TELLTALES

sailing for everyone FOUNDATION INC.

Sailing 4 Everyone Foundation

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Welcome to the S4E Special Edition Newsletter

Safety and Equity considerations for severely disabled sailors aboard Hansa sailboats

Background

There was an incident in GBR in June this year where a boat inverted and a disabled sailor drowned. This was not one of our boats so we shouldn't discuss the issues which might have caused the incident. But we can discuss the measures we have taken to ensure our boats are as safe as possible, without wrapping everyone in sterile cotton wool to protect ourselves more, under the guise of protecting them. Equality means being honest, and treating people as equals.

Nothing is 100% fail safe. Life cannot be like that, but when designing a sailboat for quads who will be strapped into seats it is a matter of finding the acceptable compromise between the dignity of risk, versus duty of care, balanced alongside the right of disabled people to live just as dangerously as everyone else if they choose. Achieve that balance in a package which also appeals to the general community and we have arrived at an example of first-class universal design. Where equipment is used in programs and sanctioned competition it raises ethical questions for equipment selectors and event organisers, and a personal decision made by hopefully informed sailors.

Our little boats are purely fore and aft rigged, that is the main and jib trail behind masts so they will luff when you point into the wind. They also don't have stays so you can ease sheets and "luff" the sails spilling wind while going downwind. That is why we have what some people think is over-length sheets, but it is actually a minor safety feature.

Our SKUD is different, it has stays and you can set a spinnaker. It is this downwind sail which changes all the dynamics and makes the boat a lot more complex, exciting and dangerous, for which there is a price to pay in the fail-safe stakes. When you add a spinnaker you have to expect your boat is going to be knocked down with the mast nearly touching the water, so you need a lot of righting moment to keep it out of the water, which invariably means deep draft.

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The general principle for a cautious cruising sailor is when going downwind set your fore and aft sails to the size you will need if you turned around and had to work back up to windward. If you have more sail area than that going downwind then you need to be prepared to reef when you make your turn. You may also elect to set a downwind sail like a spinnaker which you will safely lower in the lee of your mainsail before turning upwind. In setting the spinnaker in a breeze you have made a calculated decision that you will be able to get it down, because if you cannot get it down before turning upwind you are probably going to get knocked down.

So, sailing downwind with a spinnaker requires vigilance so you do not accidentally, or are forced by circumstances, (like a breakdown in the steering mechanism, or a sudden change in velocity and direction of the wind), to turn sideways to the wind because that will inevitably lead to a scary incident. Our SKUD uses a spinnaker but has all this taken into consideration so it handles all sorts of dangerous situations and protects its sailors. The future Mk III will be even better.

Our smaller boats don't fly spinnakers so are inherently a lot safer, not fail-safe but have a high level of safety, particularly the Liberty in which we regularly secure severely disabled people. But still these boats have to be suitably prepared and various protocols followed.

Hansa spinnaker powered sailboat – SKUD 18

Here we will look at the difference between spinnaker-powered sailboats and how to ensure they are safe, and why pure fore and aft rigged sailboats are safer, particularly those with unstayed masts and instant reefing systems. We ensure they are as fail safe as possible, without going so far as to dumb them down so they appeal to no one, except perhaps for use in therapeutic disabled sailing programs. But that is a long way from our goal of using sensible universal design principals to produce a range of craft which encourage the inclusion of everyone in open programs, regardless of their physical or intellectual ability.

While a pure fore and aft rigged sailboat is safe as long as the basic principal of setting downwind what you will want when you turn up wind, there is nothing surer that a spinnaker-powered sailboat will eventually, even occasionally be knocked down, mast and sails close to the water. But if it is under-ballasted the mainsail may be awash, the spinnaker filling with water, and the 25 knot plus wind which set the stage for the knockdown is blowing side-on to the now vertical wall of the hull, helping to push it over.

If the mast and sails are angled down into the water they are going to act like a barb and dig deeper as the vertical hull is pushed to leeward by the strong wind and waves. Unless the mast tip has sufficient buoyancy like a float, this boat is going to turn upside down. But to prevent this nightmare in the first place there needs to be a deep enough keel with enough lead ballast to prevent the mast from touching the water in the first place. If you look at the SKUD hanging on a hard stand crane with its keel down it looks like a model yacht with an out of proportion deep keel. Security for quads strapped into seats is why.

Original prototype SKUD18 –2005

Once a sailboat is on its side it has lost all its inherent form stability, like a fully loaded container ship has form stability while it is under about 45 degrees of heel, but as it goes beyond that then its cargo takes over and it becomes top heavy. On a keelboat it is a simple balancing act like a see-saw, on one side of the fulcrum, which will be the vertical centreline of the immersed hull on its side, is the weight of the ballast on its keel, and how far out to windward that is from the fulcrum.

Balance that with the centre of gravity of everything out the other side, including sailors who are strapped in their seats, plus the centre of gravity of the mast and sails several metres out from the fulcrum, all acting to outweigh the ballast bulb on the end of the keel.

Things to consider is does the boat have a self-draining cockpit, an advantage while the boat is upright, but a disadvantage when it is on its side because the cockpit floor is about 100mm above the waterline. This means the seat sitting surface is at least 250 to 300mm above the cockpit floor, putting the centre of gravity of the sailors at least 600mm above the waterline, and therefore further out from the fulcrum when the boat is on its side.

It is probably presumed that when a sailboat is on its side the crew are in the water or moving to release sheets or even cut the halyards, and working to right the boat. But in the case where disabled people are strapped into seats, their centre of gravity is well out to leeward, and if there are two sailors in seats then they may be well on the way to negating the righting moment of the ballast.

That is the worst nightmare I lived with when developing the SKUD, our only spinnaker powered monohull. You have to imagine all the scenarios that can lead to this event, live them through in your imagination, and develop the design to prevent it happening.

The next consideration is how much buoyancy does the hull actually have along the gunwales because with the hull on its side it might be like a plank on edge. What might look safe becomes dangerous with the boat on its side when there is a quadriplegic strapped into a seat, particularly if there are 2 sailors sitting side by side, the upper sailor will be ok, but the lower one may be underwater.

If it is a centreline seat then it is touch and go, depending on how much buoyancy there is along the gunwales, which can be further exacerbated if it's a canting seat, and it was canted to leeward at the time of the knock-down - a definite possibility in a wild broach which led to the knockdown. Or was the knockdown caused by the crew losing control when, after committing to a gybe the crew discovered the canting seat mechanism has failed and left them now on the leeward side, they turn through the gybe and are knocked down flat.

Also consider that the quad sailor may have no trunk support, or no neck and head support, so the trunk and head are hanging downwards, and unless that boat has a lot of buoyancy along the gunwale, the sailors head is very likely under water.

A typical canting seat will cant to max 30 degrees as it is limited by its geometry and ergonomics in the cockpit. Canting seats may add to stability by marginally shifting weight to windward, but they are primarily used for sailor comfort on normal sailing angles of heel up to say 45 degrees where a 25 degree canted seat would have the sailor reduced to 20 degrees angle from vertical.

At some point as the boat heels more, to eventually a full knockdown with the sails flat on the water, it makes little or no difference to righting moment where the seat is canted, but it will make a lot of difference to the safety of the crew and can be the difference between head under water or not. So canting seats should never be considered a serious contributor to righting moment.

We considered for a while the use of powered transferring seats for the forward crew to allow a Para to hike, but abandoned this when it was obvious that one day the boat will get knocked down with the seat on the wrong side, the sailor upside down under water. You can't dismiss that as an unlikely possibility, it's an inevitability on a small spinnaker powered sailboat .

So if the boat has a spinnaker we had better presume a knockdown is somewhere between possible, likely and inevitable, depending on the skill of the sailors who have the ability to control much, but not all of the situation. The question arises - will releasing the spinnaker sheet early enough prevent a knockdown?

Yes in certain situations it will but not all. So like the canting seat adds marginally to righting moment in moderate angles of heel, so releasing the sheets will prevent a knockdown in moderate to heavy sailing conditions, but not necessarily when hit by a violent squall. Imagine what might happen if the tack line broke, or in a classic wineglass in a plus 35 knot gust. In this situation there needs to be a knife handy to cut the halyard and free the head from the mast.

In really violent conditions with no spinnaker set, the main and jib alone can lead to a knockdown, particularly if the design hasn't adequately considered the righting moment when knocked down with strapped in crew negating much of the ballast. It was fantastic to see a 40 knot southerly front knock down the entire fleet of SKUDs racing in Sail Melbourne. The peak gust was 50knots. The safest place was on your side, knowing you would come back up when the worst had passed.

So in the end the only thing that really matters is what is the boat's attitude, what is the righting moment when it is on its side, sailors in their seats, with a 30 plus knot cross wind trying to push it over.

To give everyone the best chance of enjoying sailing in extreme conditions it is an advantage if jibs are on luff rollers and mains are easily reefed, even spinnakers on top down rollers. This is not necessarily important for advanced and highly experienced sailors, or in actual elite competition with a coach boat nearby ready to assist. The most dangerous situations arise when inadequately thought through designs are sailed by novice unsupervised crews. So boats that aren't fully thought through will not be the safest choice for inexperienced and developing territories. But that is where they are going to end up.

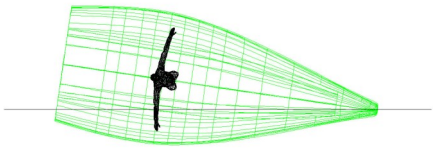
Mentioned above is being readily reef-able - a good feature as long as the crew know how it works and reef in advance. But it means nothing if the boat is being sailed by an expert strapped in quad helmsman and the crew has gone over the side. Now it comes down to how effective is the stability geometry, and how much buoyancy is there along the gunwales.

In the case of boats with heavy weather rigs which are set up in advance before leaving the shore, that is fine in theory, but probably looks so dorky and dumbed down, with under canvassed boats bobbing around before and after, there will be a reluctance to rig for the worst. So being "reef-able" like this is not really relevant as it is more likely that the "on water un reef-able boat" is going to be caught full sail in a violent squall. Let's hope it has got lots of buoyancy along the gunwales to keep the strapped in sailors out of the water.

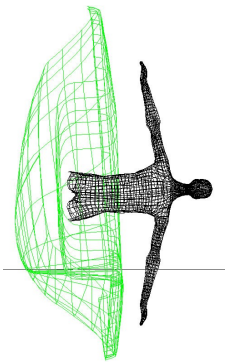
A further consideration is what happens if a knockdown is caused by the sheet being caught or jammed, or the crew goes over the side, even partially, or is otherwise incapacitated, one of which is a certain eventuality. So the sheet needs to be within the helms reach, but that is not much good if the helmsman is a quad with hands velcro'd or taped onto the steering levers.

So again, in the end it comes down to design, how much draft do we have, how much ballast, what is the boat's beam and critically, how much buoyancy does it have along the gunwales, versus how much risk is acceptable. Get all that right and the boat is approaching fail safe, unless the ballast bulb falls off, so make sure it is all a positive chain all the way up to the lock down pin.

Those were the considerations when designing the SKUD, and you can see in the drawings below of the boat on its side that the helmsman is well clear of the water. Consideration was also given to how much positive buoyancy foam is in those huge side buoyancy chambers, because you need to ensure that with the hull buoyancy chambers holed and flooded the hull will protect the sailors strapped into the seats. There were 84 SKUDs built, most are still around, more are planned. Don't write them off as they are without doubt the bench-mark in excitement and safety.



SKUD18—on side floatation



SKUD18 - on side rear floatation

Hansa 2.3, 303 and Liberty Design

The Hansa non spinnaker driven boats, which are rigged pure fore and aft on unstayed masts gain their safety credentials from a different set of principles to the conventional V bottom, stayed rig, spinnaker powered craft with self-draining cockpits which are referenced above. The Hansa 2.3, 303 and Liberty are based on innovations which make them work efficiently, and safely, presuming the safety procedures are followed.

All three classes are based on a concave bottom hull, the principal of which is easy to understand when you consider that if a flat bottom barge has X stability, if you gave that barge a V bottom you need to add some ballast to bring it back to the stability of the flat bottom. Take that to the extreme and give it a pure hemispherical shaped like a cylinder, a round bottle, it then has no form stability at all. It doesn't care which way it rolls along, so any righting moment is going to come from the ballast on the end of its keel appendage.

So a concave bottom gives positive form stability and is a good starting point if you want to create a small stable keel-boat with a keel you can separate from the hull, giving 2 manageable packages, versus a centreboard with a ballast bulb trapped under the hull meaning it needs to sit on a cradle when out of the water.

The Hansa keels are a wide cord profile to contain the lead ballast, instead of using a bulb which would prevent them being removable. The empty cavity above the lead fills with water, otherwise it would be air filled buoyancy which would negate the weight of the ballast. The water drains as the keels are lifted reducing the weight. This is not water ballast, that's a different concept.

A cradle is not a prerequisite if there is a concave bottom as the hull will sit flat on the floor, not rock like a V bottom. So concave bottom hulls give enhanced stability, plus when coupled with a bulb-less keel are eminently manageable on pontoons and boat ramps, which is great for clubs and what we do at events, where a container load of these little keelboats can be launched and retrieved like off the beach dinghies. You need 3 or 4 shore shuttles to handle 20 plus boats which sit on carpet ashore.

The concave bottom also allows water passing under the hull a flat run aft to exit out the stern with the minimum of fuss, and when the boat heels the shape presents a very symmetrical form which doesn't create weather helm, so it is easy to steer regardless of heel. The downside is in very light wind the un-heeled concave hull has more wetted surface area than a narrow waterline V, which is a reason why sailors want to sit forward to trim and heel the boat in light wind particularly when going downwind.

To augment stability sailors sit low in the boat, not high up above the waterline in a fixed seat. They can shift their weight to windward which adds to stability, or they can shift to leeward to heel the hull for better form below, and cause the sails above to fall into their aerofoil shape in a calm. Sailors feel secure as they are sitting low inside the hull, and are not tied into the seat, so if the boat does get knocked down and swamps their body weight is floating free and not negating the weight of the ballast.

Of course a sailor can swim or float out of the cockpit, they can roll out onto the mainsail, they can force the mainsail and mast down into the water if they want, but in normal circumstances the boat will self-right spilling much of the water, and sail on while the rest is bailed out by hand. So the people who sail the 303 should be mobile enough to move around and use their body weight to enhance the inherent stability. If they can't do that then they will have a far more rewarding experience sailing in a Liberty.

The Liberty also has a concave bottom, with a single centreline seat deep inside the cockpit. There are wide side decks which angle up from gunwale to coaming which allows the seated sailor to see out to windward when the boat is heeled, while the now near vertical side deck on the leeward side presents a 300mm high wall above the rushing water, so the boat stays dry at even the most extreme angles of heel. Because the Liberty is intended to have sailors strapped in it has deeper draft and twice the ballast of the 303. The Liberty also has two rudders so even at extreme angles of heel its helm is weightless and with full directional control.

The Liberty has to be the best mannered, easy to manage sailboat on the planet. It is also the safest boat in which to strap disabled sailors, enhanced by the reef-able unstayed fore and aft rigs common to all the Hansa mini keelboats.

On the Liberty and 303 both sails are on unstayed masts, which technically makes them both schooners. The masts are very light, the sails are batten-less so the rig weight has minimal effect on stability. Both main and jib are reef ready at all times which means sail area can be easily reduced on the water to suit the sailors' ability and changing weather conditions. The Liberty can be on its ear and sailing around in 30 knot winds with full sail, but why do that when it is faster and more comfortable in big winds when reefed appropriately. We have raced reefed Liberty in winds gusting 40 knots, but generally 25 knots would be the maximum in which you would start a race.

2009—World Masters Games Sydney—Wind a steady 30kts, gusting to 38knts. Hansa 303 sails reefed to suit conditions

Hansa produce Single seat versions of the 2.3 and 303, so these have wide side decks to prevent water ingress when heeled, and we supply and recommend heavier ballasted keels for these fixed centreline seat models. It is also possible to fit a 303 keel into a 2.3 Single which creates a bullet proof extremely stable sailboat, only 2.3m long with a draft 50% its overall length into which you can safely secure a quadriplegic to sail on their own, even someone of profound disability using our servo assist system. But more often today programs prefer to use 2 person boats and an instructor takes you for a ride, literally, so you don't learn much, or enjoy the wonderfully liberating solo experience.

The 303 Single can be rigged with the standard manual tacking jib, but also a smaller self-tacking, self-vanging and reef-able jib with double ended sheets that can lead to both a winch and cleat for manual trimming. These are all little features which add to the integrity and safety of the total package.

The Liberty is standard with a self-tacking jib which automatically gybes itself and hunts the breeze like a model yacht when sailing downwind. The self-tacking jib is the final piece of the puzzle which makes the package manageable by quads, allowing a strapped in motionless sailor to compete safely and beat anyone.

The 303 may be the best boat to build the numbers to reinstate sailing in the Paralympics, but it's the purpose designed single person Liberty, for the reasons outlined above, which is the best boat to provide the ultimate in fairness and equity for all.

It is all these innovative features which make these boats work. It is a package that makes them safe, always presuming that the keel pin is secured with the keel fully down, and the boat appropriately reefed to match the sailor's ability to the conditions. If the conditions change then the rig should be adjusted to suit. If the sailor is incapable of reefing then their boat must be kept under surveillance and a safety boat ready to render assistance as needed.

There are guys, yes guys, girls are usually more circumspect, who boast they have been sailing around in our boats for 10 years without the keel pin in place and there has never been anything like an incident. That may be so as a Hansa will intuitively try to sail you out of trouble and not over a cliff, but it is like saying you have been driving your car without a seat belt and nothing went wrong….. Which reminds me to ask one loveable loud mouth friend if it was a car accident that caused him to become a quad, and did the outcome have anything to do with not wearing a seat belt.

I think we are sailing into more dangerous times as there are more people with disabilities going sailing, and there are new spinnaker driven boats being sold to programs unaware of the level of increased risk that spinnakers bring. Which doesn't mean our little spinnaker-less boats aren't vulnerable, they are. Greater numbers alone means greater risk as nothing is 100% fail safe, so we need to be vigilant, keel lock down pins must be in place, make sure reefing systems work and use them, and if disabled sailors can't reef themselves they must be kept under surveillance while on the water, and preferably reefed before the event, not after.

I think a reference here to human nature and how it adjusts to innovation is warranted as Hansa mini keelboats are so innovative in so many aspects that we should not be surprised when the mainstream sailing trinity of sailing business, administration and sailors write Hansa off as multi-coloured gimmicks, not real boats. They don't take them seriously. Like when mainstream accredited coaches disregard and even dismantle the reefing system, and arrogantly fail to see how a Hansa works thanks to its different operating system.

But let's be clear, Hansa's never were designed to appeal to the mainstream, they were designed to appeal to the 98% of the population who sailing needs to attract if it is going to grow and achieve its goals - like getting reinstated in the Paralympics.

Hansa also champions the concept of Universal Design, the pathway to making places and programs accessible and rewarding for everyone, another area that can be met with conservative resistance. The sadness is Sailing actually has the opportunity to change its image, become the most inclusive sport on the planet, but it can't see it, yet. But watch developments. Maybe that is the silver lining under the cloud of being kicked out of the Paralympics.

Chris Mitchell

Hansa Sailing Systems

2009 World Masters Games, Sydney
Wind a steady 30kts
Hansa 2.3's reefed for weather conditions