



CPT Deployment Systems

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Deployment Capabilities

- Onshore
- Marshland
- Rivers
- Nearshore
- Offshore





Truck Mounted Systems

Onshore
Cone
Penetration
Systems...





Truck Mounted System

- Truck mounted or purpose built system suitable for high production – typical production of 400 ft to 600 ft per day regardless of the type of sensors
- Two types – anchor and dead weight systems
- Dead weight systems more productive than anchor type
- Anchor type uses anchors tied into earth for reaction force
- Dead weight systems use equipment weight as reaction force
- 25 (permit limitation) to 40 (requires special permits) tons typical weights for vehicle
- Additional steel plates used to increase the weight of the truck
- Four legs can elevate the vehicle and transfer its entire weight into pushing CPT
- Deepest push - 325 ft in New Orleans by pushing (without coring etc.)



Onshore
Cone
Penetration
Systems...

Truck Mounted Systems





Truck Mounted System

Limitations

- Heavy and unsuitable for softer grounds like marshland
- Bulky and require large maneuvering areas



Track Mounted Systems

Onshore
Cone
Penetration
Systems...





Track Mounted System

- Suitable for beach, snow, or soft ground with desiccated crust (not too soft) type conditions
- Rubber tired or track units – typically 4 ft wide tracks
- Reduced contact pressures of 5 to 7 psi – about ten times lower than a truck mounted system
- Typical production of 400 ft to 600 ft per day regardless of the type of sensors
- Cylinder with pads on the front and back can be used for re-leveling the vehicle
- Deepest push - 200 ft depending on soil type



Onshore
and
Marshland
Cone
Penetration
Systems...

Track Mounted Systems





Track Mounted System

Limitations

- Typically lighter than a truck and, therefore, has less pushing capacity
- Travel between locations is slower – ideal for closely located CPTs



Onshore
and
Marshland
Cone
Penetration
Systems...

Track Mounted Systems





Truck/Track Mounted Systems

Onshore
and
Marshland
Cone
Penetration
Systems...





Truck/Track Mounted System

- Suitable for farmland or undeveloped areas – access easier after rain, flooding, and rutting
- Vehicle can transition between a truck and a track
- Don't need to transport on a 18-wheeler and can drive like a truck
- Typical production of 400 ft to 600 ft per day regardless of the type of sensors
- Built in cylinders can be used for re-leveling
- Push depths dependent on whether the vehicle is operated as a truck or a track system



Truck/Track Mounted System

Limitations

- **Unsuitable in USA because of highway travel restrictions – 12 k front axle needs to be lighter than the 17 - 22 k back axle – hence can't be more than 17 tons truck**
- **Manufacturing problem as the track location disturbs the balance of the vehicle hence causing it to lift at the front**



Onshore
and
Marshland
Cone
Penetration
Systems...

High Jack System





High Jack System

- Ideal for mixed surfaces i.e. dry as well as wet/soft
- Transformer System - Track unit can move forward making it a single unit and will act like a truck
- Total weight is typically 25 to 30 tons
- Separate weights are similar to truck and track
- Don't need a Class A commercial license and can be transported as a truck
- Relatively new system in the USA
- Double cylinder, fully automated with self pipe retrieval – don't need to stop to add pipe unlike a traditional system
- Continuous pushing makes it faster
- Typical production of 800 ft to 1000 ft per day
- Can be operated by a single man
- Ergonomically correct and reduced health related issues
- Can re-level itself like a typical track



High Jack System

Limitations

- **Similar to a typical truck or track mounted system depending on the mode of operation**



Marsh
Cone
Penetration
Systems...

All-Terrain Mounted Systems





All-Terrain Mounted System

- Suitable for farmland, mud surface, and rut areas
- Provides better traction than a truck system
- Rubber tires instead of tracks
- Typical weight is 15 to 20 tons
- Slightly more stable for levees and slope access
- Suitable for industrial facilities as tracks may not be allowed on asphalt surfaces
- Typical production of 400 ft to 600 ft per day
- Slightly faster between locations as compared to a track mounted system
- Good for working on road shoulders for highway projects (similar to a tractor)



All-Terrain Mounted System

Limitations

- **Lighter and slower than a truck mounted system**
- **Requires an 18 wheeler to transport**



Marsh Buggy Mounted Systems

Marshland
Cone
Penetration
Systems...





Marsh Buggy Mounted Systems

- Suitable for marshlands
- Skid mounted on marsh buggy
- Aluminum built pontoons make it lighter
- Empty pontoons can help float the system in more than 3 ft of water
- Typically 7 to 10 tons systems but can be made heavier (15 to 17 tons) by filling pontoons with water
- Typical contact pressures of 2 to 3 psi when used as a track mounted system
- Daily production is similar to a conventional system
- Very spacious and ideal for carrying equipment and people in hard to access areas



Marsh Buggy Mounted Systems

Limitations

- Can tear aluminum if tree stumps or other hard obstructions present
- Expensive compared to typical systems
- Wider than normal systems, therefore, requiring permits and escorts for transportation
- Require more setup time due to skid installation on the equipment



Air Boat System





Air Boat System





Air Boat System

- Suitable for marsh – 0 to 5 ft water depth
- Lighter, but can be filled with water and lead weights – 7 tons maximum weight
- Minimum disturbance of marsh or wetland areas
- Same production as an amphibious system
- Double casing for very soft soils

Limitations

- Very light
- Labor intensive



Air Boat System





Rivers,
Nearshore
and
Offshore
Cone
Penetration
Systems...

Barge Mounted Systems





Barge Mounted Systems

- Existing truck, track, or buggy mounted systems on floating platforms
- Similar to other types of systems in production
- Testing requires setting casing through water and pushing the cone inside the casing

Limitations

- Needs a jack up barge rather than a free floating barge; otherwise the reference point can be offset and the pipe can be possibly damaged due to downward movement
- Depth measurement can be erroneous with a floating system



Rivers,
Nearshore
and
Offshore...

Barge Mounted Systems





Rivers,
Nearshore
and
Offshore...

Skid Mounted Systems





Skid Mounted Systems

- Suitable for testing from piers and from cantilever platforms
- Portable systems can easily be anchored in varying conditions
- Can be made heavier by adding weight in several ways, e.g. park heavy equipment or place weight atop the skid

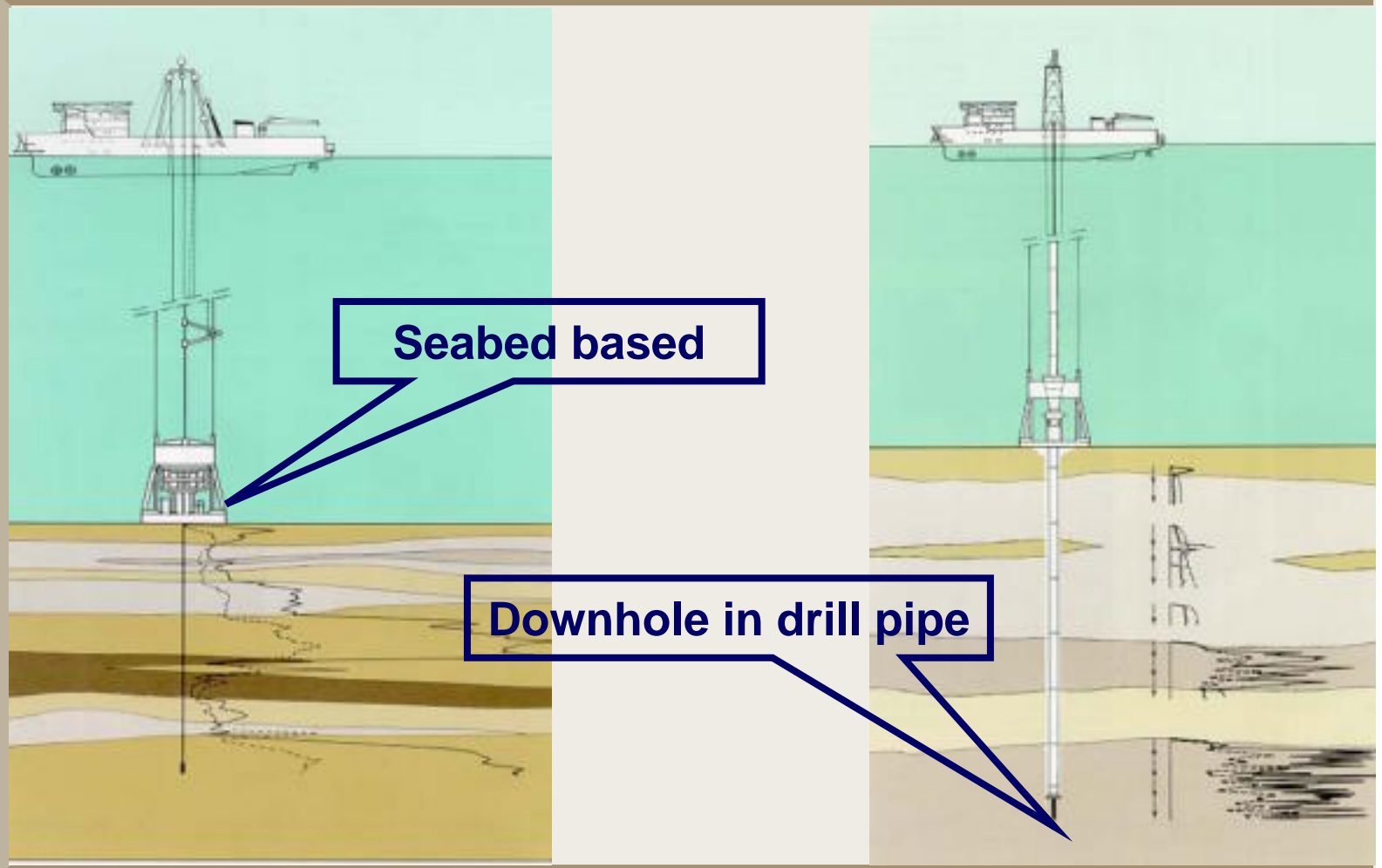
Limitations

- Less production than a conventional system
- Penetration depths governed by the reaction force
- Take time to set up and remove



Rivers,
Nearshore
and
Offshore...

Seabed Systems





Seabed Systems

- Suitable for lakes, dams, coastal areas, and oceans
- Sit on the mud line at the bottom of the water body
- Three types include stroke, coil, and wheel systems
- Use is dictated by the required CPT penetrations
- Used for Hong Kong Chep La Cok Airport Project
- Ideal for deeper water depths – typically 20 ft or more
- Required components include a floating platform, a cherry picker/crane, or an A frame and the system



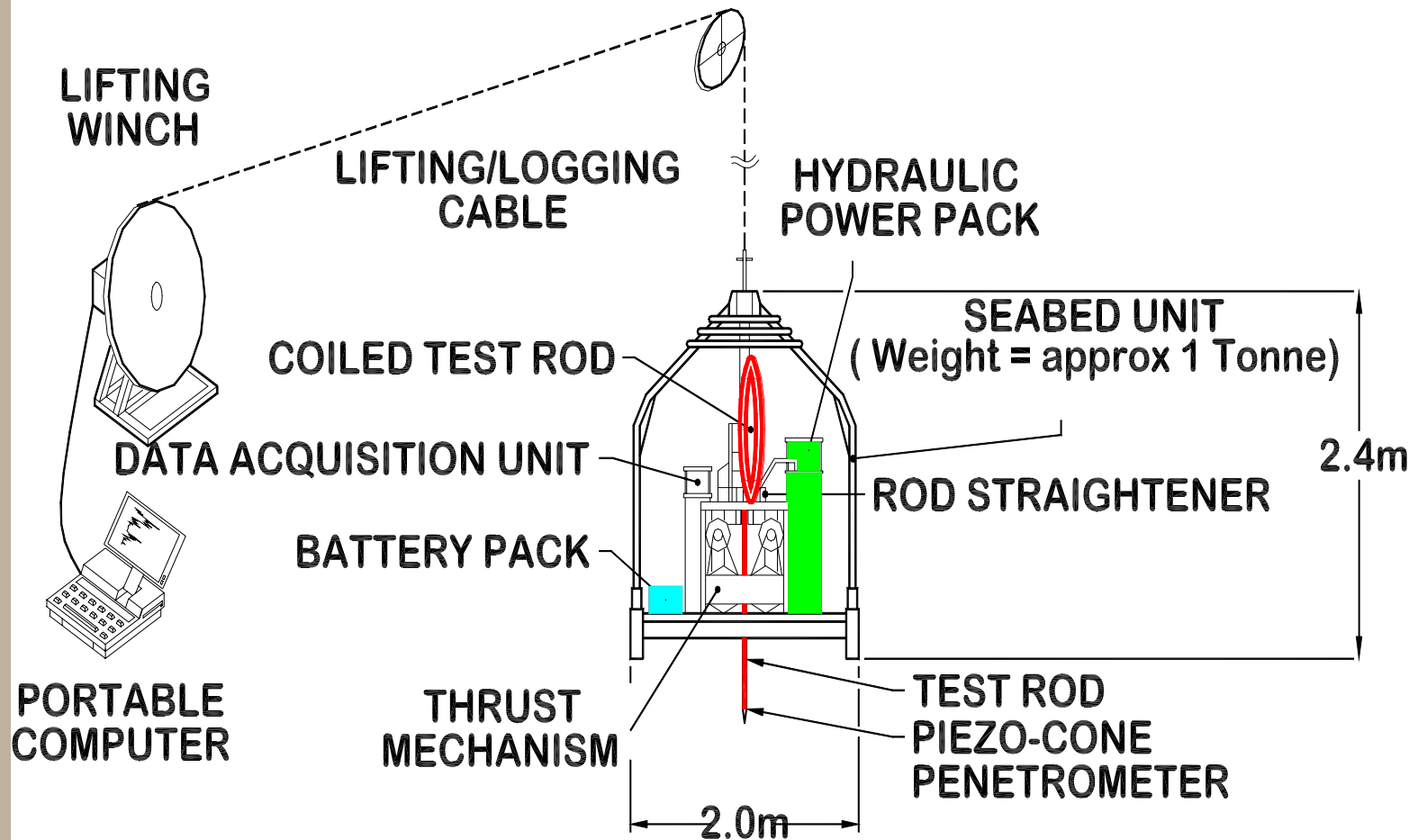
Coil and Wheel Systems

- **Coil systems include Seascout and TSP**
- **Pipe straightens and is pushed into the ground as the system is uncoiled**
- **Typical penetrations of 10 to 50 ft**
- **Wheel systems include Wheeldrive Rivercalf and Wheeldrive Seacalf systems**
- **Turning teeth on hydraulic operated wheels drive the pipes**
- **Wheeldrive systems can have single or multiple levels**
- **Capacity can vary from 5 to 20 tons depending on the number of levels**
- **Wheeldrive systems typically used for predetermined CPT penetrations**



Seascout

Offshore
Cone
Penetration
Systems...





Offshore
Cone
Penetration
Systems...

Seascout





Offshore
Cone
Penetration
Systems...

Tethered Seafloor Platform (TSP)



Probe Types:

- Cone Penetrometer
- Seismic & Piezo Cones
- Cone Pressuremeter

Penetration Capabilities:

- NC Clay: 50 to 70 m
- OC Clay: 5 to 20 m

Penetration Rate:

- 2 cm/sec



Rivers,
Nearshore
and
Offshore...

Seabed Wheeldrive Rivercalf System





Coil and Wheel Systems

- **Special skirt at the bottom of the wheeldrive systems can be used to provide suction and hence additional reaction force**
- **Pivots can be added at the base of the system for re-leveling**
- **Ideal for slopes and non smooth surfaces**
- **Wilson wireless CPT can be pushed inside the drill pipe (stays in) attached to a wire line sampler**



Seabed Wheeldrive Rivercalf System

Rivers,
Nearshore
and
Offshore...





Seabed Wheeldrive Rivercalf System

Rivers,
Nearshore
and
Offshore...





Offshore
Cone
Penetration
Systems...

Seabed Based Wheeldrive Seacalf System



- 10cm², 15cm² and 33 cm² Cones and T-bar
- 5000 kg
- For Penetration of 40m to 50m Below Seabed
- Maximum 2,250m Water Depth



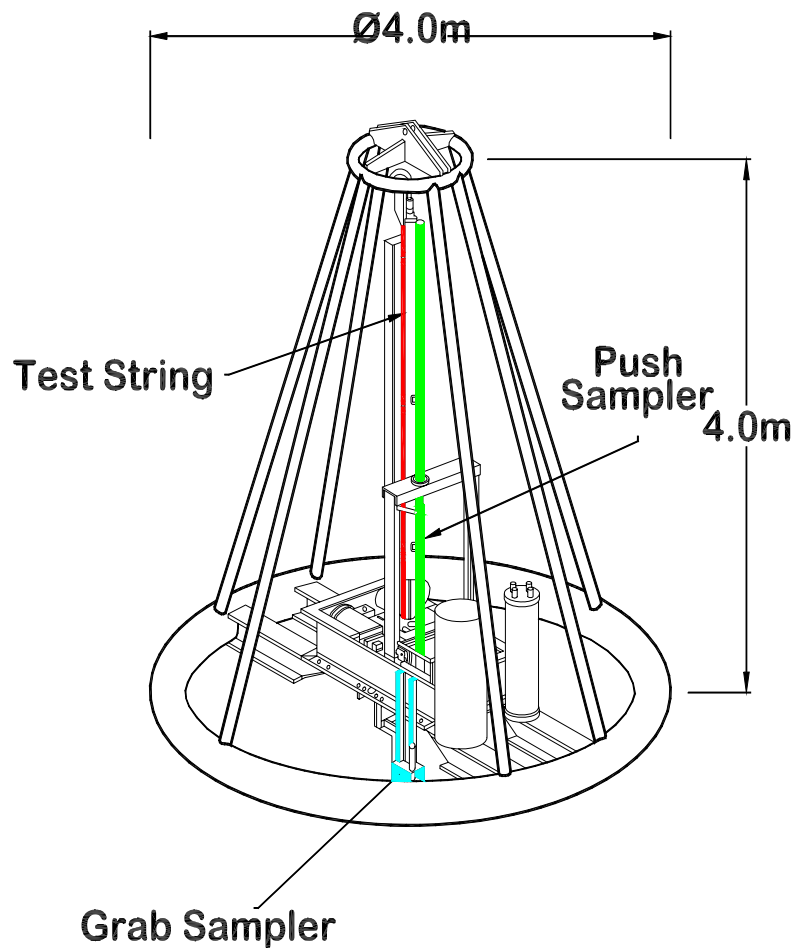
Stroke Systems

- **Stroke systems include Searobin, Dolphin Halibut Vane, and Dolphin Remote Vane**
- **Ideal for predetermined penetration depths such as for pipeline and mud slide evaluations**
- **Capable of 5 ft to 15 ft strokes**
- **Dolphin Halibut Vane can be used for multiple types of testing in the same hole, i.e. drilling, field vane, CPT, liner sampling, etc.**
- **Dolphin remote vane is used for drilling; can be attached to the end of the drill pipe and is a wire line system operated by mud pressures**



Offshore
Cone
Penetration
Systems...

Searobin



- 2 m CPTU stroke with 5 cm² and 10 cm² Cones
- 1 m push samples
- Small grab sampler
- 50 tests a day in 1,000 m water depth
- Maximum 2,000 m water depth



Offshore
Cone
Penetration
Systems...

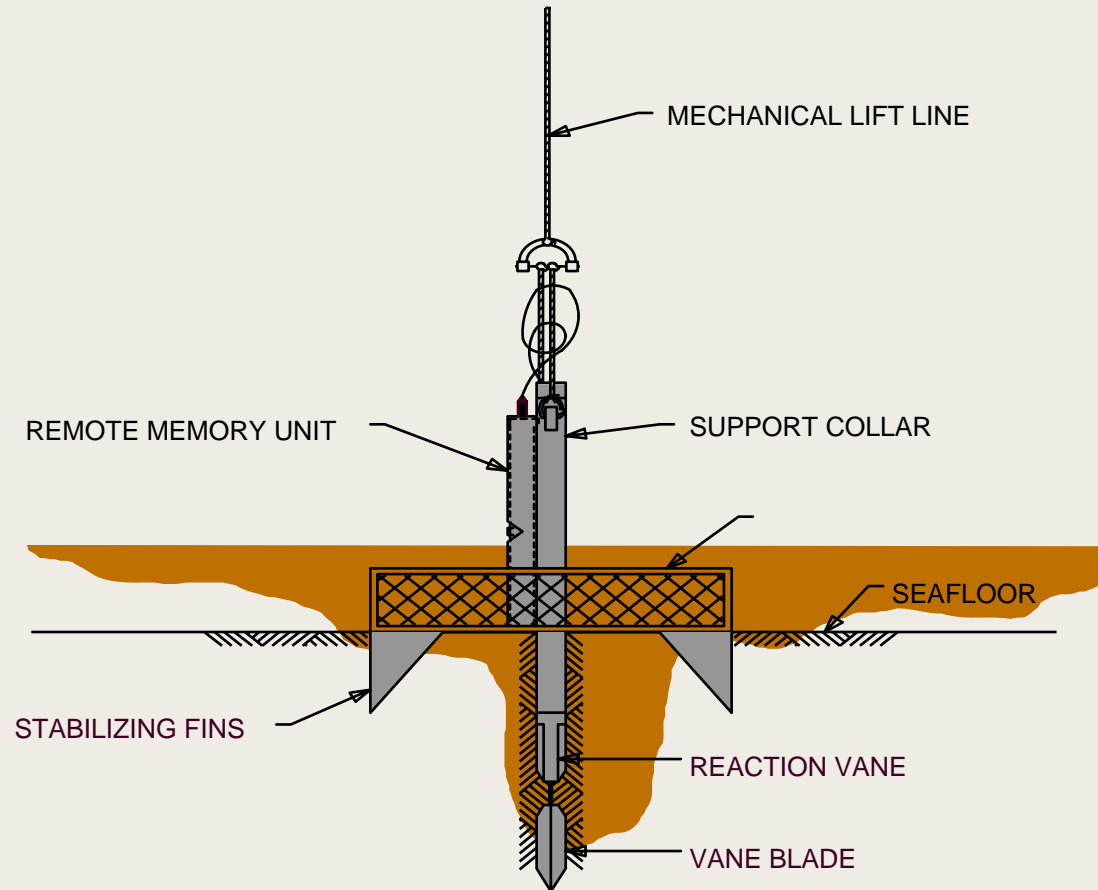
Searobin





Offshore
Field Vane
System...

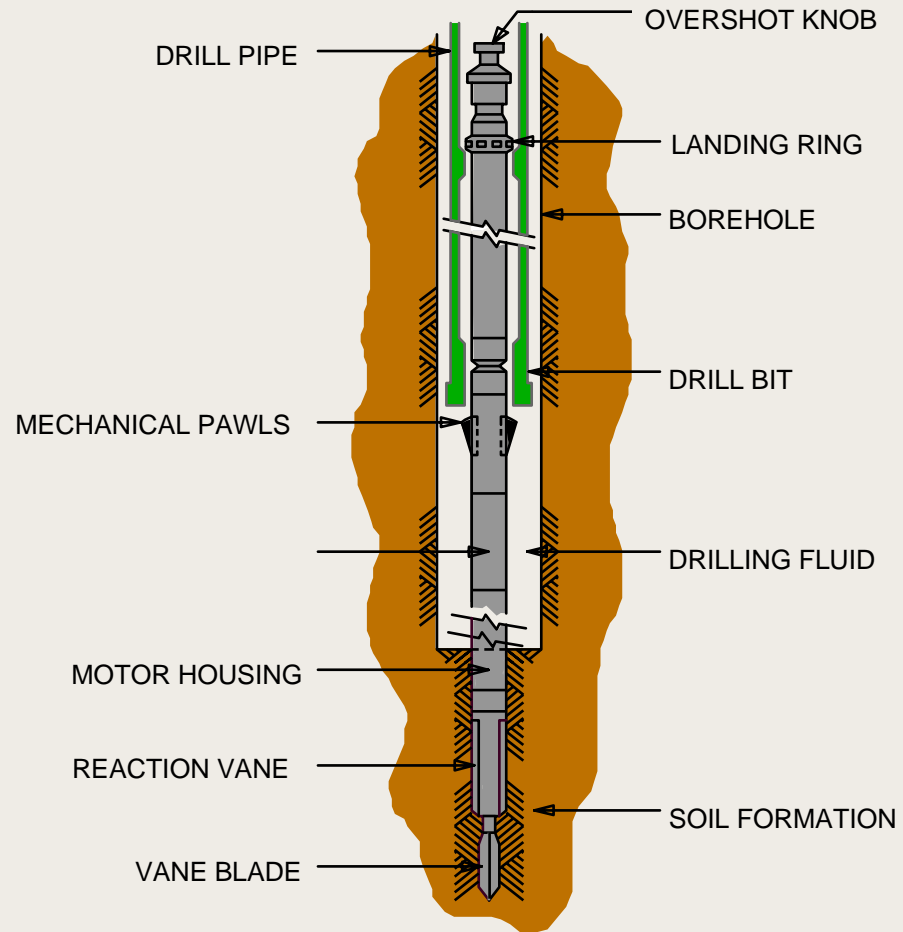
Dolphin Halibut Field Vane





Offshore
Field Vane
System...

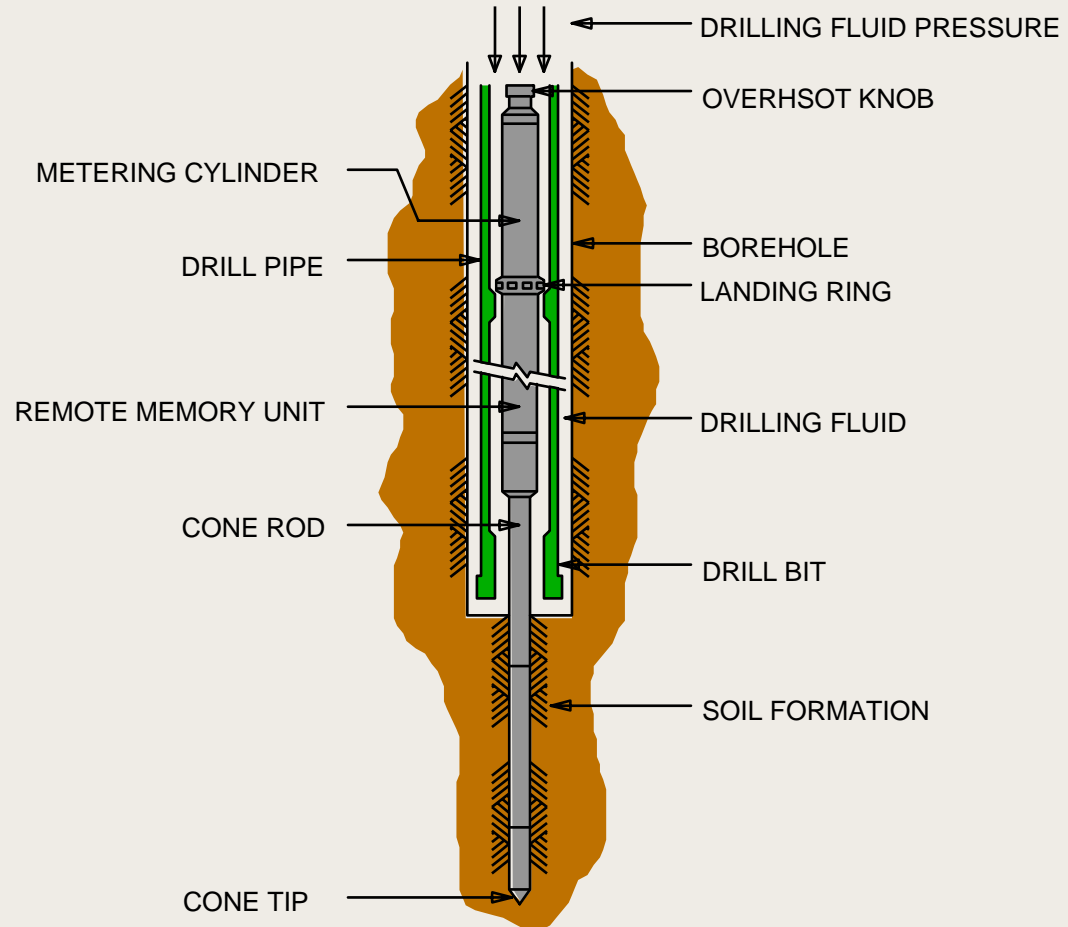
Dolphin Halibut Remote Vane





Offshore
Cone
Penetration
Systems...

Dolphin Piezocone Penetrometer





Offshore
Cone
Penetration
Systems...

Downhole Wilson XP Wireless CPT In Drill Pipe



**For penetrations to more than
200 m below seabed...**



International Systems

- **Simultaneous drilling and CPT from a barge**
- **Advantageous because saves multiple mobilizations; can compare CPT results to borings hence reducing the number of borings**
- **Picture shows innovative way of performing CPTs on slopes or levees**
- **Picture shows lateral CPT inside a tunnel; skid mounted system bolted to the tunnel lining**
- **Picture on barge shows a combination unit with drill and CPT equipment mounted on the same equipment**
- **Picture shows CPT being performed at an angle with anchors providing the reaction force**



International Systems – Simultaneous Testing





International Systems – Innovative Approach





International Systems – Innovative Approach





International Systems – Simultaneous Testing





International Systems – Simultaneous Testing





International Systems – Innovative Approach





International Systems – Innovative Approach





International Systems – Innovative Approach





Soil Related Limitations – All CPT Systems

- **Cemented sands, gravel, rock, hard clays, transition zones between very soft and hard materials**
- **Soft soils – require casing to resist horizontal deflections**
- **Advantage is that the casing is set by the CPT rig instead of a drilling method**
- **Steel casing is pushed around the cone and kept at least a meter above the tip of the cone to avoid interference with the data**