MARSHALLER SYLLABUS

Information, guidance and basics
for the training of marshallers
in commercial helicopter companies

Federal Office for Civil Aviation (FOCA)

This present marshaller syllabus was initiated by the Swiss National Accident Insurance Organisation (Suva) and decisively sponsored for the promotion of occupational safety and health

This syllabus owner is:

Bitte Marke
Timbre-poste svp
Francobollo per favore
Please affix a stamp

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FLUGHELFER-SYLLABUS
Revisions- und Adressänderungsanzeige

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Mises à jour et changement d'adresse

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Revisioni del testo e cambiamenti d'indirizzo

MARSHALLER SYLLABUS
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Part 1
Information and

quality assurance

IMPRINT

This manual has been developed in collaboration with a multitude of persons, companies and institutions. It is regularly updated and revised.

A list of the persons participating in the projects and consultations is available in the internet, see http://www.heli-syllabus.org.

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The present marshaller syllabus was initiated and, up to 1997, decisively sponsored by the **Swiss National Accident Insurance Organisation (Suva)** with view to the promotion of occupational health and safety.

MARSHALLER SYLLABUS

for the training of marshallers in commercial helicopter companies

Order number: **FH-SY.e** Personal number:

Author, cover design and drawings: Enrico Ragoni

FOCA, 2. Revision – December 2009

INTRODUCTION

Preface by the Director of the Federal Office for Civil Aviation FOCA

In 1990, the Swiss Federal Office for Civil Aviation (FOCA) and the Swiss National Accident Insurance Organisation (Suva) initiated the "Training of marshallers" project. This was done in response to the dramatic rise in helicopter movements since helicopter logging was introduced in 1983 and the resulting serious increase in the number of accidents.

The foundation of this project was laid on the occasion of the 1st Helicopter Symposium in Balsthal (SO) at the end of November 1989. After intensive analysis and discussion, employers, employees and supervisory boards recognised the need for marshallers to be thoroughly trained as one of the factors in reducing costs by preventing accidents as well as boosting profitability.

The project was started in 1990 by the then working group "Training of marshallers" under the guidance of the FOCA. It was continued in 1993 by the "Aviation Department" at the Swiss National Accident Insurance Organisation and completed in 1996.

This marshaller syllabus represents a milestone in the history of helicopter aviation. Never before has such a wealth of information and such a versatile "toolkit" adaptable to (almost) every need and every business been available to the operator for training purposes.

The versatility is based on the distinct structure (profitability, prevention of accidents) and the transparency of the material. It is no accident that the marshaller syllabus is now of interest to wider sections of the population than the actual target audience.

We know that there is still a lot of work for you to do, as is the case for the industry and everyone concerned. We are convinced that it will be easier for you to cope with the requirements of the future with the help of this extraordinary tool. And it speaks for itself that the synonym "toolkit" was created by marshallers and educators who have learned to work and deal with it.

In this first edition, consideration has been given to the necessity and the objective of always having the most up-to-date "toolkit" possible to hand for the training of marshallers. The requirements of the European JAR-OPS have also been taken into account.

We hope that through optimum training of marshallers with the help of the marshaller syllabus, the reliability and safety of helicopter flying will be further improved. With this in mind, we wish you very many happy landings.

Federal Office for Civil Aviation

The Director

André Auer

Purpose

This **modular syllabus** is for the **systematic and flexible training of people working as marshallers** in helicopter companies.

At the same time it is a **set of learning aids for the trainee**. The learning effect and learning motivation are increased considerably through active participation in training, confidence in obtaining information without assistance and the focused search for information.

For the person in charge of training in a business as well as external instructors and trainers, it serves as a **manual for modular training** on every level.

Furthermore, it serves as a **management tool** within the scope of human resource planning and personnel development.

Occupational roles like the head of air traffic and operational management as well as technical roles (e.g. material maintenance) use the syllabus in a specific way as a **source of information or a reference work**.

The contents of the lessons in part 2 as well as the information in part 3 are in line with the requirements of **health protection and occupational safety** as well as the specific requirements of a helicopter operation.

The syllabus will serve as **evidence that training has been carried out** as well as for **quality assurance** purposes within the scope of a company's quality management and the audits conducted by supervisory authorities.

Every marshaller and everyone concerned is entitled to have a personal copy which should remain in his or her possession even on changing jobs. It shall serve as a **personal proof of achievement**.

Objective

Through modular and need-oriented training, it should be possible for marshallers to take up their duties **from their very first day at work** and make an active contribution towards **preventing accidents, damage** and interruptions in operations. **Added value** is immediately apparent.

The **efficiency** of the marshaller should be increased progressively through focused, continuous and supplementary training. Thereby, **high-quality work** is guaranteed.

Individual responsibility and identification with the duties to be performed should be supported significantly through active participation by the marshaller.

Implementation of the syllabus under the aspects of **profitability and safety** will promote a company's success in the long term.

Details about structure and use

1st part: Information and quality assurance

Chapter 1.0 Imprints thanks the numerous experts in this field in recognition of their commitment and gives information about addresses needed for purchase and copyright.

Chapter 1.1 Introduction provides an introduction to working with the syllabus.

Chapter 1.2 is a table of contents, and is at the same time a list of valid pages for quality assurance purposes.

The personal details sheet (chapter 1.3) can be updated and completed in pencil periodically and in that way serves the heads of operation as a profile for operational planning, assists the trainer in planning and supervising operational readiness and can be used by the marshaller as an enclosure in their application file.

Chapter 1.4 Suggestion for amendments serves quality assurance purposes. All users can bring their own experience to bear and thereby make a contribution to keeping the syllabus up to date.

2nd part: Training

Part 2 contains 3 **training levels** with a compilation of **14 lesson sheets (modules)** each. From chapter 2.1 Immediate training onwards, the demand increases steadily through chapter 2.2 Training course until the **intended behaviour of the marshaller** is achieved (chapter 2.3, Practical introduction). The instruction can be taken up at any level of training, can be adjusted to the conditions and enhanced continuously.

The lessons cover a marshaller's normal range of duties and can be put together by the trainer according to the **needs of the company**. The order in which the lessons are completed is optional. It is left to the trainer's discretion whether to expand the number of lessons, to expand the lessons themselves or to use only part of a lesson.

Only that part of the lessons which are appropriate to the company and its services will be used. In the case of a marshaller changing jobs, the missing instruction can be defined immediately and made up accordingly.

The **safety target** describes what must be prevented in the interests of accident prevention and health and safety and therefore in the interests of profitability. It is the result of the systematic evaluation of incidents, malfunctions and accidents in the industry.

The **training objective** describes in measurable terms the intended behaviour of the marshaller.

The **learning contents** derived from the training targets correlate with the minimum requirements according to the state-of-the-art. No claims are made regarding the completeness of the learning contents

Chapter 2.1 Immediate training (red)

Basically, it is assumed that the company will conduct the immediate training under its own responsibility. Thus, varying local, internal and seasonal needs can be taken into account.

The company can also delegate this task to external personnel who meet the requirements.

Training starts when the marshaller joins the company. As a result, the necessary basic training or retraining is taken into account.

Chapter 2.2 Training course (yellow)

Training in responsible working through deepening and broadening the immediate training. Competence and individual responsibility are substantially enhanced and complementary knowledge is taught. It is recommended that this training should be started after 2 – 3 years of practical work.

This level of instruction can be suitably conducted in a central course of study which can be followed on-the-job or as a refresher course.

Chapter 2.3 Practical introduction (green)

On-the-job training during the season at the flying company. The newly gained knowledge will be consolidated and expanded through application. A major autodidactic effect can be achieved through targeted support for the learning process (see the "Objective" section).

Consolidation of the training takes place under the company's own responsibility. External specialists can also be called in.

This level of instruction is suitable as a yardstick for checking one's professional qualifications. A marshaller trained to this standard can – together with additional training – work as a Head of Training as well as fulfilling other managerial functions (Chief Flight Attendant / Chief of Transport).

Chapter 2.4 Checklists

With his or her signature, the Head of Training or the authorised course instructor certifies for every single lesson in the marshaller's training that the lesson has been conducted and completed. A general signature for the entire syllabus is not permitted. The training is to be updated continuously by the Head of Training together with the marshaller.

To ensure a lasting effect, refresher training is to be planned after an adequate period of time. In addition to the checklist, the personal details sheet also serves the same purpose (chapter 1.3).

3rd part: Appendices

The 6 chapters of "Appendices" are, by definition, not learning contents in a narrow sense but serve the purpose of imparting knowledge as needed and as appropriate. In the broadest sense, they are to be seen as a **"ready reference"** for specific matters of concern to flying companies and marshallers.

Individual pages can be extracted and used directly as checklists by the marshaller. Other pages are suitable for evaluating operational tools or assessing certain methods.

What holds true for the syllabus as a whole also holds true for the appendices: Basically, they can be used by anyone who is interested in or involved in solving problems, planning teaching or imparting knowledge.

CONTENT + LIST OF VALID PAGES

General overview

Part	Chapter	Lesson	Content
0	**--**	**--**	**Title page**
1	**0 to 4**	**--**	**Information and quality assurance in 5 chapters**
2	**1 to 4**	**0 -14**	**Training in 3 parts with 14 lessons each and checklists for the training supervision**
3	**1 to 6**	**--**	**Appendices in 6 chapters for learning by doing and to look up references**

Part 1: Information and quality assurance

Part 2: Training

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Part	Chapter	Lesson	Content	Issue	Rev	Page
		--	**Software "Training check" (FH-SY_AK)**	30.12.09	R2	2.4.1

Part 3: Appendices

Part	Chapter	Lesson	Content	Issue	Rev	Page
3	--	--	Part 3: Appendices	31.03.03	FE	3
	0	--	Content	30.12.09	R2	3.0-1
		--	**ditto: Resumption**	30.12.09	R2	3.0-2
		--	**ditto: Resumption**	30.12.09	R2	3.0-3
		--	**ditto: Resumption**	30.12.09	R2	3.0-4
	1	--	Title: Helicopter & Assignment (JAR-OPS 3+4)	09/06	R1	3.1
		--	**Loads caused by the helicopter: Load increase caused by DWD**	09/06	R1	3.1.1-1
		--	**ditto: DWD in HOGE and HIGE**	31.03.03	FE	3.1.1-2
		--	**Loads on the helicopter: FSD**	31.03.03	FE	3.1.2
		--	**Bank angle**	31.03.03	FE	3.1.3-1
		--	**Diagram "Load factor" - limitations - safety factors**	09/06	R1	3.1.3-2
		--	**Effect of the angle of inclination β (Bank-Angle) on flight behaviour**	09/06	R1	3.1.3-3
		--	**Helicopter structure limits: External load**	31.03.03	FE	3.1.4
		--	**ditto: g-load limitations**	31.03.03	FE	3.1.5
		--	**Helicopter operation limits: Minimum altitudes**	31.03.03	FE	3.1.6
		--	**Performance profile: Performance table**	31.03.03	FE	3.1.7
		--	**Fuels: Characteristics of fuels, volume calculation, Hot-Refuelling**	09/06	R1	3.1.8-1
		--	**Grounding and potential equalisation**	09/06	R1	3.1.8-2
		--	**Load Securing: Forces - Form-fit securing of load on vehicles**	09/06	R1	3.1.9-1
		--	**A short explanation of acting forces**	09/06	R1	3.1.9-2
		--	**ditto: Resumption**	09/06	R1	3.1.9-3
		--	**Sample calculations: freight vehicle and helicopter**	09/06	R1	3.1.9-4
		--	**The common misconception regarding "heavy cargo"**	09/06	R1	3.1.9-5
		--	**Charts: Sliding friction coefficient μ, tie-dow devices**	09/06	R1	3.1.9-6
		--	**Indication on tie-down strap labels - Model for calculation**	09/06	R1	3.1.9-7
		--	**Calculation: number of tie-down straps required for load securing**	09/06	R1	3.1.9-8
		--	Title: Load lifting devices & working materials	09/06	R1	3.2
		--	**Load lifting devices: Principles**	30.12.09	R2	3.2.1

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Part	Chapter	Lesson	Content	Issue	Rev	Page
	2	--	**Evaluation of the test results - Cross sections**	09/06	R1	3.2.6-4
		--	**- left blank -**	30.12.09	R2	3.2.6-5
		--	**- left blank -**	30.12.09	R2	3.2.6-6
		--	**Flexible intermediate bulk container (FIBC)**	30.12.09	R2	3.2.6-7
		--	**Minimum requirements of FIBCs for helicopter**	30.12.09	R2	3.2.6-8
		--	**Use of LLDs: Slinging techniques - Examples of permitted slinging types**	09/06	R1	3.2.7-1
		--	**Determination of the centre of gravity for asymmetrical loads**	09/06	R1	3.2.7-2
		--	**Influence of rope/leg lengths on the inclination of a load (cages)**	09/06	R1	3.2.7-3
		--	**Principles of assembling load lifting devices for helicopter load transport**	09/06	R1	3.2.7-4
		--	**Extensions/lengthenings of slinging equipment and load lifting means**	30.12.09	R2	3.2.7-5
		--	**Forbidden connections of slinging equipment and load lifting means**	09/06	R1	3.2.7-6
		--	**Limits of use and product life**	09/06	R1	3.2.8
3		--	**- left blank -**		R1	3.2.9
		--	**Example of the allocation and use of LLDs: Definitions and ELLM /LLA's**	09/06	R1	3.2.10-1
		--	**ditto: LLA's shown as loads**	31.03.03	FE	3.2.10-2
		--	**ditto: Typical loads using slings**	31.03.03	FE	3.2.10-3
		--	**ditto: Slinging equipment and AE/SPE**	31.03.03	FE	3.2.10-4
		--	**Checklist**	09/06	R1	3.2.11
		--	Introduction to the list of "Slinging Techniques	30.12.09	R2	3.2.12-1
		--	**Principles of training, Structure of the work sheets (+)**	30.12.09	R2	3.2.12-2
		--	**Structure of the work sheets (-), Assessment criteria**	30.12.09	R2	3.2.12-3
		--	**Assessment of cargo flights**	30.12.09	R2	3.2.12-4
		--	**(+) Slinging techniques; FIBC**	30.12.09	R2	3.2.13-1
		--	**ditto: Bundled sawn planks (1), 2 RS**	30.12.09	R2	3.2.13-2
		--	**ditto: Bundled sawn planks (2), 4 RS**	30.12.09	R2	3.2.13-3
		--	**ditto: Bundled sawn planks (3), 2 HB + 2 TDS**	30.12.09	R2	3.2.13-4
		--	**General recommendations**	30.12.09	R2	3.2.13-5
		--	**(-) Slinging techniques: Inappropriate or problematic slinging techniques**	30.12.09	R2	3.2.14-1
		--	**ditto: Resumption**	30.12.09	R2	3.2.14-2
	3	--	Title: Protection & Risk assessment and management	09/06	R1	3.3

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Part	Chapter	Lesson	Content	Issue	Rev	Page
		--	**Effects of noise on human beings: Helicopter**	31.03.03	FE	3.3.1-1
		--	**Behaviour-related measures**	31.03.03	FE	3.3.1-2
		--	**Construction and use of radio helmets for marshallers**	09/06	R1	3.3.1-3
		--	**Effects of wind on human beings: Temp. table**	09/06	R1	3.3.2
		--	**ditto: Beaufort scale**	31.03.03	FE	3.3.3-1
		--	**ditto: Resumption**	31.03.03	FE	3.3.3-2
		--	**Risk assessment and management: Risk management**	09/06	R1	3.3.4-1
		--	**Risk grades and risk gradient**	09/06	R1	3.3.4-2
		--	**Definition: danger - hazard - risk (basic terms)**	09/06	R1	3.3.4-3
		--	**The 4 risk classes of the JAR-OPS - risk acceptance**	09/06	R1	3.3.4-4
		--	**Risk assessment and management: Compliance List**	09/06	R1	3.3.4-5
	4	--	Title: Communication & Marshalling	09/06	R1	3.4
		--	**Interpersonal Comm.:Transm./receiver-problem**	31.03.03	FE	3.4.1
		--	**ditto: "Different frequencies"**	31.03.03	FE	3.4.2
		--	**ditto: Catchwords**	31.03.03	FE	3.4.3
		--	**ditto: Subjective – Objective**	31.03.03	FE	3.4.4
		--	**ditto: ICAO radio operator alphabet**	31.03.03	FE	3.4.5
		--	**Standard phraseology for marshalling helicopters: principles**	09/06	R1	3.4.6-1
		--	**Clock-reference system**	09/06	R1	3.4.6-2
		--	**Radio communication procedures: Approach with cargo - Helicopter emergency - Approach with persons attached**	09/06	R1	3.4.6-3
		--	**"In the cube": Spatial marshalling on 3 axises**	09/06	R1	3.4.7
	5	--	Title: Abbreviations and search topics	31.03.03	FE	3.5
		--	**Abbreviations**	31.03.03	FE	3.5.1-1
		--	**ditto: Resumption**	31.03.03	FE	3.5.1-2
		--	**ditto: Resumption**	31.03.03	FE	3.5.1-3
		--	**ditto: Resumption**	31.03.03	FE	3.5.1-4
		--	**ditto: Resumption**	31.03.03	FE	3.5.1-5
		--	**Search topics**	31.03.03	FE	3.5.2-1
		--	**ditto: Resumption**	31.03.03	FE	3.5.2-2
		--	**ditto: Resumption**	31.03.03	FE	3.5.2-3
		--	**ditto: Resumption**	31.03.03	FE	3.5.2-4
		--	**ditto: Resumption**	31.03.03	FE	3.5.2-5
	6	--	Title: Course materials	09/06	R1	3.6

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Part	Chapter	Lesson	Content	Issue	Rev	Page
		--	**Register for exercise sheets accompanying the courses**	09/06	R1	3.6.0

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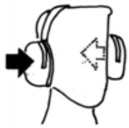
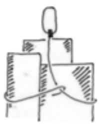
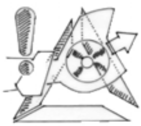
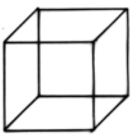
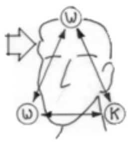
LIST OF PICTOGRAMS

The pictograms help to establish a connection between the single lessons and the treated topics over different training levels, as well as in the annexes on the subject

Pictograms	No	Topics	Pictograms	No	Topics
	**1**	Company and employer		**2**	Marshalling duties
	**3**	Administration and legal obligation		**4**	Maintenance of health and fitness for work
	**5**	Responsibility for customers and third parties		**6**	Operating equipment, calculation and application
	**7**	Load preparation techniques		**8**	Fuel and the environment
	**9**	Communication and radio-telephony		**10**	The helicopter as a working tool
	**11**	Recognising and analysing hazards		**12**	Helicopter aerial work
	**13**	Risk - Safety - Behaviour		**14**	Emergencies / behaviour and cooperation

PERSONAL DETAILS

Please enclose these sheets with your application

Personal details

Name, first name		Date of birth
Address		Post/ZIP code / Town
Tel.	Fax	E-mail

Positions held

☐ Marshaller	☐ Team leader	☐ Chief marshaller	☐ Head of transport
☐ Rescue paramedic	☐ Licensed maintenance technician / mechanic	☐ Pilot PPL (H)	☐ Pilot CPL (H)
☐	☐	☐	☐
Started as marshaller (year):			

Previously employed in the following companies (place, base, company name)	**from (date, year)**	**until (date, year)**
1		
2		
3		
4		

Training

See training check software (FH-SY_AK). All lessons can be printed and filed in register 2.4.0.

Qualifications

☐ SDR Cl. 1 - 6.2, 9	☐ SDR Cl. 7	☐ Avalanche busting	☐ Paramedic	☐ Other
☐ SOF	☐ Safety representative (SIBE)	☐ Safety expert (SIFA)	☐	☐

Languages

Your native language(s) and foreign languages skills (also in writing)				
☐ German	☐ Italian	☐ Rhaeto-Romanic	☐ French	☐ English
☐	☐	☐	☐	☐

Work with helicopters

Experience of the following helicopters (range of assignments on the following page)				
☐ SA 315 B	☐ SA 316 B	☐ SA 316 B1	☐ SA 319 B	☐ AS 350
☐ AS 350 B1	☐ AS 350 B2	☐ AS 350 B3	☐ AS 350 B3+	☐ AS 355 Twin
☐ AS 330 J	☐ AS 332 c	☐ AS 332 MK II mil	☐ EC 135	☐ EC 145
☐ EC 155	☐ EC 120	☐ BELL 205 A1	☐ BELL 206 JR	☐ BELL 206 LR
☐ BELL 204	☐ BELL 412	☐ BELL 407	☐ BELL 214	☐ BO 105 S5
☐ KAMAN 1200	☐ KAMOV KA 32	☐ MIL 8	☐ S 65 Skycrane	☐ BK 117
☐ A 109 K2	☐ A 109 DaVInci	☐ AB 139	☐ R22	☐ R44
☐ Schw. 300	☐ Schw. 330	☐ MD 520	☐ Lynx	☐ S 76
☐ S 53 Sykorski	☐ Enstrom	☐	☐	☐

Range of assignments

Types of helicopter➔ Types of assignments🡻	AS 315b Lama												
Status: **Deployment of the marshaller:** **a) Beginner** **b) Advanced** **c) Independent** **Step:** **Analogue to Chapter** **2.1 Immediate training** **2.2 Training course** **2.3 Practical introduction**													
Enter your status by putting a pencil cross in the appropriate boxes													
1. FOM theory													
2. AFM theory													
3. JAR theory													
General transportation													
4. Constr. and misc. material													
5. Bulk materials (gravel, sand, cement)													
6. Suppl. to mount. chalets / areas													
7. Silo													
8. Construction machinery													
9. Structural components (houses)													
10. Conservatories													
11. Lift motors													
12. Aggregates													
Erection work													
13. Light ground erection work													
14. Heavy ground erection work													
15. Groundwork on steep slopes													
16. Tubular masts													
17. Lattice masts													
18. Tower slewing crane													
19. Aerials													
20. Avalanche busting													
21. Pressurised pipes													
Agricultural flights													
22. Fertiliser (granulate)													
23. Sprays (liquid)													
24. Lime (powder)													
25. Oil binding agent													
26. Seeds													
Cable work / overhead power lines													
27. Cable wk for overhead power lines													
28. Cable wk: cable cars / skyl. cranes													
29. Overhead line repairs													
30. Overhead line monitoring													
Logging													
31. Litterfall exploitation													
32. Area exploitation													
33. Storm damaged trees													
34. Avalanche damaged trees													
35. Fire damaged trees													

Types of helicopter➔ / Types of assignments🡻	AS 315b Lama												
36. Agricultural tree planting													
37. Special work in parks and gardens													
Passenger transport operations													
38. VIP / PAX													
39. Heliskiing													
40. Pilot training													
41. Surveying													
42. Photo and video													
43. Parachuting													
44. Heli-round													
Transport of dangerous goods													
45. Cl. 1 Explosives													
46. Cl. 2 Gases													
47. Cl. 3 Fuels													
48. Cl. 7 Radioactive substances													
Rescue work													
49. Pneumatic winch operations													
50. Electric winch operations													
51. Horizontal net / rescue bag													
52. LAN / SAN													
53. Gondola rescue equipment													
54. Chairlift rescue equipment													
55. Avalanche operations													
56. Fissure rescue													
57. RECCO location													
58. SAR													
59. MERS													
60. Rescue rope													
61. New animal transport net													
Assignments involving the use of water containers													
62. Forest and brush fires													
63. Foaming agents													
64. Supply to construction sites													
65. "Bambi" bucket													
66. Water bucket													
Miscellaneous assignments													
67. Transporting vehicles													
68. Guns													
69. Aircraft													
70. Munitions													
71. Wrecks													
72. Night vision goggles (NVG)													

Assignments abroad													
73. Germany													

MARSHALLER-SYLLABUS

Types of helicopter➔ Types of assignments🡻	AS 315b Lama												
74. France													
75. Austria													
76. Italy													
77. Norway													
78. Others													
Special types of assignments													
79. Controller transfer service													
80. Overhead line repair from platform													
81. SAR offshore													
82. Drilling rig assignments													
Technology													
83. Work on TARMAC													
84. Transporting material from airfield													
85. Provisioning													
86. Daily inspection													
87. Night and weather grounding													
88. Equipment transport - VIP													
89. Maintenance													
90. Overhaul													
91. Repair													
92. Solvents and alkalis													
93. Hot-refuelling TARMAC													
94. Hot-refuelling aerial work													
Order processing													
95. Reconnaissance aerial work													
96. Reconnaissance rescue/SAR													
97. Preparing offers													
98. Customer care													
Other assignments													
99.													
100.													
101.													
102.													
103.													
104.													
105.													
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108													
109.													
110.													

"Amendment" form

No. Of FH-SY

The office in charge of FOCA FH-SY
***AirWork* Ragoni Services GmbH**
Kaspar-Koppstrasse 123
CH-6030 Ebikon

Key word: MARSHALLER SYLLABUS

Dear syllabus user,

The Marshaller-Syllabus must be practical as well as up-to-date. The editing team will be pleased to hear your practical request for amendments, corrections or additions and will endeavour to include them in future updates of the syllabus.

We have enclosed this form for your convenience when sending us your suggestions[1)].

Please send your suggestions to the address given above.

We look forward to hearing from you.

The editing team

Suggestion

Re:

Chapter / Page	Page heading:	Page sub-heading:

Suggestion:

1) Please only use one form for each suggestion for amendment. By copying this form from A5 up to A4 size before filling it out in the appropriate way, you can use it for mailing directly.

Suggestion

Sender:
Address: ____

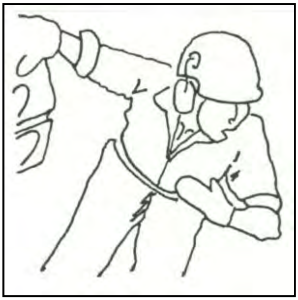
Name, First name: __________________________________ Tel: _________________________

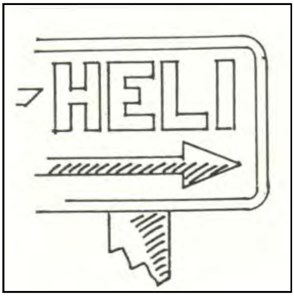
Date: _______________________ Signature: ______________________________________

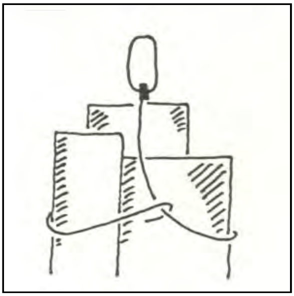
Part 2

Training

2.1







Lesson sheets

Immediate training

MARSHALLER-SYLLABUS

LIST OF LESSONS

Lessons		1. Immediate training		2. Training course		3. Practical introduction	
Work		internal		external		internal	
Time		ab initio	Page	2nd - 3rd season	Page	During the season	Page
Lesson	1	Company skills	2.1.1	Market	2.2.1	Economy	2.3.1
Lesson	2	Job schedule	2.1.2	Professional image	2.2.2	Personal responsibility	2.3.2
Lesson	3	Administration	2.1.3	Institutions	2.2.3	Duties / liability	2.3.3
Lesson	4	Personal safety equipment	2.1.4	Health protection	2.2.4	Prevention	2.3.4
Lesson	5	People from third-party comp.	2.1.5	Third-party care	2.2.5	Limit of responsibility	2.3.5
Lesson	6	Operating equipment	2.1.6	Load lifting device calculation	2.2.6	Use of devices	2.3.6
Lesson	7	Slinging techniques	2.1.7	Load techniques	2.2.7	Load transport	2.3.7
Lesson	8	Fuel skills	2.1.8	Use of fuels	2.2.8	Environmental protection	2.3.8
Lesson	9	Use of radio equipment	2.1.9	Communication	2.2.9	Communication techniques	2.3.9
Lesson	10	Helicopter skills	2.1.10	Helicopter physics	2.2.10	Helicopter assignment	2.3.10
Lesson	11	Danger zones	2.1.11	Hazard analysis	2.2.11	Measures	2.3.11
Lesson	12	Flight assignment	2.1.12	Types of assignment	2.2.12	Work assignments	2.3.12
Lesson	13	Flight obstructions	2.1.13	Perception	2.2.13	Reconnaissance	2.3.13
Lesson	14	Emergencies	2.1.14	Human factors	2.2.14	Conflict resolution	2.3.14

APPLY	UNDERSTAND	CARRY OUT

COMPANY SKILLS | Lesson 1

Safety target:

Measures must be taken to prevent the marshaller from impeding company operations as a result of unfamiliarity with the arrangements in the company.

Training target:

The marshaller can
- state the names of the manager(s) and his/her superiors
- describe the 3 most important operating targets
- describe the basic principles of the philosophy behind safety
- name the company's fields of operation and facilities

Syllabus:

1 Company and technical superiors, contact person and co-workers
- ▶ Personal discussion with the superior(s) on company and safety targets

2 Operating targets (image, company culture)
- ▶ Explanation of business targets and demands

3 Safety targets (safety philosophy)
- ▶ Description of the company's safety culture and the significance of safety where company business is concerned

4 Fields of operation
- ▶ A walk round all the offices and workshops, storerooms, hazardous materials depots, etc. while simultaneously greeting the jobholders and describing the workplaces.

Material:

Corporate image / OM

Company's own promotional material

Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language)

Relevant national laws, directives and leaflets from national aviation and safety authorities

Methodology:

Personal discussion

Tour of the company

Time required:

45 minutes per lesson. The number of lessons is determined according to the company’s request.

Individual study:

Organisation chart (OM) in accordance with the following pattern of questions; "who is my superior, whom do I report to for technical matters, whom do I consult, who is responsible for what (competencies)"

Suva 44005 leaflet "Safety when transporting lumber by helicopter", page 4 and pages 22 et seqq. (see the pictures for relevant information).

Note:

Customer care (tendering, acquisition, etc.) must be dealt with outside the scope of this syllabus.

JOB SCHEDULE	Lesson	2

Safety target:

Measures must be taken to prevent the marshallers from harming the company as a result of exceeding their authority or taking erroneous decisions.

Training target:

The marshallers can
- state their duties and rights
- describe the interfaces to other technical fields
- differentiate between their most important areas of work

Syllabus:

1 Level of authority (rights and duties)
- Processing of contractual documents and job schedule, explanation of rights and duties
- References to the relevant sections of the working contract and the OM, as well as the law of occupational safety and aviation regulations (national law and ordinances, JAR)

2 Interfaces (demarcation from other functions)
- Working through individual chapters of the OM (general topics), significance of the OM for the flying company and its daily work

3 Deployment of the marshaller
- Define deployment as a marshaller in flight process as a priority towards other jobs
- Explain the work of a marshaller before and after an assignment in terms of the provision and maintenance of fuels, materials, etc.
- Explain the deployment of a marshaller in the technical filed (daily, as required, according to suitability, winter work) or in other operational areas.

Material:

Working contract, job schedule, OM rules, staff regulations

Relevant national laws, directives or standards regarding the topics

- "Criminal liability in occupational accidents"
- "What are the duties of both the employer and employee in the field of occupational safety?"

Methodology:

Interactive teaching, random questionings

Time required:

45 minutes per lesson; the number of lessons is determined according to the company's request.

Exercises:

Produce a list of key words in A6 format (postcard) of level of authority (later to be carried in the pocket)

Individual study:

Working contract, job schedule, OM rules

ADMINISTRATION | Lesson 3

Safety target:

Measures must be taken to prevent administrative errors and faults from being allowed to lead to pointless activities and misunderstandings which cause additional costs and effort.

Training target:

The marshaller can
- correctly complete reports on hours, expenses and material
- produce a report on an event
- list the company's 3 most important documents which are to be used for the correct solution of an in-company problem

Syllabus:

1 Reporting
- ▶ Completing job-hours and expense reports
- ▶ Reporting for material orders (replacement, addition, new acquisition etc.)
- ▶ Procedure when ordering material in the technical field
- ▶ Acquisition of information for the next working day

2 Reporting events during flying operations
- ▶ Procedure when reporting, relevant data

3 Documents
- ▶ OM, MOM, AFM, explaining their location and importance
- ▶ Processing a reconnaissance form

Material:

In-company instructions (operation, technology)

Methodology:

Lesson with explanations and examples on site

Time required:

Per lesson 45 minutes, more lesson parts as well as required to the individual company

Exercises:

One helicopter is found to have a technical malfunction. What does the marshaller do?

Individual study:

Rules governing expenses, OM
Reconnaissance form

Note:

Abbreviations see on chapter 3.5.1

PERSONAL SAFETY EQUIPMENT | Lesson 4

Safety target:

Measures must be taken to prevent the marshaller from suffering personal injury which would also be detrimental to his/her company due to a lack of knowledge and a failure to use the safety equipment.

Training target:

The marshaller can
- state the five most important reasons why it should be worn
- differentiate between the resources according to their use
- look after all personal safety equipment independently

Syllabus:

1 Medical, safety and legal aspects of compulsory wear
- Hazardous areas on wire ropes caused by broken strands (hands)
- Hazards caused by kerosene, acid burns (skin, eyes)
- Hazards caused by falling objects (head)
- Hazards caused by not being seen (perception)
- Hazards caused by turbine noise (exposure time, noise levels)
- Hazards and health risks caused by objects whirling in the air and dust (eyes)

2 Correct usage
- Choice of personal safety equipment according to mission, basic equipment

3 Maintenance of personal safety equipment supplied by the company
- Care and cleaning as well as storage (batteries!)

Material:

Personal safety equipment supplied by the company

Relevant national laws, directives or standards regarding "Personal safety equipment"

Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language), page 5 ff.

Methodology:

Theoretical explanation and practical examples (turbine noise, breaks on ropes)

Time required:

Per lesson 45 minutes, more lesson parts as well as required to the individual company

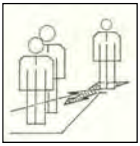
Exercises:

Test wearing comfort and efficacy of the helmet (noise)

Individual study:

Noise-, load resistance and force tables is given in the annexes 3.2 and 3.3

Immediate training



PEOPLE FROM THIRD-PARTY COMPANIES

Lesson **5**

Safety target:

Measures must be taken to prevent people from third-party companies and non-participating third parties from being exposed to danger or endangering flying operations as a result of incorrect behaviour on their own behalf or on the part of the marshaller.

Training target:

The marshaller can
- describe his/her own level of authority to the customer
- state behavioural patterns among customers
- brief customers on the 4 most important behavioural rules

Syllabus:

1 Marshaller's level of authority towards customers
- ▶ Customer briefing regarding the most important features of behavioural rules in and around the helicopter as well as at work

2 Essential features of behavioural patterns among third parties
- ▶ Behavioural pattern "stress" when exposed to unknown hazards and risks, escape reflex, difficult communication (turbine noise, rotor wind)
- ▶ Behaviour in emergency situations (escape reflex)

3 Marshaller can brief people from third-party companies on the most essential points regarding
- ▶ Allocation of work during work preparation and implementation
- ▶ Rules governing behaviour and safety
- ▶ Authority regarding information (information competence)
- ▶ Importance of passengers tickets

Material:

OM, typical accidents, Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language), page 4

Methodology:

Lesson

Time required:

Per lesson 45 minutes, more lesson parts as well as required to the individual company

Exercises:

People from third-party companies have to be set down in open country. How does the marshaller react?
What behavioural patterns must be observed? What measures must be taken?

Individual study:

Relevant OM chapters on the subject

Immediate training

OPERATING EQUIPMENT | Lesson | 6

Safety target:

Measures must be taken to prevent the marshaller from impairing flying operations or causing injury to the customer or non-participating third parties as a result of the use of unsuitable operation equipment.

Training target:

The marshaller can
- differentiate between all equipment groups according to mission
- designate material groups and their safety factors
- state the norm names and code of meanings of the operating equipment
- explain the criteria for the moment to drop
- describe maintenance and storage measures

Syllabus:

1 Equipment groups
- Flight material, flight operation material, auxiliary material, equipment, tools, operating fuel/lubricants, cleaning
- Non-company material belonging to customers or third parties

2 Material groups
- Organising the operating equipment according to material groups steel, steel ropes, textiles

3 Concepts and designations
- Lettering and designation
- Colours and barcodes, stamps
- Safety factors and working load limits in straight lifts

4 Moment to drop
- Basic maintenance and storage criteria
- Criteria of moment to drop for the various flight operating materials

5 Care
- Safety measures to deal with chemical and mechanical effects

Material:

All available operating equipment, Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language), page 8 ff.

Methodology:

Lesson, briefing, demonstration

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Determining moments to drop

Repairing wire ropes (broken strands)

Individual study:

List of flight operating equipment is given in the annex 3.2

Immediate training

SLINGING TECHNIQUES Lesson 7

Safety target:

Measures must be taken to prevent people from being put at risk or useful loads and slinging equipment from being damaged as a result of incorrect handling.

Training target:

The marshaller can
- master simple slinging techniques
- secure the load autonomously and carry out all safety precautions
- prepare autonomously simple loads using the correct equipment
- correctly create simple lengthenings/extensions

Syllabus:

1 Mastery of simple slinging techniques and load protection
- Slinging techniques ensuring form and force closure (tying, double tying)
- Choosing slinging points on usefuel loads with due consideration for centre of gravity

2 Safety precautions and load protection
- Safety precautions and/or choice of slinging equipment on sharp edges (abrasion protection)
- Joining different slinging equipment (shackles)
- Securing loads or connections

3 Put together simple loads
- Putting together net loads (small materials)

4 Lengthenings/Extensions
- Assembling of proper lengthenings using various slinging equipment and connecting devices
- Assembling of proper lengthenings using longlines and lifting hooks (electric, manually operated)

Material:

Slinging equipment and usefuel loads (wooden beams, PVC pipes, concrete pipes, sheet metal boards and metal girders with sharp edges, etc.) overhead crane or high-lift fork truck

Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language), page 32 et seqq.

Relevant national laws, directives or standards regarding "Crane transport with cages"

Methodology:

Instruction, demonstration

Time required:

45 minutes per lesson; the number of lessons is determined according to the company's request.

Exercises:

Putting together simple loads

Boards with round slings, PVC pipes with round slings and anti-slip protection

Concrete pipes with round slings and abrasion protection, steel girders with chains

Individual study:

Basic training sheets: "Slinging techniques" and "Loads caused by the slinging factor and the angle of inclination"

FUEL SKILLS | Lesson 8

Safety target:

Measures must be taken to prevent the marshaller from endangering himself/herself, other people, equipment or the environment due to handling fuels incorrectly.

Training target:

The marshaller can
- describe the most important rules with regard to handling fuels and storing them
- describe the applications for fuels and assess dangers
- explain the most important elements of fire and explosion protection

Syllabus:

1 Differentiating between fuel groups
- ▶ Examining samples of fuel groups (kerosene, diesel, aviation fuel, 2-stroke fuel, solvents and cleaning agents) and identifying them

2 Designation and danger label (hazchem)
- ▶ Designation of fuels (JET-A1, AVGAS 100, possibly similar!) and danger label (ADR class 3)

3 Storage and inner company transport
- ▶ Storage and transport containers for inner company transport, storage rooms and protective measures

4 Application and use of fuels
- ▶ Checking fuels for impurities and water
- ▶ Filling canisters and refuelling the helicopter from a fuel pump or pump station
- ▶ Checking refuelling volumes in helicopters (fuel gauge) with the rotors stationary

5 Elementary fire and explosion protection as well as combating environmental contamination (spills)
- ▶ Elementary fire and explosion protection (no smoking, damp cloths, oil spots, ventilation and length of exposure)
- ▶ Cleaning up contamination (oil binding agent)

Material:

Samples of all fuels (1/2 litre metal cans), storage and transport containers, ADR emergency gear, granulate / sawdust, etc.)

National civil aviation office instructions "Fuelling aircraft" and "Checking fuel quality"

National guidelines or standards of "Inflammable liquids"

Methodology:

Briefing and lesson, demonstration

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Checking fuels with a pocket torch or tablet

Refuelling helicopters with fill level check

Checking the helicopter tank for impurities/water (drainage)

Individual study:

ADR hazchem leaflet

Conducting company fuel checks

Note:

This syllabus does not cover the transport of hazardous substances (ADR class 3) which is the class including all fuels, cleaning agents and solvents. Only by acquiring the ASTAG/ADR certificate (hazardous substances transport) is the holder entitled to transport such substances outside the company on the road.

This syllabus does not cover the use of hazardous substances in class 2 (explosives) and class 7 (radiation sources).

ADR rules apply to transporting hazardous substances by road; the IATA's rules apply to transport by aircraft.

USE OF RADIO EQUIPMENT | Lesson 9

Safety target:

Measures must be taken to prevent people from being endangered and working processes being placed at risk due to incorrect operation of radio equipment and inadequate radio operator language.

Training target:

The marshaller can
- operate the radio equipment and its accessories
- use the main elements of radio operator language
- give instructions to a helicopter

Syllabus:

1 Operation, maintenance of the radio equipment and its accessories
- Switching the radio equipment on/off, setting the required frequency
- Checking the functions (helmet, earphones, comfort when worn)
- Checking the connection
- Maintaining the radio equipment, charging the battery
- Handling and storing spare batteries

2 Mastering the basic forms of command language and communication
- Calling a station and acknowledgement
- Call signs of the helicopters (HB-XXX) and call signs of company members
- Sharing frequencies / frequency blocking / "selective"
- Use in rain and snow

3 Giving instructions to a helicopter
- Company's command language
- Radio discipline and rules for use
- Giving instructions (left/right)
- Communication for giving instructions at landing areas
- Failure of the radio equipment: Signals and hand signals

Material:

Radio equipment and high-visibility clothing

Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language), page 16 ff.

Methodology:

Briefing, demonstration

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Operating and calling up a station with acknowledgement

Giving instructions to a helicopter (dry run)

Individual study:

Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language)

HELICOPTER SKILLS — Lesson 10

Safety target:

Measures must be taken to prevent the marshaller from placing himself/herself or the helicopter at risk, leading to damage to the company, as the result of incorrect actions and operation and due to ignorance of or failure to pay attention to dangers.

Training target:

The marshaller can
- identify "his/her" type of helicopter
- describe the main potential risks of the helicopter
- name the points of danger and behavioural rules in and around the helicopter

Syllabus:

1 Familiarity with the performance data, performance limits and power reserves of the helicopter
- Performance data of the helicopter: Safe working load, performance limit (operational), power reserves
- The main instruments: Balance, refuelling indicator (fuel gauge), battery switch, warning lamps
- Seat equipment and safety belts, loading areas and storage bays
- Control devices (pitch, stick, pedals)

2 Describing the danger zones and behavioural rules in and around the helicopter
- Danger zones: Main rotor sweep area, pitch, flapping
- Tail rotor sweep area
- Field of vision of the pilot and the blind spot
- Approaching the helicopter
- Climbing in/out or loading/unloading when hovering (egg balancing effect)

3 Familiarity with the helicopter controls that are accessible to the marshaller
- Controls, primary lifting hooks, plugs, holding points for moving, fuelling pipes, earthing points, etc.

Material:

Helicopter on site, performance data sheet, AFM, AOM

Basic sheets in the "Basics/helicopter" chapter 3.1

Suva leaflet 44005 "Safety when transporting lumber by helicopter", page 10 ff

Methodology:

Briefing, demonstration

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Installing the long-line on primary lifting hooks, checking the function of the secondary lifting hook

Sitting in the pilot's seat and checking the field of vision (blind spot)

Individual study:

Suva 44005 leaflet, performance data sheet of the helicopter

Note:

Daily maintenance and periodic servicing of the helicopter ("maintenance") by "non-mechanics" (part-time workers, long-contract temporary workers) is covered by the MOM ("Maintenance Operations Manual") and is therefore not dealt with in this syllabus. Introducing marshallers to the aspect of "maintenance" is the responsibility of the head of the maintenance company. Use of marshallers in this area differs widely from company to company due to various factors.

DANGER ZONES — Lesson 11

Safety target:

Measures must be taken to prevent injury to people and damage to property as a result of behaviour contrary to safe practice.

Training target:

The marshaller can
- describe the danger zones
- describe safety-relevant behaviour
- communicate his/her perceptions to the pilot

Syllabus:

1 Familiarity with the danger zones

- Danger zones underneath the helicopter: Loading point, unloading point, refuelling point, approach routes
- Danger zones around the helicopter: See Lesson 10

2 Escape routes and safety areas

- Behaviour in the danger zones: Escape routes, control rooms
- Securing and indicating danger zones
- Informing third parties (members of the public, police, customer, land owner)
- Possible dangers: Downwash, objects falling down or being blown upwards, breaking loads (logging), dust, rolling objects, swinging of the lifting hook

3 Perception of dangers

- Eye contact with and information to the pilot
- Leading and monitoring people from third-party companies

Material:

Suva 44005 leaflet "Safety when transporting lumber by helicopter", pages 10 ff. and 26 ff.

Methodology:

Lesson, demonstration, briefing

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company Exercises:

Making a diagram of a classic workplace and drawing in the dangers

Individual study:

Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language)

FLIGHT ASSIGNMENTS | Lesson 12

Safety target:

Measures must be taken to prevent inadequate work preparation from interrupting foreseeable working procedures and placing people or material at risk.

Training target:

The marshaller can
- state the most important types of assignment done by his/her company
- describe the individual workplaces and the preparations required
- structure an assignment site into its workplaces

Syllabus:

1 Differentiating between types of assignment

- Assignment types: logging, on-site assembly, supply flights in mountainous areas, transport in general, building materials, bulk material (concrete, gravel), photo flights, passenger flights, Human External Cargo (HEC), hazmat transports (explosives, crop dusting agents, gas containers), etc.
- Flight on the co-pilot's seat (familiarisation)

2 Preparations and discussion of the assignment

- Work preparation: assembly of a qualified flight crew, preparation of operating material and auxiliary materials, fuel, equipment and cartographic material
- Briefing: discussion with the pilot, task specialist, chief marshaller etc. (acquisition of information, initial position), debriefing

3 Organisation at the site of assignment

- Structure of an assignment site: organisational area, refuelling areas, load pickup and load dropping point(s), approach and departure lanes, setting up of roadblocks (in coordination with the police/building authority)
- Obstructions: cables, masts, houses etc.
- Meteorological clearance: wind (bows, limits), visibility (fog, variable amounts of cloud), precipitation (shower, rain etc.), temperatures (trends), local characteristics

Material:

Suva leaflet 44005 "Safety when transporting lumber by helicopter", page 22 et seqq.
(only in German, French or Italian language),

Relevant national laws, directives and leaflets dealing with the subject

Methodology:

Interactive teaching

Time required:

45 minutes per lesson; the number of lessons is determined according to the company’s request.

Exercises:

Acquisition of information: Where do marshallers get what information?

Individual study:

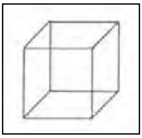
Suva leaflet 44005 and company information material

Note:

A choice of possible assignment types can be found in the logbook of "Marshaller Syllabus Training Check 2.4". There, you can add individually other types of assignments.

The following assignment types require special training and therefore cannot be treated within this manual:

- HEMS ("Helicopter Emergency and Medical Services"; rescue operations)
- HHO ("Helicopter Hoist Operations")
- EASA Part 145 (daily and other checks, maintenance)
- Air rescue operations in general



FLIGHT OBSTRUCTIONS | Lesson 13

Safety target:

Measures must be taken to prevent the helicopter, people and property inside and outside the helicopter from being endangered by obstructions.

Training target:

The marshaller can
- describe the classic flight obstructions
- explain the specific problems associated with typical obstructions

Syllabus:

1 Familiarity with classic flight obstructions and distances from obstructions / minimum altitudes

- Flight obstructions: natural such as trees, rocks, etc.; artificial such as cables, bridges, roads, houses, railway lines, etc.
- Minimum altitudes, distances from obstructions, freedom from obstructions

2 Specific problems

- Perception of obstructions: Light/shade, distances, temporary obstructions
- Effects of contacting an obstruction, comparison with other effects

Material:

Airway obstruction map 1:100,000, photos, national civil aviation office instructions "Dealing with airway obstructions"*

Chapter 3.1 "Limits of helicopter operation", Suva leaflet 44005 "Safety when transporting lumber by helicopter", page 14 ff.

Methodology:

Lesson, on-site briefing

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

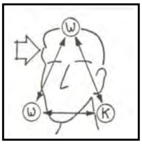
Recognising an obstruction, e.g. a cable against a dark background

Estimating distances

Individual study:

Basic sheet "Limits of helicopter operation" on chapter 3.1

Suva leaflet 44005 "Safety when transporting lumber by helicopter" (only in German, French or Italian language)



EMERGENCIES | Lesson 14

Safety target:

Measures must be taken to prevent people who have been involved in an accident from being placed at additional risk by failure to render assistance or by rendering assistance incorrectly.

Training target:

The marshaller can give first aid and ask for help within the scope of his/her assignment.

Syllabus:

1 Assessing the situation at an accident and determining what assistance is required

- Assessing the patient: ABC (air-breathing, blood, contraction), storage and security
- External dangers: Location of the patient/helper (danger of stone impact, etc.)

2 Requesting assistance (calling base or REGA relay)

- Assessing the location: Helicopter rescue necessary YES / NO; Helicopter rescue possible YES / NO

Material:

REGA first-aid leaflets

Suva 44005 leaflet "Safety when transporting lumber by helicopter", pages 14 and 44

Company's own instructions, OM

Methodology:

Lesson

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Call up national air-ambulance organisations via relay (inform organisation in advance by telephone)

Individual study:

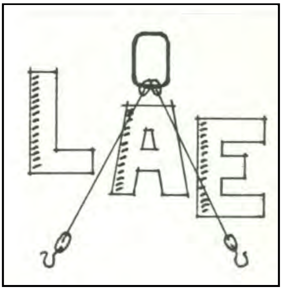
REGA first-aid leaflets, Suva leaflet: 44005, page 44

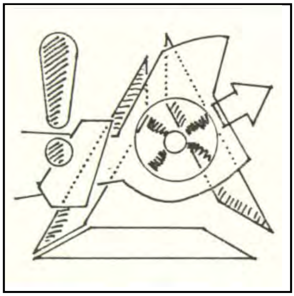
Note:

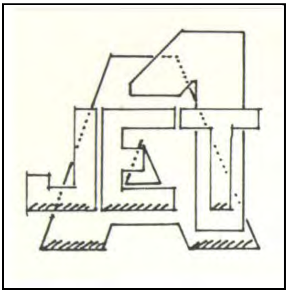
It is assumed that everyone over the age of 18 who also possesses a driving licence has received the usual first-aid training and is aware of the most important rules (ABC).

The following lessons 14 ("Human factors" and "Conflict resolutions") are causally interconnected, however only restricted to this lesson 14.

2.2







Lesson sheets

Training course

MARSHALLER-SYLLABUS

LIST OF LESSONS

Lessons	1. Immediate training		2. Training course		3. Practical introduction	
Work	internal		external		internal	
Time	ab initio	Page	2nd - 3rd season	Page	During the season	Page
Lesson 1	**Company skills**	**2.1.1**	Market	2.2.1	Economy	2.3.1
Lesson 2	**Job schedule**	**2.1.2**	Professional image	2.2.2	Personal responsibility	2.3.2
Lesson 3	**Administration**	**2.1.3**	Institutions	2.2.3	Duties / liability	2.3.3
Lesson 4	**Personal safety equipment**	**2.1.4**	Health protection	2.2.4	Prevention	2.3.4
Lesson 5	**People from third-party comp.**	**2.1.5**	Third-party care	2.2.5	Limit of responsibility	2.3.5
Lesson 6	**Operating equipment**	**2.1.6**	Load lifting device calculation	2.2.6	Use of devices	2.3.6
Lesson 7	**Slinging techniques**	**2.1.7**	Load techniques	2.2.7	Load transport	2.3.7
Lesson 8	**Fuel skills**	**2.1.8**	Use of fuels	2.2.8	Environmental protection	2.3.8
Lesson 9	**Use of radio equipment**	**2.1.9**	Communication	2.2.9	Communication techniques	2.3.9
Lesson 10	**Helicopter skills**	**2.1.10**	Helicopter physics	2.2.10	Helicopter assignment	2.3.10
Lesson 11	**Danger zones**	**2.1.11**	Hazard analysis	2.2.11	Measures	2.3.11
Lesson 12	**Flight assignment**	**2.1.12**	Types of assignment	2.2.12	Work assignments	2.3.12
Lesson 13	**Flight obstructions**	**2.1.13**	Perception	2.2.13	Reconnaissance	2.3.13
Lesson 14	**Emergencies**	**2.1.14**	Human factors	2.2.14	Conflict resolution	2.3.14

APPLY	UNDERSTAND	CARRY OUT

MARKET — Lesson 1

Safety target:

Measures must be taken to prevent marshallers from endangering commercial success due to false or inadequate provision of information/customer care.

Training target:

The marshaller can
- issue information on the relevant job competently to a limited degree
- calculate the work involved (time, material) for a simple job
- name all the services involved and the flying-time prices per minute

Syllabus:

1 How to handle jobs in connection with customers

- Briefing on the structure of a job, the information required for flying operations, discretion, what may/can/should a marshaller know
- Processing of orders by the assignment centre or sale for the aerial work assignment
- Reasons for discretion

2 Calculation of flying-time prices in minutes and time/outlay

- Flying-time prices for the relevant helicopter types in accordance with the association price list (SHA)
- Information talk on how to use flying-time prices
- Simple calculation of outlay: number of rotations and minutes; outlay as a general estimate (plus/minus 20%)

3 Services

- Naming the standard services based on prices per minute
- Familiarity with job prices (price per minute, rotation price, M^3 price, etc.)
- Describing the effects of the various job prices in terms of job execution

Material:

Jobs, price lists, reconnaissance reports

Methodology:

Briefing connected with the procedure and explanation of jobs and how to handle them (incl. discretion)

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Interpretation of a job/job sheet and selection of the information of relevance for the customer

Individual study:

All the material available

Note:

Tendering and assignment planning (job) are exceptionally tricky topics, particularly where pricing is concerned. The prices tendered are generally not made available to the marshaller and should never be discussed.

In consequence, this means that marshallers do not need to be able to put together any calculations.

However, marshallers <u>must</u> know about the type of prices (M^3, rotation, outlay, etc.) as this is of direct importance for the execution of the assignment.

SHA (The Swiss Helicopter Association) issues a price list which is recommended to members as a guideline.

PROFESSIONAL IMAGE	Lesson	2

Safety target:

Measures must be taken to prevent the marshaller from becoming demotivated and thereby acting against the interests of the company as a result of lack of recognition and monotonous employment.

Training target:

The marshaller can
- comprehensively explain his/her duties
- indicate what options are available for his/her personal development
- plan further training and calculate the costs

Syllabus:

1 Duties of the marshaller

- Activities within the profession (marshaller, work preparation, reconnaissance, material service, work with technical issues)

2 Development

- Development opportunities within the profession (chief marshaller, head of transport, customer relations worker)
- Development opportunities outside the profession (ADR hazchem transport, mechanic licence**,** rescue paramedic, "HEMS crew member")

3 Training and costs

- Preparing the planning of further training opportunities with the company (requirements)
- Costs and obligations

Material:

Information materials from companies and associations (e.g. EHA), publicity material

Methodology:

Plenary discussion and group work

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Individual study:

Available material

INSTITUTIONS | Lesson 3

Safety target:

Measures must be taken to prevent marshallers from exposing themselves to criticism as a result of unlawful actions which may harm the company due to an inadequate knowledge of legal regulations and official responsibility.

Training target:

The marshaller can
- name authorities, institutions and associations responsible for flying operations and his/her work
- explain the most important legal principles
- describe the two most important law articles (employee, employer)
- give a definition of the concept "air accident"

Syllabus:

1 Aviation and occupational safety authorities
- Introduction to national civil aviation office (supervisory authority)
- Introduction to national accident insurance office (implementation organ for occupational safety)
- Implementation of aviation law - implementation of accident insurance law (interfaces)

2 Associations and functions
- Employers' and employees' associations (names, functions, addresses, contact partners)

3 Federal Office of Flying Accident Investigations and national Advisory Agency for Accident Prevention institutions
- Accident clarification, air accidents, Federal Office of Air Accident Investigations (air accident definition)
- Accident clarification, occupational accidents, AIO (occupational accident definition)
- Accident clarification non-occupational accident, AIO / Swiss Advisory Agency for Accident Prevention (non-occupational accident definition)

Material:

Accident insurance and aviation law (incl. regulations), association documentations, promotional material

Methodology:

Briefing, lesson

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Individual study:

National laws, directives or standards of occupational safety and health, civil aviation law etc.

HEALTH PROTECTION | Lesson 4

Safety target:

Measures must be taken to prevent inadequate personal protection, incorrect actions and poor nutrition from causing accidents, illnesses and lost working days which can lead to economic and commercial harm.

Training target:

The marshaller can
- explain the possible effects of neglected safety measures
- define the effects of working behaviour (body, ergonomics)
- describe the consequences of faulty nutrition and stress

Syllabus:

1 Explanation of effects
- Wearing and "bearing" personal safety equipment
- The wrong learning process
- The physical, chemical effects of materials

2 Briefing on the principles of behaviour and movement (ergonomics)
- Bending, carrying, running, etc.

3 Learning how to handle stress and the mental processing of long-term stress
- What is stress and how can it be handled?
- What effects does food have on our performance?

Material:

Relevant national laws, directives or standards regarding "Personal safety equipment"

Methodology:

Lesson with demonstrations, group work

Time required:

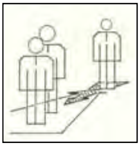
Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Handling stress

Individual study:

Relevant national laws, directives or standards regarding "Personal safety equipment"



THIRD-PARTY CARE | Lesson 5

Safety target:

Measures must be taken to prevent people from third-party companies and non-participating third parties from being exposed to danger from flying operations due to inadequate organisation or briefing on the part of the marshaller or as a result of insufficient leadership work on his/her part.

Training target:

The marshaller can
- brief on the most important behavioural measures on site
- put together and lead a working group according to suitability/requirements
- give information on the company's activities

Syllabus:

1 Immediate briefing prior to the start of work (exchange of information)
- Immediate briefing and organisation of the worksite before the helicopter arrives
- Establishment of communication (customer liaison)

2 Allocation of tasks and immediate measures (spectators, rest areas, approach/departure routes, etc.)
- Determining authority
- Discussion and organisation of work (briefing) with/without pilot
- Allocation of workplaces and safety areas

3 Methods of communication and their use
- Use of barriers and methods of communication

Material:

Available information material

Suva leaflet 44005 "Safety when transporting lumber by helicopter", page 22 ff.

Methodology:

Briefing and role-play

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Organising a working group and allocating responsibilities and tasks

Individual study:

Suva leaflet 44005

LOAD LIFTING DEVICE CALCULATION

Lesson 6

Safety target:

Measures must be taken to prevent the marshaller from using unsuitable equipment and underestimating the loads and changes caused by flying due to inadequate knowledge, thereby resulting in the material being overloaded to such an extent that the company suffers damage and people are placed at risk.

Training target:

The marshaller can
- explain the reasons for using standard terminology and uniform term definitions
- list and identify all terms for load lifting devices
- name and calculate the safety factors
- describe his/her responsibility when LLD's are manufactured independently

Syllabus:

1 Standard terminology, abbreviations and synonyms
- Why standard terminology is used and what reference sources are available
- Working with standards (e.g. EN 1492-1)

2 Flight operation material and assignment/grouping
- Standard terminology for flight operation material (LLD, LLM, LLA, SE, AE etc.)

3 Material groups, safety factors and calculation of the safety margin
- Material groups and their safety factors, calculation of safety factors and safety margins
- Special applications

4 Responsibility, liability
- Independent production (product liability)
- Documentation and storage of principles and calculations

Material:

EN standards, manufacturers' catalogues

Relevant laws, directives or standards of "Crane transport with cages"

Chapter 3.2; "Loads on load lifting devices"; Checklist of flight operations material in the appendix to the syllabus

Methodology:

Lesson, briefing, demonstration

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

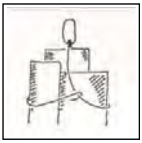
Exercises:

Calculating the safety margin

Allocation of the individual parts of the LLD

Individual study:

List of flight operations material



LOAD TECHNIQUES | Lesson 7

Safety target:

Measures must be taken to prevent flight operation material from being allowed to be overloaded as a result of false assumptions or the false calculation of load factors to such a degree that people and goods are at risk.

Training target:

The marshaller can
- correctly put together various loads under difficult conditions
- explain factors which affect material and safety
- calculate load increasing factors

Syllabus:

1 Slinging factors and physical effects on slinging points
- Determining and calculating slinging points and slinging factors on loads and LLD's
- Determining physical effects (e.g. sharp edges) on payloads and describing their effect

2 Angles of inclination and combinations of slinging factors
- Calculating loads on LLD's with angles of inclination or slinging factors
- Calculating combinations of angles of inclination and slinging factors

3 Dynamic pressure values and measures
- Calculating possible dynamic pressure values
- Taking measures to reduce loads

Material:

Usefuel load material, slings and load carrying attachments, basic sheets "Calculating load lifting devices"

Methodology:

Briefing, group work, discussion

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Calculating a model load with angle of inclination, combinations of slinging factors

Individual study:

Basic sheets "Load lifting devices"

USE OF FUELS	Lesson	8

Safety target:

In order to avoid harm to the company, when fuel is being handled measures must be taken to prevent people, aircraft, equipment and other items from being placed at risk.

Training target:

The marshaller can
- plan the safe handling of hazardous substances
- apply the most important immediate measures in cases of pollution
- set up effective protection from lightning
- protect themselves efficiently from harmful substances
- plan the correct handling of hazardous substances in accordance with the regulations in force for the protection of the environment

Syllabus:

1 Refuelling aircraft
- ▶ Basic rules of refuelling aircraft (partially dependent on the refuelling station or on the environmental situation, i.e. water protection, etc.)
- ▶ Calculating volumes of barrels and containers

2 Fire and explosion protection (protection from lightning)
- ▶ Protection from lightning and electrostatic discharge (difference of potential)
- ▶ Grounding and equipotential bonding
- ▶ Defuelling of helicopters
- ▶ Quality control of fuel (water, dirt, drainage)

3 Health protection
- ▶ Personal safety equipment (protection of hands and eyes)
- ▶ Effect of hydrocarbons on human beings
- ▶ Fumes, exposure zones and exposure time, measures (ventilation, distance, no smoking)
- ▶ Protection against electrostatic discharges

Material:

Relevant national laws, directives or standards regarding the topics
- "Halogen Ted hydrocarbons", "Skin protection", "Inflammable liquids", "Hazmat transport"
- "Fuelling aircraft" and "Checking fuel quality"

Methodology:

Briefing, group work, demonstration

Time required:

45 minutes per lesson; the number of lessons is determined according to the company’s request

Exercises:

Production of a correct potential equalisation (helicopter - refuelling vehicle - ground - people)

Individual study:

Documents: see "Materials"

COMMUNICATION | Lesson 9

Safety target:

Measures must be taken to prevent danger arising from badly or carelessly transmitted messages.

Training target:

The marshaller can
- use clear, disciplined radio operator language
- correctly interpret unclear messages by querying them
- recognize the most important communication traps
- formulate radio calls clearly and comprehensibly

Syllabus:

1 Radio-telephony / radio discipline / Modulation
- Principle of radio-telephony transmission
- Transmission of radio messages and the meaning of radio discipline in cases of interference
- Modulation

2 Spoken / Heard / Understood
- What we believe to have said, what we actually hear and what we believe to have understood
- Formulations, concepts, sentence construction, length of sentence, dialects and pronunciation

3 Clear radio communication language / positive confirmation
- Meaning of specific terms, clear messages, positive-negative contents
- Enhancement of the message, emphasis and positive confirmation

4 Night flights / radio failure
- Light signals / distress signals at night
- Hand signals / behaviour in case of radio failure during the day

Material:

Relevant national laws, directives or leaflets regarding air-ground radio communication

Suva leaflet 44005 "Safety when transporting lumber by helicopter", page 16 et seqq.

REGA radio communication handbook "Instructions for ground radio communication" or similar manuals

Methodology:

Briefing, demonstration, interactive teaching

Time required:

45 minutes per lesson; the number of lessons is determined according to the company’s request.

Exercises:

"Bush telegraph"

Interpretation exercise (what does the same written sentence mean for everybody - dependent on emphasis, history, situation, etc.)

The four pieces of information contained in a message (context, issue, request, self-revelation)

Individual study:

REGA radio communication handbook

HELICOPTER PHYSICS | Lesson 10

Safety target:

Measures must be taken to prevent the entire system (helicopter and load) from being overloaded thereby causing danger for people, material and the company.

Training target:

The marshaller can
- explain the principles of physical loads caused by the flying operation (bank angle, DWD/FS13) and calculate the resultant load increase factors
- take these factors into consideration when preparing loads

Syllabus:

1 Banking the helicopter in degrees (bank angle)
- Flight manoeuvre and gravitation as a principle

2 Load increases caused by flight operation
- What happens when banking: load increase squared and its consequences
- Load resistance caused by DWD/FSD
- Static and quasi-static load increases

3 Design factors and limits of use
- Safety limits during operations
- Different operational uses and their effects (e.g. logging)

Material:

Basic information sheets "Loads on helicopters", FAR / JAR Part. 27/29 § 303 /337 /865, AFM/AOM, OM,

"Basic Theory of the Helicopter", Aerospatiale Helicopter Division*

"Helicopter Aerodynamics" by R. W. Prouty, Rotor and Wing International*

Methodology:

Briefing, demonstration

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Calculating load increase

Table interpretation

Calculation of mixed load increase factors and LLD loads

Individual study:

Basic sheets

* Available from the relevant publishers

HAZARD ANALYSIS | Lesson 11

Safety target:

Measures must be taken to prevent that the use of inappropriate or dangerous materials or the adoption of inappropriate procedures might injure persons or cause material damage.

Training target:

The marshaller can
- carry out a simple hazard analysis (danger triangle)
- carry out a simple risk assessment
- carry out an assessment of a hazard based on simple situations (load preparation) and derive effective measures
- compile an incident/accident report and write a suggestion for improvement

Syllabus:

1 Danger triangle
- ▶ Establishing a danger triangle on the basis of an example (person/situation, risk, danger, triggering factors, event)

2 Risk assessment
- ▶ Identification of the risk (probability - severity)

3 Technical, organisational and personnel measures
- ▶ Identification of measures: Technology - Organisation - Personnel (T-O-P))

4 Evaluation of incidents/accidents, procedures for improvement proposals
- ▶ Registration and reporting of incidents/accidents
- ▶ Compilation and reporting of suggestions for improvement

Material:

Relevant national laws, directives or leaflets regarding the topics

- "Risk assessment" and "Risk analysis", "Safety: an operational analysis"
- Internal reporting systems, accident reports, statistics

Methodology:

Instruction, interactive teaching, team work

Time required:

45 minutes per lesson; the number of lessons is determined according to the company’s request.

Exercises:

Production of a simple hazard analysis based on a slinging technique

Individual study:

See "Material"

Note:

Marshallers should be able to assess the tasks they are about to perform. With the help of a danger triangle (see fire brigade: fire triangle) the complexity of the situation can be visually depicted and thus easily understood. Another important item is the diffusion of detected dangers and risks by means of suggestions for improvement or incident reports.

TYPES OF ASSIGNMENT | Lesson 12

Safety target:

Measures must be taken to prevent the marshaller causing damage to the company due to inadequate knowledge of the peculiarities of the various types of assignment.

Training target:

The marshaller can
- define and allocate all types of assignment with helicopters
- describe the peculiarities of these types of assignment
- define the special dangers when people are carried as an external load

Syllabus:

1 External loads: Heavy loads, logging, types of erection work
- How do external load assignments differ from flights with internal loads
- Various types of erection work (ground erection work, hovering erection work / erection work on loping ground)
- Techniques of erection work
- Logging and other heavy loads

2 Internal loads: "Public transport", photographic flights
- Internal loads and their peculiarities

3 People as external loads
- Special hazards when carrying people as an underload (provisionally only permitted for rescues)

Material:

Photos, OHP sheets of assignments
Suva leaflet 44005 "Safety when transporting lumber by helicopter"
Relevant national laws, directives or standards regarding "Crane transport with cages"

Methodology:

Lesson

Time required:

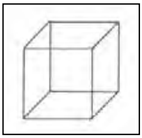
Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Practising setting people down (rescue) from the hall crane
Securing internal loads in the helicopter

Individual study:

Relevant national laws, directives or standards regarding "Crane transport with cages"



PERCEPTION

Lesson 13

Safety target:

Measures must be taken to prevent both people and working processes from being endangered as a result of excessively high expectations of human perception.

Training target:

The marshaller can
- list vital factors which influence human perception
- describe external factors which affect people
- take this knowledge into account when reconnoitring assignments and make use of them for safe helicopter assignment

Syllabus:

1 Perception and mental factors
- Perception in a normally conditioned state
- Perception under stress (4-colour conditions)
- Perception when tired/exhausted

2 Perception and external factors
- Light and shadow
- Countryside, snow and rain, moving surfaces (wheat field)
- Cable and ropes
- Training perception

Material:

Literature on the topic
Swissair Video "Perception - How Real is Reality?"

Methodology:

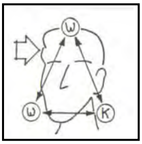
Lesson, demonstration

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

Exercises:

Looking for and finding cables in open country (reconnaissance)



HUMAN FACTORS | Lesson | 14

Safety target:

Measures must be taken to prevent anybody endangering themselves or others as a result of behaving incorrectly.

Training target:

The marshaller can
- explain the basic pattern of human behaviour (want, know, can, strengths and weaknesses, ability to react)
- understand human behaviour as part of the "technology-organisation-personnel" system (T-O-P) and adopt a critical approach to human error
- interpret behaviour (see Hazard analysis, Lesson 2.2.11)

Syllabus:

1 Human behaviour
- Pattern "Want, Know, Can"
- Reaction/change in perception when under stress (4-colour conditions)
- Reasons for accidents in human behaviour (white condition)

2 "Human error"
- There is no "human error" in an event
- Reasons for incorrect human behaviour
- Human-machine communication
- Being able to say no

Material:

Suva form 66038 "Risk analysis"

Methodology:

Lesson

Time required:

Per lesson 45 minutes, more lessons part as well as required to the individual company

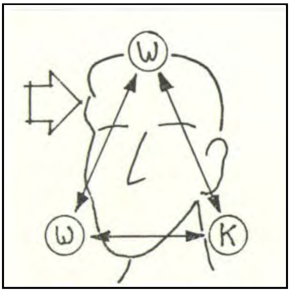
Exercises:

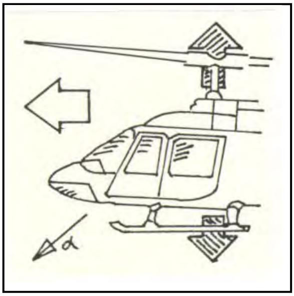
Assessment and evaluation of the behaviour of a trainee (role playing)

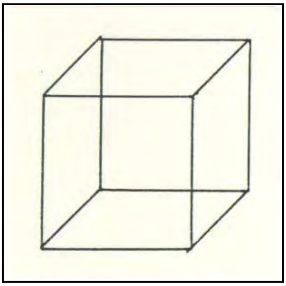
Individual study:

Suva form 66038

2.3







Lesson sheets

Practical introduction

MARSHALLER-SYLLABUS

LIST OF LESSONS

Lessons		1. Immediate training		2. Training course		3. Practical introduction	
Work Time		internal ab initio	Page	external 2nd - 3rd season	Page	internal During the season	Page
Lesson	**1**	**Company skills**	**2.1.1**	Market	2.2.1	Economy	2.3.1
Lesson	**2**	**Job schedule**	**2.1.2**	Professional image	2.2.2	Personal responsibility	2.3.2
Lesson	**3**	**Administration**	**2.1.3**	Institutions	2.2.3	Duties / liability	2.3.3
Lesson	**4**	**Personal safety equipment**	**2.1.4**	Health protection	2.2.4	Prevention	2.3.4
Lesson	**5**	**People from third-party comp.**	**2.1.5**	Third-party care	2.2.5	Limit of responsibility	2.3.5
Lesson	**6**	**Operating equipment**	**2.1.6**	Load lifting device calculation	2.2.6	Use of devices	2.3.6
Lesson	**7**	**Slinging techniques**	**2.1.7**	Load techniques	2.2.7	Load transport	2.3.7
Lesson	**8**	**Fuel skills**	**2.1.8**	Use of fuels	2.2.8	Environmental protection	2.3.8
Lesson	**9**	**Use of radio equipment**	**2.1.9**	Communication	2.2.9	Communication techniques	2.3.9
Lesson	**10**	**Helicopter skills**	**2.1.10**	Helicopter physics	2.2.10	Helicopter assignment	2.3.10
Lesson	**11**	**Danger zones**	**2.1.11**	Hazard analysis	2.2.11	Measures	2.3.11
Lesson	**12**	**Flight assignment**	**2.1.12**	Types of assignment	2.2.12	Work assignments	2.3.12
Lesson	**13**	**Flight obstructions**	**2.1.13**	Perception	2.2.13	Reconnaissance	2.3.13
Lesson	**14**	**Emergencies**	**2.1.14**	Human factors	2.2.14	Conflict resolution	2.3.14

APPLY	UNDERSTAND	CARRY OUT

ECONOMY	Lesson	1

Initial situation:

The 1st group of topics, which consists of the development stages **Company skills➔ Market ➔ Economy**, gives an overview of supraordinate company requirements.

In the 3rd part of training, which takes place on the job during the season, marshallers receive additional training. Training checklists should be kept on the material satisfactorily taught and its implementation.

Safety target:

The operating economy of the company must not suffer as a result of unqualified work.

Training target:

The marshaller can
- test the feasibility of an order (on-site)
- recognise and efficiently implement organisational requirements
- prepare loads efficiently

Syllabus:

1 Feasibility
- Is an assignment feasible (personnel, weather, technology, customer, payload, environment)?

2 Planning
- Allocation of personnel, order of cargo flights, refuelling, preparation of cargo flights
- Picking-up and dropping-down sites

3 Decisions
- Based on personal suitability, cargo composition, optimisation of weight and procedures

Material:

Usefuel loads and load lifting devices in flight operations

Suva leaflet 44005 "Safety when transporting lumber by helicopter"

Relevant national laws, directives or standards regarding "Crane transport with cages"

Methodology:

Discussions and samples during an assignment, debriefing after an assignment

Individual study:

Suva leaflet 44005

Relevant national laws, directives or standards regarding "Crane transport with cages"

PERSONAL RESPONSIBILITY — Lesson 2

Initial situation:

The 2nd group of topics, which consists of the development stages **Job schedule ➔Professional image ➔ Personal responsibility**, gives an overview of a marshaller's duties and his/her opportunities for professional development.

In the course of training, marshallers are taught how to work independently by means of training. The topicality of the specification sheet and of the job in the company must be examined and adjusted if necessary. A high level of motivation and a good awareness of responsibility can be achieved by adapting personal requirements to professional requirements.

Safety target:

Measures must be taken to prevent marshaller from being allowed to affect the operating result as a result of non-independent work.

Training target:

The marshaller can
- carry out his/her duties independently
- plan working assignments
- decide on the feasibility of an assignment
- carry out different jobs within the team
- identify with his/her job

Syllabus:

1 Duties and topicality of the job description
- The marshaller can carry out different working assignments on his/her own responsibility
- Test the topicality of the job description. Adaptation to requirements.

2 Assignments
- Planning of (simple) working assignments
- Decisions on feasibility (weather, technology, customer, work preparation)

3 Teamwork
- Carry out job rotation to keep motivation high (construction site, organisation area, technology, etc.)
- Consolidate integration into the team

Material:

Job description, assignment planning, team organisation

Methodology:

Interviews with the marshaller and continual adaptation of the documents.

Individual study:

Job description

Note:

In companies in which no job description for marshallers exists (yet), one must be produced in its basic form at least and made available to the marshaller.

DUTIES / LIABILITY — Lesson 3

Initial situation:

The 3rd group of topics, which consists of the development stages **Administration ➔Institutions ➔Duties/Liability**, gives an overview of the responsibility and legal inclusion of an employee in the working process.

In the course of training, the marshaller must be aware of his/her duties and those of the company as well as his/her liability towards the company.

Safety target:

Behaviour which is contrary to the law must not result in damage (costs, image, legal proceedings) to the employer or employee.

Training target:

The marshaller can
- name the 3 most important laws regarding safety and health
- explain the 4 most important articles of this laws
- describe an employer's and employee's rights and duties
- give reasons for the most significant consequences of a violation

Syllabus:

1 Laws and regulations
- ▶ Offering information on the contents of the relevant national laws regarding safety
- ▶ Explaining relevant national articles in laws for safety

2 Rights and duties, liability
- ▶ Defining the consequences of a marshaller's actions in respect of his/her employer

3 Consequences
- ▶ Financial and organisational consequences
- ▶ Reductions in daily pay, dismissal, prosecution

Material:

Legal bases: relevant national laws, EC-directives

Relevant national laws, directives or standards regarding "Criminal responsibility" and "Which duties... which punishments?"

Methodology:

Briefing, action-based teaching and discussion

Individual study:

Available material

PREVENTION | Lesson 4

Initial situation:

The 4th group of topics, which consists of the development stages **Personal safety equipment ➔Health protection ➔ Prevention**, gives an overview of the direct and indirect measures required to maintain good health and working capabilities.

During the season, the marshaller should be continually instructed and motivated to use the safety equipment provided, to adjust his/her clothing and food to suit relevant requirements and to recognise personal health protection as a holistic and longer-term duty.

Safety target:

The marshaller must use his/her personal safety equipment, have enough time to recover during and between assignments and be able to eat a correct diet, the aim being to provide longer-term health protection.

Training target:

The marshaller can
- use the safety material efficiently and appropriately
- plan dietary requirements
- help to lay out the course of his/her day

Syllabus:

1 Develop the measures into a comprehensive system of prevention
- Wearing personal safety equipment, its care
- Correct clothing

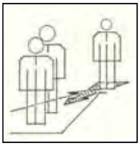
2 Promotion of workplace quality
- Balanced diet and breaks (lunch)
- Job rotation
- Further training
- Dealing with stress
- Effects of addictive drugs (alcoholics: see Perception in Lesson 2.2.13)

Material:

Personal safety equipment (PSE)

Methodology:

Repeat interviews and checks



LIMIT OF RESPONSIBILITY | Lesson | 5

Initial situation:

The 5th group of topics, which consists of the **development stages People from third-party companies ➔Third-party care ➔Limit of responsibility**, gives an overview of the marshaller's overall responsibility towards customers and non-participating third parties.

In the course of training, the marshaller is to be introduced to his/her duties as a group leader by means of repeat training.

Safety target:

Measures must be taken to prevent inappropriate organisation from being allowed to disrupt or interrupt operating procedures, or to endanger people or goods thereby harming the company.

Training target:

The marshaller can
- lead a worksite in such a way that non-participating third parties are not at any risk
- lead a working assignment in such a way that people from third-party companies are not at any risk
- agree on tasks with customers and delegate tasks

Syllabus:

1 Group leadership
- ▶ Leading a group at the worksite under the instruction of an experienced mentor

2 Organising work
- ▶ Organisation of the work group and work allocation
- ▶ Provision of auxiliary and operating equipment for the assignment

3 Delegating tasks to colleagues
- ▶ Agreements with customers / deputies
- ▶ Delegating tasks with due consideration for team interests and capabilities

Material:

Relevant national leaflets regarding "On motivating occupational safety"

Suva leaflet 44005 "Safety when transporting lumber by helicopter"

Methodology:

Team work in mentor style

Exercises:

Group leadership

Individual study:

Relevant national leaflets

USE OF DEVICES	Lesson	6

Initial situation:

The 6th group of topics, which consists of the development stages **Operating equipment ➔Operating equipment calculation ➔Use of devices**, gives an overview of the company materials to be used in flying operations, their formally correct designation and calculation.

During training, marshallers must be continually instructed on the correct use of materials as well as on allocation and use of the concepts and materials.

Safety target:

Measures must be taken to prevent inappropriate materials from being used and thus endangering flying operations.

Training target:

The marshaller can
- plan and also decide on the use of materials in the company
- handle the storage and maintenance of the equipment independently
- correctly label and designate the materials
- identify and assess materials from "non-flying operations"

Syllabus:

1 Use of materials in flying operations
- Which materials for which assignment?

2 Storage, maintenance and repair
- Storage conditions
- Maintenance (cleaning, servicing)
- Repair

3 Designation of the materials
- Concepts and designations, material groups and safety factors
- Labelling according to EN construction regulations

Material:

EN standards, manufacturers' catalogues, national leaflets regarding "Crane transport with cages"

Basic sheets from the syllabus: "Calculating LLD's" as well as "Checklist of flying operation materials"

Methodology:

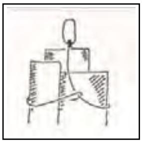
Lesson, briefing, demonstration

Individual study:

EN standards, manufacturers' catalogues

Relevant national leaflets regarding "Crane transport with cages"

Basic sheets of the syllabus, "Load lifting devices" section



LOAD TRANSPORT | Lesson 7

Initial situation:

The 7th group of topics, which consists of the development stages **Slinging techniques ➔ Load techniques➔ Load transport**, gives an overview of the techniques involved in preparing loads.

In the course of training, the marshaller should be confronted with as diverse a range of different loads as possible and be able to prepare these independently with due consideration for load increase factors.

Safety target:

Measures must be taken to prevent danger being caused by inappropriately assembled loads.

Training target:

Marshallers must also be able to prepare more complex loads independently and safely.

Syllabus:

1 Assembling a load

- Assembling loads comprising all available payloads: single loads, multiple loads, light and heavy loads
- Slinging techniques in simple straight lifts or with multiple cables and angle of inclination
- Determining slinging points and safety precautions

2 Calculations

- Calculating load weights, load increase factors (DWD/FSD), loads on LLD's caused by slinging factors
- Calculating possible load increases caused by banking (g-load) and impact

Material:

The payloads encountered in the field

Basic sections of the syllabus: "Calculating load lifting devices", "Loads on the helicopter" as well as "Loads caused by the helicopter"

Methodology:

Practice-related briefing and application

Exercises:

Full calculation of a complex load under highly demanding conditions

Individual study:

Documentation: see "Material"

ENVIRONMENTAL PROTECTION — Lesson 8

Initial situation:

The 8th group of topics consisting of the development stages **Fuel skills ➔ Use of fuels ➔ Environmental protection**, is an overview of fuel topics (hydrocarbons) in daily use.

In the course of training, marshallers must be trained in the safe and clean handling of fuels, particularly when refuelling helicopters.

Safety target:

Measures must be taken to prevent both personal health and the environment from being placed at risk through the use of fuels, exposing the company to damage.

Training target:

The marshaller can
- carry out a quality check on fuels
- use fuels safely and without any environmental pollution
- produce a correct conductive system for electrostatic charges (earthing)
- carry out the most important immediate measures when incidents occur

Syllabus:

1 Quality control
- Repeated fuel checks, in terms of water, dirt, other foreign bodies
- Cleaning contaminated fuels

2 Refuelling
- Calculating filling limits and expansion factors
- Securing refuelling stations

3 Earthing (grounding)
- Production of potential equalisation (conduction of electrostatic charges)

4 Incident management
- Fighting fuel fires
- What to do when leakage is discovered on tanks (ADR material)
- Reporting duty when incidents occur
- Limitation and elimination of environmental contamination

Material:

Relevant national leaflets regarding "Inflammable liquids", Federal law governing environmental protection, regulation governing water protection and the transhipment of liquids hazardous to water

Relevant national leaflets regarding "Rules for the safe operation of mineral-oil tankers"

Methodology:

Continual briefing and practice with monitoring, checks and repetition during the season

Exercises:

Firefighting and handling oil spillages, e.g. during a local fire brigade exercise

Individual study:

Relevant national leaflets

COMMUNICATION TECHNIQUES	Lesson	9

Initial situation:

The 9th group of topics, which consists of the development stages **Use of radio equipment ➔Communication ➔Communication techniques,** gives an overview of the safe use of communication using radio-telephony.

In the course of training, the marshaller will receive continual training in the use of radio-telephony and breathing techniques.

Safety target:

Measures must be taken to prevent radio transmissions from becoming a danger to safety, people from becoming mentally overtaxed and interrupted and unsafe working procedures from being allowed to arise due to badly-used radio language and poor breathing techniques

Training target:

The marshaller can
- use the different skills (information, command language for instructions, code calling, locating)
- control his/her breathing techniques to allow him/her to use a radio in stress situations without any losses in quality

Syllabus:

1 Communication techniques

- Transmission of information, command language for instructions, calling stations using code, locating people or things
- ICAO code, company code
- REGA alarm

2 Breathing techniques

- Breathing techniques in stress situations
- Changes in pronunciation and modulation, acoustic problems in stress situations (audiodiscrimination)

Material:

REGA radio operator handbook, Chapter 3.4 "Communication"

Methodology:

Continual practice during the season: Practising - checking - correcting - techniques

Individual study:

REGA handbook, Chapter 3.4 "Communication"

HELICOPTER ASSIGNMENT | Lesson | 10

Initial situation:

The 10th group of topics, which consists of the development stages **Helicopter skills ➔Helicopter physics ➔Helicopter assignment,** gives an overview of the helicopter as a working tool.

The marshaller is acquainted with and learns how to assess the specific dangers of this working tool on worksites.

Safety target:

Measures must be taken to prevent the aircraft from becoming damaged during use and people or goods/materials being exposed to danger.

Training target:

The marshaller can
- estimate the specific dangers of a helicopter assignment
- assess the approach distances to be used
- take the required measures

Syllabus:

1 Approaching and departing flights with loads
- Assessment of approach and departing routes to worksites with and without loads
- Assessment of wind conditions on exposed worksites
- Assessment of lighting conditions for approach flights to worksites in open country

2 Approaching unknown objects and bringing a helicopter up to such objects
- Use in restricted military areas
- Use of several helicopters
- Use in airfield traffic areas and in conjunction with hang-glider activities, glider activities
- Approaching objects with the helicopter when picking up loads
- Seeing / perceiving / recognising (see Lesson 2.2.13)

Material:

Helicopter assignments

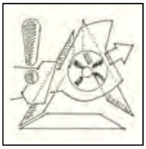
Methodology:

Personal, supervised practice following on-site briefing, particularly in the mentor phase in the first 3 months

Exercises:

Wind measurement (subjectively) and determination of wind directions

Estimating distances in open country



MEASURES and AUDIT | Lesson 11

Initial situation:

The 11th group of topics, which consists of the development stages **Danger zones ➔ Hazard analysis ➔ Audit and Measures,** provides an overview of the external factors when working with helicopters (the human factors are dealt with in lesson 14, parts 2 and 3).

During the training, the marshaller should repeatedly assess specific problems (constructs) by means of a simple hazard analysis, take appropriate measures and check their efficacy.

Safety target:

Measures must be taken to prevent people or equipment from failing under high levels of stress, thereby resulting in damage.

Training target:

The marshaller* can
- on the basis of the hazard analysis, check the efficacy of the adopted measures
- take and apply simple but efficient measures
- confer with manufacturers or certification bodies
- perform an audit and evaluate the consequences of events

* or the person filling the position of "Safety Officer" / "Responsible for Safety" within the company

Syllabus:

1 Taking measures
- Developing and assessing new techniques (constructs, safety, responsibility)

2 Assessing the effectiveness
- Check the practical efficacy of adopted measures, judge them critically and, if there are any weak points, correct them
- Taking action in response to failure or inadequacy

3 Reference sources
- Consultation with offices inside the company (CFO, CHPL, PIC, CM etc.)
- Consultation with certification bodies (in the case of more complex problems before starting any modification)

4 Internal audit - external audit
- Assessment of goals, planning, organisation and conduction of an audit
- Analysis of an audit’s results
- Verification of pre-existing measures, strategy and consultation regarding new measures, practical adoption

Material:

Relevant national laws, directives or leaflets regarding the topics
- "Hazard analysis" and "Risk analysis" und "Safety: an operational analysis"

Internal reporting systems

Methodology:

Basic course, collaboration with an expert on occupational health and safety

Exercises:

Performing a comprehensive hazard analysis of a piece of equipment used in flying operations (call in specialists)

WORK ASSIGNMENTS | Lesson 12

Initial situation:

The 12th group of topics, which consists of the development stages **Flight assignments ➔Types of assignment ➔Work assignments,** gives an overview of the wide range of demanding types of assignment which can be flown with a helicopter.

Marshallers learn the limits of helicopter assignments and can differentiate between customers' demands and the feasibility of operations.

Safety target:

The aim is to prevent damage resulting from an ignorance of assignment possibilities and a disregard for elementary basics.

Training target:

The marshaller can - participate in each assignment and work free of danger
- successfully combine customers' interests and safety requirements

Syllabus:

1 What can be flown - what cannot be flown - why can it not be flown?

- Flyable loads (weight too low, slinging points, fuel reserves, etc.)
- Unflyable loads (too heavy, too light, no slinging points, turning, tilting, etc.)

2 Weighing up customers' demands and the interests of safety

- Customers' demands - customers' requirements - pressure from customers - Meteo
- Solutions in the interest of the customer and the flying company

Material:

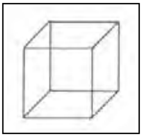
Helicopter performance table, AOM, AFM,

Methodology:

Exchange of experience between pilots - marshallers - mechanics, which helps the 3 professional jobs to carry out a joint problem-solving process (teamwork)

Individual study:

Helicopter performance table, basic sheets "Loads on load lifting devices" and "Loads caused by the helicopter"



RECONNAISSANCE | Lesson 13

Initial situation:

The 13th group of topics, which consists of the development stages **Flight obstructions ➔ Perception ➔Reconnaissance,** gives an overview of the aspect of human perception, its influence and the implementation of sensory impressions at the planning stage.

In the course of training, the marshaller learns how to put together reconnaissance reports which provide direct information for use in flying operations.

Safety target:

Measures must be taken to prevent avoidable hazards from being allowed to occur during a helicopter assignment as a result of unqualified reconnaissance.

Training target:

Marshallers can critically examine their perceptions and note them down correctly in their reconnaissance reports as well as on maps and plans or record them comprehensibly for users.

Syllabus:

1 Data acquisition

- Determining worksites - registering hazards
- Looking for and noting obstructions or hazards
- Ascertaining obstructions by asking people
- Assess obstructions against light/shadow
- Determining distances from obstructions and minimum flying altitudes including safe distances

2 Map entries

- Symbols (official and company-own)
- Entry and marking in maps / problem of map copies
- Selection of data

Material:

Reconnaissance forms / maps / plans, basic sheet "Limits of helicopter operation"

Methodology:

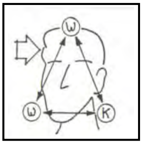
Continual briefing

Exercises:

Production of reconnaissance maps, carrying out reconnaissance with assistance

Individual study:

Map symbols, samples, basic sheet "Limits of helicopter operation"



CONFLICT RESOLUTION | Lesson 14

Initial situation:

The 14th topic group, consisting of the development steps **Emergencies ➔ Human factors ➔Conflict resolution,** gives a (restricted) overview of interpersonal aspects.

The marshaller learns how to deal with problems and conflicts factually. He/she sees company management as people he/she can trust and discusses matters in the interest of efficient, safe teamwork.

Safety target:

Team confidence must not be eroded by illegal activities, quarrels, mobbing, etc. which could harm people or the company.

Training target:

The marshaller knows the person he/she is talking to and sees himself as part of a company culture to which everybody contributes. A culture of discussion and conflict resolutions promote the success and reputation of the company.

Syllabus:

1 Objectivising areas of conflict

- Objectivising, factualisation of areas of conflict
- Differentiating between factual and relational problems

2 The culture of discussion

- Maintaining a culture of discussion
- Importance of mutual recognition
- Allowing other opinions
- Working out conflicts / handling communication
- Bearing responsibility
- Giving reasons and producing alternative suggestions

3 People one can trust

- Calling in a person one can trust, advantage - sense - purpose

Material:

Job description

Methodology:

Conducting conversations

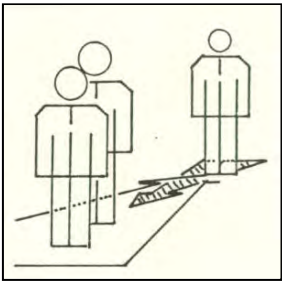
Exercises:

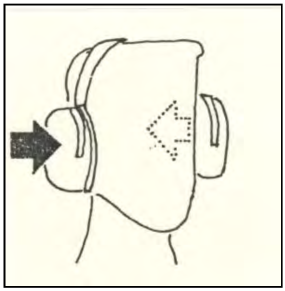
Analysing possible quarrels; what can be determined objectively, what are more feelings and emotions

Individual study:

Talk "Risk - safety - behaviour"

2.4





Training check

LIST OF TRAINING REPORTS

The individual training reports can be created by means of the Software "Training Check 2.4" and filed in this register, according to the sequence of the lessons. After having printed and filed a training report, check with an X or insert a date code (e.g. 06/04) in columns "2.1 - a)", "2.2 - b)" or "2.3 - c)".

Lesson	Training report	Part of training	2.1	2.2	2.3
		Training level	**a)**	**b)**	**c)**
All	**Company report** (printout, to be updated when necessary)				
Lesson 1	**Company and employer** Company skills, market, economy				
Lesson 2	**Marshalling duties, development** Job schedule, professional image, personal responsibility				
Lesson 3	**Administration and legal obligation** Administration, institutions, duties, liability				
Lesson 4	**Maintenance of health and fitness for work** Personal safety equipment, health protection, prevention				
Lesson 5	**Responsibility to customers and third parties** People from third-party companies, third-party care, limit of responsibility.				
Lesson 6	**Operating equipment, calculation and application** Operating equipment, load lifting device calculation, use of devices				
Lesson 7	**Load preparation techniques** Slinging techniques, load techniques, load transport				
Lesson 8	**Fuel and the environment** Fuel skills, use of fuels, environmental protection				
Lesson 9	**Communication and radio-telephony** Use of radio equipment, communication, communication techniques				
Lesson 10	**The helicopter as a working tool** Helicopter skills, helicopter physics, helicopter assignment				
Lesson 11	**Recognising and analysing hazards** Danger zones, hazard analysis, measures				
Lesson 12	**Helicopter aerial work** Flight assignments, types of assignments, work assignments				
Lesson 13	**Risk - Safety - Behaviour** Flight obstructions, perception, reconaissance				
Lesson 14	**Emergencies / Behaviour and cooperation** Emergencies, human factors, conflict resolution				
Options	**Lessons organised by the company**				
Lesson 15					
Lesson 16					
Lesson 17					
Lesson 18					
Lesson 19					
Lesson 20					

Complete the list with course certificates issued by other institutions and/or companies.

Software "Training check" (FH-SY_AK)

The FH-SY.NET software can be downloaded free of charge from the website

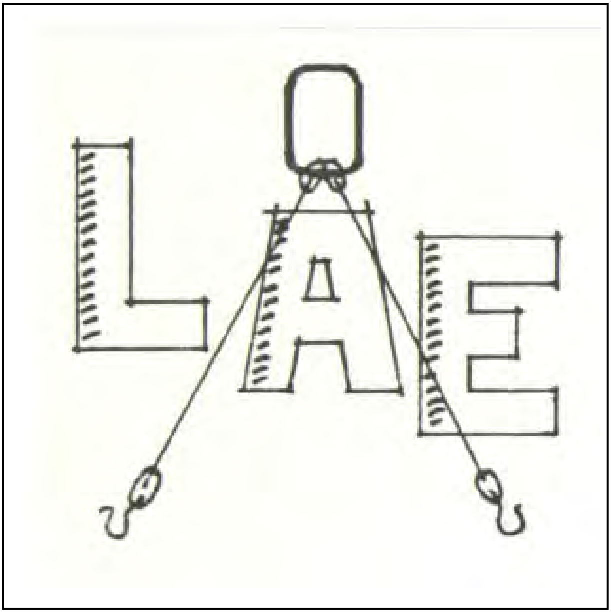
www.heli-syllabus.org, menu item "Control"

where you will also find other information, such as the installation instructions.

In case you should be asked to enter a licence key, please contact:
- info@heli-syllabus.org or
- ++41 +41 420 49 64

Updates will be done automatically. On every opening of the software, the programme will check if a new version is ready to download. Obviously, this will happen only if you are using a desktop computer or a laptop with an internet connection.

Part 3



Appendices

CONTENT Page

MARSHALLER-SYLLABUS

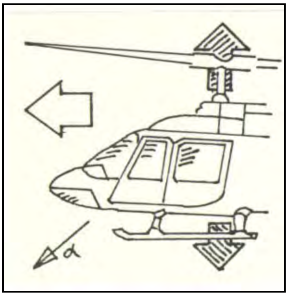
3.6 COURSE MATERIALS 3.6

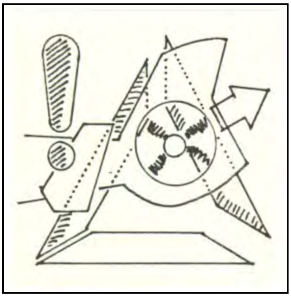
- Register for exercise sheets accompanying course

- Register for exercise sheets accompanying course 3.6.0

The lesson and exercise sheets are distributed only during the courses.

3.1





Helicopter & Assignment

(JAR-OPS 3 + 4)

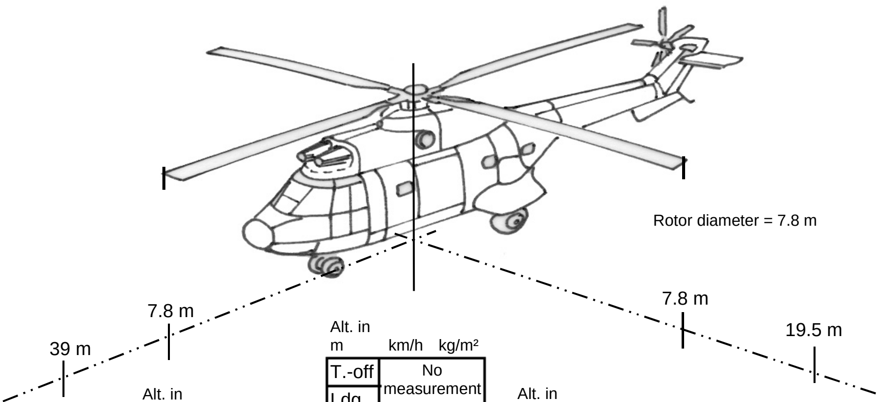
LOADS CAUSED BY THE HELICOPTER

Load increase in kg caused by down wash (AS 332c SuperPuma)

All values listed in km/h and kg were worked out in a field test and have no scientific character.

These values refer to a flat surface of one square meter (1 m²), located at right angles with the airflow. In the case of inclined or round surfaces the values may substantially decrease; in the case of hollow parts which are open at the top the values may significantly increase (backward pressure).

The measurements were performed at max. take-off weight (> 9000 kg) with an external load at various hovering altitudes.



Alt. in m	km/h	kg/m²
T.-off	40	8.5*
Ldg	20	2
10	38	7.5
20	22	2.5
30	38	7.5
50	25	3.5

Alt. in m	km/h	kg/m²
T.-off	75.5	30
Ldg	81	35
10	92	44.5
20	83	36.5
30	72	27.5
50	72	27.5

Alt. in m	km/h	kg/m²
T.-off	No measurement	
Ldg		
10	29.5	4.5
20	43	10
30	25	3.5
50	23.5	3

Alt. in m	km/h	kg/m²
T.-off	50.5	13.5
Ldg	90	43
10	65	22
20	83	36.5
30	75.5	30
50	79	33

Alt. in m	km/h	kg/m²
T.-off	75.5	30
Ldg	86.5	39.5
10	79	33
20	84.5	38
30	86.5	39.5
50	86.5	39.5

All values rounded

All values in kg (load increase factor) apply per square meter surface.

The total load increase results from the multiplication of the surface (in m²) with the load increase factor (in kg), e.g. the surface of a container:

Assumption: Surface of 6 m², at a load increase factor of 40 kg:

Result: 6 x 40 = **240 kg** load increase.

Calculation formula

Impact pressure values are calculated in m/s:

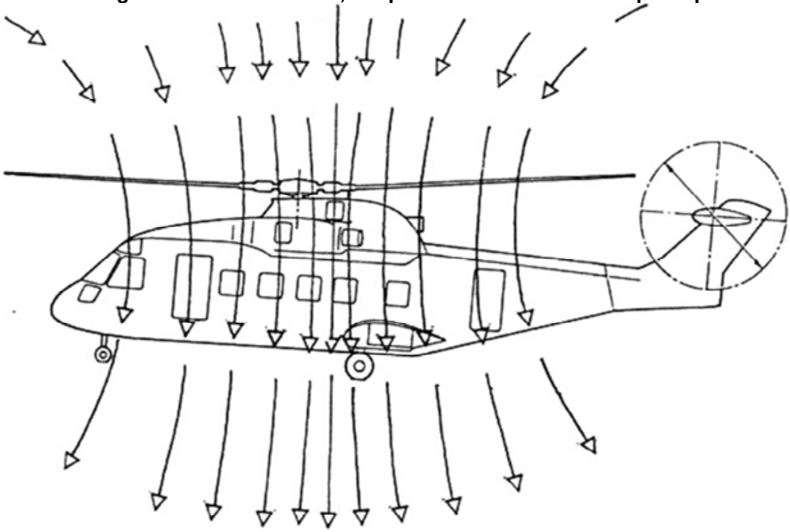
W = km/h : 3.6 = m/s — W = 40 km/h : 3.6 = 11.11 m/s

$Pw = cw \cdot \rho : 2 \cdot w^2 \cdot A : g = kg$ — $Pw = 1.1 \cdot 1.225 : 2 \cdot 11.11^2 \cdot 1 : 9.81 = 8.5$ kg

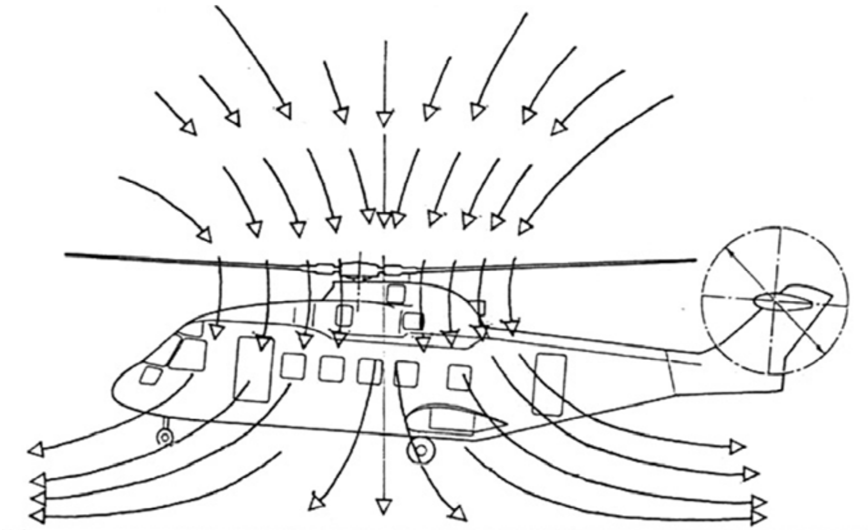
Symbols and assumptions: Load on surface Pw = [kg]; Drag coefficient cw = 1.1 [-]; Standard atmosphere (Rho) p = 1.225 [kg/m³]; Wind speed squared W = [m/s]; Surface hit by air stream A = [m²]; Acceleration due to gravity g = 9.81 [m/s²]

LOADS CAUSED BY THE HELICOPTER

Rotor down wash out of ground effect
Hover out of ground effect = HOGE, simplified illustration of the principle



Rotor down wash - hover in ground effect = HIGE



LOADS ON THE HELICOPTER

Load increase caused by forward speed drag

The load increase caused by FSD does not act in the same way as DWD. The starting point for the following calculation and illustration is the drag measured (D) and the mass (m) of the load.

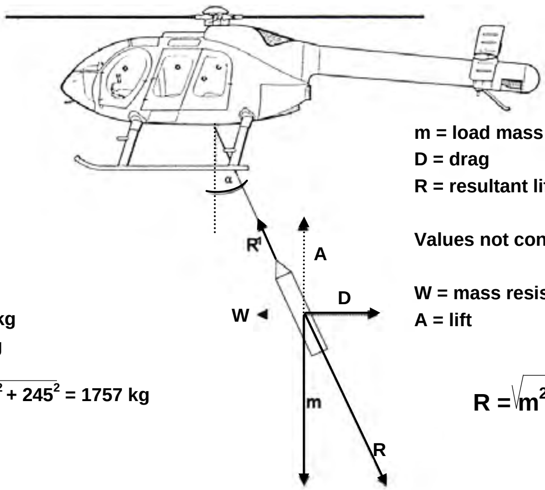
FSD (as well as DWD) are heavily dependent on the surface and the shape of loads

Assumption

D is the product of:

49 kg/m^2 x 5m^2 surface

49 x 5 = 245 kg



m = load mass

D = drag

R = resultant lifting power

Values not considered:

W = mass resistance

A = lift

Example: **m = 1740 kg**

D = 245 kg

$$R = \sqrt{1740^2 + 245^2} = 1757 \text{ kg}$$

$$R = \sqrt{m^2 + D^2}$$

The increase in load (ignoring values A, W and R^1) amounts to only 17 kg!

Reduction in increased load

Given normal loads without any particular working surfaces, FSD is unimportant where load increase is concerned. FSD can be reduced by lowering forward speed.

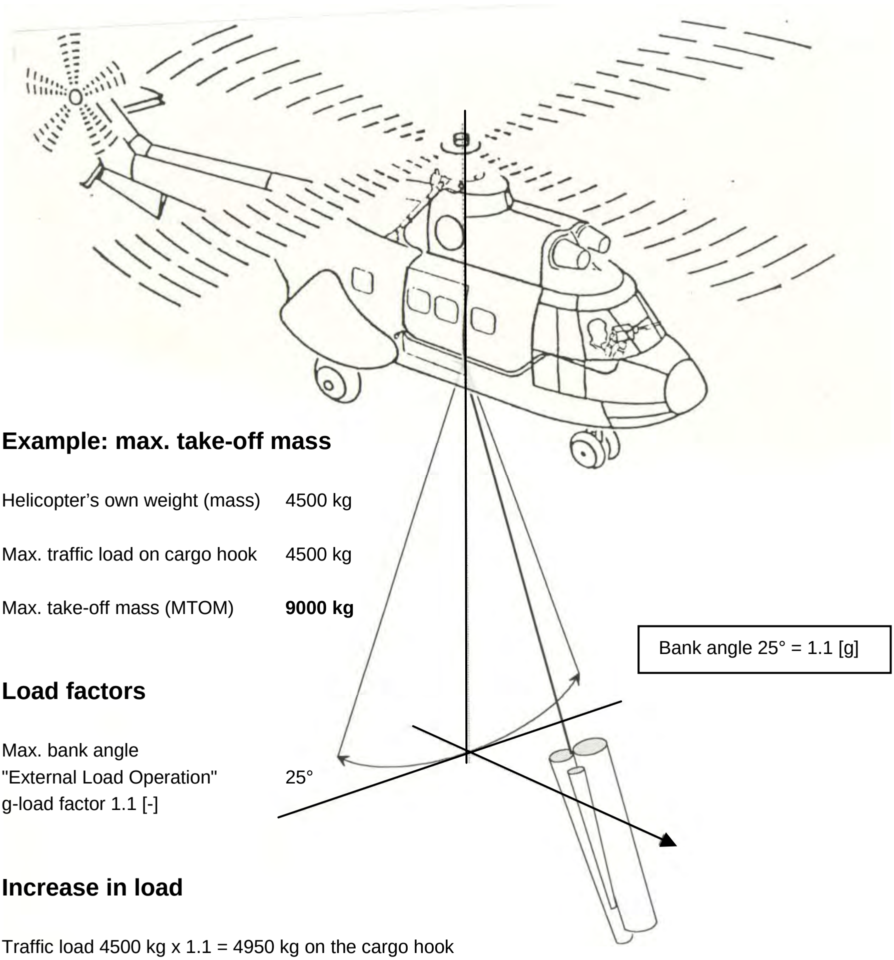
From approx. 30 km/h or approx 8 m/s, DWD is however unimportant. During acceleration phases, e.g. as a result of bank angle, FSD can be linked to the g-load.

All data is empirical and has no scientific character.

FORCES IMPOSED UPON THE HELICOPTER

Load increase (g-load) caused by bank angle

Example AS 332 c



Example: max. take-off mass

Helicopter's own weight (mass)	4500 kg
Max. traffic load on cargo hook	4500 kg
Max. take-off mass (MTOM)	**9000 kg**

Load factors

Max. bank angle
"External Load Operation" 25°
g-load factor 1.1 [-]

Increase in load

Traffic load 4500 kg x 1.1 = 4950 kg on the cargo hook

or

MTOM 9000 kg x 1.1 = 9900 kg on the rotor system

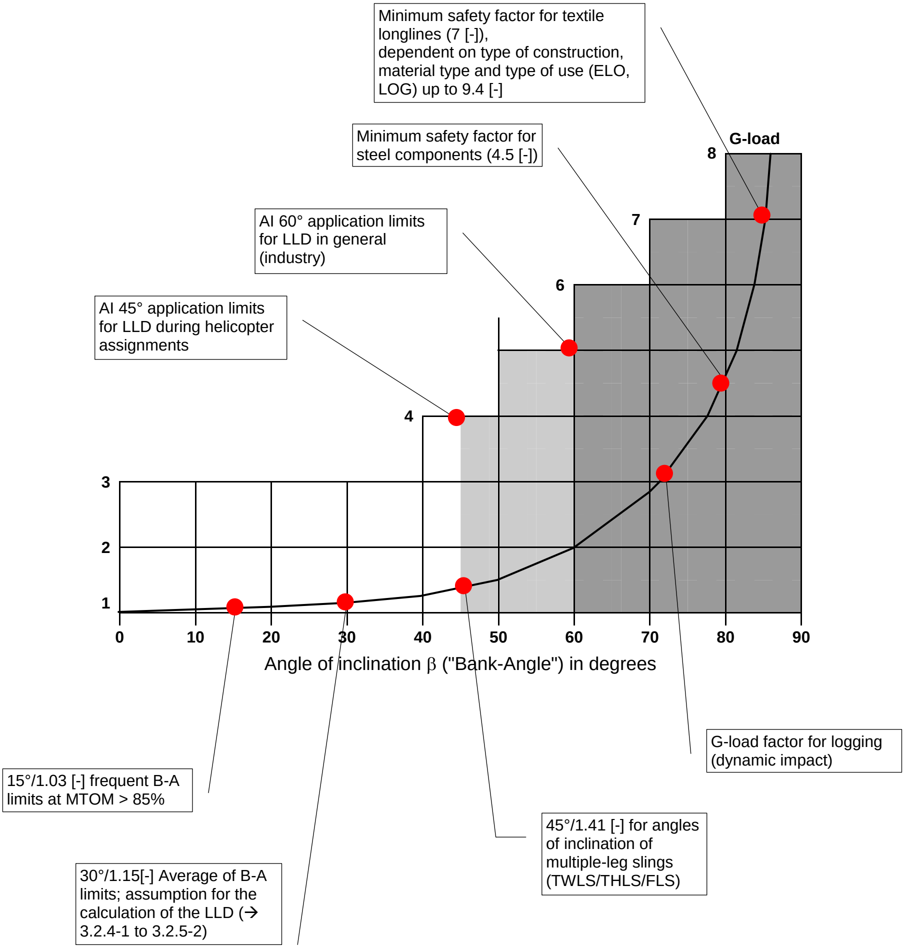
MTOM = Maximum Take Off Mass

FORCES IMPOSED UPON THE HELICOPTER (AND THE LLD)
Diagram "Load factor" - limitations - safety factors

This diagram shows the increase in the centrifugal force (G-load) caused by an increase in inclination during spiralling, by oscillating movements of the load or when the slinging device is particularly inclined (multiple-leg sling).

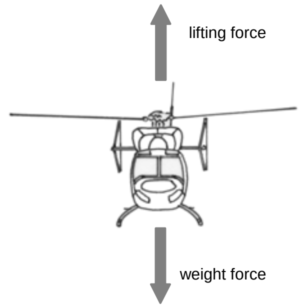
The increase in the force imposed upon the helicopter cabin, upon the load and upon the load lifting devices has a causal connexion with the pilot's flight behaviour. This means, that the pilot's flight behaviour has an important influence on the forces imposed upon the slinging devices, upon the longlines and upon the load.

This diagram shows the most common (typical) limitations. Load collectives are not considered.



Flying within the permitted flight parameters = working within the permitted slinging parameters

FORCES IMPOSED UPON THE HELICOPTER (AND LLD)
Effect of the angle of inclination β (Bank-Angle) on flight behaviour



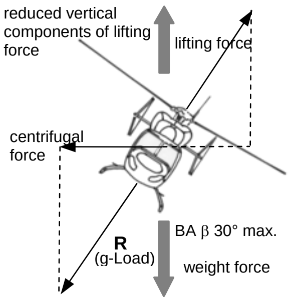
A

Figure A

Lifting force and weight force are equivalent.

During assembly work, a reserve of 10 - 15% must be taken into account; for passenger transportation it amounts to 20%.

Power reserve is achieved by attaching less weight to the hook!

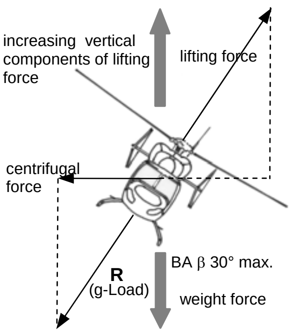


B

Figure B

A and B show an equivalent "Collective Pitch" / "Power Setting". When the “load factor” (G-load) increases, the lifting force is reduced in proportion to the weight or to the resulting weight force (R).

The aircraft will descend.



C

Figure C

When the "Collective Pitch" / "Power Setting" increases, the lifting force will be equivalent to or greater than the weight force (R).

The aircraft will fly horizontally or ascend.

Note: Formulas for calculating LLD can be found on pages 3.2.4-1 to 3.2.5-2

HELICOPTER STRUCTURE LIMITS

Table of recommended values: external load

Bank angle limitations											
BA[1] [-]	KAMOV KA-32[3]	AS 332c mk II	Bell[2] 214	AS 330J	KAMAN 1200	Bell[2] 412	AS 350B2	SA 315b	SA 316b	Bell[2] 206 J-R	g-load [g]
74°[4]	Demands made on design in accordance to FAR 27/29 = 3.5 [g]										3.5
--											--
--											--
66.5°											2.51
63°											2.2026
60°											2
45°											1.4142
40°											1.3054
35°											1.2207
30°											1.1547
25°											1.1033
20°											1.0641
15°											1.0352
10°											1.0154
5°											1.0038
	5000 kg	4500 kg	3629 kg	3230 kg	2700 kg	2041 kg	1160 kg	1166 kg	750 kg	680 kg	
	Max. external load on cargo hook[5]										

Example: SA 315b LAMA = 1066 kg x 1.15 g (30° B-A) = <u>1346 kg max. permissible load with external load</u>
(load weight x g-load = overall load).

In normal operation without an external load: Dependent on the type-specific features (see AFM's). Operation with external loads is not permissible in this area.

With an external load: Special limitations when a defined load on the primary lifting hook or other parameters are exceeded (see AFM's).

Max. external load on cargo hook, permissible up to the BA limitation given.

Explanations

1) According the list in "Rotor&Wing" /July 1994 or information supplied by operators (Suva survey in autumn 1994); conversion factor from lbs into kg = 0.46.
2) No data are BELL HELICOPTER B-A; recommendation: values 20°/1.06 [g] should not be exceeded.
3) No certification according to FAR (status March 1996).
4) 3.5 [g] corresponds to a bank of approx 74° (3.64 = 74°); this bank is not provided for in normal operation, but only listed here for the sake of completeness within the column.
5) The values in this line may also be dependent on the lifting hook system or other helicopter configurations and deviate substantially.

All data is typical.

All values may vary from machine to machine and are dependent on equipment and intended assignment.

HELICOPTER STRUCTURE LIMITS

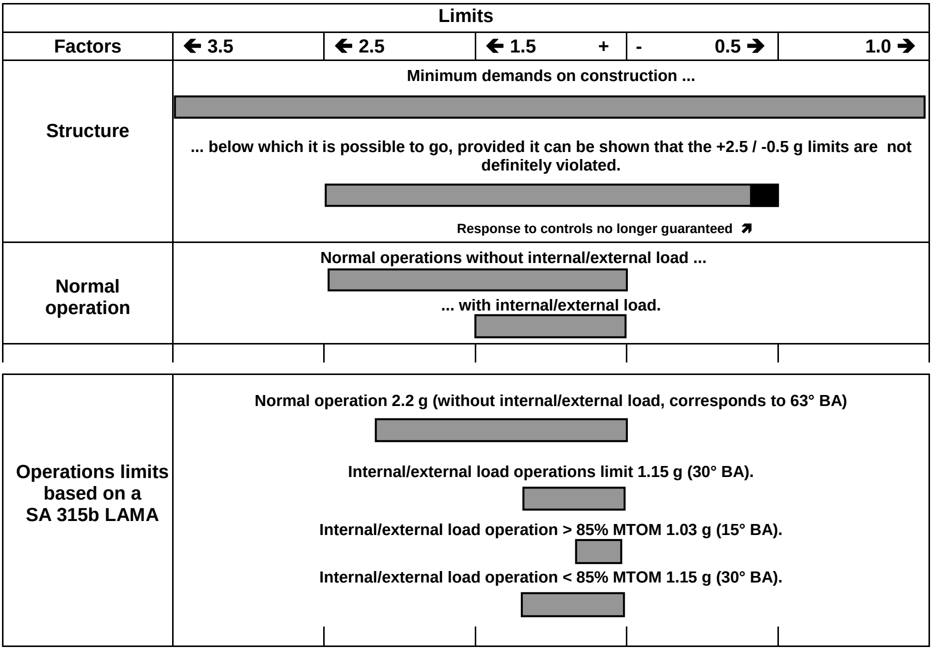
g-load limitations

g-load / bank angle					
For the following helicopter types, the limits in the AFM are defined as follows:					
HELICOPTER TYPE	**CONSTRUCTI ON LIMIT OF BREAK**	**NORMAL OPS. MAX. (no load)**	**External load limit**	**External load > 85% MTOM**	**External load < 85% MTOM**
SA 315b Lama	3.64 g	2.2 g / 63°	1.15 g / 30°	1.03 g / 15°	1.15 g / 30°
SA 316b Alouette III	3.64 g	2.2 g / 63°	1.15 g / 30°	1.03 g / 15°	1.15 g / 30°
SA 316b Alouette MIL	3.64 g	2.0 g / 60°	1.15 g / 30°	1.03 g / 15°	1.15 g / 30°
AS 332c Super Puma	3.64 g	2.51 g / 67°	1.11 g / 25°	1.1 g / 25°	1.30 g / 40°
AS 332 MK SP MIL	3.64 g	2.51 g / 67°	1.11 g / 25°	1.1 g / 25°	1.30 g / 40°

The values listed are only examples. Refer to the AFM / AOM for helicopter-specific data.

Wind gusts must be taken into consideration with +/- 0.5 to 0.8 g (additional value).

Graphic depiction of the design and operation factors in acc. to FAR 29



Explanation

The comparison between structure and normal operation shows the safety margins between construction and mission as provided for by FAR / JAR regulations, Part. 27/29.

A comparison with the specific data of the SA 315b LAMA shows that the scheduled margins were kept higher by the manufacturer.

HELICOPTER OPERATIONS LIMITS

Minimum altitudes

Altitudes / Distances from obstructions				
Minimum altitudes	**Over built-up areas**	**Outside built-up areas**	**Obstructions (civil operation)**	**Obstructions (mil. Operation)**
Metres above ground	**300 m**	**150 m**	**60 m**	**50 m**
Feet	**1000 ft**	**500 ft**	**200 ft**	**150 ft**

➔Aerial work with helicopters generally takes place below the legal minimum altitudes of 150m/500ft and is based on special permission granted by the FOCA.

Perception of obstructions is considerably affected by external factors. For example, this includes vision (lighting conditions, weather), the type of ground (vegetation, shape) and the type and extent of the obstructions (hay transport cableway, power lines) as well as physical and mental states (fatigue, stress, "go home" effect, etc.).

Power reserve when working in aerial work, hovering: HOGE!

Power reserve, independent of the helicopter type (recommendation)	
TYPE OF ASSIGNMENT	**POWER RESERVE**
PAX, VIP / general transportation	**5 %**
Ground erection jobs	**10 %**
Hovering erection jobs	**10 %**
Hazardous goods	**10 %**
People transport operations on the lifting hook (rescues only)	**20 % ***
Rescue flights (winch) / recovery flights (rescue platform)	**20 % ***

➔The perfect hovering out of ground effect (OGE) with the possibility of being able to climb at any time without exceeding operating parameters must be guaranteed with the application of current local circumstances (pressure altitude, meteorology, etc.). Please refer to the performance table in the AFM of the relevant helicopter.

* Explanation

Power reserve is largely determined by the possible hazards which can influence a person. One essential indicator which can be used to determine risks is the **type and duration of a person's exposure to the hazard**. The extent of the risk is based on the calculation of the **probability** of its occurring multiplied by the possible **consequences** of it occurring.

For example, even with substantially higher exposure time, a person inside a helicopter is less endangered due to the protection offered by the cell and many other factors than a person who is being transported unprotected outside the helicopter. In this case, it is essential to keep **exposure time** as short as possible. With a corresponding **power reserve**, one can protect oneself against further unpredictable influences.

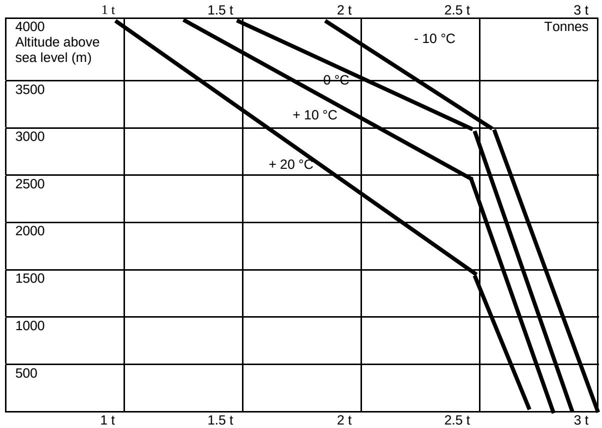
PERFORMANCE PROFILE

Performance table

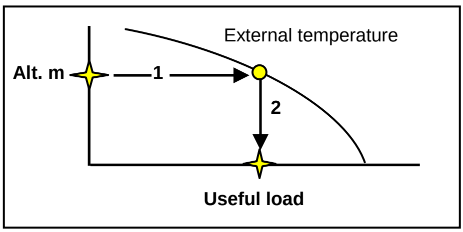
Performance calculation (maximum load), dependent on pressure altitude, temperature, power reserve, wind etc.

Affix the performance table of your helicopter type here

Example:



Reading off the values:



FUELS
Characteristics of fuels

Characteristics						**Changes**		**Hazard**		
Product	**UN No.**	**Class Hazard class**	**Flash point in °C**	**Boiling point in °C**	**Density at 20°C**	**Change in volume in $^0/_{00}$ per 1°C**	**Max. filling level in %**	**EX zone 1**	**EX zone 2**	**Risk**
Kerosene	1223	ADR 3.1a, 30	21 - 55	can be volatile	0.790	0.86	97			66
AVGAS 100	1203	ADR 3.3, 33	< 21	< 65	0.690	1.21	96			120
Benzine 95, 98	1203	ADR 3.3, 33	< 23	65 - 150	0.725	1.25	95			120

Volume calculation
(Organisational measure to avoid spilling and evaporation of hydrocarbons and bursting of tanks).

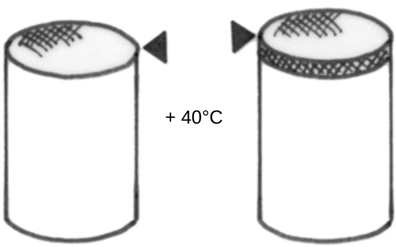
Sample calculation:
Expansion of kerosene (JET-A1), 200 L barrel, direct sun light, temperature difference ($T_{Diff.}$) 40°C

$Vol_+ = Vol ‰ \cdot T_{Diff.} \cdot Vol_{Barrel} : 1000 = \underline{Litres}$ $\quad$ $\%_+ = Vol_+ \cdot 100 : Vol_{Barrel} = \underline{Vol\ \%}$

$Vol_+ = 0.86 \cdot 40 \cdot 200 :1000 = \underline{6.88\ Litres}$ $\quad$ $\%_+ = 6.88 \cdot 100 : 200 = \underline{3.44\%}$

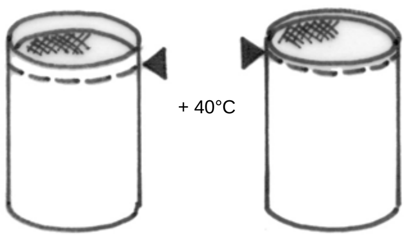
In a 200 litre barrel and at a temperature difference of 40°C, the expansion amounts to 6.88 litres or 3.44%

1st example: 100% full



200 L, 15°C + 6.88 L **~207 L, 55°C**
100 % + 3.44% **103.44 %**

2nd example: 94% full



188 L, 15°C + 6.46 l **~194.5 L, 55 °C**
94 % + 3.23% **97.23 %**

1st example: Risk of bursting! When opening the barrel, kerosene will spurt out at high pressure.

2nd example: Low risk of explosion. When opened cautiously, the gas pressure will escape.

Vaporised kerosene and other vapours can ignite in the presence of open fire. Risk of explosion.

Hot-Refuelling (see also JAR-OPS 3.305)

Hot-Refuelling (refuelling with running engines) is a normal procedure with turbine helicopters (kerosene JET-A1) and usually quite unproblematic. Prior to refuelling, make sure that potential equalisation is established by means of the grounding cable and avoid pointing the fuel nozzle in the direction of the engine bay.

Hot-Refuelling with AVGAS 100 must be avoided at all times, due to its extremely high risk of explosion. A hot engine (recently switched-off) is enough to cause it to ignite.

FUELS

Grounding and potential equalisation

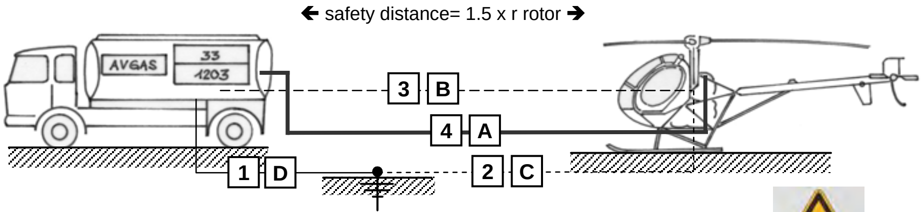
(Technical and organisational measure to avoid sparks, explosions and electric shocks)

AVGAS 100: Correct procedure for providing grounding and potential equalisation

Due to its low flash point (<21°C), AVGAS is highly inflammable; hence, handling it is extremely dangerous. Fuelling and defuelling of piston engine helicopters by means of fast and mobile fuel stations must be performed only after having established a perfect grounding:

1. Connect the tank vehicle/container to the grounding point (grounding by means of a grounding spike)
2. Connect the helicopter to the same grounding point (spike) in order to ensure potential equalisation.
3. Connect the grounding cable of the tank vehicle* with the helicopter in order to ensure potential equalisation.
4. Unroll/elongate the hose, open the tank, insert the filler neck into the tank and refuel.

The distances between the grounding point (spike) - the vehicle - the helicopter should be as close as possible.



< 21°C = R 120

Correct procedure for removing grounding and potential equalisation

A. Remove the filler neck, close the tank, coil up the hose.

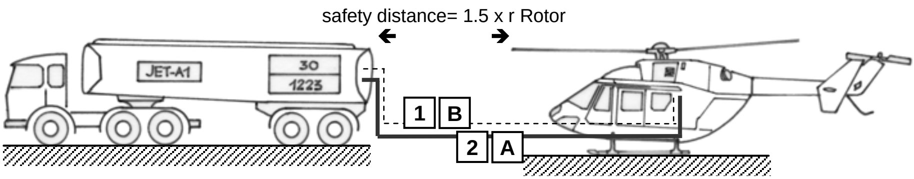
B. Remove the grounding cable between helicopter - vehicle and coil it up.

C. + D Neutralisation of the grounding (1) + (2).

Kerosene: Simplified procedure for providing potential equalisation

Similar to Diesel, Kerosene has a low degree of inflammability. Hence, providing there is good air ventilation, the formation of explosive air/gas mixtures is very improbable. Nevertheless, high potential differences or high tension differences can produce energetic sparks.

1. Connect the helicopter directly to the vehicle's grounding cable* so that equalisation will be ensured.
2. Unroll/elongate the hose, open the tank, insert the filler neck into the tank and refuel.



Correct procedure for removing grounding and potential equalisation

A. Remove the filler neck, close the tank, coil up the hose.

B. Remove the grounding cable between helicopter - vehicle and coil it up.

> 21°C = R 66

PS: On hard surfaces (TARMAC), grounding can be established on drain pipes/gutter grates (water outlets) or on manhole covers.

* Note: Normally, 3 and 4 are protected by the conductivity of the tank hose (resistance $<10^6$ Ohm). Prior to refuelling, make sure that the grounding cable is connected to the fuel nozzle!

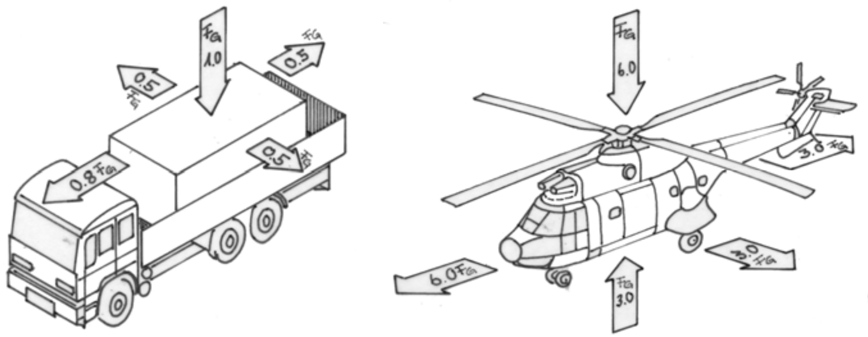
LOAD SECURING

When dealing with load securing, some notions of physics and mathematics are indispensable. In order to efficiently secure a load, the person in charge must be knowledgeable of some basic concepts regarding inertia, friction and securing forces.

The following details refer exclusively to load securing by ”tie-down lashing”.

Forces

During acceleration, deceleration (starting/slowing down) or when driving round bends, forces emerge that act upon the load on a freight vehicle. Hence, the load must be secured against such forces. If the load is not properly secured, it will slip, causing damage to the vehicle’s superstructure or it will fall off the cargo area, considerably endangering objects or third parties.

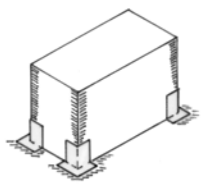


F_G indicates the weight force; 0.8 F_G = mass forces resulting from the load

Analogously, this also applies to helicopter transported cargo. In this case, the expected forces are even greater and, furthermore, they also act in a downward direction. Calculations are always made on the basis of the maximum force expected during a hard landing, in order to prevent the crew and the passengers from being endangered by the cargo. For the forces and loads allowed, for the load distribution and for the strength of the slinging points, please consult the relevant "Aircraft Flight Manual" (AFM).

Form-fit securing of loads on vehicles

The safest method to avoid cargo slipping, is **form-fit load securing**. It can be achieved, for example, by fixing angle profiles to the vehicle’s superstructure and the chassis. In this case, the additional use of tie-down straps helps prevent any tilting or oscillation (”bouncing“) of the load.



Please note:
- Angle irons should be calculated and/or fixed by authorised workshops or technicians (positioning of slinging points, calculation of breaking strength, shearing forces, etc.)
- The front wall of a vehicle’s superstructure may be constructed specifically to enable form-fit load securing! Consult your freight vehicle specialist for confirmation of the specific characteristics.

In case form-fit load securing is not possible, cargo slipping can be avoided by adopting the method of **force-fit** load securing with **tie-down straps**.

LOAD SECURING

A short explanation of acting forces

Note: All symbols and units are explained on page 7

0. Force, Newton, deca-Newton and kilo-Newton

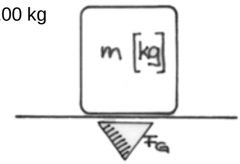
Whenever a change in velocity or direction occurs, forces (F) are produced that act upon the load. The entity of these forces depends on both the load's mass (m) and on the acceleration or deceleration values (a).

- $F = m \cdot a$ or $F = kg \cdot m/s^2$ in N

Newton (N) is the standard unit of force (F) - 100 kilograms correspond to 981 Newton of force	**Calculate ($kg \cdot m/s^2 = N$):** $kg \cdot 9.81 \cong N$
A deca-Newton is the decuple of one Newton (deca = ten) - 100 kilograms correspond to **981 N ÷ 10 = 98.1 DaN**	$kg \cdot 0.981 \cong DaN$
A kilo-Newton is a thousandfold of one Newton (kilo = thousand) - 100 kilograms correspond to 981 N ÷ 1000 = 0.981 kN	$kg \cdot 0.00981 \cong kN$

Note:

- Since all forces are indicated in DaN on tie-down straps, the following calculations are carried out in DaN.
- When making approximate calculations, DaN can be compared to kg: 98 DaN ≅ 100 kg
- In order to convert N into DaN, the N-value must be divided by 10



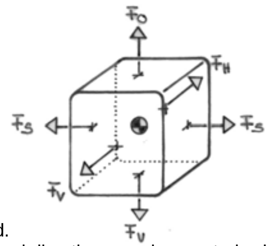
1. Weight force F_G

Weight force F_G indicates the force of gravity acting upon an object. It is always directed downward. Weight force is the product of the mass of a body (m) and the acceleration due to gravity (g):

$F_G = m \cdot g \div 10$ in DaN

Note: At identical mass values, weight force F_G remains unvaried.

2. Mass force F



Mass force is generated by the mass' tendency to "resist" any change in motion. This inertia force acts in the opposite direction of the motion, i.e. when accelerating it acts backwards, when decelerating forwards and when rounding bends laterally.

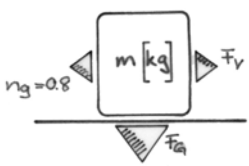
At full braking, deceleration values around 8 m/s^2 or 0.8 g can be reached. Irrespective of the prior velocity, these values only appear shortly before the vehicle comes to a stop. When starting to drive or when rounding bends, acceleration values of 5m/s^2 or 0.5 g must be expected.

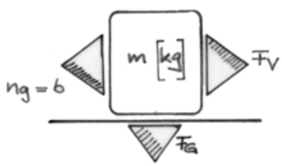
As regards helicopters, much higher acceleration values must be considered. During a hard landing, values of ~ 59 m/s^2 or 6 g in both forward and downward directions can be created, while the values in upward, lateral or backward directions amount to ~ 29 m/s^2 or 3 g for each direction. Also in this case, the forces only come into effect at the moment of landing.

The formula symbol F (force) is completed by the lower index (pedex), indicating the direction in which the force is acting (e. g.: F_V = F forward):

$F_V = n_g \cdot F_G$ in DaN

Notice: n_g is a numerical value





Note:

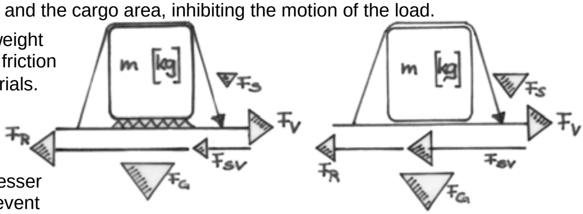
- It makes no difference if full braking is at 80km/h or at 25km/h.
- Mass force F_V augments when acceleration increases, but weight force F_G remains unvaried.

LOAD SECURING

3. Friction force F_R

The friction force acts between the load and the cargo area, inhibiting the motion of the load.

The degree of friction depends on the weight force F_G of the cargo and on the sliding friction coefficient μ of the combination of materials.



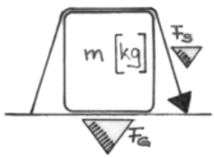
$F_R = \mu \cdot F_G$ in DaN

Note:

- The greater the friction force F_R, the lesser securing force F_{SV} is necessary to prevent forward motion of the cargo.
- An anti-slip mat (μ = > 0.6), positioned under the cargo, decreases considerably the amount of securing force needed. This means: fewer or smaller tie-down straps, but far more safety!

4. Securing force F_S

The tie-down method produces an increase in weight force F_G. The smaller friction force F_R, the greater the additional securing force F_{SV} must be to prevent forward motion of the cargo. F_{SV} can be calculated by subtracting the determined friction force F_R from the mass force directed forward F_V.



$F_{SV} = F_V - F_R$ in DaN

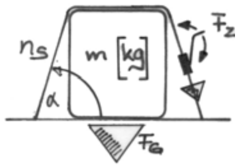
Note:

- The greater the friction force F_R, the lesser securing force F_S or F_{SV} is needed.
- The production of the force necessary for securing the cargo against forward motion F_{Sv} includes all other securing forces (lateral F_{SS}, backward F_{SH}, downward F_{SU} or upward F_{SO}), as long as those forces are lesser than F_{SV}.

5. Tension force F_Z

When using the method of tie-down lashing, in order to efficiently secure the cargo against forward motion, the calculated securing force F_{SV} must be produced by tightening the tie-down straps. Hence, the determined friction force F_R must be increased by adding tension force F_Z.

$F_Z = (F_{SV} \div \mu) \cdot (1 \div n_S) \cdot (1 \div \sin \alpha)$ in DaN



Note:

- Take into consideration the vertical angle $\sin \alpha$!
- When using the method of tie-down lashing, the tension force can be divided by the number of sides (n_S).
- When using the method of tie-down lashing, the number of sides is 2.

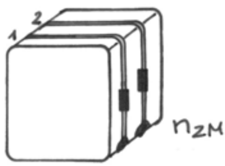
6. Number of tie-down devices n_{ZM}

The allowed tension force S_{TF} of each tie-down strap determines the number (n) of straps needed:

$n_{ZM} \geq F_Z \div S_{TF}$ in pieces

Note:

- The resulting number of tie-down straps must be rounded out to the nearest whole number of straps.
- The "Standard Hand Force" S_{HF} and the "Standard Tension Force" S_{TF} are indicated on the manufacturer's label.
- In case of free-standing cargo, at least 2 tie-down devices are necessary.



LOAD SECURING

Sample calculations: freight vehicle and helicopter

1. Weight force F_G

Freight vehicle: cargo

m = 100 kg $F_G = m \cdot g \div 10$ in DaN $F_G = 100\ kg \cdot 9.81\ m/s^2 \div 10 = \underline{98.1\ DaN}$

Helicopter: cargo

m = 100 kg $F_G = m \cdot g \div 10$ in DaN $F_G = 100\ kg \cdot 9.81\ m/s^2 \div 10 = \underline{98.1\ DaN}$

2. Mass force F

Based on the previous considerations, the mass force directed forward amounts to:

Freight vehicle: g forward

$n_{gV} = 0.8$ $F_V = n_g \cdot F_G$ in DaN $F_V = 0.8 \cdot 98.1\ DaN = \underline{78.5\ DaN}$

Helicopter: g forward

$n_{gV} = 6$ $F_V = n_g \cdot F_G$ in DaN $F_V = 6 \cdot 98.1\ DaN = \underline{588.6\ DaN}$

3. Friction force F_R

Based on the previous considerations, the friction force directed forward amounts to:

Freight vehicle: friction pairing pallet/melamin floor covering, dry, $\mu = 0.2$

$\mu = 0.2$ $F_V = \mu \cdot F_G$ in DaN $F_R = 0.2 \cdot 98.1\ DaN = \underline{19.6\ DaN}$

Helicopter: friction pairing aluminium barrel/aluminium floor, unctuous/oily, $\mu = 0.01$

$\mu = 0.01$ $F_V = \mu \cdot F_G$ in DaN $F_R = 0.01 \cdot 98.1\ DaN = \underline{0.98\ DaN}$

4. Securing force F_S

Based on the previous considerations, the securing force directed forward amounts to:

Freight vehicle: mass force directed forward

$F_v = 78.5\ DaN$ $F_R = 19.6\ DaN$ $F_{SV} = F_V - F_R = 78.5\ DaN - 19.6\ DaN = \underline{58.9\ DaN}$

Helicopter: mass force directed forward

$F_v = 588.5\ DaN$ $F_R = 0.98\ DaN$ $F_{SV} = F_V - F_R = 588.6\ DaN - 0.98\ DaN = \underline{587.6\ DaN}$

5. Tension force F_Z

Based on the previous considerations, the tension force directed forward at a vertical angle of 70° is:

Freight vehicle:

$F_Z = (F_{SV} \div \mu) \cdot (1 \div n_S) \cdot (1 \div \sin\alpha) = (58.9\ DaN \div 0.20) \cdot (1 \div 2) \cdot 1.06 = \underline{156.1\ DaN}$

Helicopter:

$F_Z = (F_{SV} \div \mu) \cdot (1 \div n_S) \cdot (1 \div \sin\alpha) = (587.6\ DaN \div 0.01) \cdot (1 \div 2) \cdot 1.06 = \underline{31'142.8\ DaN}$ **!!**

Attention: A low sliding friction coefficient μ (oily floor, aluminium on aluminium) results in a considerable increase in the tension forces needed.

LOAD SECURING

6. Number of tie-down devices n_{ZM}

Based on the previous considerations, the number of tie-down devices needed amounts to:

Freight vehicle:

$n_{ZM} \geq F_Z \div S_{TF}$ = 156.7 DaN ÷ 300 DaN = **<u>0.5</u> (2[1])** **Attention:** Use at least 2 tie-down devices

Helicopter:

$n_{ZM} \geq F_Z \div S_{TF}$ = 31'142.8 DaN ÷ 750 DaN = **<u>41.5</u> (42)** **Attention:** Load securing on the helicopter is impossible

Variation of the friction coefficient by anti-slip mat: F_Z = (587.6 DaN ÷ 0.6) · (1 ÷ 2) · 1.06 = <u>519.0 DaN</u> **!!!**

$n_{ZM} \geq$ 519.0 DaN ÷ 750 DaN = **<u>0.6</u> (2[1])** **!!!**

The common misconception regarding "heavy cargo"

To illustrate the misconception regarding cargo mass, we will give an example. Since an increase in mass m always results in an increase in mass force directed forward (F_V), each and every load will slip at the same moment when braking, provided that the sliding friction coefficient is the same.

In fact: the heavier the load, the greater the friction force keeping it fast to the cargo area. But: the heavier the load, the greater the mass forces inducing the load to slip.

Hence, slipping of the load can only be reduced by augmenting the sliding friction coefficient μ and/or by producing additional securing force F_S.

For further clarification, see these two examples:

Case 1: Dry wood on melamin flooring, <u>without</u> anti-slip mat (AM)

m_{Load} = 500 kg $\mu_{t\,Wood} = 0.2$

$F_G = m \cdot g = 500\text{ kg} \cdot 9.81\text{ m/s}^2 = 4905\text{ N}$

$F_R = \mu_t \cdot F_G = 0.2 \cdot 4905\text{ N} = 981\text{ N}$

$$a_b > \frac{F_R}{m_{Load}} = \frac{981\text{ N}}{500\text{ kg}} = \frac{981\text{ kgm/s}^2}{500\text{ kg}} = \underline{\mathbf{1.962\text{ m/s}^2}}$$

m_{Load} = 1000 kg $\mu_{t\,Wood} = 0.2$

$F_G = m \cdot g = 1000\text{ kg} \cdot 9.81\text{ m/s}^2 = 9810\text{ N}$

$F_R = \mu_t \cdot F_G = 0.2 \cdot 9810\text{ N} = 1962\text{ N}$

$$a_b > \frac{F_R}{m_{Load}} = \frac{1962\text{ N}}{1000\text{ kg}} = \frac{1962\text{ kgm/s}^2}{1000\text{ kg}} = \underline{\mathbf{1.962\text{ m/s}^2}}$$

Case 2: Dry wood on melamin flooring, <u>with</u> anti-slip mat

Case 1:

m_{Load} = 500 kg $\mu_{AM} = 0.6$

$F_G = m \cdot g = 500\text{ kg} \cdot 9.81\text{ m/s}^2 = 4905\text{ N}$

$F_R = \mu_{AM} \cdot F_G = 0.6 \cdot 4905\text{ N} = 2943\text{ N}$

$$a_b > \frac{F_R}{m_{Load}} = \frac{2943\text{ N}}{500\text{ kg}} = \frac{2943\text{ kgm/s}^2}{500\text{ kg}} = \underline{\mathbf{5.886\text{ m/s}^2}}$$

Case 2:

m_{Load} = 1000 kg $\mu_{AM} = 0.6$

$F_G = m \cdot g = 1000\text{ kg} \cdot 9.81\text{ m/s}^2 = 9810\text{ N}$

$F_R = \mu_{AM} \cdot F_G = 0.6 \cdot 9810\text{ N} = 5886\text{ N}$

$$a_b > \frac{F_R}{m_{Load}} = \frac{5886\text{ N}}{1000\text{ kg}} = \frac{5886\text{ kgm/s}^2}{1000\text{ kg}} = \underline{\mathbf{5.886\text{ m/s}^2}}$$

Note:

- The examples show that any load whatsoever, if not secured, already starts slipping at an acceleration of 1.972 m/s^2 (starting to drive, slowing down or rounding bends or, respectively, taking-off, landing or curve/ascending/descending flight)!
- Whether a cargo starts moving or not, does not depend on its mass (weight).
- Loads must always be secured, regardless of weight or how “carefully” you drive or pilot your aircraft!

---

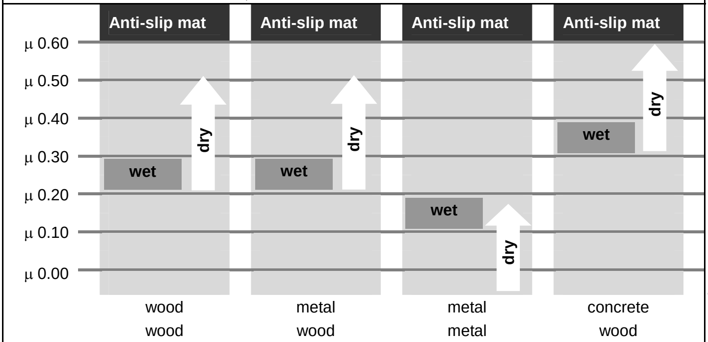
1) In case of free-standing cargo, at least 2 tie-down devices are necessary!

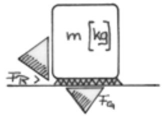
LOAD SECURING

Chart: Sliding friction coefficient μ

Sliding friction coefficients vary considerably according to the combination of materials and to the condition of the material (dry, wet, oily, etc.). The following can be assumed as orientation values:

Friction coefficients μ of different material pairings according to VDI 2700





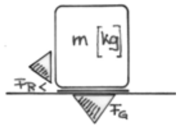
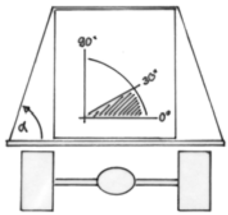


Chart: tie-down devices

The chart below is just an example and legally non-binding. However, it clarifies the direct relationship between the sliding friction coefficient and the number of tie-down devices needed!

Tie-down with ERGO ABS Ratchet: Standard Tension Force S_{TF} 750 DaN,
strap wrapped around the load (2 sides).

μ	Vertical angle α	Number of tie-down straps per load weight (kg) 500	1000	1500	2000	2500	3000	3500	kg
0.6	90° - 80°	1*	1*	1*	1*	2	2	2	n_{ZM}
0.6	80° - 45°	1*	1*	1*	2	2	2	2	n_{ZM}
0.6	45° - 30°	1*	1*	2	2	3	3	4	n_{ZM}
0.4	90° - 80°	1*	2	2	3	4	4	5	n_{ZM}
0.4	80° - 45°	1*	2	3	4	5	6	7	n_{ZM}
0.4	45° - 30°	2	3	4	6	7	8	10	n_{ZM}
0.2	90° - 80°	2	4	6	8	10	12	14	n_{ZM}
0.2	80° - 45°	3	6	9	12	15	17	20	n_{ZM}
0.2	45° - 30°	4	8	12	16	20	24	28	n_{ZM}



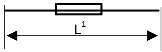
* Whenever one tie-down strap would be enough, always use a second one when the load is free-standing!

The use of tie-down devices does not make sense any more!

Please pay attention to the indications on the manufacturer's label (variations depending on the manufacturer and on the type and quality of the ratchet!)

LOAD SECURING

Indications on tie-down strap labels (example)



LC = 1250 DaN
Extension at max. LC: 4%
S_{TF} = 300 DaN
S_{HF} = 50 DaN
L_{GL} = length in mm
POLYESTER
Code Prod. Dat.
EN 12195-2
"Must not be used for lifting!"
MANUFACTURER
Code (BAR-Code)

S_{HF} 50 DaN (~50 kg), standard hand force in deca-Newton (DaN)

S_{TF} 300 DaN, standard tension force of the ratchet, which can be produced by the S_{HF} , whereas S_{TF} should be 10 - 50% of the LC!

LC Permitted Lashing Capacity.

Note:

- When pulling the ratchet manually at 50 DaN ≅ 50 kg, a "tension force" of ca. 300 DaN ≅ 300 kg is produced.
- The different values of tension force and hand tension force (300 instead of 50) are due to the length of the ratchet (lever arm).
- "ERGO" ratchets have longer levers. This means that more force can be transferred to the straps.

Caption:

All formulas are illustrated algebraically.

- m = mass [kg]
- g = acceleration of gravity [9.81 m/s^2]
- μ = sliding friction coefficient
- F_G = weight force [m · g]
- F = force (m · a); or: mass force
- F_R = friction force [μ · F_G]
- F_S = securing force [F_V - F_R]
- F_Z = tension force (produced by tying-down) [F_{SV} ÷ μ]
- F_{SV} = securing force directed forward, also: F_{SO}, etc.
- LC = lashing capacity
- n_S = number of cargo sides; wrapped = 2, direct = 1
- a_b = deceleration [a] during braking [b]
- L_1 = usable length of a tie-down strap in meters
- μ_{AM} = sliding friction coefficient using an anti-slip mat
- ≅ = corresponds to
- F_V = mass force directed forward (also: F_O upward, etc.)
- n_g = number of g's
- n_{gV} = number of g's directed forward, also: n_{gO}, etc.
- S_{HF} = standard hand force (force produced manually)
- S_{TF} = standard tension force (produced by the lever arm of the ratchet)
- F_{zul} = (formerly: = permitted lashing capacity; see LC)
- n_{ZM} = number of tie-down devices

= arrow = little arrow ≅ low force = big arrow ≅ high force

Model for calculation

The chart below resumes the previously calculated example of a "freight vehicle" whose load is secured by the tie-down method. Firstly, ascertain the data to be inserted in fields A - D.

A. Means of transport	Freight vehicle	Helicopter	Type of cargo area	Number of g's forward (helicopter: also downward)	Number of g's lateral (backward, upward)
(determine)	5 to	--	Melamin flooring	0.8	0.5
B. Load	Mass m [kg]	Mass [m^3]	Material type	Friction coeff. μ	Vertical angle sinα
(measure or read)	100	l x h x b	Wood	0.2	20°
C. Tie-down device	LC direct [DaN]	S_{TF} [DaN]	Width [mm]	Number of sides	**D. Anti-slip mat**
(read)	1250	300	35	2	

Formula	**Calculation**	**Result**	**Formula**	**Calculation**	**Result**
1. Weight force F_G [DaN]			**2. Mass force directed forward F_V [DaN]**		
$F_G = m \times g : 10$	100 x 9.81 : 10	**= 98.1**	$F_V = n_G \times F_G$	0.8 x 98.1	**= 78.5**
3. Required friction force F_R [DaN]			**4. Required securing force directed forward F_{SV} [DaN]**		
$F_R = F_G \times \mu$	98.1 x 0.2	**= 19.6**	$F_{SV} = F_V - F_R$	78.5 - 19.6	**= 58.9**
5. Tension force F_Z [DaN]					
$F_Z = (F_{SV} : \mu) \times (1 : n_S) \times (1 : \sin \alpha^*)$	(58.9 : 0.2) x (1 : 2) x 1.06			294.5 x 0.5 x 1.06	**= 156.1**
6. Number of tie-down devices n_{ZM}, in pieces, min. 2			**Requirements:**		
$n_{ZM} \geq F_Z : S_{TF}$	156.1 : 300	**= 0.5 (> 2)**	Tie-down straps	**2**	with S_{TF} **300**

LOAD SECURING

(Original size A5: copy at 1.41% = A4)

Calculation: number of tie-down straps required for load securing

Choose the tie-down device you consider sufficient and ascertain the data to be inserted in fields A - D.

A. Means of transport (determine)	Freight vehicle	Helicopter	Type of cargo area	Number of g's forward (helicopter: also downward)	Number of g's lateral (backward, upward)
B. Load (measure or read)	Mass m [kg]	Mass [m^3]	Material type	Friction coeff. μ	Vertical angle sinα
C. Tie-down device (read)	LC direct [DaN]	S_{TF} [DaN]	Width [mm]	Number of sides	**D. Anti-slip mat**

Formula	Calculation	Result	Formula	Calculation	Result
1. Weight force F_G [DaN]			**2. Mass force directed forward F_V [DaN]**		
$F_G = m \times g : 10$	x 9.81 : 10	=	$F_V = n_G \times F_G$	x	=
3. Friction force F_R [DaN]			**4. Required securing force directed forward F_{SV} [DaN]**		
$F_R = F_G \times \mu$	x	=	$F_{SV} = F_V - F_R$	-	=
5. Required tension force F_Z [DaN]					
$F_Z = (F_{SV} : \mu) \times (1 : n_S) \times (1 : \sin \alpha^*)$	(:) x (1 :) x *			x x	=
6. Number of tie-down devices n_{ZM}, in pieces, min. 2			**Requirements:**		
$n_{ZM} \geq F_Z : S_{TF}$	:	= (>)	Tie-down straps		with S_{TF}

Comparative calculation

In case the chosen tie-down device is not sufficient, change data at point C (other type of tie-down device) and/or point D (anti-slip mat), then make a new calculation beginning at point 3:

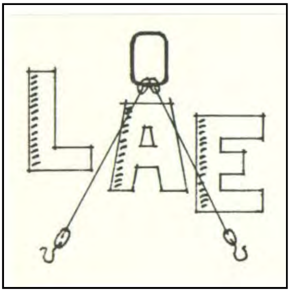
C. Tie-down device (read)	LC direct [DaN]	S_{TF} [DaN]	Width [mm]	Number of sides	**D. Anti-slip mat**

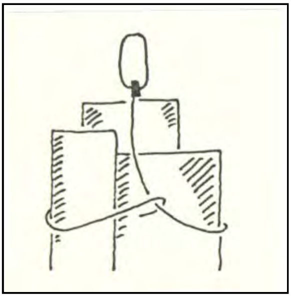
Formula	Calculation	Result	Formula	Calculation	Result
1. Weight force F_G [DaN]			**2. Mass force directed forward F_V [DaN]**		
$F_G = m \times g : 10$	x 9.81 : 10	=	$F_V = n_G \times F_G$	x	=
3. Friction force F_R [DaN]			**4. Required securing force directed forward F_{SV} [DaN]**		
$F_R = F_G \times \mu$	x	=	$F_{SV} = F_V - F_R$	-	=
5. Required tension force directed forward F_Z [DaN]					
$F_Z = (F_{SV} : \mu) \times (1 : n_S) \times (1 : \sin \alpha^*)$	(:) x (1 :) x *			x x	=
6. Number of tie-down devices n_{ZM}, in pieces, but min. 2			**Requirements:**		
$n_{ZM} \geq F_Z : S_{TF}$	:	= (>)	Tie-down straps		zu S_{TF}

The use of more than 2 tie-down devices per cargo is not realistic. Remember that the use of an anti-slip mat has considerable advantages!

* insert here the value 1 : sin α which corresponds to the vertical angle:
90° = 1 [-]; 80° = 1.01 [-]; 75° = 1.03 [-]; 70° = 1.06 [-]; 65° = 1.1 [-]; 60° = 1.15 [-];
55° = 1.22 [-]; 50° = 1.3 [-]; 45° = 1.41 [-]; 40° = 1.55 [-]; 35° = 1.74 [-]

3.2





Load lifting devices & working materials

LOAD LIFTING DEVICES

1st principle: Assessment

The calculations presented and described below are based on the finding that the forces during underload flight operations with helicopters may be greater than when using a hall crane, and therefore cannot be definitively compared.

The load lifting devices (round slings, chains, steel and textile ropes, shackles, etc.) offered by manufacturers are as a rule not adapted to the specific requirements of flight operations.

It is up to the user to select the materials appropriate for his/her requirements from the range available.

Assessment by the flying company made at the point of procurement will have to be adapted to take account of the latest information in some cases.

2nd principle: Calculations

The material to be procured can be calculated in type ways:

1. For every single load case and the material in question. This method is to be applied above all in case of doubt and when procuring special suspension gear or materials.
2. For general use. In this case, the highest expected load case is to be assumed for each item of material and the materials are to be selected with corresponding dimensions.

The following applies to both cases:

1. Calculations should be rounded up (in favour of increasing the safety margin).
2. Calculations should be recorded and stored (documentation).
3. The calculations do not include lifetime limits. These must be obtained by asking the manufacturer. The information from the manufacturer forms part of the documentation.

The calculations and values presented here are to be viewed as minimum **values on the basis of European safety law,** according to which standards have a non-binding character. It is possible to deviate from these values, however the manufacturer is required to give detailed and justifiable reasons.

3rd principle: Product liability

Product liability law states that the manufacturer of products, raw materials or semi-finished products bears responsibility for them.

Flight companies who buy in individual parts and assemble them to make a four-rope sling, for example, are deemed to be manufacturers and are liable for their finished product for 10 years.

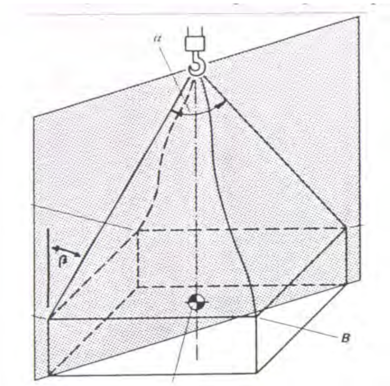
This means the calculations and considerations which led to the procurement of parts and in-house productions must be stored for 10 years (see also: European safety law, Machinery directive 2006/42/EC, annex II, point 2, "The manufacturer of machinery or his authorised representative shall keep the original EC declaration of conformity for a period of at least 10 years from the last date of manufacture of the machinery".

4th principle: Responsibilities (Switzerland)

1. The office in charge of the construction and the design of rescue and working equipment and the use of personal safety equipment (PSE) or other devices employed for human external cargo (HEC) operations with helicopters is FOCA, STEH department. In particular, the "Technical Memorandum 50.605-20" must be consulted.
2. Load lifting devices (LLD) are subject to the Swiss federal law on safety of installations and technical equipment (STEG/LSIT) or to the Machinery directive (2006/42/EC), while personal safety equipment (PSE) is subject to the Swiss directive STEV/OSIT (EC directive 89/686/EEC on PSE). Notified bodies can, however, issue type certificates, which can be used according to the "Technical memorandum" 50.605-20, art. 4.

LOADS ON LOAD LIFTING DEVICES

Statics model of a 4-rope sling



The constant displacement of the centre of gravity during flight results in changing loads on the ropes. In consequence, the load weight is not evenly distributed over the ropes of the sling. It must be assumed that, at times and in alternation, only 2 ropes are supporting the load!

This displacement can be caused by forward speed drag (FSD), down wash drag (DWID) or acceleration and deceleration at bank angle (g-load) and landing approach as well as by unequal rope lengths and slinging points which are not level.

Fig. 1 Static model

Angles of inclination, calculation of the forces

Fig. 1 shows the two angles (angle of spread α and angle of inclination β). Half of the angle of spread α corresponds to the **angle of inclination** β (Fig. 2). Only the angle of inclination is used for further calculations (DIN 30785).

Tensile force in the ropes changes in respect of the load attached by the factor $\frac{1}{\cos \beta}$

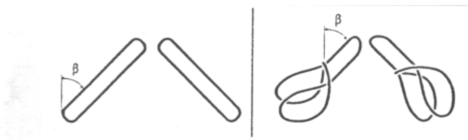
Angle α	Angle β	cos	Factor $\frac{1}{\cos \beta}$	Additional load	Load	Total load	No. of supporting ropes	Load per rope
90°	**45°**	**0.7071**	**1.41**	**41%**	**100 %**	**141 %**	**2**	**70 %**
120°	**60°**	**0.5**	**2**	**100 %**	**100 %**	**200 %**	**2**	**100 %**

These values do not take any load combinations into account!

The 60° angle of inclination is thus not recommended for load transportation by helicopters!

Fig. 2 shows the simple angle of inclination (left) and the angle of inclination with tying

Fig. 2: Angle of inclination with different types of slinging



In flight operations, only positive and self-closing slinging is permitted

- left: straight run of the rope used with shackles and/or couplings, hooks, etc.
- right: tied rope

N.B.: DIN (EN/DIN) concepts have been used

RULES OF TECHNOLOGY

General premises

Due to the special requirements of cargo flights (load collectives, dynamics, aerodynamics, number of working cycles, etc.), load lifting devices for helicopters must be able to endure higher forces and a higher number of working cycles than load lifting devices (LLD) used for normal hoisting operations.

Commonly used and well-proven industrial LLD can be adopted for helicopter cargo transport, provided they satisfy the specific requirements for this type of operation.

The details given in chapter 3.2 "Load lifting devices" are based on the experiences, calculations and considerations regarding helicopter transport. The second section of this chapter (3.2.2-2 et seqq.) establishes a comparison between practical knowledge and industrial standards, when possible and useful.

Terms

All terms referring to load lifting devices are taken from EC-machinery directive 2006/42/EC or from relevant DIN- or EN-standards. The technical terms referring to flying procedures (e.g. DWD) are taken from the aviation standards in force.

Calculations see pages 3.2.1, 3.2.4-1 to 3.2.5-2

During flight operations with helicopters, the weight (mass) of a cargo can never be calculated precisely by the flight marshaller. Hence, far more than 95 % of all cargo must be assembled and slinged on the basis of experience, estimation and testing. However, the helicopter should always carry the maximum external load permitted.

For this reason, LLD have to be adjusted in accordance with the helicopter’s maximum load capacity, without considering reduction factors such as altitude above sea level, temperature, wind, etc.

Rigging of more than one slinging device

For all standards, the illustrations showing multiple-leg slings ALWAYS feature one suspension link. The attachment of more than one slinging device, e.g. 2 or 3 round slings on one hook, is not considered herein.

Marking

According to machinery directive 2006/42/EC Annex I, art. 4.3.2 “Lifting accessories“, load lifting devices (LLD) must be marked with the following identifications (manufacturer’s brand)!

- Manufacturer	- Maximum working load (WLL)
- Material	- CE-marking

Further identification, such as the manufacturer’s address, serial number (S/N), part number (P/N), indication of length and diameter, name of user or exact type description, use restrictions (e.g. to be used only to lift by helicopter, no HEC), customised features, etc. can be required by EN-standards and, if necessary or on the operator’s request, indicated by the manufacturer.

LLD without proper marking are not safe!

Range of products

For reasons of safety and economy, a proven method for flight operation companies is maintaining a range of different LLD for each helicopter type and weight class. These stocks are used and stored separately, according to their weight class, in order to consistently reduce risks such as confusing LLD, choosing undersized LLD or making wrong decisions.

Examples:
- Helicopter type: AS 332, max. WLL 4500 kg
- Weight class: SA 315b, AS 350B2 and AS 350B3 = max. payload up to 1400 kg

Thus, marshallers are free to concentrate on correct and safe cargo rigging.

Interface: LLD - helicopter

Pay attention to the fact that some producers of helicopters or helicopter lifting hooks strictly forbid the rigging of multiple legs to the primary lifting hook without making use of an intermediate link (oval ring).

RULES OF TECHNOLOGY

Comparison: Industrial rules of technology - helicopter transports

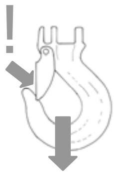
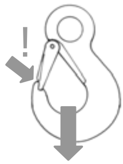
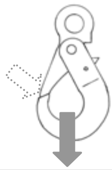
The following comparisons are not exhaustive. Hence, they must be reconsidered on the basis of the payload type, the transport mission and the chosen/available slinging device.

Deviations from the rule of technology are only permitted if an equivalent or even higher safety standard can be achieved by other methods.

The following considerations and illustrations essentially apply for all components of a load lifting device, regardless of their construction or material.

Lifting hooks see page 3.2.3-1

Basis: DIN 15'002 Lifting appliances, load carrying devices, 1.1 Lifting hooks acc. to DIN 15'401 (intended and calculated for direct load carrying).

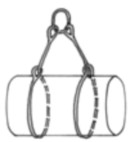
Rule of technology acc. to DIN/EN	Rule of technology for helicopter transport		
			
standard hook	protruding beak; usable only for slings (charging bucket)	no beak better	safety hook more safety

Use on helicopters: Hook with safety catch, with either non or slightly protruding beak, designed for only attaching slings (charging bucket, etc.). Better safety is achieved by using form-fit safety hooks with a self-closing and self-locking mechanism when force is applied. To such hooks, slings, lengthenings/extensions, etc. can be attached.

Reason: Safety catches increase the risk of lifting devices overturning. Self-locking hooks cannot be opened under load. Hence, the policy is that weight should only be hung from the bottom (lower curve) of the cargo hook (see DIN 15'401).

Slinging see pages 3.2.3-1, 3.2.5-1 and 3.2.7-1

Basis EN 1492-1 Hoisting belts (1492-2 round slings): The load must be reduced according to the slinging technique adopted. Round sling 1000 kg, tied: load factor 0.8 = 800 kg

Rule of technology acc. to DIN/EN			Rule of technology for helicopter transport		
					
straight lift 1	tied 0.8	tied+ inclined 45° 1.4	in any case 1, calculated for the respective load		

Use on helicopters: Lifting devices must always be chosen with reference to the maximum lifting capacity possible or to the maximum load force expected.

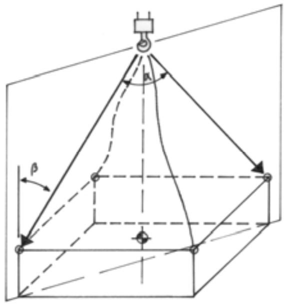
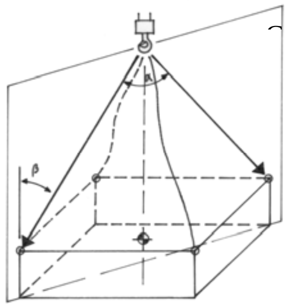
Reason: In practice, loads to be transported by helicopter can hardly ever be ascertained precisely.

Caution: The slinging factors indicated on standard slinging devices, such as round slings, hoisting belts, etc. can be misleading.

RULES OF TECHNOLOGY

Symmetry - asymmetry see pages 3.2.3-2 to 3.2.3-4, 3.2.7-2

Basis EN 1492-2 Round slings: Slinging factor "M" refers only to symmetrical loading. Hence, the indications on labels must be reduced in case of asymmetrical loading (new calculation, load reduction).

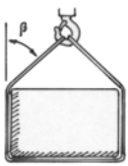
Rule of technology	Rule of technology for helicopter transport
	
The Statics model referring to the 4-leg sling (also to the 2- and 3-leg sling) applies in both cases	

Use on helicopters: Lifting devices with one and two legs must always be calculated in such a manner that **1 leg is enough to bear the entire load and all acting forces** (single- and two-leg slings = 1 or 2 legs with sufficient carrying capacity = max. 1 load-bearing leg). Analogously, in case of three- and four-leg slings, only 2 load-bearing legs can be taken into account.

Reason: During helicopter operations, cargo is never static, exactly symmetrically loaded or stable. Due to different leg lengths, uneven slinging points, oscillations/rotations of the load and spiralling at high speeds, a continuous shifting of force transmission within the single legs of the slinging devices must be taken into account. At times and alternatingly, only 1 leg (TWLS) or 2 legs (THLS, FLS) bear the whole load!

Ascertainment of the angle of inclination see pages 3.2.3-1 to 3.2.5-2, 3.2.7-1

Basis: DIN 685-5: Industrial standards allow an angle of inclination up to 45° or 60° respectively, provided that the load weight has been properly adjusted. The standards assume that in the case of a TWLS the load can be divided by 2, in the case of THLS and FLS divided by 3 (symmetrical loads).

Rule of technology	Rule of technology for helicopter transport
	For the computation of angle forces, the **angle of inclination β** is used (acc. to DIN 30'785). In relation to the attached load, the traction force within the single legs varies by the factor $\frac{1}{\cos \beta}$. The bigger the angle of inclination β, the higher the traction force acting upon the slinging point, with the result that the slinging device tends to move towards the centre of the load.
Angles of inclination exceeding 60° are forbidden!	

Use on helicopters: During helicopter operations, a maximum angle of inclination of 45° is commonly accepted. AI < 45° reduce the traction force, with the result that slinging devices tend to slip over the payload.

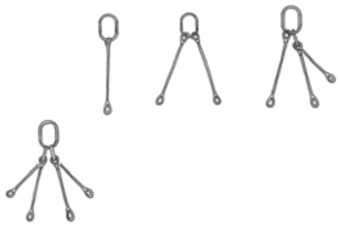
Reason: Bigger loads, load collectives, asymmetrical loads, cargo flights, shift of the centre of gravity.

RULES OF TECHNOLOGY

Calculation of forces produced by the angle of inclination see pages 3.2.3-3, 3.2.5-1

Basis: The calculations contained in the standards are made on the basis of several load factors. Provided there is enough time to make calculations and by eventually reducing the weight of the load, it is possible to rig many loads of different weights.

Rule of technology acc. to DIN/EN



Rule of technology for helicopter transport

Description	OLS	TWLS		THLS		FLS		OLS	TWLS	THLS	FLS
Number of legs	1	2		3		4		1	2	3	4
Max. inclina-tion angle β	-	45°	60°	45°	60°	45°	60°	-	45°	45°	45°
Load factor ≈	1	1.4	1	2.1	1.5	2.1	1.5	1	1	1.41	1.41
Rated carrying capacity	1	1.4	1	2.1	1.5	2.1	1.5	1	1	1	1
Bearing legs	1	2	2	3	3	3	3	1	1	2	2
Safety factor steel	4	4	4	4	4	4	4	4.5	4.5	6.34	6.34
AI max. 60° - different WLL								**AI max. 45° - one WLL for all**			

Use on helicopters: Load lifting devices must be **calculated** in such a manner that they can, at all times and in all circumstances, in consideration of the expected load forces (load collectives!), of their progressive ageing and general condition, **safely carry the load while exploiting the helicopter's maximum carrying capacity**. The sling's label must indicate this maximum load.

Reason: When performing flight operations, nobody has time to check calculations. In order to guarantee safety, the maximum permitted external load of a helicopter must be available at all times.

Load collectives see pages 3.2.3-4 (illustration), 3.2.4-1 to 3.2.5-2

The concurrence of several forces (load collectives) generated simultaneously by tying, asymmetrical loads, oscillations, spiralling, dynamic impacts, etc. produces load forces which in part considerably exceed those of normal industrial applications.

Materials see pages 3.2.6-1 to 3.2.6-3

Materials feature characteristics which can be useful for helicopter cargo transports. Each characteristic has advantages and disadvantages. Every component of a load lifting device is the product of these characteristics in combination with the type of construction, the planned assignment, the flight behaviour etc. The information contained in this chapter provides indications relevant for safety and reflect the rule of technology.

Ageing see pages 3.2.6-1 and 3.2.6-2, 3.2.8

Slinging devices, load lifting devices and instruments are subject to ageing caused by use (strain, dirt, sharp edges, overstressing, base solutions, oils, UV light, etc.). The extent of ageing depends on the specific characteristics of the material.

Underdimensioned slinging devices age more rapidly, since the load forces acting upon them are often close to the "yield point" (shortly before the "breakage/tearing point" is reached).

Due to the forces produced during flight operations (banking, dynamic loads, number of working cycles, load alternations and moments of force), the requirements for helicopter transports are considerably different from those concerning industrial applications.

Material, slinging techniques and **life spans** must be ascertained according to the requirements.

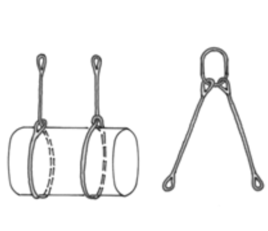
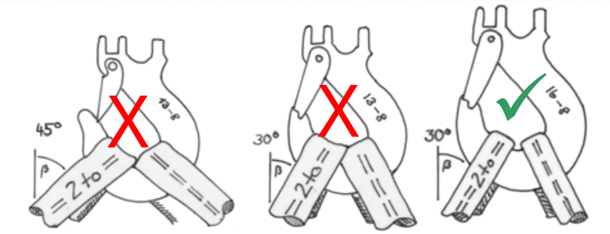
RULES OF TECHNOLOGY

Cross sections see page 3.2.6-4

The industrial standards neglect the importance of cross sections as aerodynamic elements. In industrial applications, they are only considered when dealing with the optimisation of force transmission/reduction of friction. However, cross sections are of great importance for helicopter transport, as bad aerodynamic profiles cause high lifting forces, oscillations and pendular movements of the load and thus more wear and other dangers.

Geometry - lifting hooks see pages 3.2.7-1, 3.2.7-4

Basis: All illustrations showing multiple-leg slings ALWAYS feature one suspension link.

Rule of technology acc. to DIN/EN	Rule of technology for helicopter transport
	
Pairs of slinging devices are rigged by using a 2-leg sling or a traverse	Lifting hook size 13-8 (WLL 5.4 tn), overdimensioned for the load (>1 tn), but: left: 45°- round slings 2tn = hook not optimal and might even be critical centre: 30°- round slings 2tn = better, but the round slings overlap right: 30°- round slings 2tn, hook size 16-8 = enough space for round slings

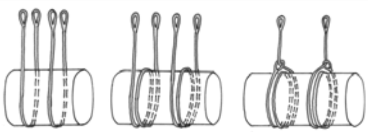
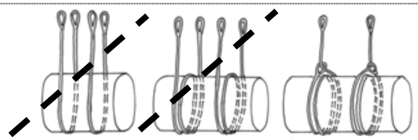
Use on helicopters: If the size of the lifting hook is big enough in proportion to the diameters of the lifting devices, it is possible to attach two single ropes. Abiding by the **rule AI < 45°,** rigging to the lifting hook is performed with more safety. The hook must be calculated in such a manner that it can resist the additional forces produced by the AI. For the calculation, see FH-SY 3.2.5-1.

Reason: Due to reasons related to the load and the available slinging devices, the attachment of two single slinging devices (f. ex. 2 tied round slings) to one lifting hook is unavoidable during helicopter cargo transport.

Attention: If the edges of a hoisting belt are bent, the WLL is considerably reduced. Lifting hooks are designed (calculated) only for the direct attachment of slinging devices.

Form-fit and force-fit slinging see page 3.2.7-1

DIN 30'785 Slinging during lifting operations: The slinging technique "Wrapped" (page 3.2.7-1), permitted by industrial standards, is only form-fit. It is performed exclusively by personnel specialised in slinging techniques and only after exhaustive consideration, calculation and choice of slinging devices.

Rule of technology acc. to DIN/EN	Rule of technology for helicopter transport
	
pairs of single slinging devices wrapped coiled around double tied	the wrapped and coiled around methods require additional securing (complex and time-consuming)

Use on helicopters: To achieve the required safety in helicopter cargo transport, a combination of form-fit and force-fit slinging is necessary (for example: "tying" slinging technique).

If the shape of the payload and/or the need of a specific slinging technique does not allow a complete force closure, additional securing measures must be taken keeping in mind the possible risks (i.e. securing of the payload by means of tie-down straps).

Reason: During load transportation, oscillating movements, rotations and inclinations are often generated collectively. If loads are not rigged in a force-fit manner, they can slip out of the lifting device due to strong inclination, air resistance or collision with obstacles. This is totally unacceptable because it might endanger third parties, personnel or cause material damage. In the daily routine of flight operations, time-consuming calculations or extensive load securing procedures can very rarely be performed.

Hence, for helicopter cargo transports only form-fit <u>and</u> force-fit slinging techniques can be recommended.

RULES OF TECHNOLOGY

Relevance of rope/leg length and assembling of long lines see page 3.2.7-3 and 3.2.7-4

A relevant item regarding safety during helicopter external cargo transport is the adequate length of slinging devices. In fact, keeping a sufficient distance from the load and from obstacles is important for the ground crew, third parties and the environment, as well as for the proper handling of the load.

When the attachment length of multiple-leg slings increases the angle of inclination of the single legs is reduced and thus the inclination of the load. Less inclination = less force required for load handling.

The longer the load-carrying ropes, the smaller the "Down Wash Drag" acting upon the load and on the environment. Contemporarily, the helicopter's noise level is reduced, resulting in an increase in the marshallers' ability to manoeuvre the load. When long load-bearing ropes are adopted, the pilot, in case of a 'vortex' (stall), for example, has more room to manoeuvre than when loads are directly hooked to the helicopter!

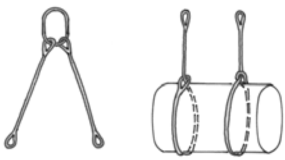
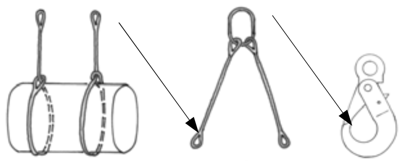
Rule of thumb: Rotor diameter x 1.5 = area presenting the strongest "downwash effect" and eddy flow caused by the rotor. Hence, load-bearing ropes should exceed the size of this area.

Load-bearing ropes must be as static as possible and must be protected from twisting by low-torque swivels. In order to prevent hard impacts (dynamic load peaks) caused by the load from passing on through the load-bearing rope and subsequently affecting the helicopter cabin and other helicopter components, it would be useful to connect a short shock-absorbing element between the rope and the helicopter.

Lengthenings/extensions see pages 3.2.7-5 and 3.2.7-6

EN 1492-1 Hoisting belts (also applies to round slings acc. to EN 1492-2). 3. Definitions; 3.10 Suspension link: On multiple-leg hoisting devices*), a link forming the upper fitting used for rigging the hoisting device to the hook of a crane, to other lifting devices or to other slinging devices.

Shortly: The rigging of multiple-leg slings to a hook is permitted exclusively when a suspension link is adopted!

Rule of technology acc. to DIN/EN	**Rule of technology for helicopter transport**
	
2-leg sling 2 single slinging devices	2 single slinging devices 2-leg sling hook

Use on helicopters: A pair of single ropes can be combined with a 2-leg or a multiple-leg sling. Furthermore, due to this lengthening/extension, the angle of inclination will be reduced.

Reason: Parallel or multiple rigging of slinging devices to one lifting hook is not permitted. Helicopter cargo operations often require the assembly of different types of extensions attached to the lifting devices. Inappropriate lengthenings/extensions, e.g. with "knots", can lead to a considerable reduction in carrying capacity. **Knots are forbidden!**

*) Note: the common term is "sling".

RULES OF TECHNOLOGY

Definitions

Acknowledged rules of technology (as defined by EN 45'020, 1.5) are:

“Technical provisions acknowledged by a majority of representative experts as reflecting the state of the art.”

Examples: Slinging techniques in lifting operations acc. to DIN 30'785; chains and fittings, quality class 8 acc. to EN 818-4; round slings acc. to EN 1492-2, etc. The EN-standards are in force in Switzerland as well (SN EN).

State of the art (definition according to EN 45'020, 1.4)

“Developed stage of technical capability at a given time (…) based on the relevant consolidated findings of science, technology and experience”

Examples: Long lines made from HMPE fibre, calculated according to FH-SY 3.2.5.

Appropriate use

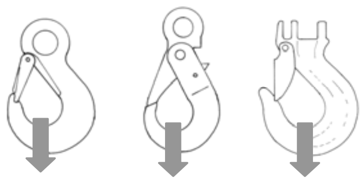
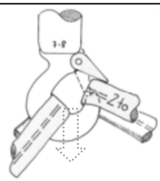
All operations for which a device is qualified and designed on the basis of its material characteristics, its construction, calculation and finishing, as well as on the basis of accumulated experience.

Example round sling: rigging of loads, tying

Inappropriate use:

All of the uses a device is not qualified and designed for; the disregard of the appropriate use may lead to damages.

Example round sling: towing of vehicles, knots in round slings

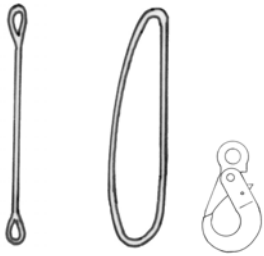
Appropriate use	Inappropriate (non-intended) use
	
DIN 15'002 Lifting appliances, load carrying devices; 1.1 Lifting hooks according to DIN 15'401 (designed and calculated for the direct lifting of loads)	

LOADS AFFECTING LOAD LIFTING DEVICES

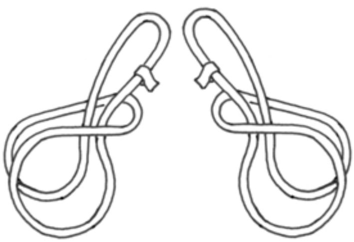
Assembling and calculation of the load (mass) depend on the maximum permitted external load of a helicopter as described within the 'Aircraft Flight Manual' (AFM)!

Load lifting devices must be **calculated** in such a manner that they can, at all times and in all circumstances, in consideration of the expected load forces (load collectives!), of their progressive ageing and general condition, **safely carry the load while exploiting the helicopter's maximum carrying capacity**.

One-leg load lifting means and slinging equipment

Slinging type "Straight lift"	**Slinging factor (SF)**	
	**Load on the LLD:**	
	Load (mass)	100%
	Slinging factor	-
	Additional load	-
	Total load	100%
	Load distribution:	
	No. of legs in use	1
	No. of load-bearing legs	1
	Load per leg	**100%**
Mass 100% - Load 100%		

"Tying" (T)	**Slinging factor (SF)**	
	**Load on the LLD:**	
	Load (mass)	100%
	Slinging factor T	1.2 [-]
	Additional load	20%
	Total load: 100 x 1.2 =	**120%**
	Load distribution:	
	No. of legs in use	1
	No. of load-bearing legs	1
	Load per leg	**120%**
Mass 100% - Load 120%		

"Tying and 45° angle of inclination" (AI)	**Slinging factor (SF)**	
	**Load on the LLD:**	
	Load (mass)	100%
	Slinging factor AI	- [1)]
	Slinging factor T	1.2 [-]
	Additional load	20%
	Total load:100 x 1.2 =	**120%**
	Load distribution:	
	No. of legs in use	2
	No. of load-bearing legs	1
	Load per leg	120%
Mass 100% - Load 120%		

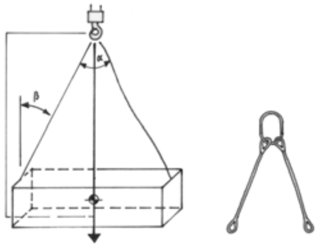
1) The slinging factor AI is ignored, as it is assumed that the total load is carried by 1 leg.

The values calculated refer to each single leg in all cases.

LOADS ON LOAD LIFTING DEVICES

Multiple-leg slinging equipment

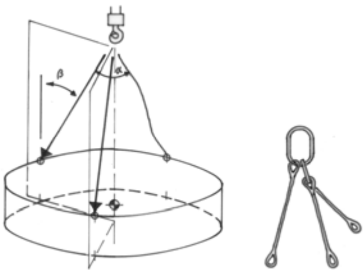
AI 45° with 2-leg slings



Slinging factor (SF)	
Load on the LLD:	
Load (mass)	100%
Slinging factor AI	-
Additional load	-
Total load:	**100%**
Load distribution:	
No. of legs in use	2
No. of load-bearing legs	1
Load per leg	100%

Mass 100% - Load 120%

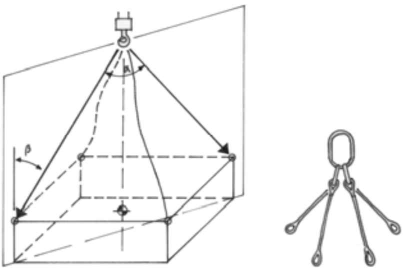
AI 45° with 3-leg slings



Slinging factor (SF)	
Load on the LLD:	
Load (mass)	100%
Slinging factor AI	1.41 [-]
Additional load	41%
Total load: 100 x 1.41	**141%**
Load distribution:	
No. of legs in use	3
No. of load-bearing legs	2
Load per leg 141% : 2	**70%**

Mass 100% - Load 141%

AI 45° with 4-leg slings



Slinging factor (SF)	
Load on the LLD:	
Load (mass)	100%
Slinging factor AI	1.41 [-]
Additional load	41%
Total load: 100 x 1.41	**141%**
Load distribution:	
No. of legs in use	4
No. of load-bearing legs	2
Load per leg 141% : 2	**70%**

Mass 100% - Load 141%

1) Slinging factor AI ignored (as it is assumed that the total load is carried by 1 leg).

Also pay attention to the producers' specifications referring to standardized products (EN 1492):
For example: "The values indicated on round slings and other slings are valid exclusively when all legs are equally loaded".

LOADS ON LOAD LIFTING DEVICES

AI 45° with 3-leg slings and tying

Slinging factor (SF)

Load on the LLD:

Load (mass)	100%
Slinging factor AI+ Tying: 1.41 x 1.2	1.7 [-]
Additional load	41%
Total load: 100 x 1.41 x 1.2	**170%**

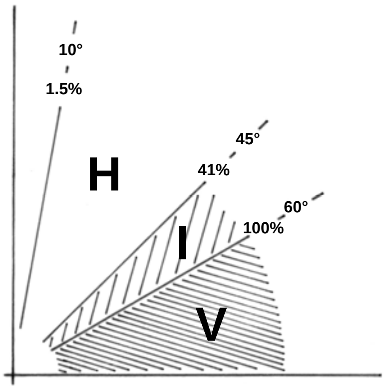
Load distribution:

No. of legs in use	3
No. of load-bearing legs	2
Load per leg 170% : 2	**85%**

Mass 100% - Load 170%

Angle of inclination

Permitted / prohibited angles of inclination



AI < 45° reduce the traction force, with the result that slinging devices tend to slip over the payload. The bigger the angle of inclination β, the higher the traction force acting upon the slinging point, with the result that the slinging equipment tends to move towards the centre of the load.

Caption

H = AI 10 - 45° recommended.

I = AI > 45° up to max. 60° are allowed by industrial standards; however they cannot be recommended for helicopter load transport (see load collectives)!

V = AI > 60° are FORBIDDEN in all cases!

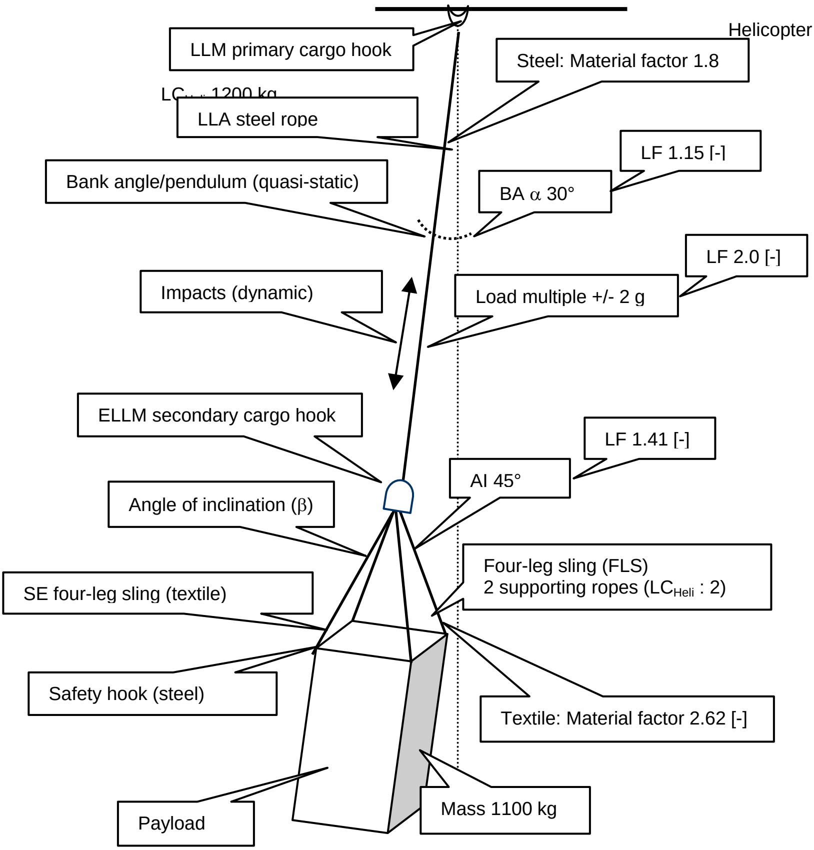
The angles of inclination must be determined for each single leg!

Load forces caused by flying techniques see 3.1.3 - 3.1.5, 3.2.4-1 to 3.4.4-4

For calculations, also the load forces caused by flying techniques have to be taken into account.

CALCULATION OF LOAD LIFTING DEVICES

Examples of loads on LLDs and load factors (LF); load collectives



See pages 3.2.2 to 3.2.4-2 for details regarding the individual items
See pages 3.2.10-1 to 3.2.10-4 for sample loads

CALCULATION OF LOAD LIFTING DEVICES

The forces and safety factors listed below represent the current state of knowledge.

Known forces caused by flying techniques and slinging techniques

No.	Cause or force	Symbol	Factor	Note
1. Flying technique				
1.1 "Operation External Load Transport" (ELO)				
1.1.1	g-load, e.g. by banking (max. permissible 30°[1)])	SF_{BA30°	1.15 [-]	1.15 x 2. 0 = 2.3 [-], covered by the static limit load factor of 2.5 [-] (FAR27/29.865)
1.1.2	Load multiple in transport operations caused by impact	$SF_{LM\ ELO}$	2.0 [-]	
1.1	**"Safe load" during transport**	$\mathbf{SL_{ELO}}$	**2.5 [-]**	
1.2 "Operation External Load Logging" (LOG)				
1.2.1	g-load, e.g. by banking (max. permissible 30°[1)])	SF_{BA30°	1.15 [-]	The factor 3 [-] is considered adequate as smaller load factors result during load peaks (force limitation of the helicopter system)
1.2.2	Load multiple in logging caused by impact[2])	$SF_{LM\ LOG}$	3.0 [-]	
1.	**"Safe load" during logging**	$\mathbf{SL_{LOG}}$	**3.0 [-]**	
2. Slinging techniques				
2.1	Straight lift Angle of inclination β 0° - 10°	$SF_{Straight}$	1.0 [-]	For straight lifts with AI up to 10°, no angular force must be taken into account.
2.2	**Angular force caused by the angle of inclination β 10° - max. 45°**	$\mathbf{SF_{AI45}}$	**1.41 [-]**	A maximum of 45° is recommended. Larger angles increase the stress acting upon accessories and safety catches and increase the risk of slinging devices slipping over the payload (load collectives).
2.3	**Bending radius from tying**	$\mathbf{SF_{Tying}}$	**1.2 [-]**	In the best case, the radius is equal to or less than the producer's specifications.
2.4	**or the product: 2.2 x 2.3**	$\mathbf{SF_{ST}}$	**1.7 [-]**	Optional; the factors can also be adopted individually.
3. Material strength				
3.1 Steel				
3.1.1	Safety from breakage 3)	$SF_{Breakage}$	1.5 [-]	Minimum safety from breakage. Yielding of material is not considered.
3.1.2	Steel: wear/tear and ageing	SF_{Steel}	1.2 [-]	Specific material requirements for protection against overloading.
3.1	**Safety factor for steel**	$\mathbf{SF_{Steel}}$	**1.8 [-]**	Minimum value for steel.
3.2 Textile				
3.2.1	Safety from breakage	$SF_{Breakage}$	1.5 [-]	Minimum safety from breakage. Yielding of material is not considered.
3.2.2	Textile: wear/tear and ageing	$SF_{Textile}$	1.75 [-]	Specific material requirements for protection against overloading and ageing.
3.2	**Safety factor for textiles [4)]**	$\mathbf{SF_{TEXTILE}}$	**2.62 [-]**	Minimum value for textiles.
Calculation: position 1.1 or 1.2 times the corresponding factor of position 2.2 or 2.3 or 2.4. times the corresponding factor of position 3.1 or 3.2. See also the following page.				

1) The specific limits vary according to the helicopter type!
2) The load values caused by impact are based on measurements.
3) The factors given are minimum values! (→ 3.2.4-2)
4) The minimum value for type of finishing, ageing and manufacturing must be taken into account for each material (→ 3.2.4-2, Pt. 5).

CALCULATION OF LOAD LIFTING DEVICES

Summary of the factors to be used

		Operation External Load Transport (ELO)				Operation External Load Logging (LOG)[1*]	
	Material group	LLA	SE	3- / 4-leg sling excl./ incl. tying		LLA	SE
1. Flying technique [2*] (SL_{ELO} or SL_{LOG})	Steel Textile	2.5	2.5	2.5	2.5	3.0	3.0
2. Slinging techniques (SF_{AI}, SF^T, SF_{ST})	Steel Textile		T [3*] 1.2	AI [4*] 1.41	AI+T 1.7		T 1.2
3. Material strength[5*]	Steel	1.80	1.80	1.80	1.80	1.80	1.80
SF_{Steel} + $SF_{TEXTILE}$)	Textile	2.62	2.62	2.62	2.62	2.62	2.62
Products (J) [6*]							
Individual load*	Steel	4.50	5.40	6.34	7.65	5.40	6.48
(LF) ➔ 3.2.5-1	Textile	7.00 [8*]	7.86	9.23	11.13	7.86	9.43
General use (LF)	**Steel**	**5.40**		**7.65** [4*]		**6.48**	
	Textile	**7.86**		**11.13** [4*]		**9.43**	

All values are without dimensions [-]

Explanations

1. **Logging:** No angles of inclination are considered in logging (straight lift). In contrast, the loads to be expected by impact are higher than in normal transport operations. The value "Multiple load logging" 3.0 [-] is considered adequate due to the force-limited system of the helicopter. Peak impacts are generally produced when taking up and releasing loads. A combination with banking can therefore be excluded.
2. **Flying technique:** The static limit load factor 2.5 [-] (FAR 27/29.865) covers the quasi-static loads, e.g. caused by the g-load up to 1.15 [g] (30° banking). Dynamic loads caused by impact are still covered in it up to max. 2.17 [g].
3. **Slinging**: **Slinging equipment** such as round slings or chains are generally tied and used in pairs, i.e. are subject to angles of inclination. This corresponds to a 2-leg sling (2 legs in use, 1 load-bearing leg). In practice, the two legs never carry the load symmetrically, because a continuous shifting of force transmission occurs due to different leg lengths, spiralling and oscillations or rotations of the load. In the event of a banking, up to 85% of the payload's mass can bear on only one leg, while the second leg is almost without a load. Each leg must therefore be able to support the entire load. For this reason, at straight lift only the slinging factor "Tying" of 1.2 can be used for the calculation, without dividing the payload's mass (see also point 4).
4. **3- and 4-leg slings:** In the case of two symmetrically supporting slings, each sling carries ~50% of the loads. The products in the corresponding column therefore refer to the carrying capacity per leg reduced by half. A load combination of AI x T is often required. It is recommended that calculations are based on the maximum value J = 11.13 [-].
5. **Factors due to finishing:** According to the material used (textile = PA, PES, HMPE, etc.; steel = G8, G10, high-grade steel, aluminium, etc.), its ageing properties (textile 3 - 30% per annum) and its type of finishing (spliced strands, spliced core-cover, sewing, knots, weld seam, rivet), other factors of varying magnitudes must also be considered.
6. **Product "J"** The maximum possible product (J) must be used as the basis for the calculation of load carrying attachments or slings which are to be used for all types of assignment and are to be loaded by various combinations of loads and slings. In this way, it is also possible to cover the worst load case within the permissible parameters.
7. **Individual cases:** The design of special slings requires precise calculation with consideration given to all the loads expected and all applicable factors.
8. **Safety:** The computed value is 6.55 [-]. The minimum value indicated in Machinery Directive 98/37/EC,
Annex I, art. 4.1.2.5 amounts to 7 [-].

CALCULATION OF LOAD LIFTING DEVICES

Calculation for design and inspection

Helicopter type:	LLD component:	Material (textile, steel):	Type of assignment:

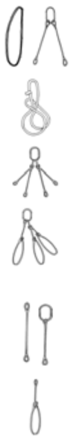
The following 5 steps are recommended for each individual helicopter type and component!

1. Determining the external working load capacity of the helicopter (WLL_{Heli}) in kg [1)]

☐ a) Max. external load capacity of the helicopter according to the AFM or
☐ b) Max. load with LLD for special loads (load < WLL_{Heli}) [2)] WLL_{Heli} = ____________________ kg

2. Determining type of assignment, selecting LLD and calculating max. working load (WL_{max})

LLD **Material** **Slinging technique** (Please refer to page 3.2.4-2 for a list of factors)



LLD	Material	Slinging technique	LF [2)]	x WLL_{Heli}	= WL_{max} in kg
1. 'Operation External Load Transport' (ELO)					
☐ 1.1 LLA/TWLS	textile	straight lift < 10°	7.00	x ________________	= ________________
☐ 1.2 "	steel	"	4.50	x ________________	= ________________
☐ 1.3 SE	textile	tying	7.86	x ________________	= ________________
☐ 1.4 "	steel	"	5.40	x ________________	= ________________
☐ 1.5 THLS/FLS	textile	AI max. 45°	9.23	x (½ WL_{Heli}) ________	= ________________
☐ 1.6 "	steel	"	6.34	x (½ WL_{Heli}) ________	= ________________
☐ 1.7 THLS/FLS	textile	AI max. 45° + tying	11.13	x (½ WL_{Heli}) ________	= ________________
☐ 1.8 "	steel	"	7.65	x (½ WL_{Heli}) ________	= ________________
2. 'Operation External Load Logging' (LOG)					
☐ 2.1 LLA	textile	straight lift	7.86	x ________________	= ________________
☐ 2.2 "	steel	"	5.40	x ________________	= ________________
☐ 2.3 SE	textile	tying	9.43	x ________________	= ________________
☐ 2.4 "	steel	"	6.48	x ________________	= ________________

All values WL_{max} in kg apply to each individual rope!

3. Determining the breaking strength of the component LLD (BS_{LLD}) in kg [1) 2)]
Breaking strength in kg or tonnes and safety factor = information from the manufacturer! [3)]

Formula: $BS_{LLD} = WLL_{LLD} \times SF$

$BS_{LLD} = WLL_{LLD}$ ______________ x SF ___ = __________________ kg

4. Calculating the safety margin (SM); the safety margin must be greater than zero (> 0)

Formula;

$$SM = \frac{\text{Breaking strength LLD } (BS_{LLD}) \text{ in kg}}{\text{max. working load } (WL_{max}) \text{ in kg}} - 1 = \underline{\geq 0}\ [-]$$

$$SM = \frac{\boxed{\qquad\qquad}}{\boxed{\qquad\qquad}} - 1 = \_\_\_\_.\_\_\_\_\ [-]$$ [4)]

5. Judging the load lifting device / component regarding its appropriateness

☐ **The LLD <u>satisfies</u> the requirements of the type of assignment ($BS_{LLD} > WL_{max}$); Dimensions + _____ %**
☐ **The LLD <u>does not</u> <u>satisfy</u> the requirements of the type of assignment ($BS_{LLD} < WL_{max}$); Dimensions - _____ %**

Notes:
To simplify matters, the conversion from mass ([kg]) into force (Newton [N]) has not been performed (N = kg x 9.81)
- to 1) The term "load capacity" is also referred to in the manufacturer's documents as WLL (working limit load).
- to 2) See pages 3.2.4-1 and 3.2.4-2 for a list of load factors (LF). The load factor is the product (J) of several factors.
- to 3) IMPORTANT: As with the safety factors, the information from the manufacturers is not standardised.
- to 4) The decimal places in the result can also be expressed as a percentage (SM = 0.04 [-] = 4%).

CALCULATION OF LOAD LIFTING DEVICES

Formulas for the calculation (example below)

How to calculate the stress caused by slinging techniques and flying techniques, which subsequently acts upon load lifting devices, has been documented on pages 3.2.2 to 3.2.4-2. The form on page 3.2.5-1 summarizes these considerations for users so that they can be applied for their calculations or checks.

The notions given on pages 3.2.2 to 3.2.4-2 can be expressed in formulas in the following manner:

Example 1: - page 3.2.5-1, pt. 2, no. 1.6
- three-leg chain sling (THLS): steel, without tying, two load-bearing legs
- helicopter: AS 350B3 (WLLHELI 1400 kg)

Formulas:

$$F_{LLD\ MAX} = \frac{WLL_{LLD} \cdot SF_{STEEL\ 2} \cdot g}{1000} = \frac{BS_{LLD} \cdot g}{1000} \quad \underline{\textbf{in kN}}$$

$$F_{HELI\ MAX} = \frac{WLL_{HELI}}{E_{TST}} \cdot (SL_{ELO} \cdot SF_{BREAKING} \cdot SF_{STEEL\ 1} \cdot SF_{AI\ 45°}) \cdot \frac{g}{1000} = WLL_{HELI\ ½} \cdot LF \cdot \frac{9.81}{1000} = WL_{MAX} \cdot \frac{9.81}{1000} \quad \underline{\textbf{in kN}}$$

$$SM = \frac{F_{LLD\ MAX}}{F_{HELI\ MAX}} - 1 = \underline{\mathbf{> 0\ [-]}}$$

Example of a possible calculation:

$$F_{LLD\ MAX} = \frac{1400\text{ kg} \cdot 4 \cdot 9.81\text{m/s}^2}{1000} = \frac{5600 \cdot 9.81}{1000} = \underline{\mathbf{54.93\ [kN]}}$$

$$F_{HELI\ MAX} = \frac{1400\text{ kg}}{2} \cdot (2.5 \cdot 1.5 \cdot 1.2 \cdot 1.41) \cdot \frac{9.81}{1000} = 700\text{ kg} \cdot 6.34 \cdot \frac{9.81}{1000} = 4438 \cdot \frac{9.81}{1000} = \underline{\mathbf{43.53\ [kN]}}$$

$$SM = \frac{54.93\text{ kN}}{43.53\text{ kN}} - 1 = \underline{\mathbf{> 0.26\ [-]}}$$

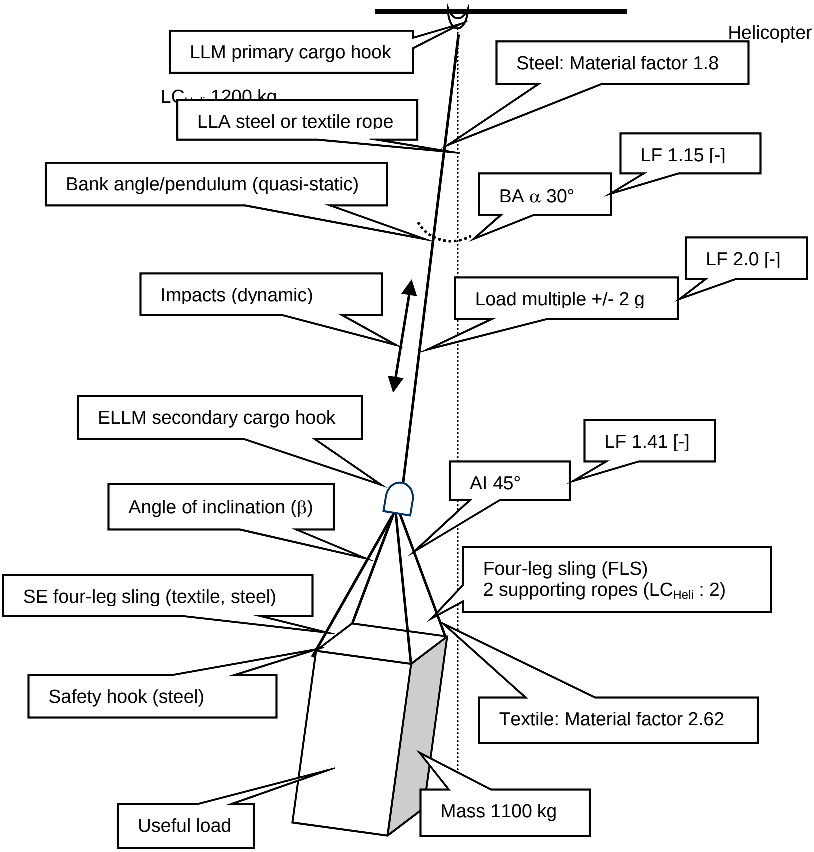
In grey colour = load factors, see pages 3.2.4-2 and 3.2.5-1, pt. 2, grey column

Caption:

BS_{LLD}	Breaking strength of load lifting device, in kN
g	Acceleration due to gravity 9.81 [m/s^2]
$F_{LLD\ MAX}$	Maximum force that can be born by the load lifting device (before breaking).
$F_{HELI\ MAX}$	Maximum force produced by flying techniques and slinging techniques that can act upon the LLDs.
WL_{max}	Maximum working load
LF	Load factors (product "J" resulting from all factors being applied)
SM	Safety margin (remaining safety after subtracting the max. working load from the breaking strength)
$SF_{STEEL\ 1}$	Minimum safety factor for LLD made of steel during helicopter work (in combination with the load factors)
$SF_{STEEL\ 2}$	Safety factor for steel indicated by industrial standards according to Machinery Directive 98/37/EC, Annex I, art. 4.1.2.5
$SF_{Textile\ 1}$	Safety factor for textiles indicated by industrial standards according to Mach. Dir. 98/37/EC, Annex I, art. 4.1.2.5
E_{TSt}	Number of load-bearing legs (not to be confused with the number of legs in use; see page 3.2.3-1)
WLL_{LLD}	Working load limit of load lifting device
WLL_{HELI}	Working load limit of helicopter, in kg

CALCULATION OF LOAD LIFTING DEVICES

Examples of loads on LLDs and load factors (LF)



CONSTRUCTION OF LOAD LIFTING DEVICES

Appropriate materials: type, properties, limits

This chart provides a general idea of the properties and the possible applications of the most commonly used materials. The material's properties, together with the way it is manufactured, are decisive in choosing its application.
Example: PA 3-strand, 15% elongation = up to a length of 2 m,
suitable for shock-load absorption but NOT SUITABLE as a load rope.

Technical data	**Textile materials**			**Steel**		
Material	**High modulus Polyethylene**	**Polyester**	**Polyamide**	**Quality class 8 (chain)**	**Quality class 10 (chain)**	**Steel wire (ropes)**
Abbreviation	**HMPE**	**PES**	**PA**	**G8**	**G10**	**galvanised**
Breaking tenacity in N/mm^2	360	110	90-95	1100 – 1200	1200 – 1350	1770
Elongation of fibre at break [1)]	3.8%	10-17	18-35%	20%	20%	3 - 5 %
Elongation at 50% of load [1)]	< 2%	5 - 10%	15- 20%	< 2%	< 2%	~ 1 %
Weight: specific gravity in g/cm^2	0.96	1.38	1.14	7.8	7.8	7.85
Tenacity Rkm value	~ 300	~ 100	~ 100	n/a	n/a	~ 50
Melting point in °C	140°C	225°C	215-260°C	> 1500	> 1500	1000°C
Resistance to UV	excellent	excellent	good	excellent	excellent	excellent
Resistance to alkalis	excellent	good at room temperature	excellent to weak alkalis	depends on the alkali type: from good to very poor [2)]		poor
Resistance to acids	excellent	fair	fair	poor		poor
Resistance to benzene/oils	excellent	excellent	good	excellent	excellent	good
Creep	only with heavy load	hardly measurable	low	irrelevant	irrelevant	measurable
Tenacity with knots	ca. 50%	ca. 30%	ca. 50%	-	-	ca. 10%
Ageing pa in %	3%	>3%	8 - 10%	n/a	n/a	n/a
Types of manufacturing (examples)						
Laid	X	X	X			
Woven		X				
12-plait	X	X	X			
3-strand laid rope		X	X			
Crane rope						X
Kernmantel (core-cover)	X	X	X			
Cast				X	X	
Die-forged				X	X	X
Drawn						X
Applications (examples)						
Slinging		X		X	X	X
Connecting	X	X		X	X	X
Load-carrying, straight lift	X	X	X	X	X	X
Shock-load absorption			X			

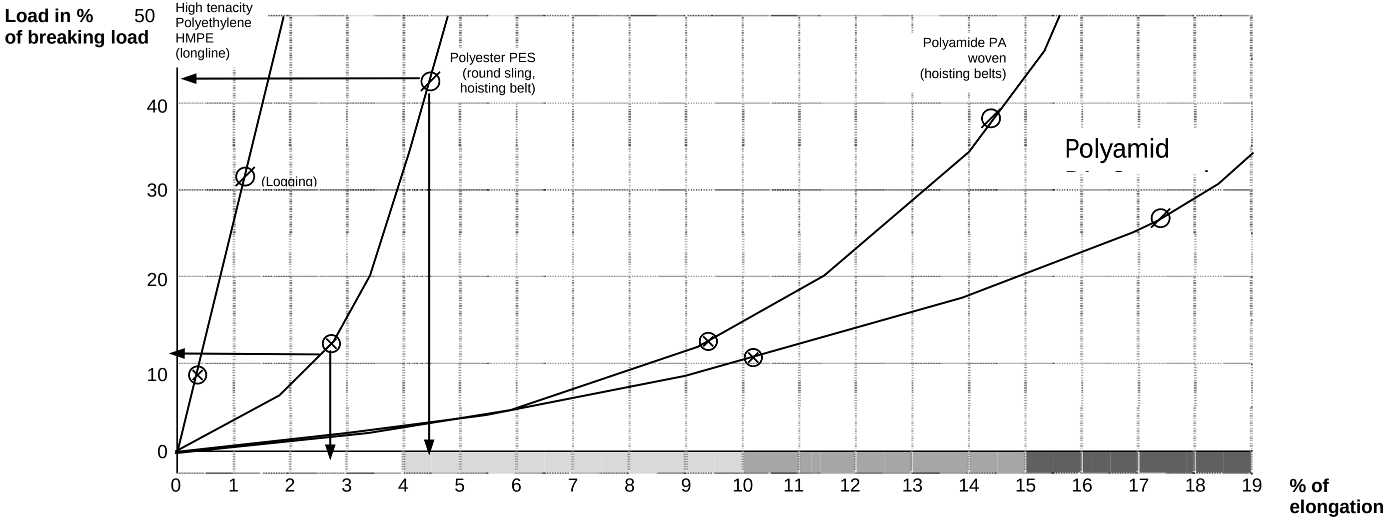
n/a = not applicable

1) Dependent on type (manufacturing)
2) Cement and cement composites are inoffensive, fertilisers (e.g. phosphates) are critical. Please consult the manufacturer.
3) Abbreviations: see pages 3.2.11 and 3.5.1-1 et seqq.

CONSTRUCTION OF LOAD LIFTING DEVICES

Diagram: ratio between force and elongation of textile materials

The elongation properties of work materials depend on the material's linear elongation and the way it is manufactured (linear laid = only material elongation, braided or cabled= elongation according to the material and the type of manufacturing).



Code	Elongation	Applications:
	static 1 - 4%	Transport ropes (shortline < 20m, longline > 20m), slinging devices, e.g. round slings, hoisting belts PES up to 3%
	quasi static 4 - 10%	Slinging devices, e.g. round slings, hoisting belts PA up to 10%
	dynamic 10 - 15%	Shock absorber PA (3-strand laid or laid and sheathed)
	highly dynamic >15%	Not suitable for helicopter load transport. Extreme danger at breakage due to the sudden release of dynamic energy (high elongation = shooting up of rope).

Example: round sling

⊗ = The working load limit of a RS with a safety factor of 7.86 amounts to 12.7 % of the breaking load (100 %), elongation corresponds to < 3 %

∅ = The working load of a RS, considering tying and dynamic loads, amounts to 42.85 % of the breaking load (100 %), elongation is circa 4.5 %.

CONSTRUCTION OF LOAD LIFTING DEVICES

Behaviour of ropes in case of loss of cargo

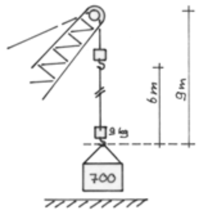
The following notions refer to an empirical test performed in 1984 and show the behaviour of different rope types in case of cargo loss. (empirical = experience acquired by observation and experiment)

Test arrangement

Load: 700 kg
Attachment length: 6m
Distance crane hook - lifting hook: 6 m
Distance crane top - lifting hook: 9 m
Mass of lifting hook: 9 kg
Load release: electric

The illustrations are not in scale!

Situation of departure



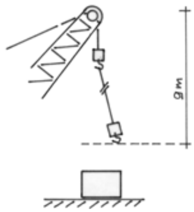
Test 1: Steel rope

Rope length: 6 m
Rope diameter: 11 mm
No. of legs:1
Total breaking load: 6750 kg
Type of rope: crane lifting rope
Rope properties: low-torque, low elongation

Results:

Elongation under load: not measurable
Behaviour after cargo release: slight oscillation

Result 1



Evaluation: + only slight oscillation; - no shock-absorbing of impacts = rope appropriate but shock absorber needed

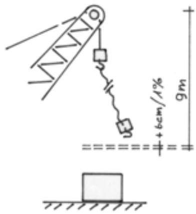
Test 2: Polyester round sling

Rope length: 6 m
Rope diameter: 18 mm (per leg)
No. of legs:2
Total breaking load: 12'000 kg
Type of rope: endless round sling
Rope properties: low elongation

Results:

Elongation under load: ca. 1 % (load ca. 50% of WLL)
Behaviour after cargo release: slight oscillation

Result 2



Evaluation: + slight oscillation; - impacts not absorbed = rope appropriate (strands bundled by protective sheathing), shock absorber needed

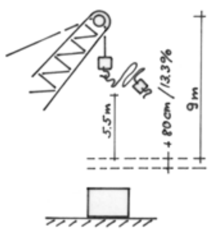
Test 3: Polyamide rope

Rope length: 6 m
Rope diameter: 16 mm (per leg)
No. of legs:2
Total breaking load: 9100 kg
Type of rope: 3-strand laid
Rope properties: 26% elongation

Results:

Elongation under load: 80 cm or 13.3 %
Behaviour after cargo release: shooting up of rope incl. lifting hook (9 kg !) up to 5.5 m

Result 3



Evaluation: DANGER - > 10% elongation at ca. 50% of load, shooting up of rope and lifting hook! = unusable!

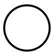
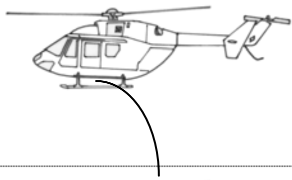
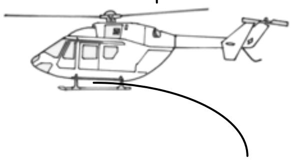
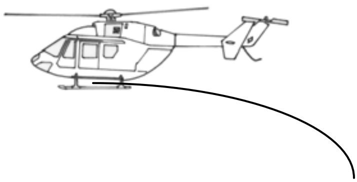
CONSTRUCTION OF LOAD LIFTING DEVICES

Evaluation of the test results[1)]

The test results lead to the conclusion that dynamic textiles are not appropriate for use as load lifting attachments (load rope) or slinging equipment.
In case of cargo loss or rope breakage, combined with other factors such as rope profile/diameter, the helicopter's rate of descent and forward speed, other significant hazards may appear.
Regarding slinging equipment, the following must be considered: the higher the hoisting belts or round slings' elongation, the longer the fibres' working elongation = higher friction and heat generation and lower load-carrying capacity!
However, the linear behaviour of ropes is just one factor of many.

Cross sections

The shape of a rope's cross section is very important as it affects its aerodynamic properties.
The rope's cross section, in combination with its dynamic properties, may significantly increase dangers, i.e. in case of cargo loss during forward flight or descent, a dynamic rope with an oval cross section will inevitably flap up.
Static rope constructions with stiff core and a small, round cross section, during forward flight or descent will swing slightly backwards and have little tendency to "whipping".
However, if during forward flight or descent the rope should hit an obstacle, even a heavy steel rope will shoot up together with the lifting hook.

Description	Illustration (principle)
Round cross section  Best aerodynamic behaviour.	
Oval cross section  Problematic. "Wobbles" during flight and produces a relatively strong lift.	
Rectangular cross section Extremely problematic if used as a load rope. Strong vacillations (vibrations perceivable on pitch or stick), accessories and nooses can be damaged by the vibrations. Strong lift and strong whipping.	
Cross sections of multiple legs (round, oval or rectangular) Multiple-leg load ropes, extensions/lengthenings or long legged slinging equipment strongly vibrate and produce very high resistance = lift	

[1)] Source: Heliswiss 1983, H. Wyder, H. Stocker, A. Marty

CONSTRUCTION OF LOAD LIFTING DEVICES

Flexible intermediate bulk containers (FIBC) for non-dangerous goods

The following requirements for FIBCs have been formulated in consideration of the specific hazards that may arise during helicopter external cargo transport.
The recent increase in incidents has induced FOCA to charge the Load Lifting Devices Work Group (LLD WG) with the task of defining minimum requirements for FIBCs. ➔ www.heli-syllabus.org / work group

Particular dangers

Due to their material and manufacturing characteristics, the adoption of FIBCs for helicopter transport can represent a significant, sudden danger, especially if they are used in an inappropriate way. In case of FIBC failure, there is a high probability that human beings, the environment and the helicopter may be affected. For this reason, such elevated risks require special countermeasures.
Particular dangers are (list not exhaustive):

- Loss of the FIBC bottom due to mechanical damage to the seams or the cloth provoked by UV rays. This leads to:
- Sudden loss of cargo during flight, which leads to:
- Sudden flying up of the FIBC, due to the wind flow created inside the remaining hollow "pipe-like" FIBC;
- Aggravation of the aforementioned effects during descent
- Overstress or rupture of the seams and/or the lifting straps if they are too short
- Disintegration of the sackcloth caused by inappropriate payloads (PP/PE in contact with bitumen, sharp edges, hot objects, chemicals, etc.)

Basic laws and directives referring to the construction of FIBCs (CH and EU):

- (CH) Federal law on safety of installations and technical equipment (STEG/LSIT, SR/RS 819.1)
- (CH) Directive STEV/OSIT, SR/RS 819.11 on safety of installation and technical equipment
- (CH) Swiss directive on machinery safety (MaschV, SR/RS 819.14)
- (EU) EC-Machinery Directive 2006/42/EC

Rule of technology

- (CH) SN EN ISO 21'898 Packaging -- Flexible intermediate bulk containers (FIBCs) for non-dangerous goods
- (EU) EN ISO 21'898 Packaging -- Flexible intermediate bulk containers (FIBCs) for non-dangerous goods

This standard is not harmonised.

State of the art

The construction and the use of FIBCs, in the light of the specific requirements for helicopter external cargo transport, are described in the Marshaller-Syllabus on the basis of empirical values, experience and a risk analysis.

Construction and design requirements

The responsibility for the construction and the design requirements, in conformity with the acknowledged rule of technology and the state of the art, lies with the producer.

Use of FIBCs

Chapter 3.2.13 describes the usage, chapter 3.2.14 the specific dangers of FIBCs.

CONSTRUCTION OF LOAD LIFTING DEVICES
Minimum requirements of FIBCs for helicopter external cargo transport

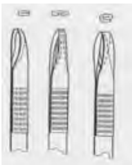
- ☐ FIBC in conformity with EN ISO 21'898
- ☐ Safety factor 8:1 according to art. 3.1.2 (repairable), or safety factor 6:1 according to art. 3.1.3 (not repairable)
- ☐ WLL of FIBC: 15 kN for helicopters up to WLL 14 kN
- ☐ Lifting straps calculated according to FH-SY 3.2.5-1, pt. 2.1.5, FLS (slinging equipment, SE). Example:

$$\text{Safety margin per leg} = \frac{\text{Breaking strength LLD}}{\text{½ maximum working load helicopter}} - 1 = \mathbf{> 0\ [-]},\ \textbf{Example:}\quad \text{SM/leg} = \frac{95\ \text{kN}}{76.45\ \text{kN}} - 1 = \mathbf{0.24\ [-]}$$

- ☐ Lifting straps ≥ 1 m of length, sewn loop end the same as for lifting strap EN 1492-1 (fig. 1 and 2)
- ☐ Lifting straps manufactured in PES (good quality), looped around the bag and crossed at the bottom (fig. 3)
- ☐ Double-walled FIBC bottom; lifting straps sewn between 1st and 2nd bottom.
- ☐ In order to counteract lateral pressure due to the settling of the filling, 2 horizontal belts can be sewn on at a height of approximately 15 and 30 cm from the bottom.
- ☐ Tag: according to art. 7 of the standard, but double-sized, written in big font and UV and abrasion resistant. It can be printed on the sackcloth or completely sewn on (i.e. all 4 sides of the tag). Optionally, the tag may be sewn together with a protective foil onto the cloth.
- ☐ An optional tag may bear the term "HELIBAG" and/or a company logo.
- ☐ A pictogram showing the "method of use", which clearly indicates that 4 loops can be rigged to the hook (in case of straps ≥ 1m), otherwise a four-leg sling must be used (in case of straps < 1 m) (fig. 4)
- ☐ Quality of sackcloth and cover: UV-resistant and of good quality or double-walled (including the bottom)
- ☐ No openings at the bottom; possibly loops attached for easier bag emptying (180° turn)
- ☐ Size (L x W x H): no restrictions

Fig. 1

Fig. 2



Materials

Sackcloth: PP/PE, UV-resistant

Lifting strap/loops: PES

Fig. 3

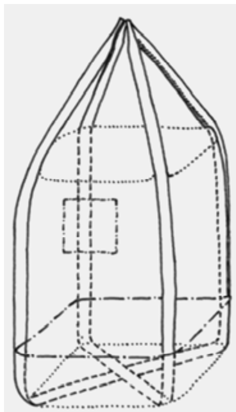


Fig. 4.a Fig. 4.b Fig. 4.c

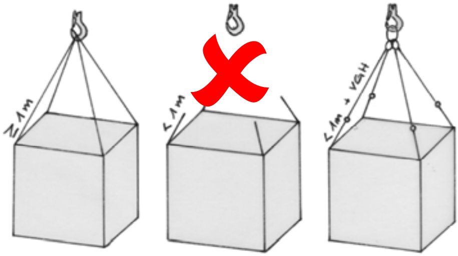


Fig. 1: FIBC in use; hook of sufficient size for 4 loops (see 3.2.2-5), torque-compensated (see 3.2.7-4)

Fig. 2: Design of the loops according to EN 1492-1

Fig. 3: Basic construction: 2 lifting straps looped around the bag and crossed at the bottom, in case of straps ≥1 m; in case of shorter straps assembled with a four-leg sling (see 3.2.2-3, 3.2.7-1).

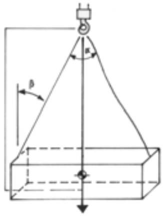
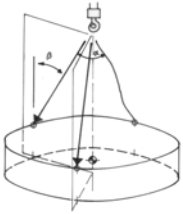
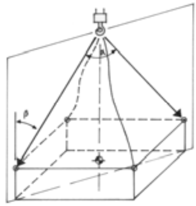
Fig. 4: Pictograms: a: Correct rigging to the hook; b: FORBIDDEN rigging to the hook; c: Rigging in combination with a four-leg sling in case of short straps/loops.

Pictograms 4.a to 4.c can be used in addition to or as substitutes for other usual and necessary pictograms.

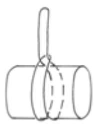
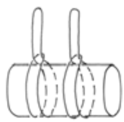
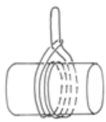
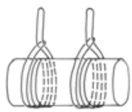
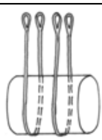
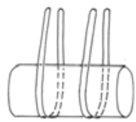
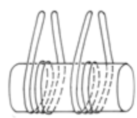
USE OF LOAD LIFTING DEVICES

Slinging techniques

Slings can consist of: round slings, wire ropes, textile ropes with loose rings, round steel chains (for others, please refer to the list of load lifting devices).

Examples of permitted slinging types

Sling / Slinging techniques	One-leg sling		Two-leg sling *)	Endless rope	
	single	pair		single	pair
Direct/ straight lift					
Tied					
Double tied					
Looped			◄ only in form closure ► additional securing of load and slinging equipment required!		
Coiled around			◄ in moderate force closure ► additional securing of load and slinging equipment required!		

*) The illustrations of the slinging techniques for double ropes also apply to multiple leg slings.

Annotation: The areas crossed out refer to slinging techniques which are not permitted for helicopter external cargo transport. Danger of loss of payloads!

Source: DIN 30'785 "Anschlagen im Hebezeugbetrieb" ("Slinging during lifting operations")

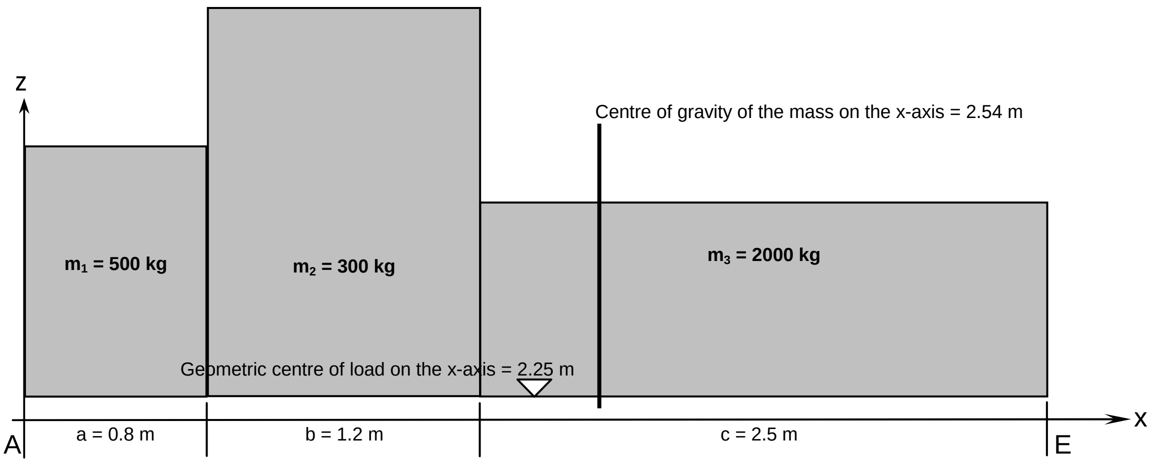
USE OF LOAD LIFTING DEVICES

Determination of the centre of gravity for asymmetrical loads; example for the calculation of the x-axis

The calculation of asymmetrical loads is performed on the basis of the horizontal line of the load's width and depth (see figure), as well as on the basis of the plumb line.

In case of low-lying cargo (low height in proportion to width) the vertical calculation can be omitted.

Calculation in words: half of width a times mass m_1, plus width a plus half of width b times mass m_2, plus a plus b plus half of width c times m_3, divided by total mass.



Calculation formula:

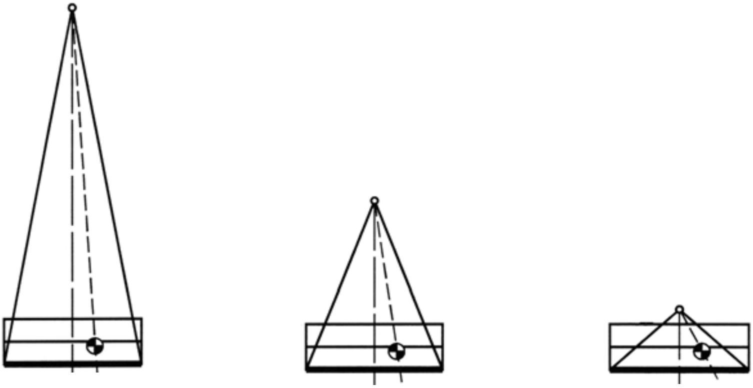
$$CG = \frac{\left(\frac{a}{2} \cdot m_1\right) + \left(\left(a + \frac{b}{2}\right) \cdot m_2\right) + \left(\left(a+b+\frac{c}{2}\right) \cdot m_3\right)}{m_1 + m_2 + m_3} = \frac{\left(\frac{0.8\ m}{2} \cdot 500\ kg\right) + \left(\left(0.8\ m + \frac{1.2\ m}{2}\right) \cdot 300\ kg\right) + \left(\left(0.8 + 1.2\ m + \frac{2.5\ m}{2}\right) \cdot 2000\ kg\right)}{500\ kg + 300\ kg + 1400\ kg} = \underline{\mathbf{2.54\ m}}$$

Calculation:

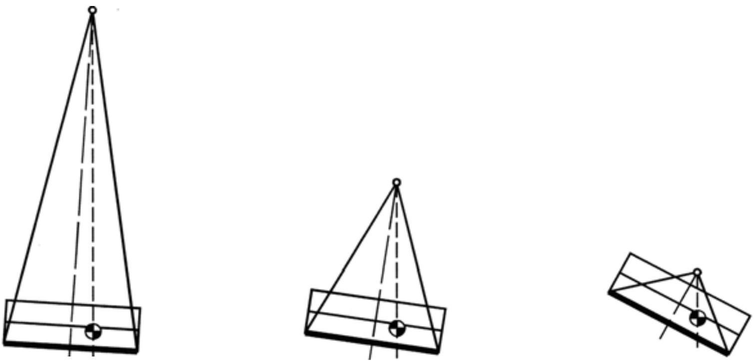
$$CG = \frac{0.4\ m \cdot 500\ kg + ((0.8\ m + 0.6\ m) \cdot 300\ kg) + ((0.8\ m + 1.2\ m + 1.25\ m) \cdot 2000\ kg)}{500\ kg + 300\ kg + 2000\ kg} = \frac{0.4\ m \cdot 500\ kg + 1.4\ m \cdot 300\ kg + 3.25\ m \cdot 2000\ kg}{2800\ kg} = \underline{\mathbf{2.54\ m}}$$

USE OF LOAD LIFTING DEVICES
Influence of rope/leg lengths on the inclination of a load (cages)

Leg length 8 m | Leg length 4 m | Leg length 2 m



Consequences on inclination



For practical purposes, this also means that with short slings more force is required for the alignment of the load.

The consequences of leg lengths are even greater if the sling is directly attached to the helicopter. A long line, for example, offers more margin for the handling of heavy loads.

Practical experience has shown that leg lengths of 5 m for three-leg (THLS) and four-leg slings (FLS) give good results.

The legs of multiple-leg slings can be extended with the aid of other slinging equipment (see next page).

USE OF LOAD LIFTING DEVICES
Principles of assembling load lifting devices for helicopter load transport

Description	Illustration
Helicopter with primary cargo hook The illustrations are not in scale!	
Shock absorber (SA), always **between primary cargo hook and cargo rope** 3-strand Polyamide rope, double or 4-fold, with or without sheathing Laid Polyamide fibres, sheathed Working elongation: ca. 15% Length 1 to 2 m Attention: for terminal accessories see instructions of the lifting hook manufacturer!	 L[1] 1 - 2 m
Cargo rope (CR) of adequate length Low-torsion steel rope (crane rope, ROTEX type) Textile ropes with low elongation Cross section as small as possible Round cross section Weight as low as possible in proportion to lifting hook Working elongation < 10% When round slings are used for extensions, they must be held together with a protective sheathing! **Cargo rope length incl. shock absorber, swivel joint and lifting hook = > rotor diameter x 1.5**	ShortLine L[1] < 20 m LongLine L[1] > 20 m 
Low-torque swivel / swivelling hook (SWH), **positioned where torsion begins,** **i.e. before it can influence the rope** Both manually or electrically operated ropes must always be detorqued. Torsion is very harmful to any rope!	
Cargo (lifting) hook (CH) of adequate size Cargo hook (manually or electrically operated) and low-torque swivel, heavier than cargo rope	
Slinging equipment of sufficient size/length	

Annotation: Illustrations refer to a manually operated line.

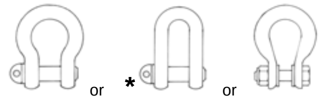
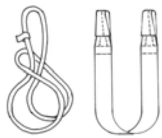
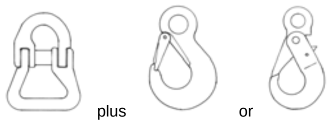
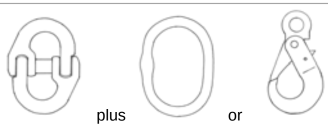
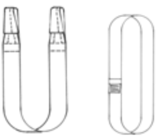
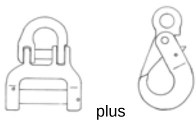
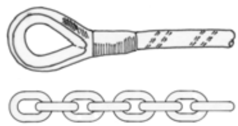
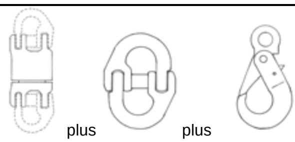
USE OF LOAD LIFTING DEVICES

Extensions/lengthenings of slinging equipment and load lifting means

The following figures, showing possible connections, are in conformity with the rules of technology.

The connections must be adequate for the intended use and regularly checked. Connections made with connex and hook are usually permanent (self-locking, self-securing hook).

The list is less than exhaustive.

Slinging equipment ➔	**Connection element ➔**	**Slinging equipment**
 For example round slings 	 * or * or	
		
	 plus or	
	 or	
	 plus or	
Hoisting belts 	 plus	
Load lifting device ➔	**Connection element ➔**	**... Load lifting device**
	 plus plus	

*** Safety advice:** Shackles are only suitable for temporary connections which are undone after each transport and subsequently reassembled. For permanent connections, i.e. for extensions of long lines or shock absorbers, shackles are not advisable; in fact, they can loosen in the case of impacts or vibrations. Due to their height, it is not possible to check the shackles visually. Both D-shackles and bow shackles can lead to shunt loadings!

Generally, however, when using shackles for permanent connections, further precautions are necessary and/or laces, lock wire or splint pins should be used for effective securing!

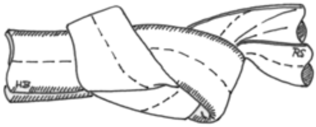
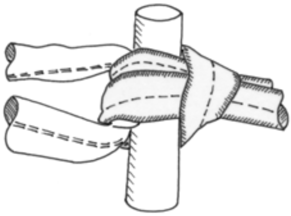
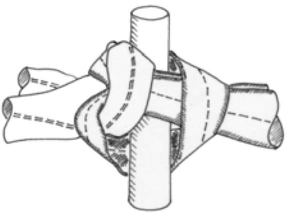
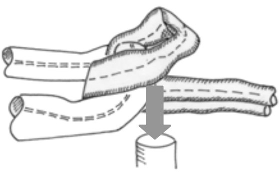
USE OF LOAD LIFTING DEVICES

Forbidden connections of slinging equipment and load lifting means

Although forbidden, these types of connections can be seen in real life! The reason why 2 round slings or hoisting belts are connected is often a lack of adequate connection elements or simply for convenience.

These types of connections are unqualified and forbidden! Any product catalogue states it clearly!

At full load, high temperatures are generated within the knots; furthermore; the use of knots results in a significant loss of carrying capacity. When a "false knot" is made, the load can even be lost.

Type of knot ➔	Description ➔	Consequences
	Ropes Simple knot	40 to 60% of loss of carrying capacity
	Round sling - hoisting belt Simple knot	Strong deflection = heat, loss of carrying capacity of ca. 20 to 40% Relatively tight knot
	Round sling - round sling Simple knot	Strong deflection = heat, loss of carrying capacity of ca. 20 to 40% Extremely tight knot
	Round sling - round sling Simple knot with distance keeper (DK)	 Loss of DK = knot remains
	Round sling - round sling False knot with distance keeper (DK)	 Loss of DK = loss of load

Attention: This symbol can be found in any product catalogue!!
FORBIDDEN - KNOTS - FORBIDDEN !!

The list is less than exhaustive.

USE OF LOAD LIFTING DEVICES

Limits of use and product life

		Assignment types for external cargo transport and slinging techniques																						
Material	**Abbr. 1)**	Logging	Erection work	Transports	Passenger transport		Sharp edges	Chemical substances	Friction	Extension	Temperature < 120°C	Temperature > 120°C	Slinging points	Angle of inclination up	Tying	Double tying	Coiled around		Life limit in h	Life limit > 3 years	According to condition			
Cargo hook	CH	●	●	●						●											●			
Swivelling hook	SWH	●	●	●						●											●			
Electrical cargo hook	ECH	●	●	●						●											●			
Textile or steel cargo rope	CR	●	●	●						●										●				
Shock absorber	SAS	●	●	●															●					
Concrete bucket	CB			●				●																
Load bag	LOB			●				●									●				●			
Load net	LON			●													●				●			
Water bag	WAB			●																	●			
Water bucket	WBK			●																	●			
Distribution bucket	DB			●				●													●			
Round slings	RS		●	●						●	●			●	●	●				●				
Round steel chains	RSC		●	●			●	●	●	●		●		●	●					●				
Wire ropes	WR	●		●				●			●				●	●				●				
Flat textile ropes	FTR		●	●							●			●	●	●				●				
Hoisting belts	HB		●	●							●													
Ropes with ring reinforcements	RRR			●						●				●	●	●				●				
Shackle	SH	●	●	●			●	●	●	●		●									●			
Four-leg sling	FLS		●	●						●											●			
Three-leg sling	THLS		●	●						●											●			
Two-leg sling	TWLS		●	●						●											●			
Eye bolts	EB		●	●									●											
Lashing straps	LS		●	●	only for load handling or securing																			
Pipe hooks	PH		●	●																				
Holding lines	HL		●	●																				

Explanation: ● = Permitted, provided employment is in accordance with the designated use

This table is not exhaustive and makes no claim to be complete.

Principle: According to EC-Directive 89/655/EEC on the use of work equipment, the latter must be checked regularly, at least once a year, by a qualified person who is expert in the field.

See also laws, directives and leaflets issued by national authorities.

1) For the abbreviations, see "Check list LLD" page 3.2.11

USE OF LOAD LIFTING DEVICES; Checklist

Allocation of the individual load lifting device components in helicopter lifting operations

Definitions of terms used	**Abr.**
Flight operation material All materials and accessories suitable for use in flight operation	**FOM**
Load lifting device All devices which serve to connect the useful load with the helicopter (lifting equipment)	**LLD**
Load lifting means	**LLM**
Cargo (Lifting) hook	CH
Swivelling hook	SWH
Electrical load lifting means Electrical or mechanical parts of the LLD which can be operated from the cockpit (pilot)	**ELLM**
Electrical cargo hook (long line in various lengths; logging or transport operations); (primary cargo hook, backup cargo hook, external cargo hook)	ECH
Load lifting attachments All devices for the direct attachment or positive and frictional slinging of useful loads and their attachment	**LLA**
Textile or steel cargo rope	CR
Concrete bucket	CB
Load bag	LOB
Load net	LON
Water bag	WAB
Water bucket	WBK
Distribution bucket	DB
Rescue platform	RP
Ski basket	SKI
Cradle	CR
Slinging equipment Positive and frictional equipment to be attached to the useful load or to serve as connectors	**SE**
Round slings (polyester)	RS
Round steel chains (quality grade 8)	RSC
Wire ropes (steel rope)	WR
Flat textile ropes (o.e. with loose ring)	FTR
Ropes with ring reinforcements	RRR
Shackle	SK
Four-leg sling	FLS
Three-leg sling	THLS
Two-leg sling	TWLS
Special equipment	**SPE**
Eyebolts, pipe hook	EB
Shock absorber	SAS
Ancillary equipment **Unsuitable for slinging loads as no load-carrying capacity is defined**	**AE**
Lashing straps (tiedown provision)	LAB
Holding lines	HL

This list is not conclusive and makes no claim to be complete.

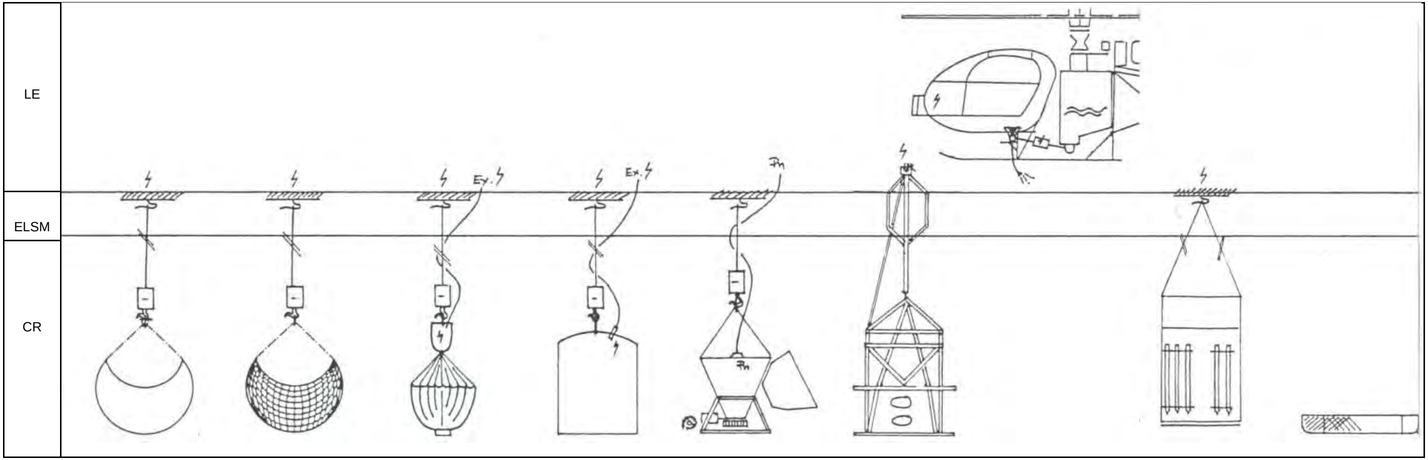
EXAMPLE OF THE ALLOCATION AND USE OF LLDs; Part 1: Definitions and ELLM / LLA

AL	m	CM	LE	  TC or STC!
			ELLM	 Primary cargo hook of the helicopter
EC Machinery Directive 98/37/EC	Load lifting device			CE-marking and EC-declaration of conformity must be supplied by the producer!    

Load ropes must always be used with a shock absorber.

AREA + ABB.				ALLOCA-TION	DESIGNATION	1. Aircraft	2. Long-Line	3. Load rope	4. Extension / lengthening	5. Rescue winch	6. Concrete bucket
Aviation law	m	CM	LE	Part of LIFTING EQUIPMENT	LIFTING EQUIPMENT (Helicopter)	Helicopter					
			ELLM		ELECTRICAL LOAD LIFTING MEANS	Various models of primary cargo hooks				Rescue winch	
EC Mach. Dir. 98/37EC	Load WL (Mass)	LLD	LLM	Not part of LIFTING EQUIPMENT (Helicopter)	LOAD LIFTING MEANS		Load rope Low torque swivel	Shock absorber / Load rope	2 x Load rope		Load rope and concrete bucket
			LLA		LOAD LIFTING MEANS / ELECTRICAL		Electrical cargo hook	Swivelling hook	Safety hook		Swivelling hook
			SE		SLINGING EQUIPMENT						3-leg sling on a bucket
			USL		USEFUL LOAD					People animals	Loose material

Part 2: Load lifting attachments (LLA's) shown as loads



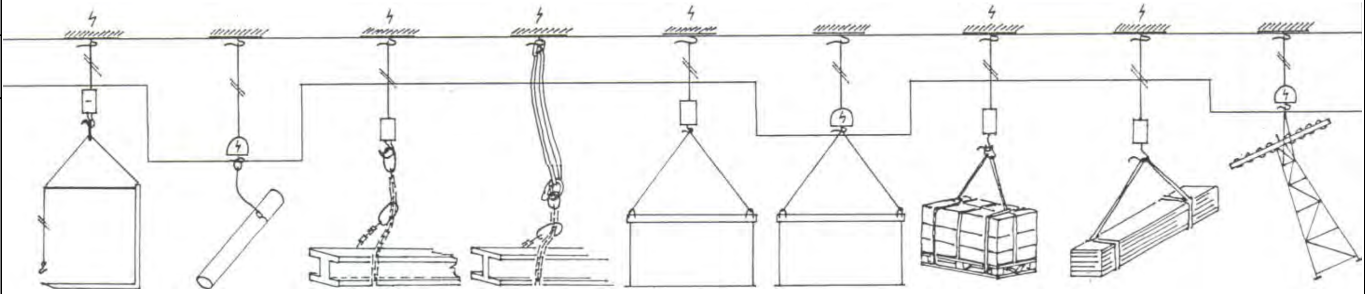
	7. LOAD BAG	8. LOAD NET	9. BAMBI	10. WATER BUCKET	11.DISTRIBUTION BUCKET	12. RESCUE PLATFORM *	13. SPRAY SYSTEM*	14. EXPLOSIVES CONTAINER *	15. SKI BASKET
LE							Helicopter		
ELLM	Primary cargo hook	Primary cargo hook	Primary cargo hook	Primary cargo hook	Primary cargo hook	Primary cargo hook		Primary cargo hook	
LLM	Can be used with swivelling hook or direct on the ELLM.								
LLA	Load rope and load bag	Load rope and load bag	Load rope and water bag "	Load rope and water container	Load rope and distribution bucket	Special sling	Spraying tanks	Special sling	Ski basket
SE	Shackle on the edge rope	Shackle on the edge rope	Shackle on the control unit	Lug on the container	3-leg sling				Rubber bungees or horizontal net (cat. STC)
USL	General and loose goods	General goods	Water	Water	Distribution material	People	Spray	Explosive and detonators	Skis, rucksacks

Part 3: Typical loads using slings

LE

ELSM

CR



	16. Cradles	17. Logging	18. Transport operations 1	19. Transport operations 2	20. Transport operations 3	21. Transport operations 4	22. Transport operations 5	23. Transport operations 6	24. Erection work
LE									
ELLM	Primary cargo hook	Primary cargo hook and electric long line	Primary cargo hook	Primary cargo hook	Primary cargo hook	Primary cargo hook and electric long line		Primary cargo hook	Primary cargo hook and electric long line
LLM	Swivelling hook		Swivelling hook		Swivelling hook				
LLA	Load rope and loading cradle		Load rope		Load rope		Load rope	Load rope	
SE	4- leg sling on cradle	Wire rope	Round steel chain	Round sling, shackle and round steel chain	4-leg sling	4- leg sling	Round slings or textile ropes	Round slings or textile ropes	Round slings or round steel chains
USL	Pallets	Round log	Sharp-edged steel	Sharp-edged steel	Containers, aggregates	Containers, aggregates	Paletted sacks	Boards, switchboards, pilings	Masts, cranes

Part 4: Slinging equipment and AE/SPE

SE	

	25. SE 1	26. SE 2	27. SE 3	28. SE 4	29. SE 5	30. SE 6	31. SE 7	32. SPE	33. AE
LE									
ELLM									
LLM									
LLA									
SE	Wire rope	Round sling	Round steel chain	Reinforced rope, steel	Flat textile rope	Shackle	2/3/4-leg sling	Shock absorber	Lashing straps
USL	Round log	No sharp edges	Sharp edges	Sling rope	No sharp edges	Link	Cubic useful load	Between LE and ELLM	Load securing

USE OF LOAD LIFTING DEVICES; Checklist

Allocation of the individual load lifting device components in helicopter lifting operations

Definitions of terms used	**Abbr.**
Flight operation material All materials and accessories suitable for use in flight operation	**FOM**
Load lifting device All devices which serve to connect the payload with the helicopter (lifting equipment)	**LLD**
Load lifting means	**LLM**
Cargo (lifting) hook	CH
Swivelling hook	SWH
Electrical load lifting means Electrical or mechanical parts of the LLD which can be operated from the cockpit (pilot)	**ELLM**
Electrical cargo hook (longline in various lengths; logging or transport operations);	ECH
Load lifting attachments All devices for the direct attachment or the form-fit and force-fit slinging of payloads	**LLA**
Textile or steel cargo rope	CR
Shock absorber	SAS
Concrete bucket	CB
Load bag	LOB
Load net	LON
Water bag	WAB
Water bucket	WBK
Distribution bucket	DB
Rescue platform	RP
Ski basket	SKI
Slinging equipment (including accessories, such as oval rings, connecting links, safety hooks, etc) Force-fit and form-fit equipment to be attached to the payload or to be used as connectors	**SE**
Round slings (polyester)	RS
Round steel chains (quality grade 8 or 10)	RSC
Wire ropes (steel rope)	WR
Flat textile ropes (o.e. with loose ring)	FTR
Hoisting belts (made of woven "Polyester")	HB
Ropes with ring reinforcements	RRR
Shackles	SH
Four-leg sling	FLS
Three-leg sling	THLS
Two-leg sling	TWLS
Special equipment	**SPE**
Eyebolts	EB
Ancillary equipment **Unsuitable for slinging loads, as no load-carrying capacity is defined**	**AE**
Lashing straps (tie-down device)	LS
Holding lines	HL
Pipe hooks	PH

This list is not exhaustive and makes no claim to be complete.

USE OF LOAD LIFTING DEVICES

Introduction to the list of "Slinging Techniques"

The list only shows the **principles** (basic rules) of the different slinging techniques (ST). As it is not exhaustive, it can be corrected or added to at any time.

The supreme principle of **"Safety First"** prevails over all short-term considerations or objections such as "it's too expensive, we don't have (enough) materials" or statements like "we've always done it the other way".

The main target is to guarantee safety during flying operations, i.e. to avoid total/partial loss of or damage to the cargo, as well as consequential property damage and/or personal injuries.

The risks are complex, in particular:
- The possible **effects the cargo may have** on human beings and the environment (danger to third parties or damage to the property of third parties);
- The possible **effects on cargo** (damage to the client's property, potential claims for compensation for loss of profits and business interruption);
- The possible **effects on slinging equipment** (damage), which may result in total or partial loss of cargo;
- The possible **effects on the aircraft service company** (personnel shortage or lost working days, percentage shares to be paid, liability, claims for compensation, prosecution, tarnishing of the company's reputation), which may detract funds for investment.

All accident investigations clearly show that the **"Non-observance of the basic rules"** often represents one of the triggering factors for an accident.

Any slinging technique, provided it has been thoroughly practised and is carefully performed, contributes to the minimisation of risk. This is why these pages mainly appeal to people who are being trained to work as marshallers.

A further prerequisite in order to guarantee safety during flight operations is the use of appropriate slinging equipment (SE) with CE-conformity, as described in chapter 3.2 of the Marshaller-Syllabus.

The construction and use of slinging and load lifting equipment are based on the acknowledged rules of technology (e.g. EN-standards), but standard slinging equipment and slinging techniques are not always up to the requirements of helicopter operations. These specific requirements are: dynamic, aerodynamic and weather-related influences, as well as the fact that during helicopter external cargo transports great distances and altitude differences must be rapidly and safely dealt with.

On pages 3.2.1 to 3.2.6 of the Marshaller-Syllabus, deviations (amplifications, additions) from the acknowledged rules regarding the construction and the necessary equipment (calculation, assembly, choice) are described, while the specific characteristics for the use of slinging and load lifting equipment (slinging, extensions, combined use, etc.) can be found on pages 3.2.7 to 3.2.14.

There is no such thing as a zero risk. Hence, the revision of practical experience, continuous discussion aimed at finding better solutions and the impartial, but critical examination of new procedures are musts (page 3.3.4). Please also see: ICAO DOC 9859 SMM, AN/474, chapters 4 and 5)

Exceptions

Deviations from the acknowledged rules of technology are only permitted if at least the same or a higher level of safety can be achieved in a different way. The basic principles according to the general rules of technology (standards) and the specific rule of technology (Marshaller-Syllabus) must be well-known, thoroughly practised and must have already been performed.

+ To know the basic principles means: to be able to develop, on the spot, extended, but safe slinging techniques by amplifying safe standard slinging techniques, know how to combine different work equipment (assembly of extensions) and be able to solve problems as they arise.

+ The fundamental prerequisite for any deviation from the basic principles is having a thorough knowledge of them, wide experience as well as the development of a risk assessment.

Principles of training

Any total or partial loss of cargo must be avoided by all means!

The appropriate and inappropriate slinging techniques shown in chapter 13 (+) and 14 (-) must be taught on the 2.1 training level (immediate training).

Regarding the assembly of cargo, the proven graduation of the training in chapter 2 is applied as follows:

2.1 Simple and safe assembly of cargo, probably suitable for more than 80% of payloads.
Application: marshallers who have undergone basic training (initially supervised by a tutor / experienced marshaller)

2.2 Complex assembly of cargo
Application: experienced marshaller, assisted by other marshallers or neo-marshallers

2.3 Exceptional cargo
Application: marshaller with considerable experience.
Precondition: thorough risk analysis and written justification for the transport of exceptional cargo!

Structure of the work sheets (+) slinging techniques

The work sheets provide basic terms, safe applications as well as safety advice.

Their main focus is on the cargo – consisting of the payload, the slinging equipment and, in certain cases, auxiliary means for securing – and on the specific slinging technique required by the type of cargo in order to guarantee safe handling.

The illustrations are not exhaustive!

Type of payload

Short list of possible types of payloads.

Equipment / Type / Abbreviation

Indication of the type of slinging and load lifting equipment (see also 3.2.11)

Application +

Illustration of a type of cargo, consisting of the useful load (payload), the slinging equipment or the load lifting means and, in certain cases, special equipment (definitions USL, SE, LLM, SPE, etc. see page 3.2.11)

Basic principles of slinging technique / Extensions

Any slinging technique is based on several principles, which can be found in chapter 3.2 of the Marshaller-Syllabus. Relevant page numbers are indicated.

The basic principles of the correct assembly of "extensions" are illustrated by means of examples. By referring to the page numbers you will better understand why it may sometimes be necessary to extend slinging equipment.

Advantages / Risks / Limitations / Forbidden

Short descriptions of the essential characteristics of the different slinging techniques, with indications of relevant pages in the Marshaller-Syllabus.

Measures

A short list of possible measures to avoid hazards.

Recommendations (at the end of the list of (+) slinging techniques

Summary of the positive results of the different measures adopted and some additional recommendations.

Structure of the work sheets (-) slinging techniques

Illustrations and short descriptions of the most serious risks. Due to technical and safety reasons (special requirements for helicopter external cargo transport), the information given may differ from the acknowledged rules of technology or from other publications issued by equipment producers and/or authorities.

The lists and illustrations of possible hazards and their consequences are not exhaustive.

Illustration
The inappropriate slinging techniques and their danger zones are shown in drawings. Possible hazards have been confirmed by tests carried out with a crane.

Reasons
Short descriptions of the danger zones.

Attention: Do not reproduce the illustrations shown with one of your company's helicopters, as this may create significant hazards!

Assessment criteria for the correct assembly of cargo
(choice of slinging techniques)

The following explanations will help users and instructors to correctly assess a load.

Definition "partial loss of cargo"
When part of a cargo is lost during transport:

- a wooden board that has slipped out of its stack
- a demolition chisel that has fallen out of the cargo net
- pieces of wood that have slipped out of a wire mesh collapsible pallet.

Loss of a branch during logging, a screw during construction work or a pebble during air transport of concrete all constitute a partial loss of cargo!

These types of partial loss of cargo are part of the remaining risk and can, therefore, not be completely excluded. Hence, besides the adoption of safe slinging techniques, additional measures must be taken.

- During cargo preparation, look for loose parts and remove them (= elimination of hazard)
- Do not allow unauthorised third parties into the danger zone (= exclusion of hazard)
- Reduce the number of persons involved to the minimum necessary (= limitation of hazard)
- Wear personal protective equipment (= protection from hazard)
- Carefully observe the cargo during helicopter approach and departure (= shortening of reaction time)

Definition "total loss of cargo"
When the entire cargo is lost during transport:
- due to damaged slinging and/or load lifting devices
- due to inappropriate slinging techniques
- due to involuntary release from the cargo hook
- due to disassembly of the cargo (cargo loosing its shape/stability/cohesiveness).

Obligation to report: Even if no damage has occurred, total and partial losses of cargo must be reported to the aviation authority in charge (SMS aviation notification system).

The partial or total loss of cargo must be avoided by all means!

Assessment of cargo flights taking place in different work environments

☐ **Short flights, safe territory**

Danger to persons excluded, small effects on the environment, little damage to the payload (no or small compensation for damages/liability).

- "Safe territory" means: ravines, grassland, forests, building sites with no admittance to unauthorised personnel
- "Partial losses" means: stones from charging buckets, logs, boards, sacks, branches, etc.
- Type of payload: innocuous (non-hazardous goods), replaceable
- Difficulty of slinging technique: normal, simple, no need of auxiliary means (tie-down straps, etc.).

☐ **Long flights, populated area**

Danger to persons never permissible, small effects on the environment, from little to considerable damage to the payload (from small compensation for damages to cases of legal liability, legal prosecution cannot be excluded).

- "Populated area" means: isolated farm houses, hamlets, roads and railroads, tourist facilities
- "Unknown objects" means: foreign objects that are hidden or cannot be seen by the marshaller or client during the cargo preparation phase
- Type of payload: innocuous (non-dangerous goods), replaceable
- Difficulty of slinging technique: considerable, more slinging equipment necessary, use of auxiliary material may be necessary.

☐ **Assembly work (persons exposed to risk)**

Partial losses of cargo not permissible, danger to persons from considerable to fatal, effects on the environment from considerable to exorbitant, considerable damage to the payload (compensation for damages, legal liability, legal prosecution).

- "Exposure to risk" means: when on masts, in open territory, inside wells or buildings
- "Danger to persons" means: when under suspended cargo, in the absence of escape routes, when persons are tied to objects for safety reasons (secured with PPE)
- Type of payload: lifts, cranes, funicular masts, masts in general, containers of dangerous goods
- Difficulty of slinging technique: high, use of safe slinging equipment and slinging points, repeated use of auxiliary material may be necessary (tie-down straps, safety nets, etc.), PPE for marshallers obligatory.

☐ **Flights over towns or densely populated areas**

Danger to persons from considerable to fatal, effects on the environment from considerable to exorbitant, considerable damage to the payload (compensation for damages, legal liability, legal prosecution).

- "Densely populated" means: hamlets, villages, towns, public facilities (baths, stadiums, train stations)
- "Danger to persons" means: when under suspended cargo, in the absence of escape routes
- Type of payload: all types of payloads
- Difficulty of slinging technique: elevated, use of safe slinging equipment and slinging points, repeated use of auxiliary material may be necessary (tie-down straps, safety nets, etc.).

List not exhaustive.

Editorial notes

At our website www.heli-syllabus.org you will find the item "Work Group", as well as a specific work group dealing with load lifting devices (LLD WG). Feel free to participate at any time in this group and to forward us your constructive criticism.

For a table of contents of chapters 3.2.13 and 3.2.14, see chapters 1.2 (Contents + List of valid pages) and 3.0.

(+) Slinging techniques

Type of payload	Loose materials, small parts, crates, hoses, concrete-breaker				
Equipment	Load lifting means (LLM)	**Type**	Flexible intermediate bulk container	**Abbr.**	FIBC

Application +

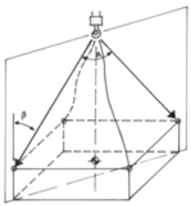
FIBC, SF 8:1 or 6:1

Construction and design requirements see page 3.2.6-7

Caption: Flexible intermediate bulk container (FIBC) for non-dangerous goods.

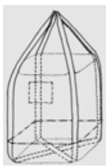
Basic principles of slinging technique

Four-leg sling



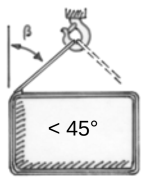
Pages 3.2.3-2, 3.2.7-1

1 pair of lifting straps looped around the bag and crossed at the bottom



Page 3.2.7-1

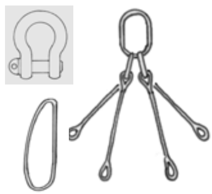
Angle of inclination (AI)



Page 3.2.3-3

Extensions

4 x or



Pages 3.2.2-6, 3.2.7-5

Advantages

- Transport of small parts
- Stable cargo
- Interim storage possible
- Weather protection

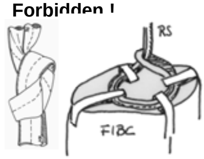
Risks

- Sharp edges (metal sheets, tiles)
- Heat exhaustion at > 120°C or in case of friction or hot cargo
- Chemicals, UV rays, fuels
- FIBC of unknown origin

Limitations

- Only adopt FIBC SF 5:1 (single trip FIBC) if you are sure of their origin and of the fact that they are used only once.
- Lifting straps with short seams and loops = risk of breakage (rupture of seam or cloth)

Forbidden !



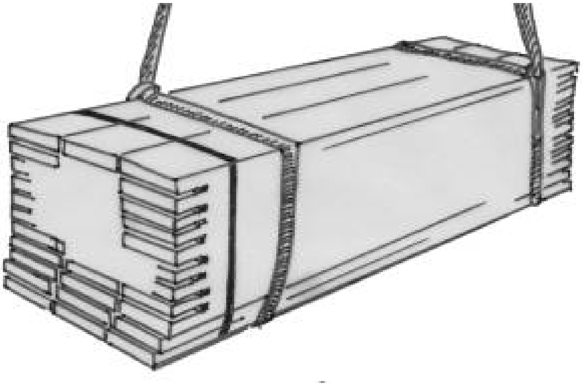
Any type of knots!
See also page 3.2.7-6

Measures:	Wrap problematic materials in adequate and resistant packaging	Transport FIBCs of any SF, which are damaged, inappropriate or dubious, within a cargo net	Use extensions, if the legs are too short (< 1m)

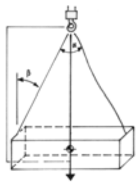
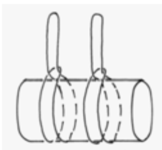
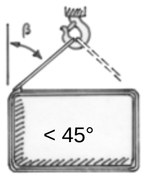
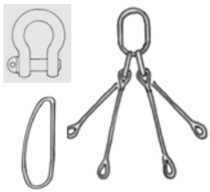
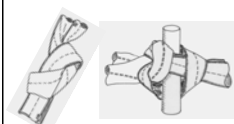
(+) Slinging techniques

Type of payload	Stacks of wooden boards, beams, square timbers; several stacks placed side by side (1)				
Equipment	Slinging equipment	**Type**	Round sling	**Abbr.:**	RS

Application +



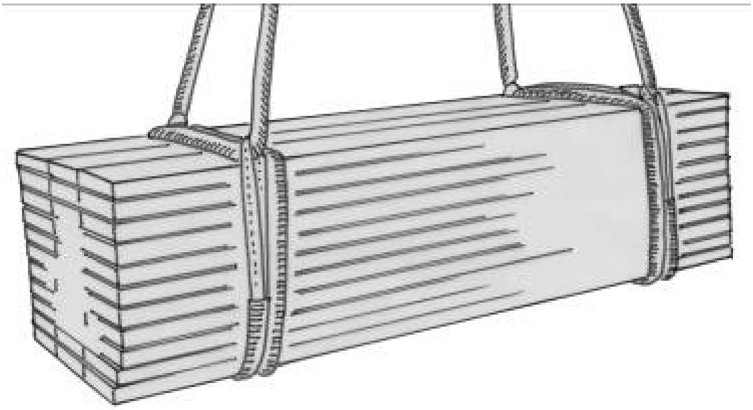
Caption: Bundled, rough sawn planks with stacking batten, tied together by means of a steel strap. Rigged on the left and the right by 1 round sling per side, with traction exerted on the deflection. Good form and force closure.

Basic principles of slinging technique			**Extensions**
Two-leg sling  Pages 3.2.3-2, 3.2.7-1	1 pair of tied round slings  Page 3.2.7-1	Angle of inclination (AI)  Page 3.2.3-3	4 x or  Pages 3.2.2-6, 3.2.7-5
Advantages ▶ Fast slinging	**Risks** ▶ Sharp edges, splinters of wood ▶ Heat exhaustion at > 120°C or in case of friction ▶ Fuel, oil, particulates ▶ Sling leg wobbling ▶ Steel straps, binding wire	**Limitations** ▶ Slinging technique appropriate only for tied stacks of wood ▶ AI not greater than 45° (load collectives) ▶ Cargo tends to seesaw or rotate	**Forbidden !**  Any type of knots! See also page 3.2.7-6
Measures:	Protection of all edges, Protective sheathing	Securing with tie-down straps	Use of extensions (page 3.2.7-5)

(+) Slinging techniques

Type of payload	Stacks of wooden boards, beams, square timbers; several stacks placed side by side (2)				
Equipment	Slinging equipment (SE)	**Type**	Round sling	**Abbr.**	RS

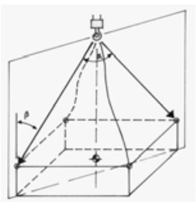
Application +



Caption: Rough sawn planks, loosely stacked. Rigged on the left and the right by 2 round slings per side, with traction exerted on the deflection. Good form and force closure, stable cargo.

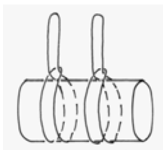
Basic principles of slinging technique

Four-leg sling



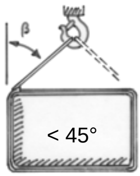
Pages 3.2.3-2, 3.2.7-1

2 pairs of tied round slings



Page 3.2.7-1

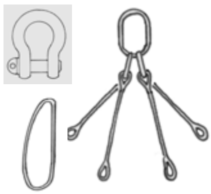
Angle of inclination



Page 3.2.3-3

Extensions

4 x or



Pages 3.2.2-6, 3.2.7-5

Advantages

- Safe transport of stacks without stacking battens and steel straps
- Stable cargo

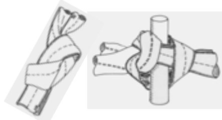
Risks

- Sharp edges, splinters of wood
- Heat exhaustion at > 120°C or in case of friction
- Fuel, oil, particulates
- Sling leg wobbling
- Steel straps, binding wire

Limitations

- Angle of inclination (AI) not greater than 45° (load collectives)
- All round slings used must be of the same length

Forbidden !



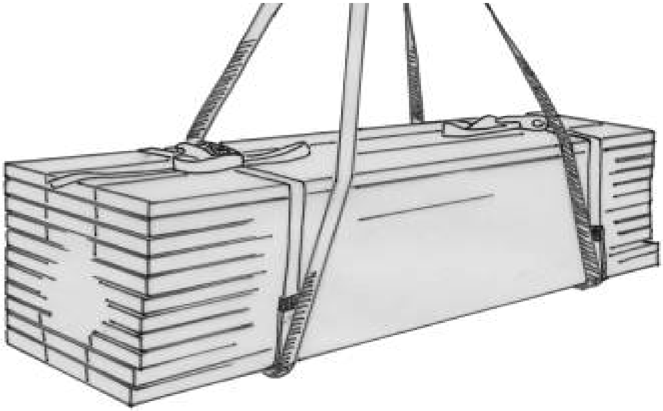
Any type of knots!
See also page 3.2.7-6

Measures:	Protection of all edges or protective sheathing	Availability of enough RS, extensions	Use extensions (page 3.2.7-5)

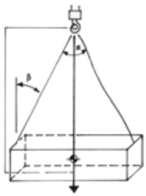
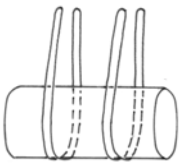
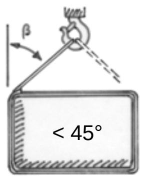
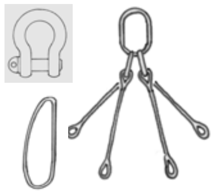
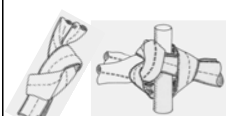
(+) Slinging techniques

Type of payload	Stacks of wooden boards, beams, square timbers; several stacks placed side by side (3)				
Equipment	Slinging equipment (SE)	**Type**	HB, TDS	**Abbr.**	LAM-LT

Application +



Caption: Loosely stacked planks. Cargo is secured by means of 2 tie-down straps (TDS), all edges are covered with protective sheathing. The hoisting belts (HB) are looped around the cargo.

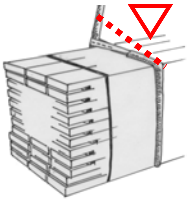
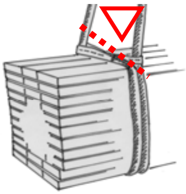
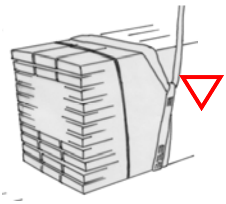
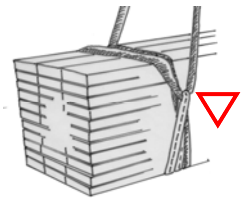
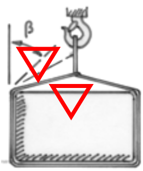
Basic principles of slinging technique			Extensions
Two-leg sling  Page 3.2.3-2, 3.2.7-1	1 pair of hoisting belts, looped around the cargo  Page 3.2.7-1	Angle of inclination (AI)  Page 3.2.3-3	4 x or  Pages 3.2.2-6, 3.2.7-5
Advantages	**Risks**	**Limitations**	**Forbidden !**
▶ Safe transport of stacks without stacking battens and steel straps ▶ Stable cargo ▶ Tying the lashing straps increases pressure, keeping the cargo together.	▶ Sharp edges, splinters of wood ▶ Heat exhaustion at > 120°C or in case of friction ▶ Fuel, oil, particulates ▶ Sling leg wobbling ▶ Steel straps, binding wire	▶ Angle of inclination (AI) not greater than 45° (load collectives) ▶ All hoisting belts or round slings must be of the same length	 Any type of knots! See also page 3.2.7-6
Measures:	2 protective sheathings endowed with nooses; Remove all foreign bodies	Cargo strapping consisting of 2 tie-down straps to secure the load.	Use extensions (page 3.2.7-5)

General recommendations

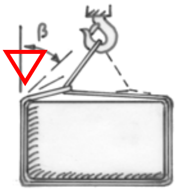
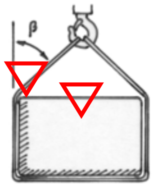
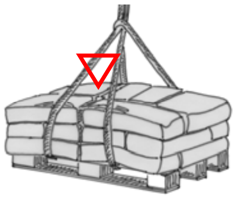
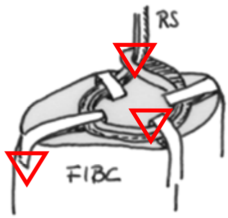
- Round slings should have a sufficient length to be within the range of the indicated angles of inclination (see pages 3.2.2-3, 3.2.3-2 and -3).
- The shorter the lifting straps, the greater the angles of inclination which leads to a banking position of the cargo (see also page 3.2.7-3).
- If the round slings available are too short, please use a four-leg sling (FLS) (see page 3.2.2-6) or other round slings and maybe shackles to create an extension (see page 3.2.7-5).
- Round slings should be covered with a sheathing in order to protect them from dirt and abrasion. Furthermore, this guarantees easier handling of the sling, prevents the wobbling of its legs and avoids entanglements of the slings both on the cargo and on the ground.
- Protective sheathing also facilitates the gliding of the hoisting belt on bends and deflections.
- Round slings with protective sheathings must be moved inside the sheathing from time to time in order to avoid stress always at the same point.
- Never use steel straps for securing the load, but only tie-down straps (the breaking strength of steel straps is not specified).
- Only use FIBCs with SF 5:1 if you can be sure they are new, undamaged and correctly filled. If the legs/loops are too short, use a four-leg sling for transport.

(-) Slinging techniques (ST)

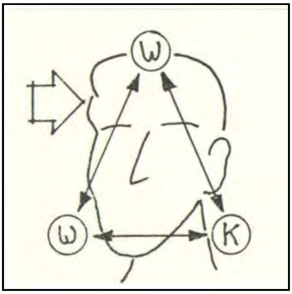
▽ = Danger zones

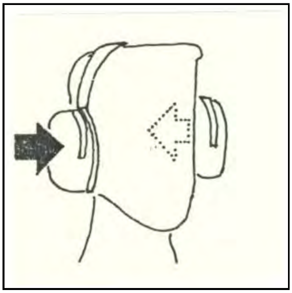
Inappropriate or problematic slinging techniques		
No.	**Illustration**	**Reasons**
1	**ST: 1 lifting belt / round sling per side, tied without deflection** 	▽ Round sling slips upwards ▽ Jerky shifting of round sling cannot be excluded ▽ Planks/beams might slip out of the cargo ▽ The illustration contained in Suva leaflet 88801 "Slinging of cargo", figure 5, is unsuitable for helicopter cargo flights.
2	**ST: 1 pair of lifting belts / round slings per side, tied without deflections** 	▽ Round slings slip upwards ▽ Jerky shifting of round slings under tension or during flight ▽ The illustration contained in Suva leaflet 88801 "Slinging of cargo", figure 5, is unsuitable for helicopter cargo flights.
3	**ST: 1 lifting belt / round sling per side, tied in strong deflection below the upper edge** 	▽ Half knot ▽ Extremely strong deflection ▽ Heat development under tension ▽ Strong tendency to seesawing
4	**ST: 1 pair of lifting belts / round slings per side, tied with strong deflections below the upper edges** 	▽ Half knot ▽ Extremely strong deflection ▽ Heat development at deflection point
5	**ST: tied with deflection at the centre** 	▽ Angles of inclination greater than 45° and more than 60° (AI >60° are forbidden, see page 3.2.3-3) ▽ Planks/beams might slip out of the cargo ▽ Planks/beams might loosen and flip up due to lateral pressure (assembly of round cargo) ▽ Insufficient form and force closure

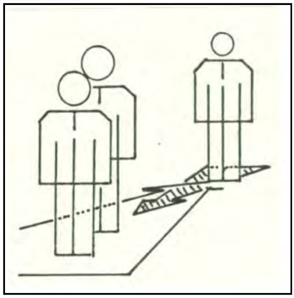
Inappropriate or problematic slinging techniques

No.	Illustration	Reasons
6	**ST: tied with deflection dislocated to one side**	
		▽ Angles of inclination greater than 45° and more than 60° (AI >60° are forbidden, see page 3.2.3-3) ▽ Planks/beams might slip out of the cargo ▽ Planks/beams might loosen and flip up due to lateral pressure (assembly of round cargo) ▽ Insufficient form and force closure
7	**ST: sling only looped around the cargo (without additional securing)**	
		▽ Sling is only looped around the cargo ▽ Insufficient force closure ▽ Cargo might fall out of the round sling ▽ See page 3.2.7-1
8	**ST: 1 tied round sling**	
		▽ One round sling is never enough! ▽ Refers to all types of cargo
9	**FIBC with safety factor 5:1**	
		▽ On principle, FIBCs with SF 5:1 are for single trip use ▽ Damage due to UV rays (bottom rupture during flight, loss of cargo, flying up of empty FIBC) ▽ Damage to FIBC, caused by its content (bitumen, sharp edges, etc.) ▽ Origin, age, state, content of FIBC? ▽ WLL, seams and lengths of loops? ▽ Existence of openings and/or closure devices on the FIBC bottom may cause sudden opening during flight

3.3







Protection

&

Risk assessment and management

EFFECTS OF NOISE ON HUMAN BEINGS

Helicopter noise levels and the effect of noise on people in their workplaces

Noise (L_m) > 85 dB(A) can cause irreparable damage to the hearing. Damage to the hearing caused by workplace noise and inadequate hearing protection are considered by the AIL as occupational illnesses. Hearing protection is compulsory when noise levels >88 dB(A).

Noise table + the effects of noise

Helicopter type and values	**Marshaller, lifting site**	**Marshaller, unloading site excl. refuelling**	**Marshaller, unloading site incl. refuelling**	**Marshaller/ mechanic, refuelling only**	**Pilot**
SA 315b LAMA					
L_m dB(A) [1]	87	85	90	103	96
Exposure % [2]	50	50	50	10	60
L_{eq} [3]	84	82	87	90	93
HP [4]	**--**	**--**	**(X)**	**X**	**X**
AS 350 Ecureuil					
L_m dB(A)	84	81	93	98	93
Exposure %	50	50	50	10	60
L_{eq}	81	< 80	90	88	91
HP	**--**		**X**	**X**	**X**
Bell 214					
L_m dB(A)	85	83	90	106	--
Exposure %	50	50	50	10	--
L_{eq}	82	80	87	96	--
HP	**--**	**--**	**(X)**	**X**	**--**
KAMAN 1200 K-MAX					
L_m dB(A)	80	80	--	105	100
Exposure %	50	50	--	10	60
L_{eq}	< 80	< 80	--	102	98
HP	**--**	**--**	**--**	**X**	**--**
AS 332c Super Puma					
L_m dB(A)	89	84	92	106	95
Exposure %	50	50	50	10	60
L_{eq}	86	81	89	96	92
HP	**(X)**	**--**	**X**	**X**	**X**

Key:

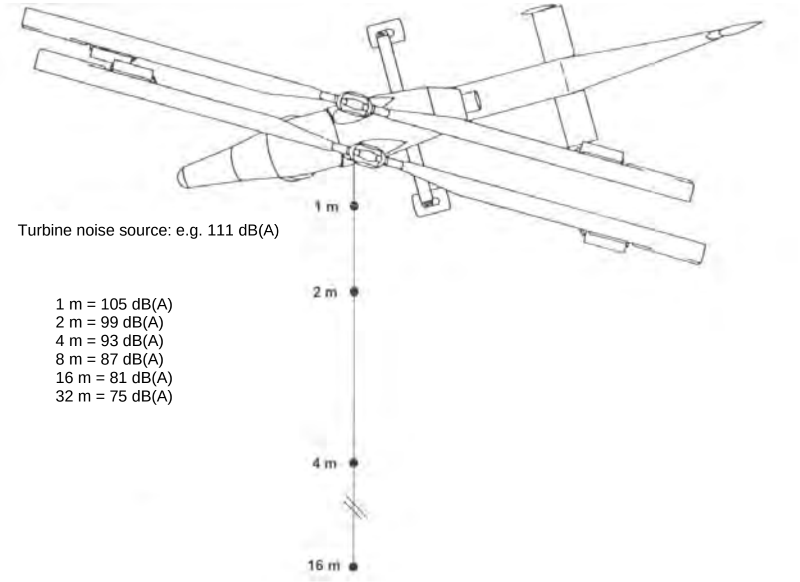
1) L_m is the average noise level measured over a certain length of time. All data subject to verification.
2) Exposure times are based on the assumption that the pilot achieves a maximum of and an average of 60% exposure per day (100% = 8 hours per day). In the case of marshallers, it has been assumed that exposure while flying in the helicopter achieves overlapping noise levels of approx. 50% between the individual groups, etc.
3) L_q takes exposure time (logarithmic value) into consideration
4) HP = hearing protection: -- = not necessary, usually present as part of the headset;
   (X) = in the border zone between 85 and 88 dB(A), hearing protection is recommended; X = hearing protection is compulsory

Hearing protection is compulsory above a threshold value of 88 dB(A)!

EFFECTS OF NOISE ON HUMAN BEINGS

Behaviour-related measures

1. Doubling the distance reduces the effect of noise by 6 dB

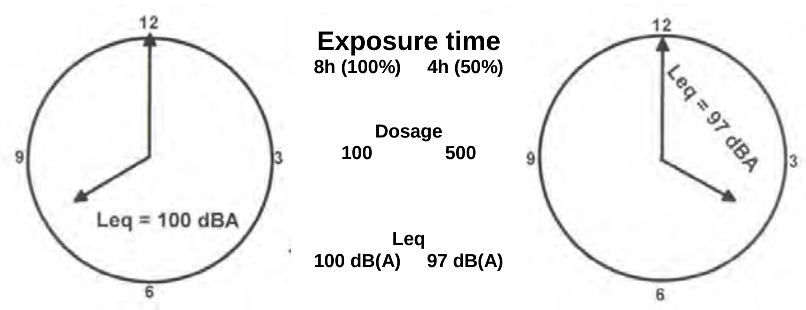


Turbine noise source: e.g. 111 dB(A)

1 m = 105 dB(A)
2 m = 99 dB(A)
4 m = 93 dB(A)
8 m = 87 dB(A)
16 m = 81 dB(A)
32 m = 75 dB(A)

2. **The dosage E (energy) at constant sound pressure level L decreases with the shortening of the exposure time**

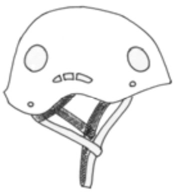
   Example: L of 100 dB(A) per 8 hrs/day = exposure of 100% = Leq 100 dB(A) or a dosage of 1000
   L of 100 dB(A) per 4 hrs/day = exposure of 50% = Leq 97 dB(A) or a dosage of 500



NOISE PROTECTION

Construction and use of radio helmets for marshallers

Basic construction



The use of mountaineer helmets (EN 12'492) with added noise protection / speaking devices (Headsets, EN 352-1 to -3, noise protection class 2) has given good results.

- good ventilation
- does not put pressure on the head (impact absorbing material not foam based)
- chin strap
- short front rim to maximise upward visibility
- short rear rim to allow backward movement of the head
- lateral profile of helmet suitable for the integration of a headset
- if possible, there should be openings for inserting a headset
- solidly mounted and weather resistant headset, microphone, PTT button (Push To Talk), cable to radio
- headset screwed or clicked in (dependent on helmet type)

Please pay attention to the fact that helmets, according to their construction type, may loose their EC-homologation (type approval) when a headset is mounted (boreholes, cut-outs).

However, protection according to EN 12'492 is of less importance than providing marshallers with multifunctionality by combining the possibility of communication with protection and comfort!

Practical use: "Full protection - two way communication"

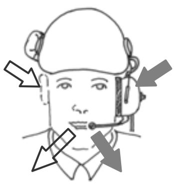
Full protection (head, ears, eyes)

Two-way communication (marshaller - pilot or marshaller - marshaller)

Communication only with the help of the speakers (listen) and the microphone (talk)

- Working in proximity of a helicopter (fuelling, loading/unloading of persons or objects, crew member on board, assembly work, etc.).
- Fuelling, elevated concentration during assembly work, short attachment lengths (< 20m), crew member on board.

Practical use: "Partial protection - multiple communication"



Partial protection (one ear free)

Multiple communication (marshaller - pilot - third parties)

Left = radio communication with helicopter; right = team, ground, third parties

- Working (logging, assemblies, transport, etc., communication with clients, third parties)
- Adjacent noises (rolling stones, wood, rushing noises, car traffic, direction of an approaching helicopter).
- Voice communication with collaborators or third parties (information on tasks, moving objects, warnings regarding approaching danger).
- Orientation (direction of approaching helicopter, position of other persons, location of rolling stones).
- Information given by the pilot or other marshallers.
- Working with loads, attachment/detachment of loads, communication within the team, training, breaks during work on the ground or during stand-by.

Communication by radio
Direct communication by voice

EFFECTS OF THE WIND ON HUMAN BEINGS (WINDCHILL)

Temperature table dependent on wind speed (Source: H.A.I. Safety Manual, Page 1000-3)

Wind speed [1]				Static temperature (°C)											
Calm				**10**[1]	**4.5**	**- 1**	**- 6.5**	**- 12**	**- 18**	**- 23**	**- 29**	**- 34.5**	**- 40**	**- 45.5**	**- 51**
mph	**kts**	**m/s**	**km/h**	**Average resultant external temperature °C**[2]											
5	4.4	2.2	8	9[3]	3	- 3	- 9	- 14.5	- 20.5	- 26	- 32	- 38	- 44	- 49	- 55.5
10	8.8	4.4	16	4.5	- 2	- 9	- 15.5	- 23	- 31	- 36	- 43.5	- 50	- 57	**- 64**	**- 70.5**
15	13.4	6.7	24	2	- 5.5	- 13	- 20.5	- 28	- 35.5	- 43	- 50	- 58	**- 65**	**- 73**	**- 80**
20	17.6	8.8	32	0	- 8	- 15.5	- 23	- 32	- 39.5	- 47	- 55	**- 63.5**	**- 71**	**- 79**	**- 86.5**
25	22.4	11.2	40	- 1	- 9	- 18	**- 26**	- 34	- 42	- 50.5	**- 59**	**- 66.5**	**- 75.5**	**- 83.5**	**- 91.5**
30	26.8	13.4	48	- 2	- 10.5	- 19	- 28	**- 36**	- 44.5	- 53	**- 61.5**	**- 70**	**- 78.5**	**- 87**	**- 95.5**
35	31.2	15.6	56	- 3	- 11.5	- 20	- 29	- 37	- 46	- 55	**- 63.5**	**- 72**	**- 80.5**	**- 89.5**	**- 98.5**
40	35.6	17.8	64[4]	- 3.5	- 12	- 21	- 29.5	- 38.5	- 47	- 56	**- 65**	**- 73.5**	**- 82**	**- 91**	**- 100**

NO RISK	**LOW RISK**	**INCREASED RISK**	**HIGH RISK**
Applying standard precautions, the conditions are still quite comfortable	Thermo clothing necessary	Risk of frostbites on exposed body parts within minutes	Unprotected body parts may freeze within 30 seconds

Attention: risk of frostbites

Risk of frostbites at prolonged exposure at **-26** Frostbite possible within 10 minutes at **-36** Frostbite possible within less than 2 minutes at **-59**

1) The conversion of wind speeds is carried out from mph (US) to kts, m/s and km/h. (1mph = 1.609km/h, vice versa 1km/h = 0.621mph; 1kt = 1nm/h; 1nm/h = 1.852km/h vs. 1km/h = 0.539nm/h; 1m/s = 3.6 km/h vs. 1km/h = 0.277m/s; 1m/s x 2 = 1kt.
The decimal numerical values in the original table (example: 30 °F = -1.1 °C), resulting from the conversion from Fahrenheit (°F) to Celsius (°C), have been rounded to the nearest whole or half number. Conversion formulas: °C: = °F - 32 x 5 : 9 (example –20°F - 32 : 9 · 5 = –28.8°C); vice versa °F: = °C : 5 x 9 + 32 (example: –4°C : 5 · 9 + 32 = 24.8°F). Source of conversion values: "Geographical Conversion Tables", Amiran + Schick, The Hebrew University of Jerusalem / Zurich 1961, pages 52, 59 and 2404). Wind speeds higher than 64 km/h have a low additive effect.

This table can be used for:
- marshallers exposed to down-wash (choice of protective clothing, time of exposure)
- rescue personnel attached to the rescue winch in forward flight (choice of protective clothing, time of exposure)
- persons exposed to the wind on chairlifts, etc. (time of exposure)

EFFECTS OF THE WIND ON HUMAN BEINGS

Wind speeds and their effects (Beaufort scale)

Helicopter flights are also dependent on the wind. The point at which a flight is cancelled can lie between Beaufort 3 and 5 according to the type of work, exposure or the type of load. Consideration must also be given to the fact that constant wind is less hazardous than gusts.

On the other hand, helicopters produce down wash in the range between Beaufort 5 and 10 and higher.

The feasibility of a helicopter flight can also be dependent on the marshaller's adequate or inadequate degree of protection from the cold.

In conjunction with the temperature table on the previous page, the effects of the wind and the down wash on human beings can be interpreted.

Beaufort scale

Beaufort		km/h	Knots (kts)	Fanion	Down wash e.g. AS 332
0	Calm or almost calm	1	<1	No movement	
	Smoke rises almost vertically				
1	Light air	3	2	No movement	
	Direction shown by smoke				
2	Light breeze	9	5	Slight movement	
	Wind felt on face, leaves rustle				
3	Gentle breeze	16	9	Flapping	
	Leaves and twigs in motion				21 km/h During take-off, 40 m in front of the helicopter in the direction of take-off
4	Moderate breeze	24	13	Stretched	
	Raises dust, loose paper and moves small branches Flags fully unfurled				32 km/h Helicopter standing on the ground, rotor rotating
5	Fresh breeze	33	18	Tightly extended	
	Small trees in leaf begin to sway				34 km/h No external load, 10m hovering, within the rotor area
6	Strong breeze	45	24	Tightly extended	
	Large branches in motion, whistling in telegraph wires. Wind audible on houses and fixed objects.				43 km/h With max. external load, 20 m hovering, in the centre of the down wash
7	Moderate gale	56	30		
	Whole trees in motion Difficult to walk against wind				56 km/h No external load, 20 m hovering, within the rotor area

Beaufort km/h Knots (kts) Fanion Down wash e.g. AS 332c

8	Fresh gale	68	37	
	Twigs break off trees Progress impeded			74 km/h No external load, 10 m hovering, in the rotor area at the side of the helicopter
9	Strong gale	82	44	
	Large branches not in leaf break off Slight structural damage occurs (chimney pots and slates blown off)			94 km/h No external load, 10 m hovering, 20 m at the side of the helicopter
10	Whole gale	96	52	
	Trees blown down or uprooted Considerable structural damage			104 km/h With max. internal load, 20 m hovering 20 m at the side of the helicopter
11	Storm	110	60	
	Numerous instances of damage			108 km/h With max. external load, 10 m hovering 20 m at the side of the helicopter
12	Hurricane	115	63	Maximum value measured
	Widespread destruction			115 km/h at take-off with max. take-off weight (internal load) of 9000 kg

Organisational measures

When helicopters are around always make sure that

.... ski jackets, bits of plastic sheeting, cardboard boxes, boards, signposts, chairs tables, large and small panels,
plastic buckets, empty drums, tablecloths, glasses,
table settings, sun umbrellas, small dogs, chickens,
geraniums and other flower pots, toys ...
... and anything that could break free on its own ...

... are tidied away!!!

Behaviour-related measures

Consideration must always be given to the cooling effect of the wind where assignments in working areas exposed to the wind are concerned. Warm protective clothing or other suitable equipment are recommended.

RISK ASSESSMENT AND MANAGEMENT (Principles applying to company management and personnel responsible for safety/safety officers)

Risk management

"Risk Assessment and Management" must be performed with reference to all personnel, all branches of the company, all work stations, all work equipment, procedures, etc. For this purpose, an external expert on occupational safety, health protection and safety of machinery/PSE and/or an expert on JAR-OPS 3 and 4 can be called in.

1st step

Establishing goals, responsibilities and tasks.

Contract with an expert in RAM

Participants:

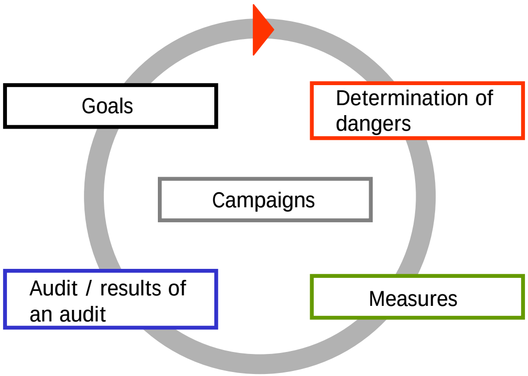
Company management, contact person for occupational safety (COPOS), expert in RAM

2nd step

Danger evaluation, **risk analysis, risk assessment**

Participants:

Contact person for occupational safety (COPOS), expert in RAM,



3rd step

Assessment of **measures**, remaining risk after having taken measures, reporting system, responsibilities and **due dates**.

Participants:

Company management, COPOS and /or experts in the field, expert in RAM

4th step

Verification of **goals**, responsibilities and **measures** put into practice.

Reporting system.

Participants:

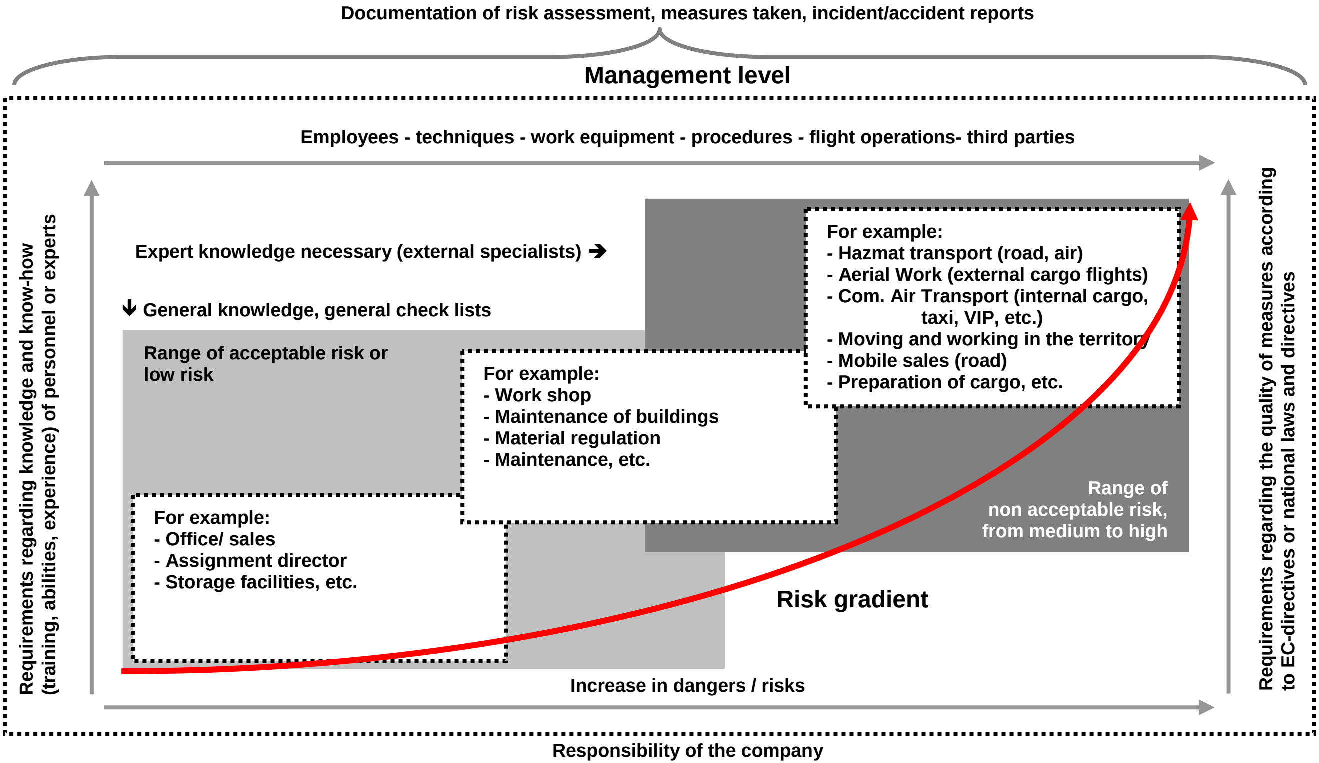
Company management, COPOS and /or experts in the field, expert in RAM

Documentation

References: EC-Directive 89/391/EEC (Safety and health of workers), EC-Directive 98/37/EC (Machinery), EC-Directive 89/686/EEC (Personal protective equipment), 89/655/EEC (Work equipment), EN 1050 (Principles for risk assessment), ISO 9001 (Quality management systems); national laws, decrees and directives.

RISK ASSESSMENT AND MANAGEMENT

Risk grades and risk gradient



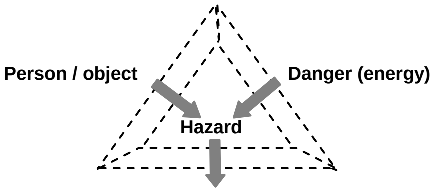
RISK ASSESSMENT AND MANAGEMENT

Definition: danger - hazard - risk (basic terms)

Danger - hazard - triggering factor - event

A hazard is the result of an interaction (temporal/local concurrence) between a danger (energy) and a person or event.

An event is the result of an interaction between a hazard and one or more triggering factors.



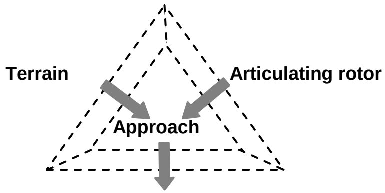
Triggering factors

↓

↙ Event ↘

Personnel and/or material damage

Example:



Gust of wind, person bailing out, vortex, underestimation of distance, helicopter skid getting caught, getting ensnarled in technical installations

↓

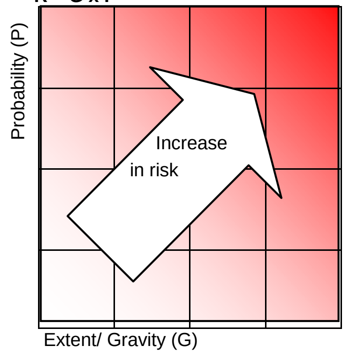
↙ Touching of terrain by the rotor ↘

2 injured persons, 2 deceased persons **Total loss**

Risk

Risk (R) in reference to the considered hazard	is a result of	**Gravity / Extent (G)** of possible damage that can be caused by the hazard considered	and the	**Probability of occurrence of the damage (P)** "Probability" in this case can be defined as: **Frequency** and **duration** of **exposure to the hazard** or: **Probability of occurrence** of the **hazardous event** or: **Possibility** of **avoidance** or **limitation** of **damage**

R = G x P



RISK ASSESSMENT AND MANAGEMENT

The 4 risk classes of the JAR-OPS - risk acceptance (basic terms)

The calculated risk is further specified with the help of the concept of "risk acceptance". Risk groups with the lowest risk acceptance (RA) are those who are most entitled to protection. Whoever endangers persons of group "A" must expect hard sanctions (prosecution, benefit cuts, punishments).

Definition JAR-OPS: Risk classes

A Third parties (RA = 4C - 3C)

e.g. clients, employees from partner companies, uninvolved third parties, specialised workers (COM-HEC)

B Passengers (RA = 3C - 2B)

Paying passengers, a client's personnel transported during assignment flights ("*Positioning*")

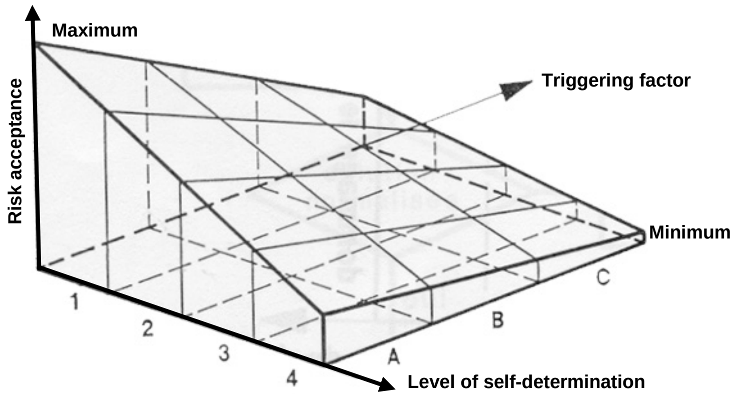
C Assignment & ground specialists (RA = B3 - A1)

Persons responsible for transport, marshallers, squad leaders

D Crew (RA = B2 - A1)

Pilots, marshallers, air rescue workers

Graphic illustration of risk acceptance (RA)



Level of self-determination

1 Volunteer
2 High involvement in decision making
3 Low involvement in decision making
4 No involvement in decision making

Triggering factor

A One's own wrong behaviour, wrong decision
B Wrong decision of a third person
C Technical error

See also "JAR-OPS 4, Code of Practice", chapter "XI Risk Assessment and Management"

RISK ASSESSMENT AND MANAGEMENT

Compliance List

JAR-OPS 4/Code of practice	EC-Directive 89/391/EEC, article	EN 1050, article	Marshaller-Syllabus (CH, international), pages	Suva 44005 (CH), pages
XI. a) Risk evaluation	6(1), 6(3)a), 9(1)a),	7	2.2.11	4-5
XI. b) Risk management	7, 8, 9(2)	8	2.2.11, 2.3.11	4-5
XI. c) Accident/incident reporting	9(1)c)	9	2.2.11, 2.3.11	
XI. d) Personal information	10, 11 (possibly 12)		2.2.11, 2.3.11	22-23

This list does not claim to be correct and exhaustive.

Original English text: XI RISK ASSESSMENT AND MANAGEMENT

a) Risk evaluation for third parties, ground crew and task specialist, crew member: *(JAR-OPS 4 does not mention passengers. Passengers should also be taken into account in JAR-OPS 3)*

Determine the possible risk for each category of persons involved in the activity.

b) Risk management:

Define the procedures to apply to eliminate or mitigate the level of risk for each category, special attention should be given to the briefing before starting the work

c) Accident and incident reporting:

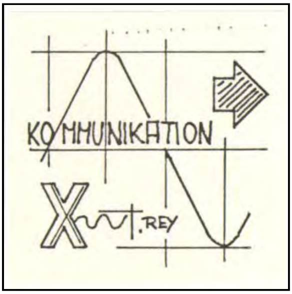
A methodology to be put in place for all participants involved in the activity to report accident and incident.

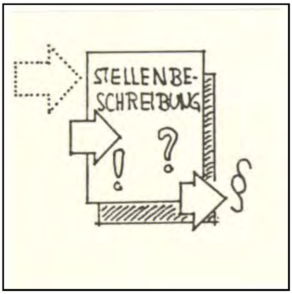
d) Personal information:

Put in place an information system for all company personnel involved in Aerial Work activities of all the accidents, incidents and the conclusions that do emerge for preventing future occurrence.

(The above information is not legally binding; information dating from September 2006)

3.4





Communication & Marshalling

INTERPERSONAL COMMUNICATION

"Transmitter/receiver-problem"

Communication is a complex process in which many aspects play a role. Some of these aspects can be illustrated on the basis of a few examples.

The first example on communication clearly shows that we frequently only hear what we want to hear. A natural process that is very tricky. The "transmitter/receiver" problem is described below.

Said is not the same as heard

Messages transmitted may not reach the receiver.

Heard is not the same as understood

Messages are normally understood in a person's own world of imagination.

Understood is not the same as agreed

A message received may not necessarily meet with identification in the receiver, it may cause concern.

Agreed is not the same as tried out

Agreement or concern must not necessarily trigger off a need for action.

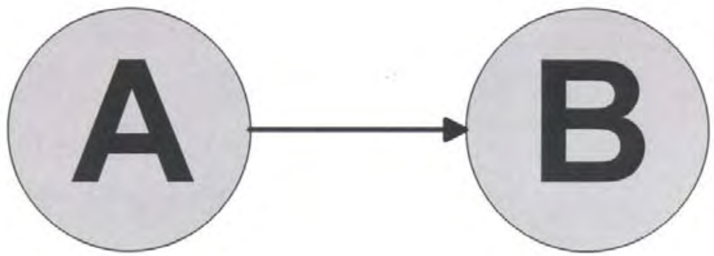
Tried out is not the same as retained

Messages are reflected by personal behaviour when they are confirmed by personal experience.

INTERPERSONAL COMMUNICATION

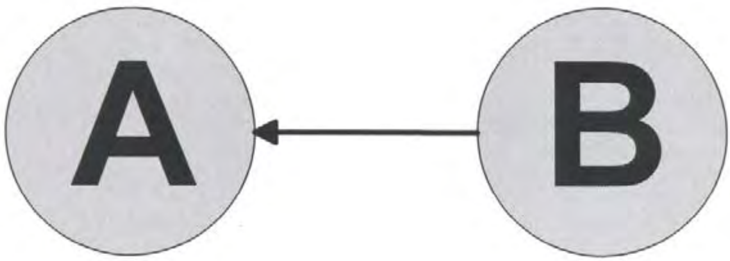
"Different frequencies"

This example again illustrates the "transmitter/receiver" problem.



says what he/she thinks is necessary

hears what is useful for him to hear



hears those parts of B's words that are useful for him to hear

answers what he/she heard, not what A said

Understanding one another is not always as easy as it seems.

So, when in doubt, also make sure by asking:

"Did I understand that correctly ... ?"
“Did you mean it like that ... ?"

INTERPERSONAL COMMUNICATION

Catchwords

Every day, we use concepts such as success, stress, etc. in an exclusively positive or negative way. These **catchwords affect our communication** via our emotions. Valuations are usually linked to these concepts.

Basically speaking, however, many are neutral in value and only receive their positive or negative meaning through additional concepts.

Here are a few examples and their bandwidth between "positive" and "negative".

☺	**Catchword** Area of application	☹
Victory	**SUCCESS** Bookkeeping / Profession / Human being	**Loss**
Chance / Recovery	**CRISIS** Profession / Health	**Depression / Illness**
Praise	**CRITICISM** Profession / Education / Partnership	**Blame**
Excitement	**STRESS** Work / Experience / Partnership	**Unable to fulfil what is demanded**
Initiative, **Company**	**AGGRESSION** Work / Partnership	**Attack** **Quarrel**
Drive	**TENSION** Work / Experience / Adventure / Partnership	**Resistance**

Bandwidth

Refusing to associate oneself with pre-established or unconsciously made valuations is a significant step towards **rationalising discussions in conflict situations.**

It is also necessary to think about **emotional words** like "success" or "stress".

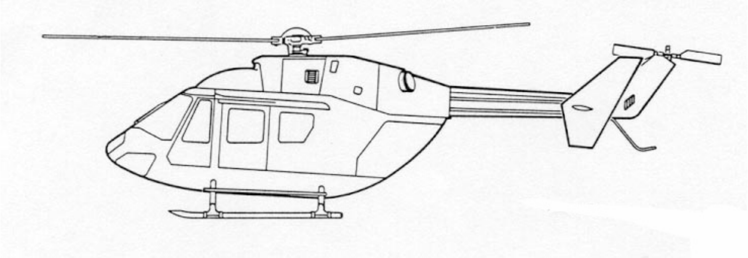
MARSHALLER-SYLLABUS

INTERPERSONAL COMMUNICATION

Subjective - Objective

An additional aspect concerning the rationalisation of discussions (factual discussions or arguments) is the difference between subjective and objective viewpoints. Subjective assessments are generally accompanied by valuating terms, are dependent on emotions, impressions, experience, appeal, etc. Objective assessments, however, must fulfil a rule or be reproducible and measurable.

Subjective (not measurable)	Object: Helicopter	Objective (measurable)
- with reference to an object		**- with reference to an object**
A big helicopter		Length. width, height, dimensions
A nice helicopter		Shape, colour, layout, design, functionality equipment
The best helicopter		Performance, speed, flying characteristics, transport capacity, consumption
- with reference to a person		**- with reference to a person**
A fantastic pilot		Type, character, behaviour, manner
The best pilot		Experience, behaviour, personality, abilities



[1]

Subject: Pilot (person)

RADIO COMMUNICATION

ICAO radio operator alphabet

The official letters must be used when calling a station or a helicopter. These are valid throughout the world.

A	ALPHA	**J**	JULIET	**R**	ROMEO
B	BRAVO	**K**	KILO	**S**	SIERRA
C	CHARLIE	**L**	LIMA	**T**	TANGO
D	DELTA	**M**	MIKE	**U**	UNIFORM
E	ECHO	**N**	NOVEMBER	**V**	VICTOR
F	FOXTROT	**0**	OSCAR	**W**	WHISKEY
G	GOLF	**P**	PAPA	**X**	X-RAY
H	HOTEL	**Q**	QUEBEC	**Y**	YANKEE
I	INDIA			**Z**	ZULU
		4	FOUR		
1	ONE	**5**	FIVE	**8**	EIGHT
2	TWO	**6**	SIX	**9**	NINE
3	THREE	**7**	SEVEN	**0**	ZERO

All numbers apart from full hundreds or thousands are transmitted by pronouncing each individual figure:

"HUNDRED", "THOUSAND"

How to call helicopters:

HB-XNE	**"Hotel Bravo-X-Ray November Echo"**
or the abbreviation	**"November Echo"**

Sample numbers:

10	**ONE ZERO**
75	**SEVEN FIVE**
583	**FIVE EIGHT THREE**

RADIO COMMUNICATION

Standard phraseology for marshalling helicopters

If the following principles are respected, safe marshalling is guaranteed! (company-specific adaptations are possible if in line with the general principles).

Principles

Commands ➔ clear statements - **Sequence ➔ chronological** - **Pronunciation ➔ articulate, clear**

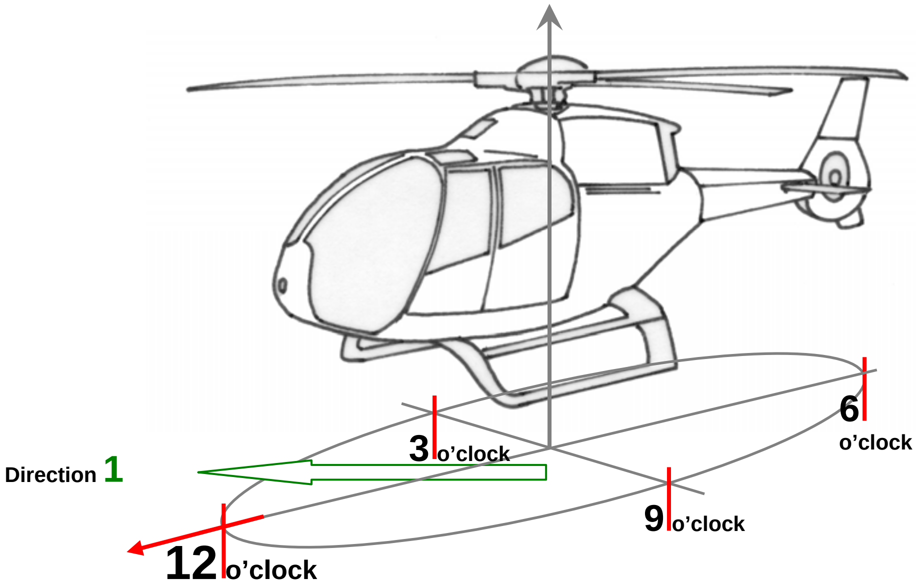
Command	General transports	Human External Cargo (HEC, COM-HEC)
Down	Helicopter descends	Helicopter descends
Up	Helicopter climbs	Helicopter climbs
Altitude 3, 2, 1	Indication of position in metres, e.g. distance load - ground	Indication of position in metres, e.g. distance person - ground
Hold	Helicopter maintains height and position	Helicopter maintains height and position
Right/left	Helicopter hovers to the right/left from the pilot's point of view	Helicopter hovers to the right/left from the pilot's point of view
Proceed forward/back	Helicopter hovers forward/back from the pilot's point of view	Helicopter hovers forward/back from the pilot's point of view
Direction 10 o'clock	Helicopter hovers towards indicated direction (pilot's point of view)	Helicopter hovers towards indicated direction (pilot's point of view)
Contact	Marshaller seizes lifting hook at shoulder level / load touches ground	Hook on the fix rope is seized or rescuer clasps object
Attached	Slinging device is attached to the hook	PSE is attached to the hook of the fix rope
Rope tightened	Load lifting device (load rope) tightened / under load	Fix rope between helicopter and person is tightened / under load
Detached	Load lifting device is detached from the lifting hook	PSE is detached from the hook of the fix rope
Secured	--	Person is secured to the object
Disconnected	Slinging device disconnected from the load (SD still attached to hook)	Person has been disengaged from the object
Clear	No evident obstacles in flight path	No evident obstacles in flight path
Stop.stop	Break-off of current operation, awaiting further instructions	Break-off of current operation, awaiting further instructions

Annotation: The commands and their meanings are examples taken from practical experience. Adapt these commands to your specific needs!

Clock-reference system

Indications regarding flight directions are given in metres following the sequence "direction (clock-reference system) + distance in metres".

Command	Meaning
1	Indication of distance in metres
Up/down 1	Indication of direction and distance
Direction 1 o'clock 10m	Movement following the clock-reference system (12 o'clock = standard flight direction/helicopter's nose)



Radio communication procedures (examples for practical use)

Approach with cargo destined for assembly work (on the object)

Command	Meaning	Risk zone		
		1	2	3
Altitude 2, 1	Helicopter with external load approaching			
Hold	Continue hovering			
Contact	Marshaller in contact/gripping the object			
Secured	Load has been secured to the object			
Down 1	Untighten longline/slinging device			
Detached	Load is detached from the hook			
Up	Climb with longline attached			
Clear	Departure is clear, no obstacles			

Helicopter emergency (engine failure or other)

Captions regarding the hazardous circumstances (from the point of view of the person on the ground)

1		Helicopter departs without the load: no hazard
2		Helicopter drops longline: moderate hazard (rope can fall on the head or cause stumbling, falling)
3		Helicopter departs still connected to load/object: serious hazard (helicopter may crash on persons)

Approach towards the object with persons attached

Command	Meaning	Risk zone		
		1	2	3
Altitude 2, 1	Helicopter with person attached approaching			
Hold	Continue hovering			
Contact	Person in contact/gripping the object			
Secured	Person is secured to the object			
Down 1	Untighten fix rope			
Detached	Person is detached from the hook			
Up	Climb with fix rope attached			
Clear	Departure is clear, no obstacles			

Helicopter emergency (engine failure or other)

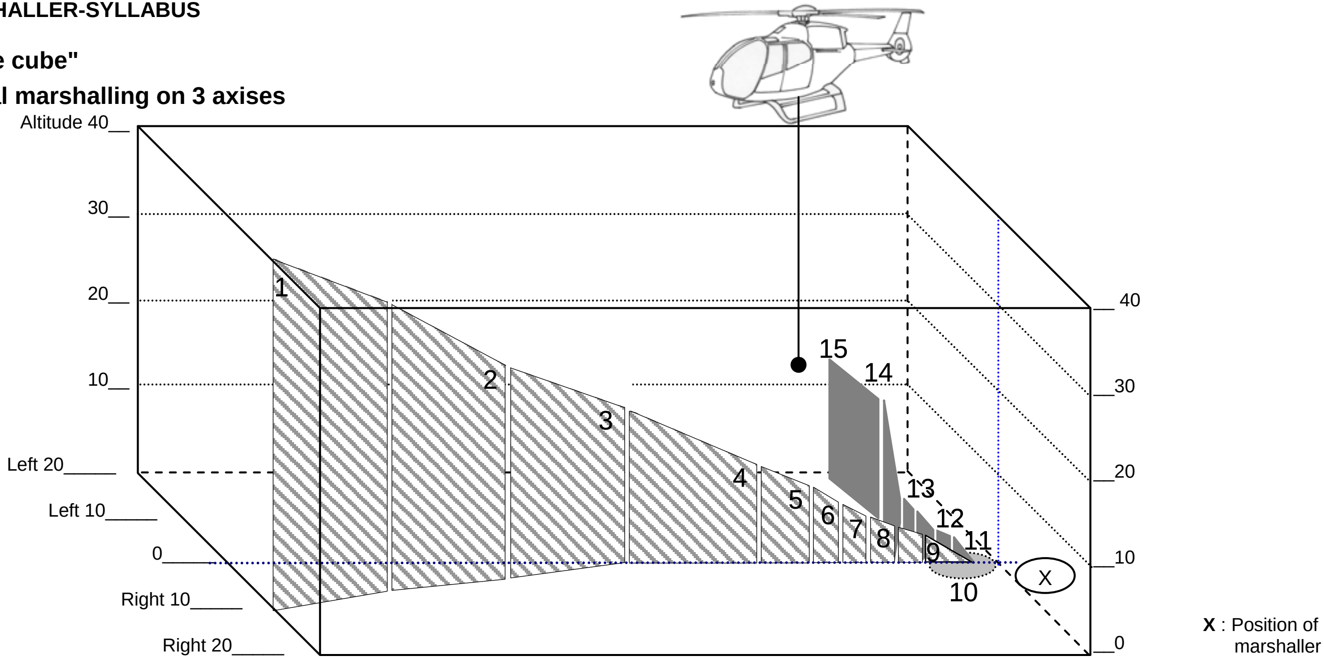
Caption regarding the hazardous circumstances (from the point of view of the person attached to the hook)

1		Helicopter departs with fix rope attached: no hazard
2		Helicopter drops fix rope: minor hazard (rope can fall on the head or cause stumbling, falling)
3		Helicopter departs with persons attached: serious hazard (helicopter crash, loss of person during flight)

MARSHALLER-SYLLABUS

"In the cube"

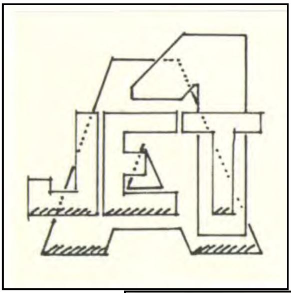
Spatial marshalling on 3 axises

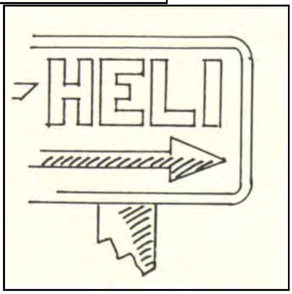


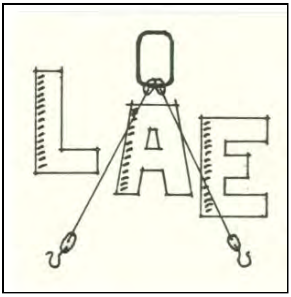
Phase	Approach	Depositing	Slings	Departure
Commando	Altitude 40 left 10 I see you left 5 Altitude 20 10 7	5 4 3 2 1 Contact Click off Detached	Slings on the left Up	Clear Next fuelling OK
Radio Marshaller	¬.----------------.¦ ¬.------.¦ ¬.---------.¦ ¬.- -.¦ ¬.- -	¬.-.¦ ¬.-.¦ ¬.------ - - - -.¦ ¬.---------.¦ ¬.-------------.¦	¬.-------------.¦¬.-------.¦	¬.----.¦ ¬.---.¦
Radio Pilot	¬.-------.¦			¬.----------------.¦
Position	1 2 3 4 5	6 7 8 9 10	11 12	13 14 15
Signs	¬ Push radio button; . 1/10 sec. pause; ------- normal speaking; - - - - slow speaking; ¦ Release radio button			

Examples: Adaptations for the company's specific flight operations should be carried out by the persons responsible.

3.5







Abbreviations & search topics

MARSHALLER-SYLLABUS

ABBREVIATIONS

Remark

The following abbreviations are drawn from everyday use in aviation companies and the engineering industry. They are also used in this syllabus. However, colloquial expressions are not used.

α	Alpha: Symbol for angle
AA	Air accident
ABC	Code for first aid (Air, Blood, Contraction)
Abr.	Abbreviation
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
AE	Ancillary equipment
AFM	Aircraft flight manual
AI	Angle of inclination
AIL	Accident insurance law (relevant national laws)
AIO	Accident insurance Organisation (relevant national boards)
AL	Aviation law (relevant national laws)
Alt. m	Altitude above sea level in metres
AOM	Aircraft operation manual
AOPA	Aircraft Owners' and Pilots' Association
Art.	Article
AS	Aerospatiale (French helicopter manufacturer)
ASPP	Association Suisse des Pilotes Professionnels
AW	Aerial work
β	Beta: Symbol for angle
BA	Bank angle
BABLW	Federal Office for Air Force Operations
BAZL	Bundesamt für Zivilluftfahrt (official title of the FOCA)
BFU	Swiss Federal Air Accident Investigation Bureau
BL	Breaking load (technical)
BS	Breaking strength (technical)
C	Symbol for Celsius (temperature)
CAA	Civil Aviation Authority (GB)
CB	Concrete or cement bucket (LLD)
CC	Civil code (relevant national laws)
CDR	Commander; also: PIC)
CFO	Chef flight operation
CG	Centre of gravity
CH	Cargo hook
CHPL	Chef pilot
civ	Civil
CM	1. Chief marshaller
	2. Conveyor mean
COPI	Co-pilot
cos	Cosine, trigonometric function in mathematics
CR	Cradle or cargo rope (for useful loads)

D	Directive
DB	Distribution bucket (LLA)
dB(A)	Decibel; "volume", or more accurately: sound pressure level measured using the evaluation filter A
DIN	German industrial standard (now also DIN/EN)
DWD	Downwash drag (air resistance of the rotor downwash)
E	Symbol for energy (in the context of volume = energy dose)
EB	Eyebolts (SE)
EC	European community (economically)
ECAC	European Civil Aviation Conference
ECH	Electrical cargo hook
EEC	European Economic Community (economics, technical bodies of rules)
EHA	European helicopter association
ELLM	Electrical load lifting means (cargo hook)
EN	European standard
EU	European Union (political)
F	Symbol for Fahrenheit (temperature, used in the USA)
F+W	Eidgenössisches Flugzeugwerk (Swiss national aircraft manufacturer, until 1995, now RUAG)
FAA	Federal Aviation Authority (USA)
FAR	Federal Aeronautics Regulations (airworthiness requirements of the US FAA)
FC	Friction closing (technical)
FCL	Flight crew licensing
ff.	following (e.g. further pages, chapters, etc.)
FH-SY	Marshaller-syllabus
FO	Flying operations
FOCA	Federal Office for Civil Aviation
FOM	Flight operation material
FOM	Flight operations manual also OM Operations manual
FLS	Four-leg sling
FS	Fatigue strength
FSD	Forward speed drag (air resistance in forwards flight)
FTR	Flat textile rope
ft	Foot (imperial unit of length)
GA	General Aviation
g-load	Gravity load
GR	Gruppe Rüstung (Swiss Defence procurement agency)
h	Symbol for hour
H.A.I.	Helicopter Association International (USA)
HB-	Hotel bravo (ICAO call sign for Switzerland, part of the registration)
HELI	Helicopter
HEMS	Helicopter Emergency and Medical Service
HIGE	Hover in ground effect

HL	Holding lines (AE)
HOGE	Hover out of ground effect
HoT	Head of transport
HP	Hearing protection
IAS	Indicated air speed (speed displayed on the instrument)
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
J	Symbol for the product of a multiplication of safety factors (2 x 2 = J 4)
JAA	Joint Aviation Authority
JAR	Joint Aviation Requirements (joint aviation rules of the JAA**)**
JAR OPS	Joint Aviation Requirements Operations (joint operational aviation rules of the JAA)
Jet A-1	Aviation fuel for turbine-engined helicopters (kerosene)
kg/m^2	Kilograms per square metre
KIAS	Knots indicated air speed (displayed speed in knots; 1 kt = 1.852 km/h)
km/h	Kilometres per hour
kt/kts	Knot or knots: 1 kt = 1 NM/h = 0.5144 m/s or 1.852 km/h
L	Sound pressure level
LC	Load capacity
LAB	Lashing straps
LAN	Large animal net
LBA	Federal Aviation Office (aviation supervisory authority for Germany, based in Braunschweig)
Ldg	Landing
LE	Lifting equipment (helicopter)
L_{eq}	Equivalent sustained sound pressure level to ISO 1999
LF	Load factor
LL	1. Limit load (technical)
	2. Long line (LLA)
LLA	Load lifting attachment
LLD	Load lifting device
LLM	Load lifting mean (cargo hook)
L_m	Time-average sound pressure level (measured and averaged sustained sound pressure level)
LOB	Load bag (LLA)
LON	Load net
LP	Lifting point
M	Marshaller
m	Symbol for mass
m/s	Meters per second
Marshaller	Synonym for all Task- and Ground-specialists on all performance levels

MD	Machinery Directive 98/37/EC (European technical law)
Mentor	Supervisor, coach
mil	Military
MIL-STD	Military standard
MIN	Minimum
MLLF	Manoeuvring limit load factor
MOM	Maintenance organisation manual
mph	Miles per hour, 1 land mile = 1.6093 km, 1 nautical mile = 1.852 km)
MPP	Means for picking up people
MTOM	Maximum take-off mass; still occasionally referred to in this syllabus as MTOW
N	Symbol for force (standard force)
NAV	Navigation
NM	Nautical mile
NOA	Non-occupational accident
NOAI	Non-occupational accident insurance
NTSB	National Transportation Safety Board (national office for transport safety in the USA)
OA	Occupational accident
OAI	Occupational accident insurance
OAI	Ordnance on accident insurance (SL, 832.202)
OFAC	Office Fédéral de l'Aviation Civile (French form of BAZL/FOCA)
OI	Occupational illness (medical)
OL	Obligations law (SL, 220)
OL	Overload
OM	Operation manual
OpCoe	Operating coefficient
OS	Occupational safety
PAX	Passenger
PC	Positive closing
PH	Pipe hook
PIC	Pilot in command
PrLL	Product liability law (relevant national laws)
PSE	Personal safety equipment (also Personal protection equipment PPE)
R	Symbol for force (resulting force)
REGA	Call sign of the Swiss Air-Ambulance Ltd.
RP	Rescue platform
RRR	Ropes with ring reinforcements (LLA)
RS	Round sling
RSC	Round steel chain
s	Symbol for second
S.A.	Société Anonyme (public limited company)
SA	Sud Aviation (French helicopter manufacturer)

SAN	Small animal net
SAR	Search and rescue
SAS	Shock ansorber
SE	Slinging equipment
SF	1. Safety factor
	2. Slinging factor
SF	Swiss company for aircraft and systems (from 1.1.96, formerly F+W, nowhere RUAG)
SHA	Swiss Helicopter Association (association of Swiss helicopter companies)
SheV	Swiss Helicopter Association
sin	Sine, trigonometric function in mathematics
SK	Shackle (SE)
SKI	Ski basket (LLA)
SLLF	Static limit load factor (FAR/JAR part 29.865)
SPE	Special equipment
ST	Slinging technique
STC	Supplement type certificate
STEG	Swiss Federal law on the safety of technical equipment and devices (SL, 819.1)
Suva	Swiss National Accident Insurance Organisation
SWAF	Swiss Air Force
SWH	Swivelling hook
SWL	Safe working load
SYLLABUS	Program of studies, course; used as "program of studies" in aviation terminology; Latin sillybus, Greek sillybos; List of all modern theologies to be rejected, published by Pope Pius IX in 1864;
T	Tying
T.-off	Take-off
TARMAC	Airfield apron
TE	Transport equipment
TF	1. Tearing force
	2. Tensile force
THLS	Three-leg sling
TL	1. Team leader
	2. Traffic Load (technical: useful load and LLD taken together)
TLV	Threshold limit value (e.g. of pollutants, energy or radiation)
TOM	Take-off mass
T-O-P	Technology - Organisation - Personnel
TR	Textile ropes
TS	Tensile stress
TWLS	Two-leg sling
UeG	Patrol squadron (armed forces)
UFAC	1. Ufficio Federale dell'Aviazione Civile (Italian form of FOCA)
	2. Uffizi federal da l'aviaziun civila (Rhaeto-Romanic form of FOCA)
USL	Useful load (transport material)
UL	Ultimate load (breaking load)
UTC	Universal Time Coordinated (international time)

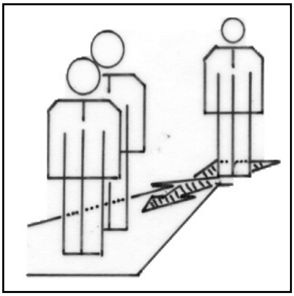
VFR	Visual flight rules
VIP	Very important person
VMC	Visual meteorological conditions
WAB	Water bag
WB	Weight and balance
WBK	Water bucket
WE	Winding equipment
WL	Working load (static mass on the lifting hook in [kg] or force acting in Newtons [N])
WLL	Working limit load (max. safe working load)
WP	Work preparation
WR	Wire ropes
X	X-ray (1st letter of the registration for helicopters in Switzerland)

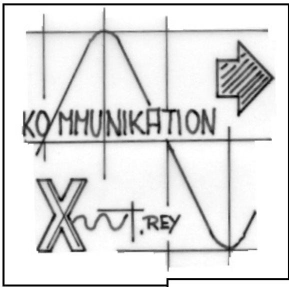
Miscellaneous:

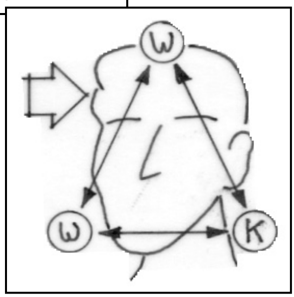
°	Symbol for degrees (angular measurement or temperature)
[ ]	Symbol for a physical unit of measurement; Example: [N] = [kg m/sec^2], unit of measurement for force, [SM] = [-] Unit of measurement for safety margin (without dimension)
<	Less than (e.g. < 30 means 29, 28, 27, etc.))
>	Greater than (e.g. > 30 means 31, 32, 33, etc.)

Search topics

3.6







Course materials

Exercise sheets for
Marshaller-Syllabus courses

REGISTER FOR EXCERCISE SHEETS ACCOMPANYING THE COURSES

The lesson and exercise sheets are distributed only during the courses.

In the box under **"Course no."**, fill in the current course number (e.g. SYL2501.d) and in the box under **"Date"** the day on which the course was held.

The individual training reports can be created by means of the CD-ROM "Training Check 2.4" and filed in the register 3.6, according to the sequence of the lessons.

Chapter	Course	Course title	Course no.	Date
3.6.1	**SYK**	**Basic course for managers and executives**		
3.6.2	**SYL**	**Methodology & didactics for operators**		
3.6.3	**SYA**	**Introduction to the training check**		
3.6.4	**VAD**	**Guide and reference material for staff**		

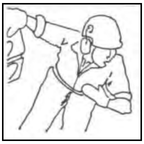
Complete the list with course certificates issued by other institutions and/or companies

PICTOGRAMS 3.6

Lessons **No** **Topics**

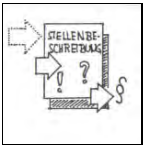
1 Company and employer

Company skills
Market
Economy
(Supraordinate company requirements)



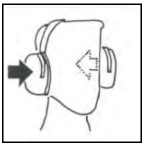
2 Marshalling duties, development

Job description
Professional image
Personal responsibility
(Marshaller's professional opportunities for development)



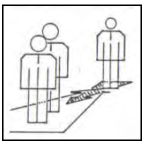
3 Administration and legal obligation

Administration
Institutions
Duties / liability
(Legal integration of the marshaller into the working process)



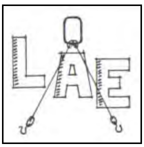
4 Maintenance of health and fitness for work

Personal safety equipment
Health protection
Prevention
(Direct and indirect measures)



5 Responsibility to customers and third parties

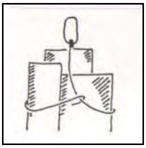
People from third-party companies
Third-party care
Limit of responsibility
(Marshaller's leadership duties to customers and non-participating third parties)



6 Operating equipment, calculation and application

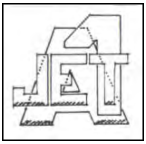
Operating equipment
Load lifting device calculation
Use of device
(Calculation and application of marshaller's working equipment)

Explanations



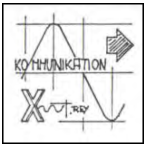
7 Load preparation techniques

Slinging techniques
Load techniques
Load transport
(Physical and technical principles of load techniques)



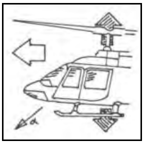
8 Fuel and the environment

Fuel skills
Use of fuels
Environmental protection
(Daily use and immediate measures in emergencies



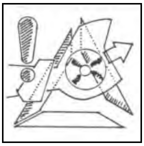
9 Communication and radio-telephony

Use of radio equipment
Communication
Communication techniques
(Safe communication in daily use)



10 The helicopter as a working tool

Helicopter skills
Helicopter physics
Helicopter assignment
(Specific hazard in and around the helicopter and at the workplace)

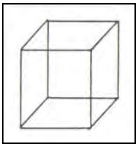


11 Recognising and analysing hazards

Danger zones
Hazard analysis
Measures
(Hazards affecting people due to technology and processes)

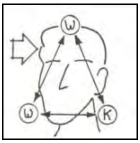
12 Helicopter aerial work

Flight assignments
Types of assignment
Work assignment
(Variety and demands of working assignments using helicopters)



13 Risk - safety - behaviour

Flight obstructions
Perception
Reconnaissance
(Effect of human perception on daily work)



14 Emergencies / behaviour and cooperation

Emergencies
Human factors
Conflict resolutions
(Interpersonal aspects, problems, conflicts and dealing with them)