

A Uniquely Versatile Anchor

Near Normal Load and Conventional Drag Embedment Modes
A full mooring spread can be shipped on one AHV

Near Normal Load Mode

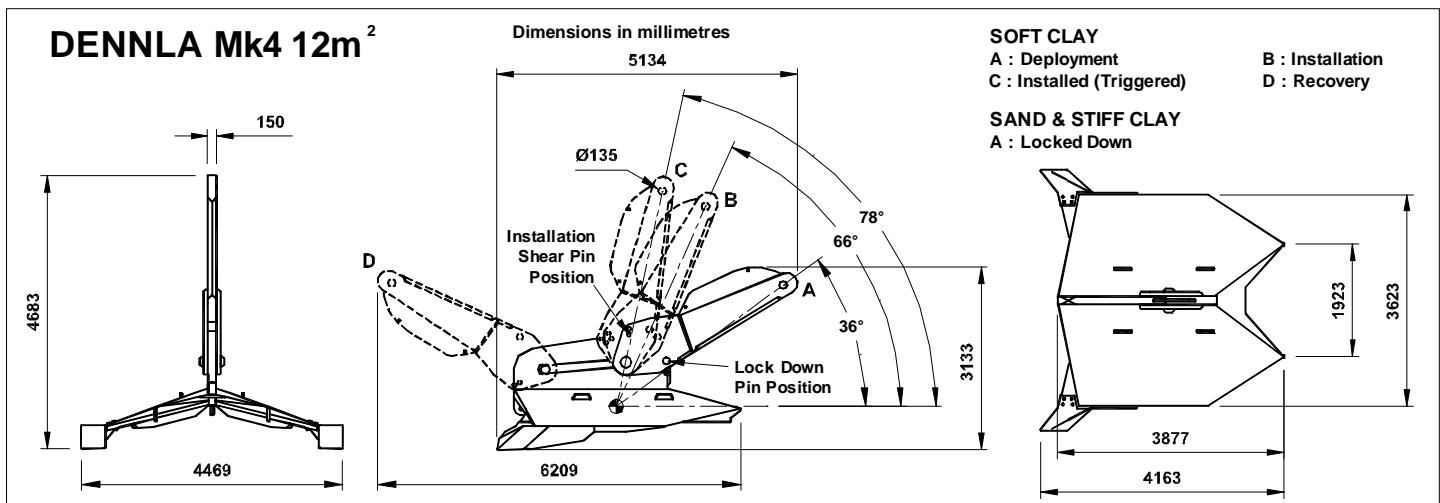
- High capacity at high uplift for deepwater applications
- Handles out-of-plane loading by veering
- Avoids verticality issues of drop-in anchors
- Not subject to Vertical Load Anchor (VLA) pullout failure
- Shank slides aft for low load recovery by mooring line
- Proven track record for deepwater applications

Conventional Drag Embedment Mode

- Shank lock down gives high performance in sand and stiff clay
- Low profile for deeper embedment

Either Mode

- Rapid turnaround on deck
- Single load path shank gives determinable fatigue life
- No need for a ROV, pendant lines, or sub-sea connection



Near Normal Load Mode

The 'vertical' load anchor or VLA, which preceded the Dennla, was a special design of drag-embedment anchor that could be 'triggered' by parting an installation shear pin so that the load line through the centroid of its fluke increased to a final angle of 90° (i.e. normal) to its fluke. When triggered, the VLA provided a holding capacity exceeding twice the pull-in load but further loading could cause it to pull out of the seabed, a problem that was mitigated but not solved by imposing a higher safety factor on the VLA than on a conventional drag-embedment anchor.

The Dennla Mk4 is a low profile anchor which solves this problem by having its final centroid angle reduced from 90° to 78° ('near normal'), a modification that enables the anchor to continue embedding after triggering and to do so when pulled at angles at the mudline as high as 45°, a feature important for deepwater applications. At the same depth of embedment as a triggered VLA of equal fluke area, the triggered Dennla has about 90% of the holding capacity of the VLA. However, on loading further, the VLA will pull out whereas the Dennla will continue to embed and generate an increasingly greater holding capacity than that at which the VLA would have failed. This is a crucial advantage of the Dennla over its VLA predecessor.

Conventional Drag Embedment Mode

The Dennla Mk4 has the added feature of a shank that can be locked down to fix the fluke centroid angle at 36°. This enables the 12m² and 14m² Dennla Mk4 anchors to equal respectively the performance of a 12,000kg and a 15,000kg Bruce FFTS Mk4 anchor in sand and stiff clay.

Deployment

For soft clay sea beds, the Dennla is pulled in until a chosen line tension is reached at a mooring line scope giving a final uplift angle of 15° to 25° at the mud line. Scope is then shortened, increasing the uplift angle to 35° to 45°. This produces leverage which parts the shear pin and allows the shank to rotate to establish a new centroid angle of 78°. On reducing the uplift angle at the mud line and pulling further, the fluke inclination increases and the anchor penetrates deeper than would otherwise have been possible.

For sand and stiff clay, the Dennla Mk4 is installed conventionally with its shank locked down.

Recovery

Near Normal Load Mode

To avoid the problem of high recovery loads, encountered with VLAs and bulky drop-in or gravity installed anchors, the Dennla's shank can rotate and slide to the rear of the fluke to exploit the anchor's low profile for recovery. This enables an AHV to pull the anchor out backwards at well below the installation bollard pull. Typical recovery loads are about half of the installation load.

Conventional Drag Embedment Mode

Recovery is similar to that of a conventional high holding power drag embedment anchor, e.g. Bruce FFTS Mk4. In either mode, the Dennla is recoverable without the need for a ROV, pendant line, or sub-sea disconnection.

The Dennla negotiates stern rollers smoothly and is compact and easy to handle on deck, features which reduce turnaround time for presets in deep and ultra deep water. A mooring spread of Dennlas can be installed, recovered, and reinstalled at a new location in significantly shorter time than suction piles, suction installed plate anchors, VLAs, or drop-in anchors. This translates into a saving of two to three days or more per rig-move compared with such anchors, a track record established since 2002.

The addition of the lock down feature of the Dennla Mk4 adds high performance in sand and stiff clay. The anchor can also be racked sideways on bolster bars ready for deployment from a MODU as a near normal load anchor for soft clay, or, by locking down its shank, as a conventional anchor for sand and stiff clay.