



Artificial High Directionals and Artificial Frames Workshop

Learning outcomes and key teaching points



About Rescue 3 Europe

Rescue 3 Europe develops state of the art technical rescue courses, providing internationally recognised accreditation for organisations and individuals operating in high risk environments.

As an international accrediting body, Rescue 3 provide up to date best practice guidance that is constantly evolving in line with new research and testing. All changes and developments of Rescue 3 courses go through a process of peer review and oversight by a steering committee made up of industry experts from all over the world.

Rescue 3 training providers deliver courses worldwide, in multiple disciplines, including: rope, water, boat, ice and confined space rescue. Our large suite of courses have been adopted by mountain rescue teams, wind turbine operators, fire and rescue services, ambulance teams, utilities providers, and military personnel.

Within each discipline, Rescue 3 accredited courses cover every level of operations, whether this is at an awareness level, avoiding risks and applying simple safe systems of work; or at more advanced levels where practitioners must acquire high levels of personal skills and understanding to access and navigate difficult environments.

For over four decades Rescue 3 has provided the standard for technical rescue training, offering guidance and support for maintaining best practice.





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Artificial High Directionals and Artificial Frames Workshop (AHDW)

Course overview and target audience

The Artificial High Directionals and Artificial Frames Workshop is designed for rope rescue team members who wish to expand their knowledge of the use of directional frames and anchor frames. The course focuses on the specific requirements for rigging and using multiple configurations of multipods, eg Rock Exotica Arizona Vortex, SMC Terradaptor, or Ferno Arachnipod. The course progresses from basic use of easel-leg tripods, up to more advanced techniques including the rigging and guying of A-frames and monopods.

AHDW

Contact hours 18 hours (3 days)	Prerequisites Rescue 3 Rope Rescue Technician (RRT) or Equivalent experience of team-based rope rescue system rigging and operation, including basic use of AHDs and artificial frames.
Qualification valid for 3 years	Accredited by Rescue 3 Europe

Taught by

- Artificial High Directional Workshop and Artificial Frames Instructor (AHDWI)
 - » This is an RRTI who has completed an AHDW Instructor workshop.
- Rope Rescue Specialist Instructor (RRSI)

Assessed elements

- Foundation knowledge

Venue

Where possible, a mixture of natural and artificial/urban environments should be used.



Artificial High Directionals and Anchor Frames Workshop skill sheet contents

Theory	
1.	Prerequisite knowledge at RRT level
2.	Anchor frames and directional frames
3.	Loads and forces on artificial frames
4.	Guying artificial frames
Practical	
5.	Prerequisite skills at RRT level
6.	Securing and hobbling feet
7.	Symmetrical tripod as anchor frame above a hatch
8.	Easel-leg tripod as directional frame
9.	Easel-leg tripod as anchor frame over an edge
10.	Sideways A-frame as directional frame
11.	Sideways A-frame as anchor frame over an edge
12.	Lazy legs
13.	Lazy leg sideways A-frame as directional frame
14.	A-frame as directional frame
15.	A-frame as anchor frame above a hatch
16.	Monopod as directional frame
17.	Artificial frames in doorways, windows and other openings

AHDW



Artificial High Directionals and Anchor Frames Workshop (AHDW) learning outcomes and key teaching points

AHDW

	Skill sheet element		Learning outcome	Key teaching points
1	Prerequisite knowledge at RRT level	1.1	Recall rope rescue knowledge, as covered on the Rescue 3 Rope Rescue Technician or equivalent course.	The Artificial High Directionals and Anchor Frames Workshop is designed for rope rescue team members with prior experience in team based rope rescue techniques who wish to expand their knowledge of the use of artificial high directionals and anchor frames. The course focuses on the specific requirements for rigging and using multiple configurations of multipods. The core principles of working at height apply in both the RRT and AHDW courses, including (but not limited to) appropriate use of work restraint, fall arrest, rope protection, anchor construction etc. Instructors may choose to reiterate some elements from the RRT course based on time constraints and student needs.



	Skill sheet element		Learning outcome	Key teaching points
2	Anchor frames and directional frames	2.1	Recall the definitions of directional frames and anchor frames	Directional frame: the working ropes connected to the load are anchored away from the frame. Typically used for 'over the edge' rope rescue situations. Anchor frame: Working ropes connected to the load are anchored to the frame. Typically used when working within the footprint of the frame, eg hatch entries.
		2.2	Recall factors when selecting frame configurations	Equipment available. Remoteness of site (eg weight/ transportation considerations). Training level of team. Space available at stance. Anchor availability for frame and guys. Topography of stance, edge and fall line - consider moving frame back from edge if needed. Anchor frame or directional frame (eg winch or rope-based MA used to haul). Frame is designed/rated for the type of operation (eg over-the-edge or above a hatch/hole).
		2.3	Recall the importance of selecting basic frame configurations where possible	The AHD Workshop looks at a range of frame configurations of varying complexity. These all form part of a rescue team's toolbox of options, but rescuers should aim to use the most basic setup that is suitable for their task, rather than automatically defaulting to the most complex option.
		2.4	Recall other types of artificial frames, their merits and limitations	Eg quadpods, Larkin frames etc. Their use is not covered on this course. Always follow manufacturers' guidance for their use and configurations.



	Skill sheet element		Learning outcome	Key teaching points
3	Loads and forces on artificial frames	3.1	Identify forces acting on a directional frame	Compression and tension forces, direction and magnitude of resultant force, force multiplication at head due to angle, addition of attendant and movement in the system and how this can affect the stability of the frame, eg movement of attendant and package over the edge, grabbing the frame after a slip, sideways movement to avoid natural obstacles on lower.
		3.2	Identify forces acting on an anchor frame	Compression and tension forces, direction and magnitude of resultant force, force multiplication at head due to angle, addition of attendant and movement in the system and how this can affect the stability of the frame, difference between anchor frame being used over a hole and being used over an edge, how this changes resultant and how it can affect the stability of the system, considerations for redundant guying etc.
		3.3	Identify the footprint for easel leg tripods, sideways A-frames, A-frames, lazy-leg sideways A-frames and monopods (gin poles)	Artificial frame footprint.



	Skill sheet element		Learning outcome	Key teaching points
	Loads and forces on artificial frames (cont.)	3.4	Identify the direction and magnitude of the resultant force for a directional frame	Forces acting through the head of the directional frame and pulleys exert compression to stabilise the frame. Generally, the resultant force is at the mid-point of the angle at the directional pulley between the section of rope connected to the load and the rope leading to the anchor.
		3.5	Identify the direction and magnitude of the resultant force for a directional frame with mechanical advantage system between the head of the frame and the load.	Effect on resultant of adding a mechanical advantage system and how it differs from a standard directional frame resultant.
		3.6	Identify the direction and magnitude of a resultant force for an anchor frame	In the same direction as the rope between the load and the head of the frame.
		3.7	Recall the importance of keeping the resultant force within the footprint of a frame	The stability of a system depends on keeping the resultant within the footprint to prevent toppling of the artificial frame.



	Skill sheet element		Learning outcome	Key teaching points
	Loads and forces on artificial frames (cont.)	3.8	Recall the correct method of managing ropes in directional frames	DCTTRS rope rescue systems operate most effectively when both ropes pass through independent pulleys at the head of the frame. This elevation should be maintained throughout the operation - both during and after the edge transition. Testing has shown the operational and safety benefits of DCTTRS in this situation. Historically, with DMDB, the main rope was elevated, with the belay rope either running on the ground or connected to the frame with a mechanical advantage system that allowed it to be raised/lowered as required for parts of the operation. Artificial frames are amongst the strongest parts of rope rescue systems, with some manufacturers proof-loading certain configurations to over 20kN. When correctly rigged, hobbled and guyed, they are unlikely to fail.



	Skill sheet element		Learning outcome	Key teaching points
4	Guying artificial frames	4.1	Recall when and why artificial frames should be guyed	To ensure the frame will not move during operation. Guying needs to cope with both the expected forces applied to the frame during normal use, and other reasonably foreseeable forces, such as attendant error or edge attendant error (eg stumbling and grabbing the frame), rope failure, and wind moving the load laterally during raise/lower.
		4.2	Recall guying considerations for artificial frames	Sufficient number of guy lines for stability and redundancy. Guy angles, resultant angles, guy planes and frame planes.
		4.3	Recall guying considerations for artificial frames where the resultant falls outside of the footprint	Importance of guying for redundancy where the resultant falls outside of footprint. Importance of rigging for redundancy as well as stability.
		4.4	Recall the importance of using low-stretch cord/line/rope when guying artificial frames.	Prevents stretch in guys from allowing artificial frames to move and potentially topple. Check system after first loading to ensure guys have not 'settled'. Tighten if necessary.
		4.5	Recall manufacturer's recommendations for length of life of low-stretch cord, compared to other ropes in the system.	Refer to manufacturer's specifications. Typically low-stretch cord has a shorter length of life than other ropes in the system.



	Skill sheet element		Learning outcome	Key teaching points
	Guying artificial frames (continued)	4.6	Identify appropriate angles for guying	Guy angle (angle between the guy line and the frame) ideally more than 45 degrees, and never less than 30 degrees. Guy angle must be larger than the resultant angle (angle between the resultant force the guy is acting on, and the frame). With multiple guys, calculation based on guy plane. With multiple legs, calculation based on frame plane.
		4.7	Identify minimum guying setups for easel leg tripods, sideways A-frames, A-frames, lazy-leg sideways A-frames and monopods (gin poles)	Easel leg tripod - whilst a well-placed easel leg tripod should be very stable, a rear guy allows for unforeseen circumstances, eg attendant slipping and grabbing a leg. Sideways A-frame - side guys. Consideration for front or rear guys if the anchors for side guys aren't in optimum positions. A-frame - front and rear guys. Lazy-leg sideways A-frame - securing of lazy leg to prevent movement. Monopod (gin pole) - X, Y or reverse Y configurations. For all frames, additional guy lines may be needed for stability and redundancy, eg guying the upwind side on a windy day.
		4.8	Recall minimum guy strength	20+kN, as per system strength. Take account of knotted strength, eg 3 strands of low-stretch high strength cord.
5	Prerequisite skills at RRT level	5.1	Ongoing demonstration of practical rope rigging skills throughout course, at RRT standard,	To ensure personal and team safety. Instructors may choose to reiterate some elements from the RRT course based on time constraints and student needs.



	Skill sheet element		Learning outcome	Key teaching points
6	Securing and hobbling feet	6.1	Recall why artificial frame feet should be secured and hobbled	To prevent splaying of feet
		6.2	Identify methods of securing feet to prevent movement	Use of spiked feet in natural depressions or cracks in a natural environment. Use of flat feet and lashing, or use of expansion bolts in urban environment.
		6.3	Demonstrate lashing feet	Using tape or cord. Triangular 'crushing' of flat feet method.
		6.4	Identify methods of hobbling	Eg, low-stretch high strength cord, or hobble straps, terminated at each leg (not a continuous loop). Lashing the foot to a floor-level anchor, eg tree/boulder. Securing to the floor with anchor bolts.
		6.5	Recall minimum hobble strength	5+kN, in relation to commercially available hobble straps.
		6.6	Secure and hobble an artificial frame	Eg easel-leg tripod with hobble straps, terminated at each leg (not a continuous loop). Feet secured appropriately for the environment.



	Skill sheet element		Learning outcome	Key teaching points
7	Symmetrical tripod as anchor frame above a hatch	7.1	Identify rigging considerations of a tripod as an anchor frame for raising and lowering, where the resultant is inside the footprint (above a hatch)	The resultant force applied to the anchor frame is in the same direction as the rope between the load and the head of the frame. Leg-mounted winch, mechanical or powered? Leg-mounted MA rope system?
		7.2	Rig, check, load and operate a tripod as an anchor frame, where the resultant is inside the footprint (above a hatch)	The symmetrical tripod should be rigged, checked and operated with a lower and raise in an appropriate environment. Throughout all practical elements of this course, instructors may choose to limit length of lowers and raises of the system, and use a single person load, to concentrate on the setup and transition with a short lower and raise to maximise use of time.



	Skill sheet element		Learning outcome	Key teaching points
8	Easel leg tripod as directional frame	8.1	Identify rigging considerations of an easel leg tripod	Artificial frame as a critical point and consequences of failure. Reduces manual handling risks during edge transitions. Reduces fall factor. Limitations: selection of appropriate artificial frame designed and rated for use on an edge. Considerations for running both ropes through the artificial frame. Guying needs to cope with the expected forces applied to the frame during normal use and other reasonably foreseeable forces, eg attendant slipping and grabbing the frame, wind, rope failure. Hobbling requirements.
		8.2	Rig, check, load and operate an easel leg tripod as a high directional	The easel-leg tripod frame should be rigged, checked and operated with a lower and raise in an appropriate environment.
9	Easel leg tripod as anchor frame over an edge	9.1	Identify rigging considerations of an easel leg tripod as an anchor frame for raising and lowering, where the resultant is outside the footprint (over an edge)	The resultant force applied to the anchor frame is in the same direction as the rope between the load and the head of the frame. Leg-mounted winch, mechanical or powered? Leg-mounted MA rope system? If an anchor frame is used for an 'over the edge' operation, the resultant is outside of the footprint. Redundant guying (eg two or more rear guys under tension) will be needed to prevent a single point of failure of the anchor frame.
		9.2	Rig, check, load and operate a tripod as an anchor frame, where the resultant is outside the footprint (over an edge)	The easel-leg tripod should be rigged, checked and operated with a lower and raise in an appropriate environment.



	Skill sheet element		Learning outcome	Key teaching points
10	Sideways A-frame as directional frame	10.1	Identify rigging considerations of a sideways A-frame	Can be placed closer to the edge than an A-frame. Requires side guys. Depending on lateral guy plane angle, may need rear or front guys. Considerations for length of legs. Appropriate placement and hobbling of feet, to prevent movement. Resultant force within the footprint. Guying needs to cope with the expected forces applied to the frame during normal use and other reasonably foreseeable forces eg attendant slipping and grabbing the frame, wind, rope failure. Regular checks of guy lines during operation to ensure there has been no settling of the system/guys which could introduce slack into the system.
		10.2	Rig, check, load and operate a sideways A-frame as a high directional	The sideways A-frame should be rigged, checked and operated with a lower and raise in an appropriate environment.



	Skill sheet element		Learning outcome	Key teaching points
11	Sideways A-frame as anchor frame over an edge	11.1	Identify rigging considerations of a sideways A-frame as an anchor frame for raising and lowering, where the resultant is outside the footprint (over an edge)	The resultant force applied to the anchor frame is in the same direction as the rope between the load and the head of the frame. Leg-mounted winch, mechanical or powered? Leg-mounted MA rope system? If an anchor frame is used for an 'over the edge' operation, the resultant is outside of the footprint. Guying considerations - side guys plus inclusions of redundant guying (eg two or more rear guys under tension) will be needed to prevent a single point of failure of the anchor frame.
		11.2	Rig, check, load and operate an A-frame as an anchor frame for an over the edge transition where the resultant is outside of the footprint (over an edge)	The sideways A-frame should be rigged, checked and operated with a lower and raise in an appropriate environment.



	Skill sheet element		Learning outcome	Key teaching points
12	Lazy legs	12.1	Recall what a lazy leg is on an artificial frame	A lazy leg is a leg that is rigged in such a way that it can operate in both compression and tension.
		12.2	Identify common frame configurations for lazy legs	The most common application for lazy legs is a sideways A-frame, but may be used with other frame configurations.
		12.3	Identify general rigging considerations for lazy legs	A lazy leg may be added to a frame, eg if there aren't suitable guying locations on the opposite side. The lazy leg may be in contact with a wall, tree, solid object, or floor, depending on topography. The lazy leg is guyed on the same side to prevent movement away from the wall or solid object. Appropriate placement and hobbling of feet, to prevent movement. Resultant force within the footprint. Considerations for movement as attendant goes over the edge. Guying needs to cope with the expected forces applied to the frame during normal use and other reasonably foreseeable forces eg attendant slipping and grabbing the frame, wind, rope failure. Regular checks of guy lines during operation to ensure there has been no settling of the system/guys which could introduce slack into the system.



	Skill sheet element		Learning outcome	Key teaching points
13	Lazy leg sideways A-frame as directional frame	13.1	Identify rigging considerations of a lazy leg sideways A-frame	A lazy leg may be added to a sideways A-frame, eg if there aren't suitable guying locations on the opposite side. The lazy leg may be in contact with a wall, tree, solid object, or floor, depending on topography. The lazy leg is guyed on the same side to prevent movement away from the wall or solid object. Appropriate placement and hobbling of feet, to prevent movement. Resultant force within the footprint. Considerations for movement as attendant goes over the edge. Guying needs to cope with the expected forces applied to the frame during normal use and other reasonably foreseeable forces eg attendant slipping and grabbing the frame, wind, rope failure. Regular checks of guy lines during operation to ensure there has been no settling of the system/guys which could introduce slack into the system.
		13.2	Rig, check, load and operate a lazy leg sideways A-frame as a high directional	The lazy leg sideways A-frame should be rigged, checked and operated with a lower and raise in an appropriate environment.



	Skill sheet element		Learning outcome	Key teaching points
14	A-frame as directional frame	14.1	Identify rigging considerations of an A-frame	Requires front and rear guys. It may be hard to find suitable anchors for the front guys on/ over the edge. Appropriate placement and hobbling of feet, to prevent movement. Resultant force within the footprint. Considerations for movement as attendant goes over the edge. Guying needs to cope with the expected forces applied to the frame during normal use and other reasonably foreseeable forces eg attendant slipping and grabbing the frame, wind, rope failure. Regular checks of guy lines during operation to ensure there has been no settling of the system/guys which could introduce slack into the system.
		14.2	Rig, check, load and operate an A-frame as a high directional	The A-frame should be rigged, checked and operated with a lower and raise in an appropriate environment.



	Skill sheet element		Learning outcome	Key teaching points
15	A-frame as anchor frame above a hatch	15.1	Identify rigging considerations of an A-frame as an anchor frame for raising and lowering, where the resultant is inside the footprint (above a hatch)	The resultant force applied to the anchor frame is in the same direction as the rope between the load and the head of the frame. Considerations for positioning of hobble straps between A-frame legs running over hatch. Angling of A-frame over the hatch with suitable redundant guying. Conflicting requirements of aiming for frame as close to vertical as possible, but also needing access to hatch. Leg-mounted winch, mechanical or powered? Leg-mounted MA rope system?
		15.2	Rig, check, load and operate an A-frame as an anchor frame, where the resultant is inside the footprint (above a hatch)	The A-frame should be rigged, checked and operated with a lower and raise in an appropriate environment.



	Skill sheet element		Learning outcome	Key teaching points
16	Monopod as directional frame	16.1	Identify rigging considerations of a monopod (gin pole)	Requires multiple guys, ideally 4 (minimum 3), and consideration for when redundant guys are needed. It may be hard to find suitable anchors for the front guys on/over the edge. Appropriate placement of foot, to prevent movement. Resultant force as close to the footprint as possible. Considerations for height of monopod - just enough height to enable an easier edge transition. Guying needs to cope with the expected forces applied to the frame during normal use and other reasonably foreseeable forces eg attendant slipping and grabbing the frame, wind, rope failure. Regular checks of guy lines during operation to ensure there has been no settling of the system/guys which could introduce slack into the system.
		16.2	Rig, check, load and operate a monopod (gin pole) as a high directional	The monopod should be rigged, checked and operated with a lower and raise in an appropriate environment.



	Skill sheet element		Learning outcome	Key teaching points
17	Artificial frames in doorways, windows and other openings	17.1	Identify rigging considerations of artificial frames in doorways, windows and other openings	Venue considerations, eg stairwell, simulated lift shaft etc, dictating frame configuration. Doorway configuration - eg space needed from door jamb? Directional or anchor frame? Hobbling and guying? Resultant force can change depending on configuration and loading.
		17.2	Rig, check, load and operate an artificial frame in a doorway, window or other opening	The artificial frame should be rigged, checked and operated with a lower and raise in an appropriate environment. The exact configuration used will be dictated by the available venue (eg stairwell, simulated lift shaft etc).





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