SCITEK Tow Tank Seeder

Technical Specification

SCITEK Consultants Ltd., 10 Jubilee Parkway, Derby, DE21 4BJ, United Kingdom
Tel: +44 (0) 1332 365 652
https://www.scitekconsultants.co.uk

Table of Contents

1 INTRODUCTION

Research on marine vessels is normally carried out in a towing tank which is a large tank, several metres wide and in some cases hundreds of metres long. This tank features a towing carriage that runs on two rails on either side of the tank normally towing a model. The carriage and model are instrumented so that it can record or control parameters such as speed, propeller thrust and torque, rudder angle, flow field pressures and many other parameters.

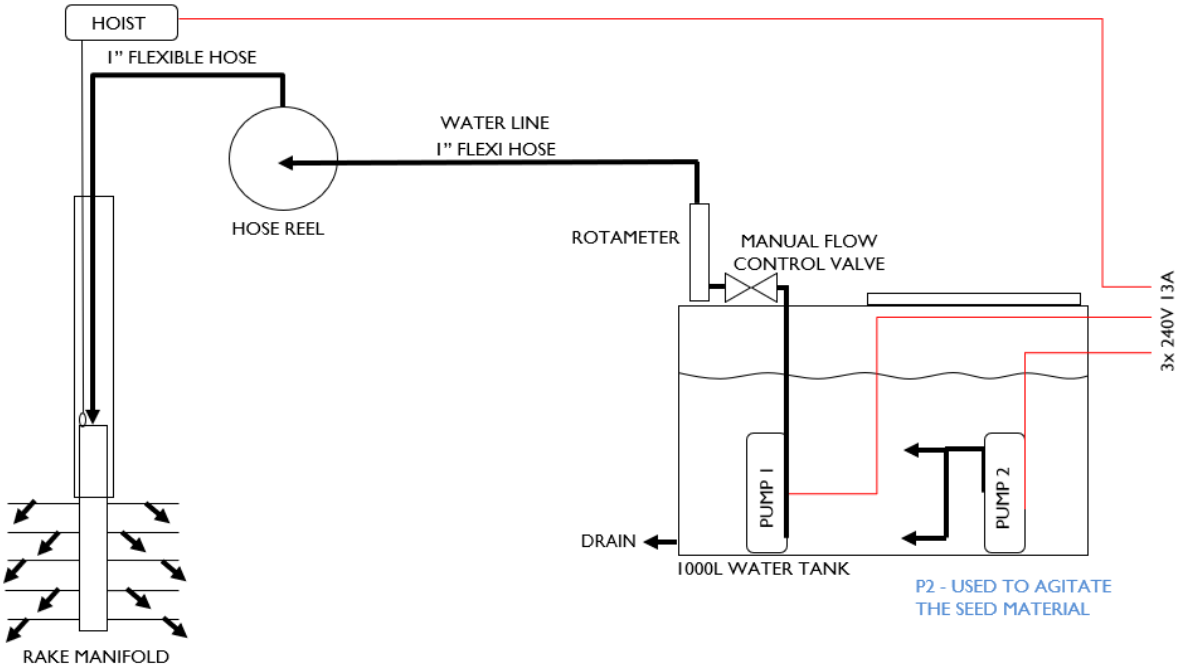
Optical flow field measurement techniques such as laser Doppler anemometry (LDA) or particle image velocimetry (PIV) are increasingly used as they can provide invaluable insights into the flow field generated by the hull of a ship or the propeller and such measurements are used to validate CFD with the aim to improve the performance of the vessel. All optical techniques require particles that are small enough to be carried out by the fluid so that when they pass through the measurement volume of the instrument their velocity and direction can be measured and thus mapping the flow field around the hull of the model.

SCITEK has been specialising in seeding systems for over twenty years. We offer a number of seeders of varying sizes and across a range of applications, including for use with air flows, in small flow rigs, in combustion rigs, as well as in large wind tunnel facilities. Recently, we also produced seeding systems that can be used in tow tanks to mix in the water small particles in the path of the vessel to facilitate good quality optical measurements. As all tow tank facilities are different, our device can be customised so that it can be adapted to suit each facility.

2 MAIN FEATURES

The intended use of the Tow Tank Seeder System is to deposit hollow glass spheres, approx. 10-micron diameter into a water test tank. It is designed to be mounted at a suitable location on the carriage so that it can seed a small area around the vessel and thus minimise contamination of the tank, thus also minimising the quantity of particles used. The carriage then traverses over the length of the tank with the seeder immersed at the required depth. Once the seeding has been deposited, the seeder is retraced from the water and the carriage commences the measurement run. Flow measurements are not carried out during the seeding phase but shortly afterwards as the seeder will produce undesirable flow disturbance in the water which will adversely affect the flow measurements. The particles are nearly neutrally buoyant and they remain in the water for ~~ample time/ or~~ “a generous amount of time” to carry out several flow measurement passes

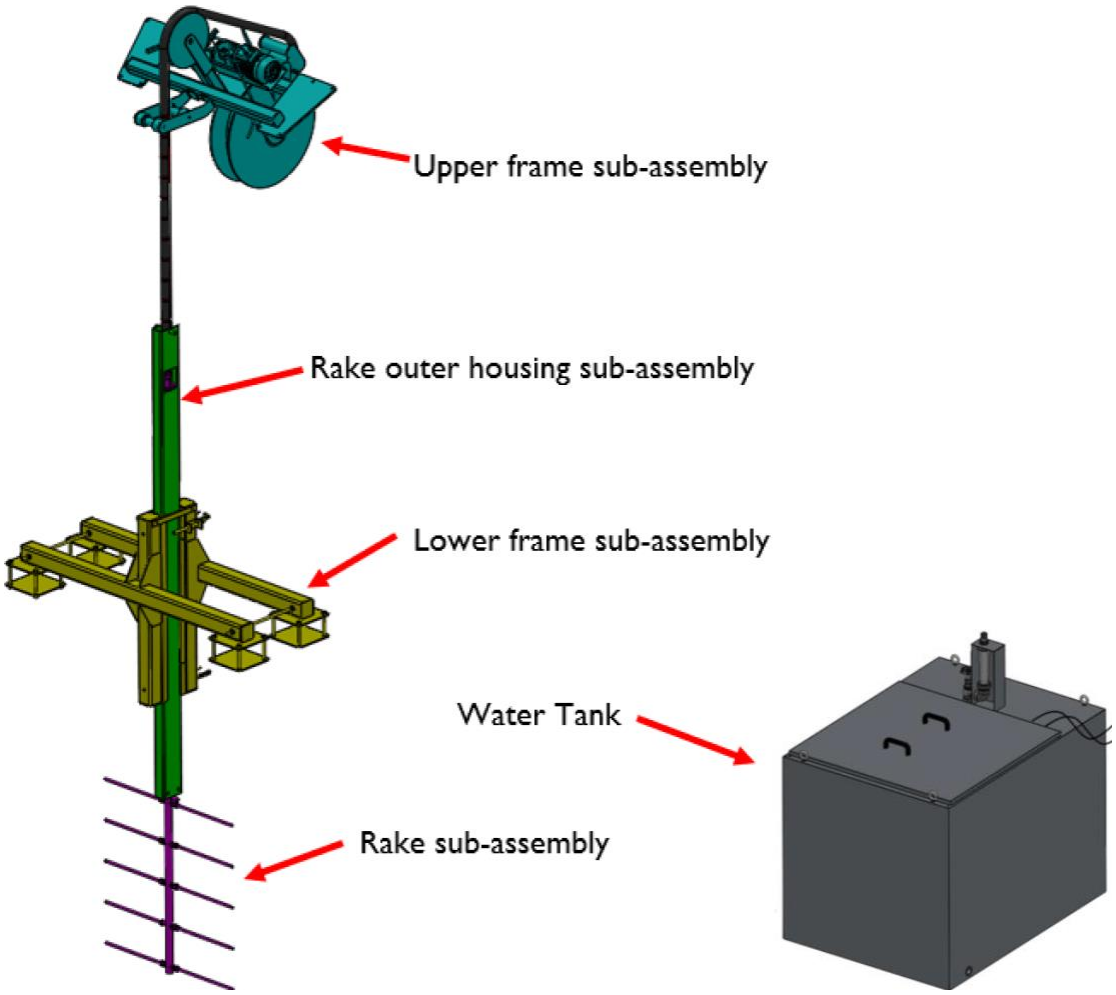
By design the seeder is retractable so that it can be permanently installed on the carriage. It can also be easily removed when not in use. Deployment and retraction is easily facilitated by an electrically operated winch.



The basic components of the SCITEK Tow Tank seeder are shown in the schematic diagram shown above. It comprises of the rake which is essentially five rows of metal tubes with multiple holes drilled on the wall of each tube that are used to discharge water that is premixed with hollow glass spheres. The rake is designed to spread the seeding evenly in the area of interest.

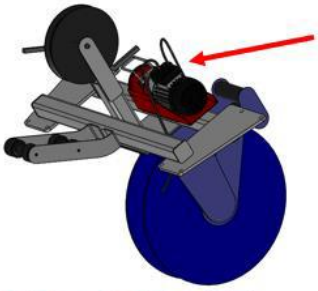
The rake is mounted on a telescopically retractable boom so that it can be immersed in to the water at the desired depth and then fully retracted out of the water when the seeding operation has been completed. At the top of the telescopic boom an automatic hose reel is used to reel or unreel the flexible water hose that feeds seeded water to the rake. The telescopic boom is designed to be strong enough so that it does not bend from the drag it experiences when immersed in the water and towed along the tank. Maximum tow speed for the seeder is 1.2m/s

Seeded water is fed to the seeder from a purpose-built tank (1000 litres) via a submersible water pump. The flow rate of seeded water can be adjusted using a hand operated valve with the flow rate displayed on a rotameter that is situated at the top of the tank. This tank needs to be situated on the carriage and should be close to the retractable boom. In order to ensure that the water within the tank is constantly agitated so that the glass spheres are evenly mixed within the tank, a second submersible pump is used with suitable located outlets which facilitate constant agitation within the tank.



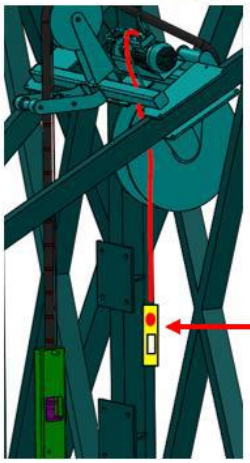
The SCITEK Tow Tank seeder with all its sub-assemblies is shown above and these are explained in more detail below.

2.1 UPPER FRAME ASSEMBLY



Electric hoist

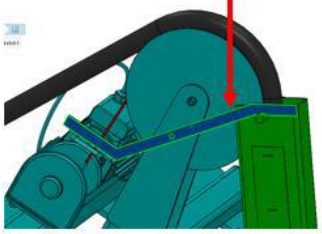
- Max load capacity – 125kg single cable & 250kg double cable
- Lift height – 12 metres single cable & 6 metres double cable
- Lift speed – 10m/min single cable & 5m/min double cable
- Powered by a 540W, 230V motor
- 3mm diameter, 12m twist free cable
- Approx. Seeder/Rake Mass: 38Kg
- ~20secs to fully retract rake from 2.4m depth
- Frame suitable for lifting full load capacity



Pendant placed in holder fixed to frame

May need to extend cable

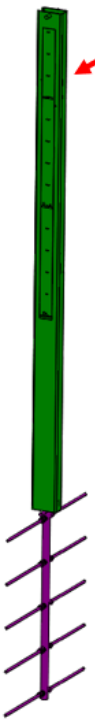
Pivot lever triggers high limit switch

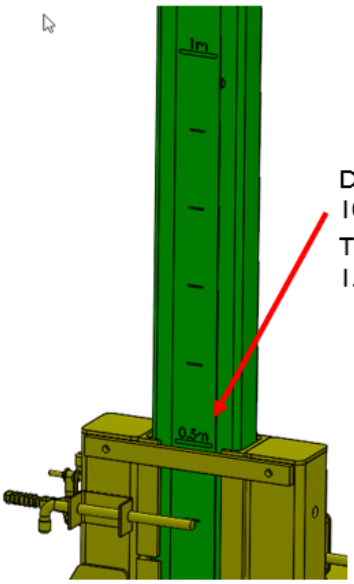


2.2 RETRACTABLE BOOM ASSEMBLY

Outer Housing

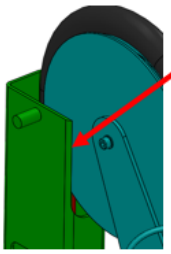
- 120 x 60 x 4 SHS
- Stainless Steel 316L





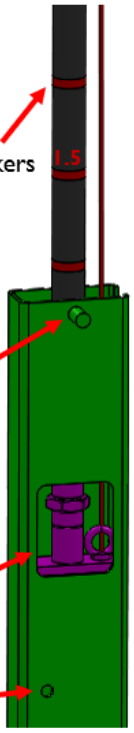
Depth gauge plate 100mm markers

Text at 0.5m, 1m and 1.5m



Cut away to accommodate pulley

Depth markers

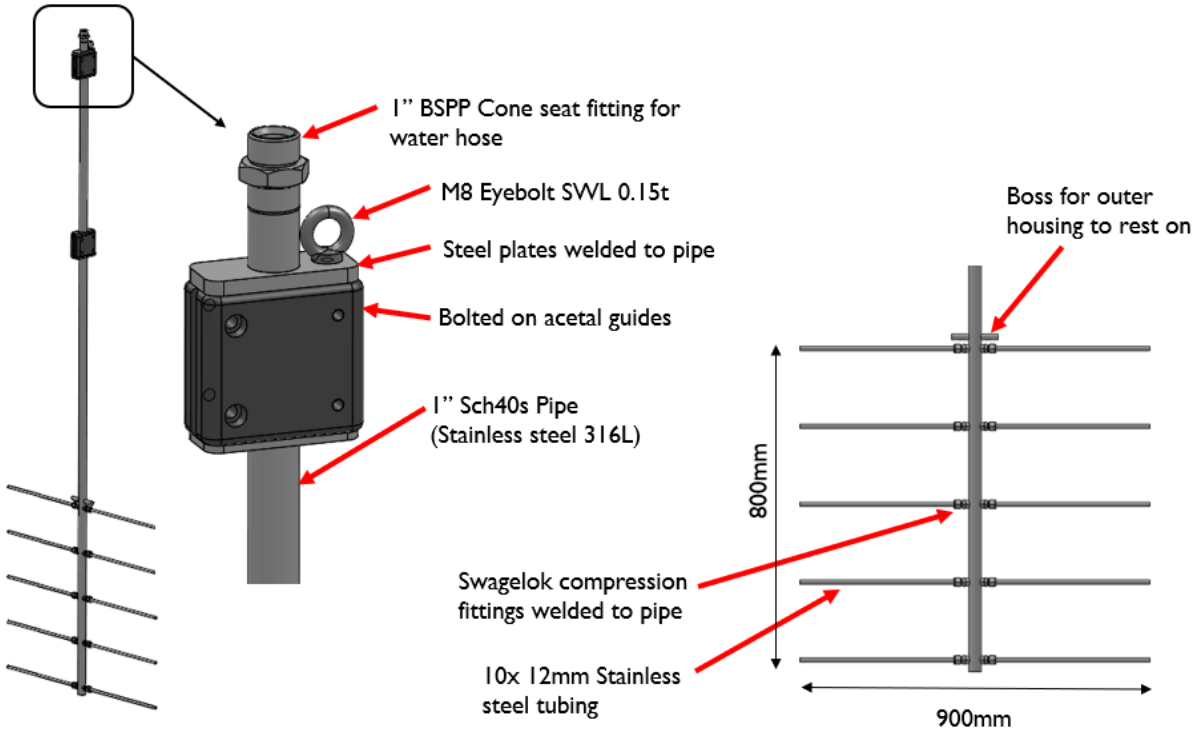


Boss to activate high limit on hoist also to stop rake passing through lower assembly

Access for water hose and hoist connection

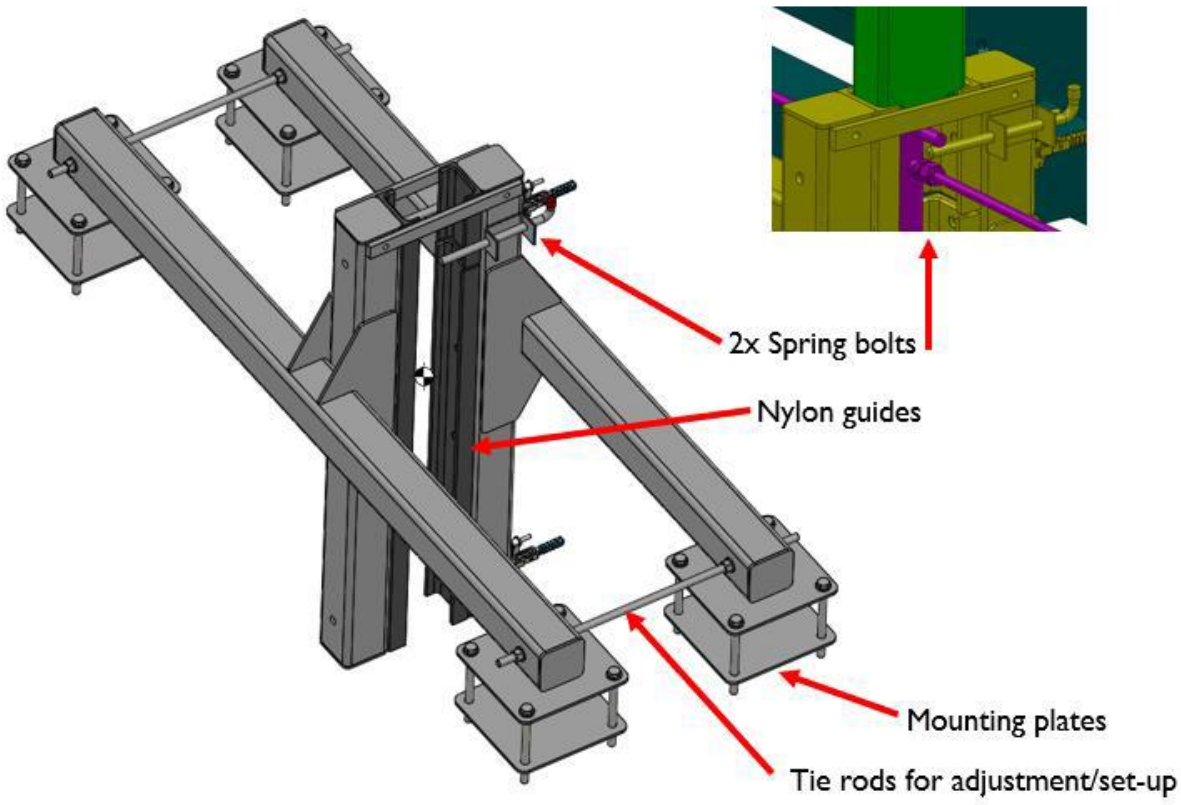
Pin hole to lock internal rake (more info later)

2.3 RAKE ASSEMBLY



The rake assembly can also be custom made to suit customer requirements. The retractable boom can immerse the rake up to a depth of 2.5meters.

2.4 FRAME MOUNTING ASSEMBLY



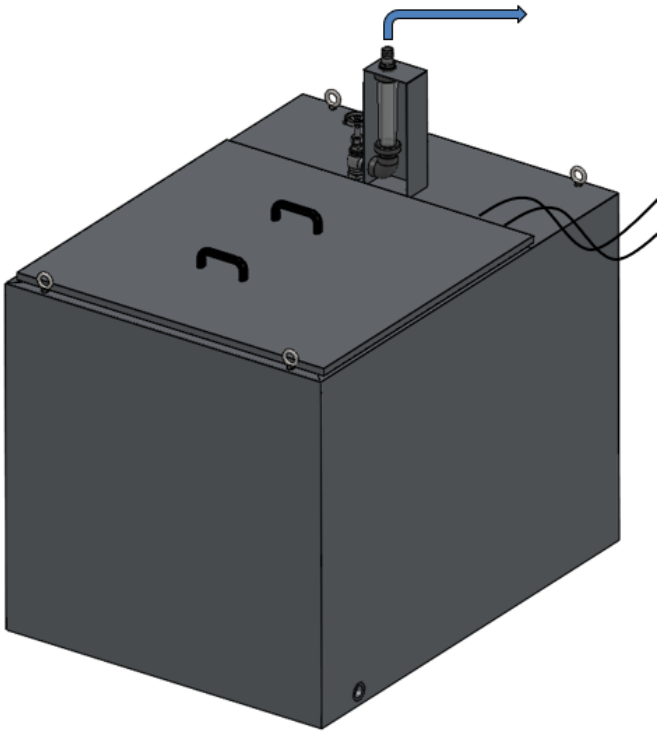
This assembly is normally custom made by SCITEK to suit installation on the customer's carriage.

2.5 SEEDING TANK ASSEMBLY

1000 L Water Tank

Flowrate: 1 L/s (60 L/min)
- Duration to empty tank: 16 min
- Seeding distance (at 0.7m/s): 670 m

- Stainless steel fabrication
- Removeable lid
- 1" hose connector
- 1" drain connector
- Filler/Breather Cap
- Level gauge
- Manual flow control valve and flow meter mounted on top of tank
- Pumps mounted internally
- Lifting eye bolts on side of tank
- Pump electrical cables passes through rubber grommets
- Internal baffle plates
- Pumps secured internally



2.6 INSTALLATION

It is recommended that installation of the Tow Tank Seeder System and associated equipment is carried out by SCITEK. However, where this is not possible, it can be shipped with appropriate installation instructions.

SCITEK appreciate that each tow tank facility is different and may have specific requirements which we are happy to discuss with you. The operation of the seeder can be customised and automated to suit the operation of your facility.

Company Overview and Capabilities

Founded in 1997, SCITEK Consultants Ltd provides Research and Development services to the Aerospace, Pharmaceutical, Power Generation and Automotive industries.

Rig design & manufacture
CAD & FEA
Dynamic modelling
Thermal modelling
Instrumentation

Test facilities
Spray characterisation
Strain Gauge Calibration
Airjet excitation for HCF
Vibration testing
Small gas turbine test rig

Instrumentation & control systems
Sensors
Signal processing
Test rig infrastructure

Image analysis
Computer vision
Feature recognition
3D scanning
Flow viz analysis
Advanced Image Proc.

Fluid mechanics
CFD
LDA
PDPA
Sprays

The company is based in Derby and also has in house electronic and manufacturing capability to support its project activities.

We are experienced in collaborative R&D programmes and offer a link between academic partners and industry.

SCITEK has participated as a member in many EU and UK government funded projects.