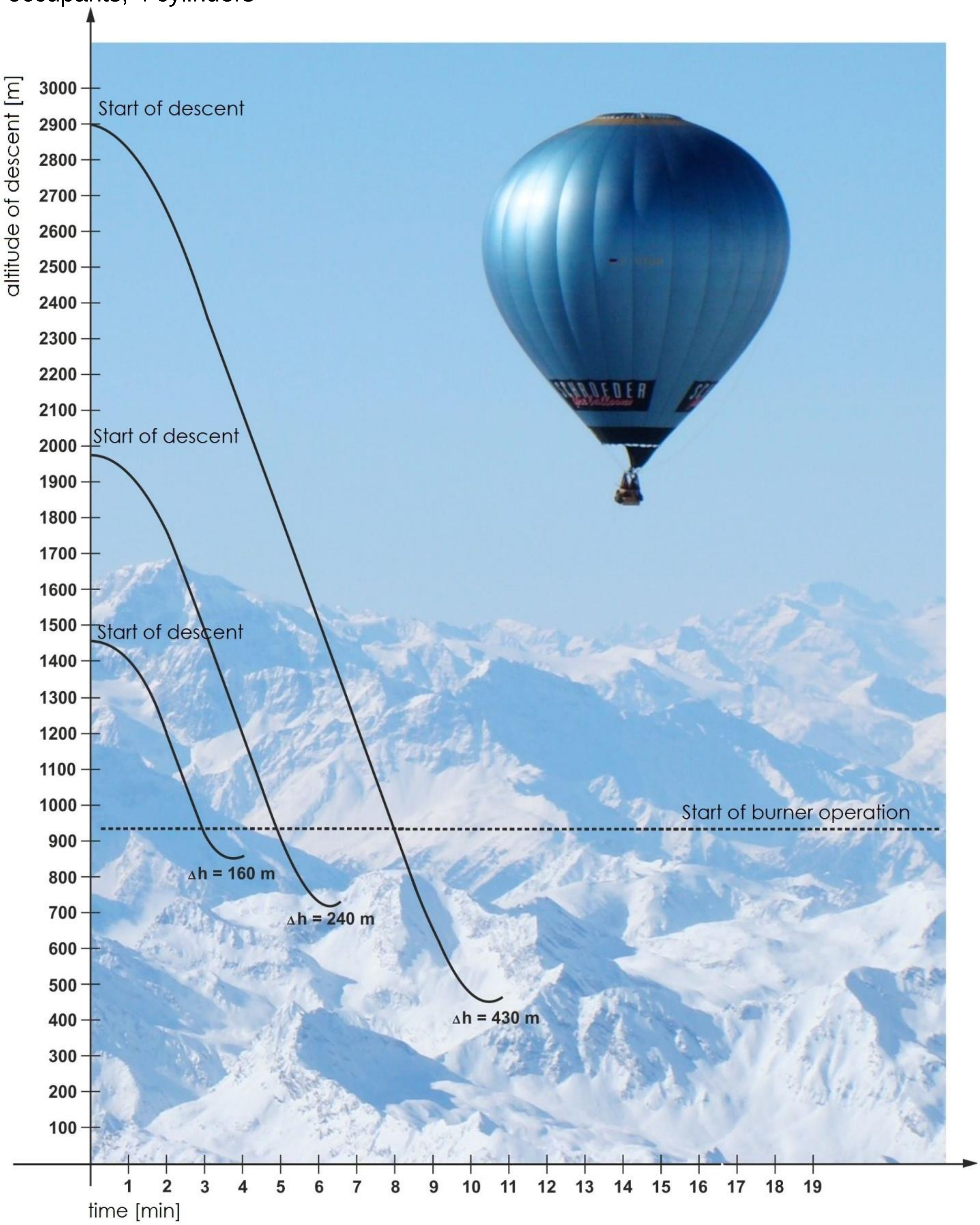
Envelope size 2500 m³; least fuel pressure 0,3 MPa (3 bar); FB 6 double; ISA condition, 4 occupants, 4 cylinders



Picture 3-1: Cold descent 2500m³

3.14. Reaction of a 3000 m³ balloon

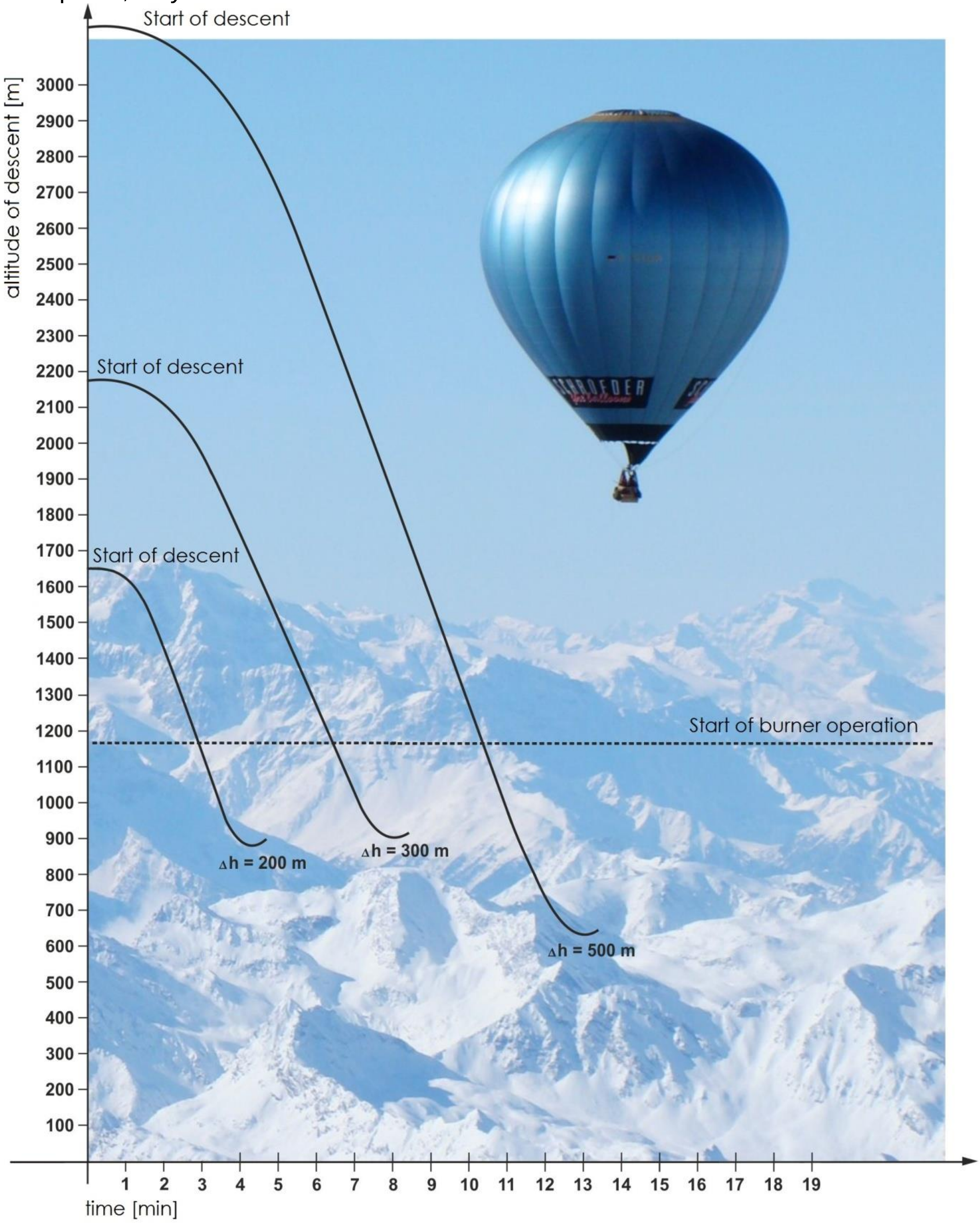
Envelope size 3000 m³; least fuel pressure 0,3 MPa (3 bar); FB 6 double; ISA condition, 4 occupants, 4 cylinders



Picture 3-2: Cold descent 3000m³

3.15. Reaction of a 4500 m³ balloon

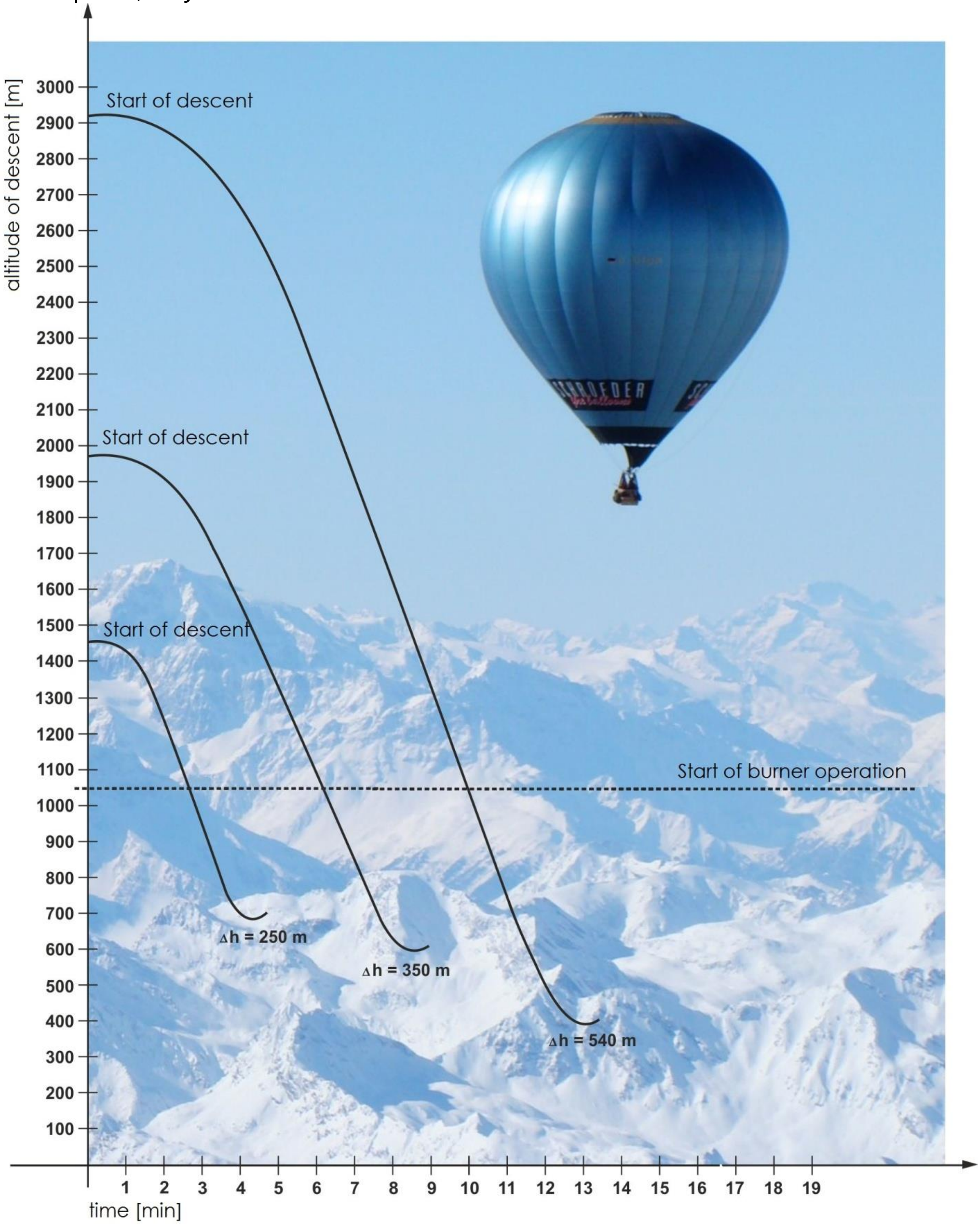
Envelope size 4500 m³; least fuel pressure 0,3 MPa (3 bar); FB 6 double; ISA condition, 4 occupants, 4 cylinders



Picture 3-3: Cold descent 4500m³

3.16. Reaction of a 8500 m³ balloon

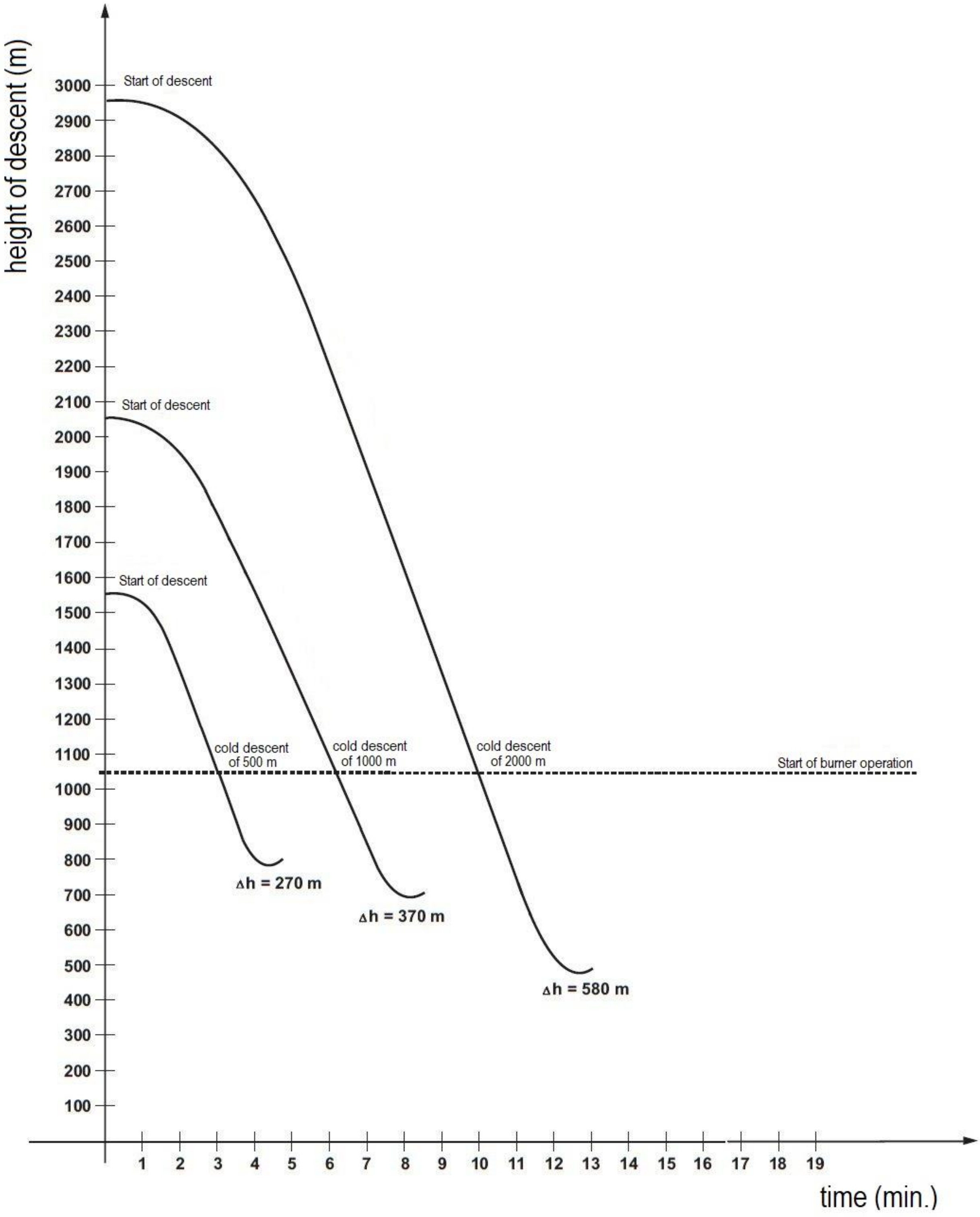
Envelope size 8500 m³; least fuel pressure 0,3 MPa (3 bar); FB 6 double; ISA condition, 13 occupants, 6 cylinders



Picture 3-4: Cold descent 8500m³

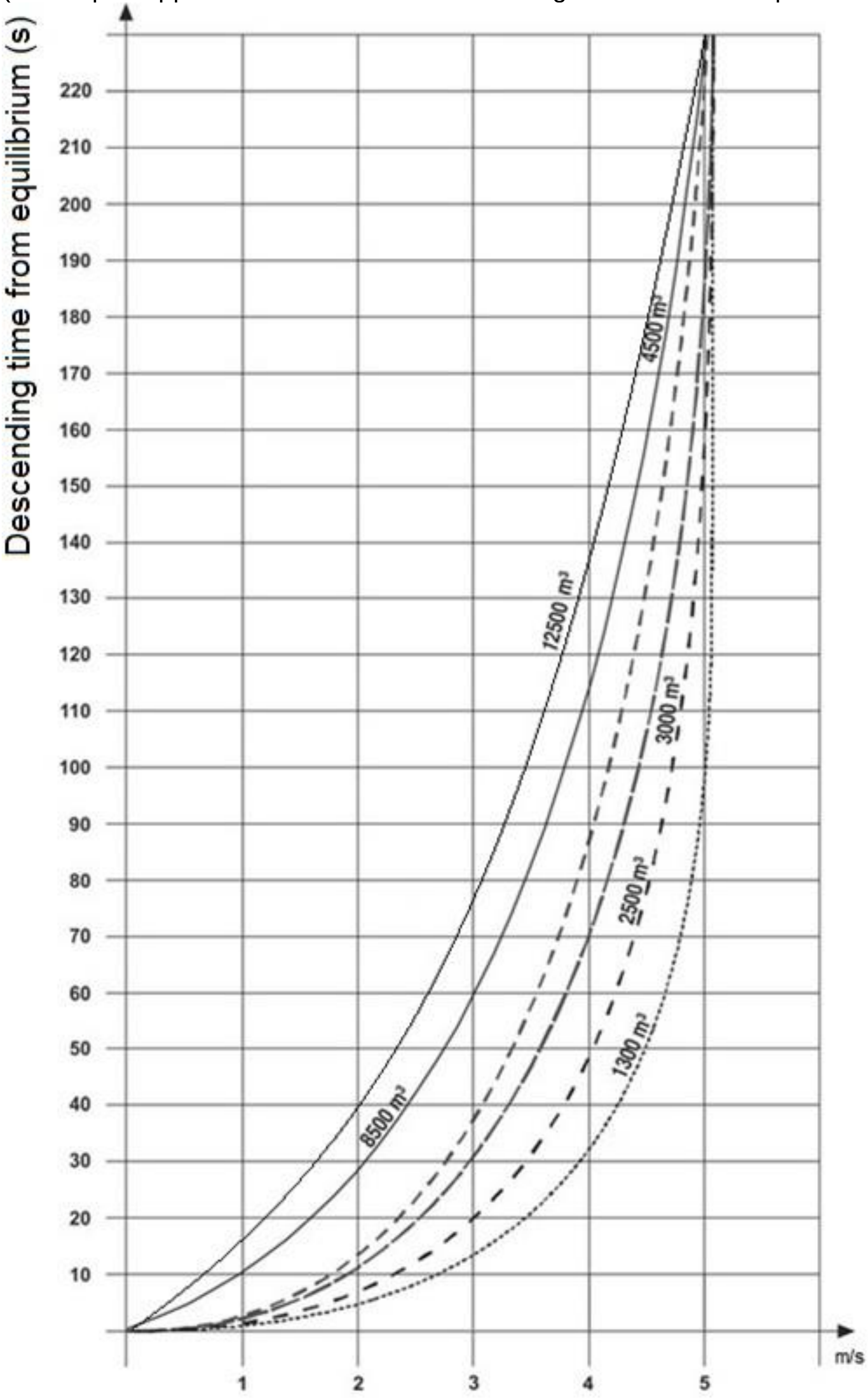
3.17. Reaction of a 12500 m³ balloon

Envelope size 12500 m³; least fuel pressure 0,3 MPa (3 bar); FB 7 quad burner; ISA condition, MTOW 3560 kg



Picture 3-5: Cold descent 12500m³

Approximate reaction during descent from equilibrium level flight
(Valid up to approx. 10 000 ft at medium loading and intact envelope coating)



Picture 3-6: Descent reaction from equilibrium

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.
If 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 it 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 failure:

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 hance 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. There may be a mechanical malfunction of the main valve. The valve lever may get stuck in an undefined position and cannot be moved again. If the valve gets stuck in the closed position, the second burner must be operated to control the balloon. Alternatively the start and silent burner valves can be used to heat the envelope.
   If the valve gets stuck in the open position, the burner can still be used by operating the fuel cylinder valve. The heat output of the burner depends on the position of the the valve shaft. The pilot must evaluate the performance of the burner and adjust to the new situation. The next opportunity for landing must be taken for safety.
   The background for the malfunction is usually a mistake in valve maintenance.

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.
   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.
4. The passengers must not leave the basket without permission from the pilot even after a hard touchdown

Shut off the burner

5. Close quick shut-off valves of the pilot lights.
6. Close fuel valves on the fuel cylinders depending on the situation.

Deflation of the envelope

7. 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.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 rapture 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)

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 of forests are in flight direction. The pilot must bee 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 Section 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 launch restraint as described in section 'take-off aid' (page 2-24).
2. Drag the bottom part of the envelope out of the envelope bag so that the marking on the inside of the envelope edge (() 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.Speading the envelope

There are many methods for the inflation of the envelope. Two of these are described here. Is the ground soft and free of obstacles, the envelope and crown line can be layed out in the direction of the wind. The envelope can be spread to the sides by pulling the load tapes to the left and right. The best load tapes are these where the last karabiners of the scoop are attached. These mark the middle of the envelope on both sides. Spreading the envelope should be started at the lower opening of the envelope. Cold air can be blown into the envelope with an inflation fan.

When using an inflation fan, the safety advices of the instruction manual must be obeyed.

The second method is to install the envelope for flight and directly use the inflation fan for blowing cold air into the envelope while helpers pull the envelope out of the sack in the direction of the wind. The envelope will partly spread aside by itself and fully with a little help by carefully pulling the envelope to the sides again. This method is recommended on bad ground (concrete, stubble field). Layout the entire crown line in wind direction. The envelope should be tightly / completely filed and free of wrinkles before deploying the envelope. The starting burner can carefully be used during cold inflation to get a taut cold filling of the envelope.

Step 5.Lines

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

Step 6.Sealing the deflation system

These descriptions apply to all Schroeder deflation systems. As soon as the cold inflation is initiated, the Parachute can be pulled towards the upper opening of the envelope. The Parachute retrieving line can be used for this. The retrieving line is attached to the crown ring.
Entering the envelope should be avoided. If entering is not avoidable, shoes should be taken off to prevent damages to the fabric. Walk carefully, the fabric can be slippery when stacked.
Carefully pull the parachute towards the top. If the pulling force increases, fabric might be pulled into the pulley by the operating lines. Make sure that the lines and pulleys are running freely inside the envelope. Before attaching the parachute to the envelope, make sure that it is set in the right position. That can be checked by finding one of the two red marked Velcros® (Pic. 3-6) attached to the parachute and the counterpart on the edge inside the envelope. These marked Velcros® are usually on the envelope edge above the registration mark. Move from the red marked Velcro® of the parachute to its edge. A distance line is attached to the edge running into the envelope to a fixing point attached to a load tape. If that distance line is parallel to the corresponding load tape, the parachute is in the right position. Close the marked Velcro® and check the next Velcro® to the left and right for a marked one to make sure. If the position of the parachute inside the envelope is correct, the Velcros® can be connected along the edges of parachute and envelope.

Picture 3-6: Marked Velcros®
Vecro® strips lose their retention force if gras gets stuck in them. It helps cleaning them with a coarse scrubbing brush. If that does not improve the retention force, the soft Velcro® strips must be replaced.

Turning vent check

The procedure of checking the turning vent is analogue to the check of the deflation system. Make sure that all lines are running free, no knots or plating have formed and the lines are not burned or damaged.

Step 7.Check of the envelope

Once the deflation system is closed, the envelope gets filled up with cold air. During cold inflation the check of the envelope can begin or be commenced. The shroud / distance lines of the deflation system must be checked for knots and plating.
The pulleys of the operation lines must be free and not be twisted. The operating lines must not show plaiting or knots and must also be running freely. A visual check through the parachute- and fire opening is sufficient.
If a line is damaged or burned, the position of the damage must be discussed with the maintenance organization. Plaiting or unplanned knots in lines must be removed. The envelope must be checked for tears and holes. The tolerances for damages of the envelope is declared in the maintenance manual.
The recommendation is to also keep the crown line free of knots and loops. Knots might get stuck when getting in contact with obstacles like trees.
If a safe flight is in doubt due to envelope damages, the operation of the balloon must not be continued.

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 2.7.6, 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: The mouth of the envelope must be held open to let the inflation inflation-fan blow cold air into the envelope. Once the envelope is sufficiently filled with cold air, the envelope must heated up. During this process one person must operate the crown line and slowly lead the envelope into the upright position. It must be ensured that the helpers wear safety gloves, skin covering clothing and are well instructed for the assignment. The number of persons needed for the inflation of a hot air balloon depends on the weather, the envelope size and personal experience.

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 overheating (due to low distance between flame and fabric).

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 m³. 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 he envelope is turned with short heating phases.

The helper on the corm 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.

Step 11. 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.

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 line and detaching the Velcro® tapes.
  The Parachute line must be pulled down until all Velcro® tapes of the parachute are detached. The inner pressure of the envelope must be sufficient for that. The parachute must be observed during the process to see when the last Velcro® tape detaches. The parachute can carefully be ascended to the sealing position. Depending on the pace of ascending the parachute, the basket may briefly lift off the ground. The assistants on the ground must be advised to watch out that all feet stay away from the basket. The following list declares the Parachute line colours of the different deflation systems:

Parachute system:	red line
Para Vent: system:	red-white line
Easy Vent system:	red-white line
Paraquick system:	red-white line
Smart Vent system:	red-white line
Lite Vent	red-white line

Functional check of the fast deflation system

The red line must be pulled for the operational check of the Paraquick system. Open the Paraquick system shortly and close it again with the red-white line. The Smart Vent or Lite Vent system can be checked by pulling the red line to briefly open it. Close The Smart Vent or Lite Vent system again by operating the white line. This procedure must be conducted continuously and quick to avoid a descending of the parachute due to a lack of inner envelope pressure. If the operational check of the fast deflation system must be repeated, the envelope must be heated up between the procedures to keep the pressure on a sufficient level

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 m³ balloon, the loading by helpers should not be more than 80 kg, at a 2200 m³balloon maximum 100 kg, at 3000 m³ 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 unmistakeably 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. When the pilot is confident that the burners are not needed for landing, the pilot should extinguish the pilot light shortly before touch down. 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 extend, 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 vale 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 ore 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 an 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 gimbaled 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. Tough 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:
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.
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 Braunschweig, the 02. Mar 1995
II 1-602.2/40/95
The director of the Luftfahrt-Bundesamt (German federal civil aviation authority):
Horst

5.10. Ground handling and transport of burner

5-3: Ground handling burner

This chapter contains recommendations for ground handling and storage of the burner.
The gas hoses should be free of gas before transport as well as storage. To do this, close the liquid phase valve and burn off any gas left in the hoses in a controlled manner. All valves must be closed before transport and storage. Under no circumstances should unburnt gas be allowed to escape into the environment.
The burner hoses should be separated from the gas cylinders so that they can be fixed to the burner frame for transport. Make sure that the bending radius of the hoses is not less than 10 cm. The hose connections should not swing freely and should be closed with the protective caps provided. It is not advisable to transport the burner erected on the basket, as vibrations may cause damage to the components. When transporting the burner with it suspended from the spigots in the basket, make sure that the spirals point downwards. If the burner is transported hanging horizontally, the connection of the burner units can be damaged by the shocks during transport. For the same reasons, it is not advisable to transport the burner horizontally.
If burner hangers are used for transport in the basket, they must be adapted to the size of the basket. Burner suspensions that are too short or too long can cause damage to the basket, gas cylinders and burner.
When loading and unloading, handle the basket and burner with care. After and landing, the lower part of the balloon should be placed gently on the ground and not knocked over. Shocks should be avoided.
During storage, protect the components from moisture and UV radiation to prevent rapid ageing. If there is moisture on the components of the balloon, ensure that they dry out.

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.