Gulf Cobla L.L.C.
Dredging, Survey & Reclamation

SURVEY SERVICES

1. INTRODUCTION

Gulf Cobla (Limited Liability Company) is specialized in dredging & reclamation works and survey services. Formed in 1977, it has undertaken numerous challenging ventures in the Middle East region.

Our main scope of operations is to provide dredging and discharging services such as capital dredging, reclamation, stockpiling, maintenance dredging, trench dredging and backfilling activities. Other main services that we provide are, survey activities (hydrographic and topographic), hire out of plant & equipment (long term as well as short term) and hire out of personnel.

Gulf Cobla's offices have been established in the United Arab Emirates (Abu Dhabi, Dubai), and the Netherlands. The head office, as well as a support yard depot is located at Al Jadaf Dockyard, Dubai. A services branch is maintained in the Netherlands.

Gulf Cobla and its predecessor have, since 1965, played a key role as a contractor in some of the significant transformations at the land-water interfaces in the U.A.E. and other regional countries.

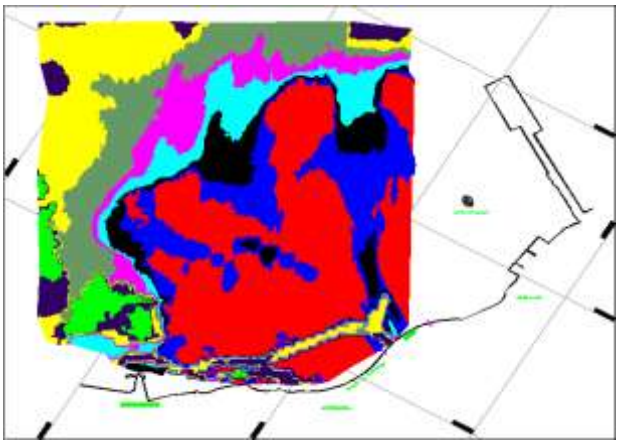
In line with the changing global and regional market developments, Gulf Cobla LLC has documented their operations to suit with requirements as set out by the International Organization for Standardization.

Lloyds Register, via their Dubai office, performed the certification audit and in May 2000 Gulf Cobla LLC received accreditation for ISO 9002 - 1994. During 2000 Gulf Cobla LLC upgraded their Quality Management System to the latest internationally recognized Standard. Subsequently, upon their satisfactory audits, Lloyds Register accredited Gulf Cobla with ISO 9001 : 2000.

Gulf Cobla LLC, as a dredging, survey and reclamation company has established a control system, which can be easily adapted to suit specific requirements from Client's or to dovetail with a Main Contractor's established Quality Management System.

Our experience with the implementation of a documented system, including frequent review of all its elements, has been very good. Although the quality of our products has historically always been satisfactory, the inclusion of recorded control points and frequent execution of root cause review of intermediate results has increased overall efficiency, production, and ease of operations.

These improvements naturally go hand in hand with an increased level of quality. By promoting internal commitment, awareness and dedication of all employees within the organization the established system is continuously being reviewed in our ongoing hunt for continuous improvement. The procedures and processes are constantly evolving because of increased experience, upgraded / more modern equipment and a better perception of our Clients.



2. RESOURCES

It is important for any (contracting) company to be well equipped with apt resources and to be able to meet the challenges of diverse projects. Subject to client requirements, site conditions and other several project factors, the allocated and available resources, be it human or equipment should enable the contractor to execute his/her project with time and cost effective means.

2.1 Resources - Human

A nucleus of key personnel oversees the main operations with Gulf Cobla and several senior employees have been with the company since its inception. Furthermore a team of well-trained and committed employees is available to assist in fulfilling contractual requirements. Additional personnel are acquired as needed and in accordance with contract circumstances and any special requirements of the Client. It has been common for such additional personnel to rejoin the company on several occasions.

All of our employees have received appropriate discipline orientated training towards maintenance and improvement of our Quality Management System. We are very proud that all operational divisions within the organization are included, and satisfactory maintained in our ISO-9001 scope.

The United Arab Emirates has, as first GCC-country, recently been included in the “white list” for the STCW regulations and we are very pleased to state that all our registration and licenses for both crew and plant are fully compliant with this international standard.

In addition to externally supplied training, Gulf Cobla has a vast library of internal course material and training subjects. Training requirements and achievements for all personnel are recorded and appropriate training subjects are presented to the individuals when appropriate.

Gulf Cobla has an excellent Survey Department with the latest survey equipment and qualified and well-experienced personnel.

Most of the survey team members have been working with the Company for an extended period and have proven their capabilities in many of our (major) dredging projects and hydrographic survey contracts.

Advancement in technology has always been changing the working methods of the surveyors. New equipment like the Global Positioning System (GPS), a satellite system that precisely locates points on the earth, facilitates ease of work increasing efficiency and accuracy.

Deployment of such advanced technology requires appropriate training to be imparted to relevant personnel. Internal and external training given to all Gulf Cobla employees in their area of work to keep them selves updated with the latest trends to improve the quality of services provided by us.

2.2 Resources – Equipment & Instrumentation

Gulf Cobla is completely self-proficient with equipment & instrumentation related to hydrographic and land surveys, which also include latest Differential Global Positioning Systems, high precision echo sounders, and total positioning theodolite stations.
Efficient and effective availability of machinery and equipment is very important to maintain a high level of timely completed projects. Maintenance of machinery and equipment, and direct related logistic activities are therefore part and partial of our Quality Management System.

GC ID	Equipment Type & make	Model / Serial Nr.	Accuracy Equipment
DIFF. GLOBAL POSITIONING SYSTEM			
M153	GPX PRO	G 12	< 1 mtr.
M125	Novatel	Dredger	< 0.2 mtr.
		Hydro surveyor	
M157	CSI wireless	133-8759-0004	< 1 mtr.
M154	LEICA SR 530	Rover, Reference	< 0.05 mtr.
M170	LEICA SR 530	Rover, Reference	< 0.05 mtr.
M159	Aquarius 5001	Reference station	< 0.1 mtr.
M160	Aquarius 5001	Mobile	
M161	Aquarius 5001	Reference station	< 0.1 mtr.
M162	Aquarius 5001	Mobile	

GC ID	Equipment Type & make	Model / Serial Nr.	Accuracy Equipment
ECHO SOUNDERS			
M152	Knudsen	320M - dual freq.	High = 0.01 m ,Low = 0.1 m
M124	Navisound	MS 2000 - dual freq.	High = 0.01 m ,Low = 0.1 m
M158	Navisound	MS210 - single freq.	High = 0.01 m ,Low = 0.1 m
M156	Navisound	MS210 - single freq.	High = 0.01 m ,Low = 0.1 m
M163	Navisound	MS210 - single freq.	High = 0.01 m ,Low = 0.1 m
M169	Navisound	MS215 - single freq.	High = 0.01 m ,Low = 0.1 m

GC ID	Equipment Type & make	Model / Serial Nr.	Accuracy Equipment
TIDE GAUGES			
M126	Vyner	Receiver RX MK2	± 5 cm
	Vyner	Transmitter TX MK2	± 5 cm
M128	Vyner	Receiver RX MK2	± 5 cm
	Vyner	Transmitter TX MK2	± 5 cm
M166	Vyner	Transmitter TX MK2	± 5 cm
	Vyner	Receiver RX MK2	± 5 cm
M167	Vyner	Receiver RX MK2	± 5 cm

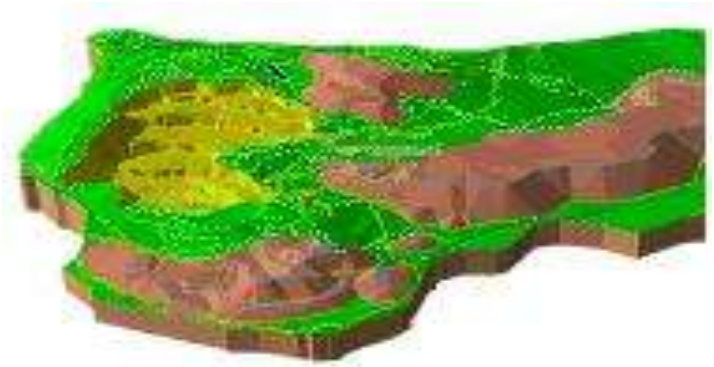
GC ID	Equipment Type & make	Model / Serial Nr.	Accuracy Equipment
LEVEL INSTRUMENTS			
M136	Wild	NA2 370479	1 mm / 30 mtr.
M109	Wild	NA2 365743	1 mm / 30 mtr.
MICRO RANGER			
M145	Vyner	910724	0.1% of dist.
M164	Esprit	880203	0.1% of dist.
SEXTANTS			
M133	DSR	790204	± 0.1°
M134	DSR	783059	± 0.1°
M131	Tamaya	69189	± 0.1°

GC ID	Equipment Type & make	Model / Serial Nr.	Accuracy Equipment
TOTAL POSITIONING STATIONS			
M127	LEICA	TC1800	angle: 0.1 mgon
		413062	dist: 2 mm+2ppm*D
M120	SOKKIA	Set 2c	angle: 0.6 mgon
		28744	dist: 3 mm+2ppm*D

3. A GENERAL VIEW ON HYDROGRAPHIC & TOPOGRAPHIC SURVEY

Land and hydrographic survey is a key part of dredging and reclamation operations. We have always been a self-provider for the pre-dredge, intermediate and post-dredge surveys, associated with our work.

Gulf Cobla have also undertaken numerous land and hydrographic surveys since its formation.

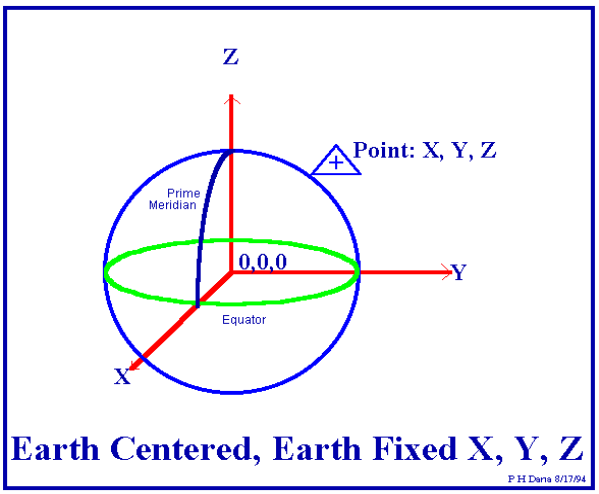


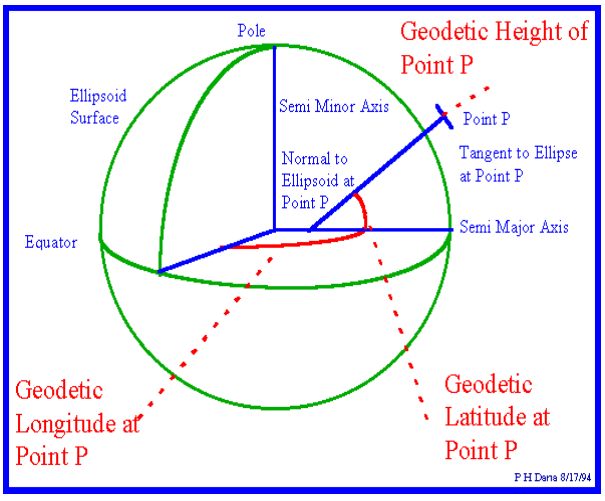
Over the last few years, we have expanded our survey standalone activities to serve the market needs and our Clients for the relevant survey needs by meeting their requirements and exceeding their expectations on numerous occasions.

Survey practices have evolved since the past 2 decades from hand sounding leads (which are still being used widely) to single/dual frequency echosounders for water depth measurements and from sextants/theodolites to total positioning systems and state of the art differential global positioning systems (GPS/DGPS/RTK) which give instant position with centimeter accuracy.

Our valuable motivated staff is the key ingredients to our successful survey projects. Our surveyors have gained extensive experience using the above instrumentation, in sometimes demanding circumstances, and we continue to upgrade and update our survey assets on a regular basis.

3.1 Geodetic Datum

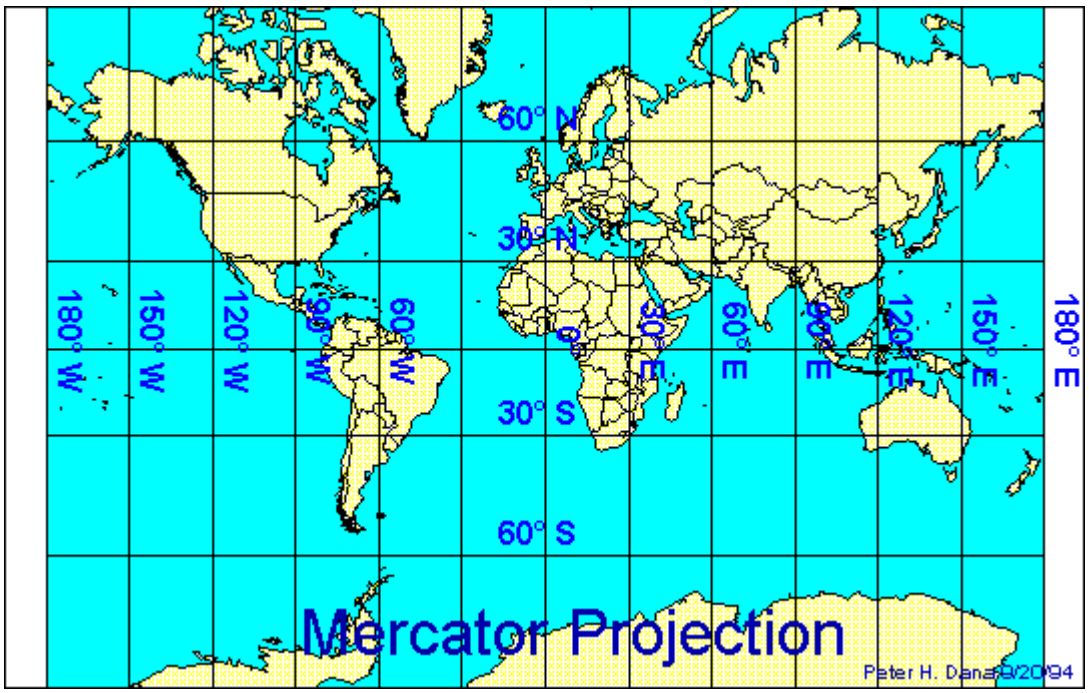




The most straightforward way to describe a position in three-dimensional space is by means of a Cartesian coordinate system. Such a coordinate system is generally known as a geodetic datum. The coordinates x, y, z are defined with respect to some reference point. Although the reference point can be arbitrarily selected, for a global coordinate system usually the center of the Earth is chosen. Instead of using a Cartesian system it is often more convenient to use a curvilinear system, with coordinates latitude Ø, longitude ƛ and height h. This allows for a separation between “horizontal” position (Ø, ƛ) and its vertical component h.

3.2 Map Projection

The Earth is approximately an ellipsoid. This ellipsoid can never be projected onto a flat surface, like a map, without distortion. A large number of map projections have been developed to map the Earth o parts of it. Each of them has its own characteristics with regard to distortion. For geodetic purposes, only conformal mapping functions are of interest, since these mapping functions preserve the angle of intersection between any two curves. The surface of projection can be a cylinder, a cone o a plane. For hydrographic applications the cylindrical Mercator or Transverse Mercator projections are the most widely used. The reason for this popularity is that the Mercator projection is the only projection for which rhumblines are mapped onto straight lines (a rhumbline or loxodrome is a curve intersecting the meridians at a constant azimuth).



4. HYDROGRAPHIC SURVEY

Hydrography is the precise determination of navigational information, and the provision of charts and other navigational products for use by the mariner and those with a responsibility for conservancy.

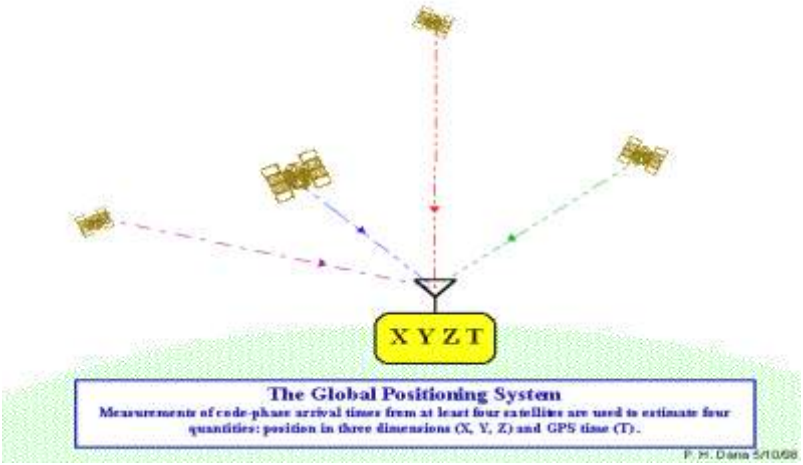
4.1 Position

Survey data must be positioned relative to a geographical co-ordinate reference frame. Our survey vessels are fitted with a Differential GPS Positioning System

4.1.1 GPS = Global Positioning System

The Global Positioning System is a constellation of satellites that orbit the earth twice a day, transmitting precise time and position (latitude, longitude and altitude) information. With a GPS receiver, users can determine their location anywhere on the Earth. Position and navigation information is vital to a broad range of professional and personal activities, including hiking, hunting, camping, boating, surveying, aviation, national defense, vehicle tracking, navigation and more.

The complete system consists of 24 satellites orbiting about 12,000 miles above the Earth, and five ground stations to monitor and manage the satellite constellation. These satellites provide 24-hour-a-day coverage for both two-and three- dimensional positioning anywhere on Earth.



4.1.2 How Does GPS Works?

The basis of GPS technology is precise time and position information. Using atomic clocks and location data, each satellite continuously broadcast the time and its position. A GPS receiver receives these signals, listening to three or more satellites at once, to determine the users position on earth.

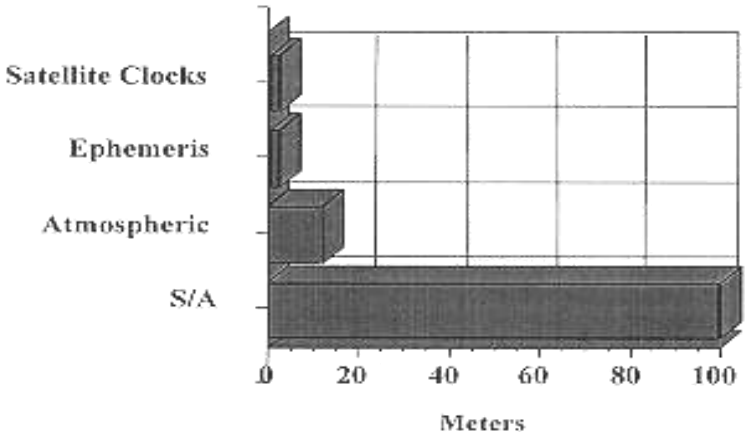
By measuring the time interval between the transmission and the reception of a satellite signal, the GPS receiver calculates the user and each satellite. Using the distance measurements of at least three satellites in an algorithm computation, the GPS receiver arrives at an accurate position fix. Information must be received from three satellites in order to obtain two-dimensional fixes (latitude and longitude), and four satellites are required for three-dimensional positioning (latitude, longitude and altitude).

Under normal conditions, the GPS signal will provide a civilian user an accuracy of better than 15 meters (50 feet). However, using a technique called differential GPS (DGPS), the user can increase the overall accuracy of the GPS receiver to approximately 1-3 meters. With DGPS, one GPS receiver unit is placed in a known location and the position information from that receiver is used to calculate correction in the position data transmitted to other GPS receivers in the area. Depending on "base station" accuracy, data collection method and calculation, the resulting real-time accuracy can be within centimeters (both horizontally & vertically).

4.1.3 System-Wide GPS Error Sources

GPS error sources which are systematic, and which can be partially or wholly removed by differential correction, are summarized in the chart.

As can be seen, the major systematic error source is S/A, or Selective Availability, which is a programme administered by the United States Department of Defense, to deny availability of high accuracy GPS to civilian users of the system.



A 1996 U.S. Presidential directive announced that Selective Availability would be disabled by the turn of the century, enabling civilian users of GPS to enjoy autonomous accuracy of 12-15m. However, even with the removal of S/A, accuracies of better than 12-15m will still be achievable only using differential correction techniques.

4.1.4 Local GPS Error Sources

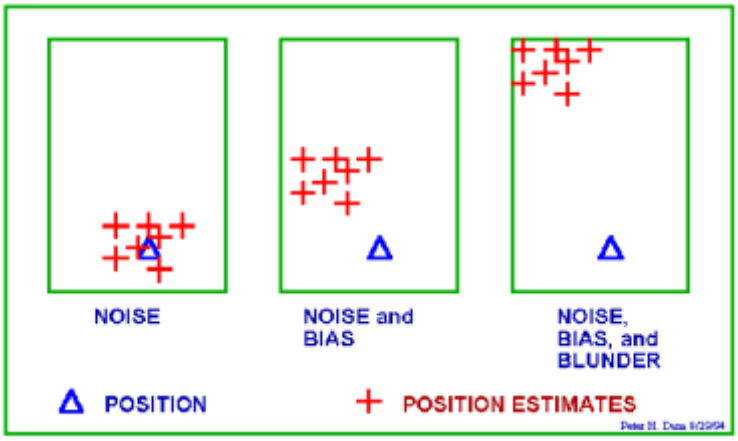
There are a variety of GPS error sources, which are local to a particular operating environment, or specific to a particular GPS receiver design. Environmental error sources include:

- Multipath, which occurs when a GPS signal travels through two separate paths before reaching a GPS antenna on the ground. In this case, the reflected signal arrives at the antenna later than the direct signal, and unless the receiver architecture can eliminate the reflected signal the receiver will compute an erroneous satellite pseudo-range measurement, leading to an inaccurate GPS position.
- Satellite geometry (PDOP). When satellites are spread evenly across the sky, a set of pseudo-range measurements to these satellites has a good geometry for trilateration, the mathematical operation of computing a position on the ground given the position of the satellites and the pseudo-range distances to these satellites. When satellites are close together in the sky, the trilateration geometry is not so good, and measurement errors tend to compound, leading to a poor computed GPS position.

Receiver-related error factors can include:

a- Receiver channel noise
b- Receiver clock errors

The best GPS receivers are internally 'clean', with respect to radio-frequency interference, and are also resistant to external RF interference or jamming.



- ***Noise error*:** Noise errors are the combined effect of PRN code noise (around 1 meter) and noise within the receiver noise (around 1 meter).

- ***Bias errors result from Selective Availability and other factors:***

1- Selective Availability (SA)

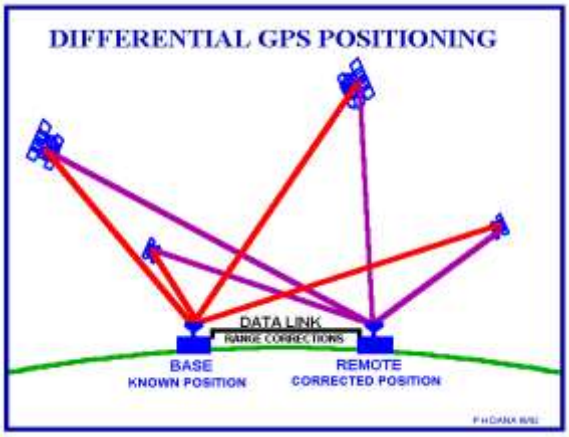
- SA is the intentional degradation of the SPS signals by a time varying bias. SA is controlled by the DOD to limit accuracy for non-U. S. military and government users. The potential accuracy of the C/A code of around 30 meters is reduced to 100 meters (two standard deviations).
- The SA bias on each satellite signal is different, and so the resulting position solution is a function of the combined SA bias from each SV used in the navigation solution. Because SA is a changing bias with low frequency terms in excess of a few hours, position solutions or individual SV pseudo-ranges cannot be effectively averaged over periods shorter than a few hours. Differential corrections must be updated at a rate less than the correlation time of SA (and other bias errors).

2- Other Bias Error sources;

- SV clock errors uncorrected by Control Segment can result in one meter errors.
- Ephemeris data errors: 1 meter
- Tropospheric delays: 1 meter. The troposphere is the lower part (ground level to from 8 to 13 km) of the atmosphere that experiences the changes in temperature, pressure, and humidity associated with weather changes. Complex models of tropospheric delay require estimates or measurements of these parameters.
- Unmodeled ionosphere delays: 10 meters. The ionosphere is the layer of the atmosphere from 50 to 500 km that consists of ionized air. The transmitted model can only remove about half of the possible 70 ns of delay leaving a ten meter un-modeled residual.
- Multipath: 0.5 meters. Multipath is caused by reflected signals from surfaces near the receiver that can either interfere with or be mistaken for the signal that follows the straight-line path from the satellite. Multipath is difficult to detect and sometime hard to avoid.

- ***Blunders can result in errors of hundred of kilometers:***
  - Control segment mistakes due to computer or human error can cause errors from one meter to hundreds of kilometers.
  - User mistakes, including incorrect geodetic datum selection, can cause errors from 1 to hundreds of meters.
  - Receiver errors from software or hardware failures can cause blunder error s of any size.

4.1.4 Differential GPS (DGPS) Positioning

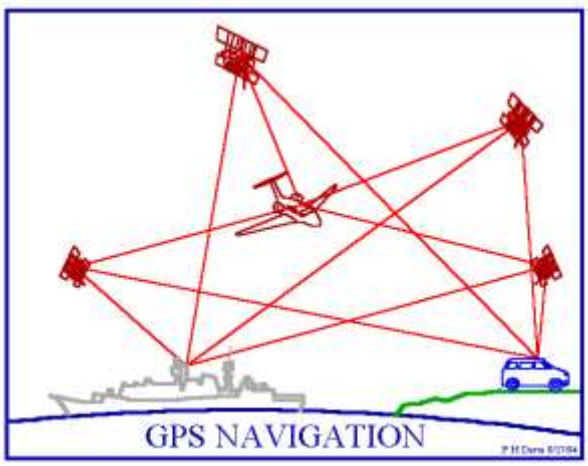


In differential GPS (DGPS) positioning mode, two or more GPS receivers operate simultaneously, with at least one receiver serving as reference, usually in static mode. By differencing observations collected by at least two receivers, a number of substantial errors affecting GPS measurements eliminated, or at least significantly reduced. The product of differential positioning is a relative position of one station with respect to the reference station expressed in terms of coordinate differences.
There are several advantages achieved through differential positioning.
The following errors are reduced/eliminated:

- Orbital errors (reduction)
- Ionospheric and tropospheric propagation errors (reduction)
- Errors caused by Selective Availability (reduction/elimination)
- Satellite and receiver clock errors (reduction/elimination)

4.1.5 Real-Time DGPS

Real-time DGPS is used to obtain differential GPS positions in real-time. A reference station equipped with a GPS receiver collects GPS data and transmits it to users using a radio link. The remote receivers use the data transmitted from the reference station to correct their GPS observations for ranging errors, which are correlated with those at the reference station, thereby, improving substantially the DGPS positioning accuracy. The distance over which the corrections may be sent is a function of the data link frequency used. In practice, more than one reference receiver may be used to improve reliability.



There are an increasing number of real-time differential correction sources, including:

- Commercial Real-time DGPS providers, both Terrestrial (e.g. RDS) and Satellite-based (e.g. Omnistar, Landstar).
- Governmental providers, such as Coast Guard beacons.
- Custom systems, which require you to have a source of DGPS correction in RTCM SC 104 format (i.e. a Base Station), and a data link, for example, a data radio (modem and transmitter) or GSM cellular telephone.

Almost all commercial sources of differential corrections provide code-phase corrections only. The operational range of carrier-phase differential corrections is currently quite limited (50km at most, and more typically 20km), so most RTK installations require you to establish your own base station network.

4.2 Depth of seabed

Echo sounders measure depth using timed pulse technology. Essentially the echo sounder generates an acoustic pulse into the water column through the transducer. All soundings must be reduced to Chart or contract Datum by applying observed tidal heights.

Observations of the rise and fall of the tide should be made both to reduce soundings to a common datum as well as to enable analysis of the predictions in the tide tables produced by the UK Hydrographic Office.

4.2.1 Echo Sounder Operation

In bathymetry, the object to be positioned is frequently the seabed. Usually, the horizontal position of a surface vessel is obtained first, and then the distance between the vessel and the seabed.
Depth is calculated from the measured travel time ΔT

Depth = c (ΔT / 2)

Where c is the speed of sound in water.
A basic echo sounder, used to measure the pulse's two-way travel time through the water column.

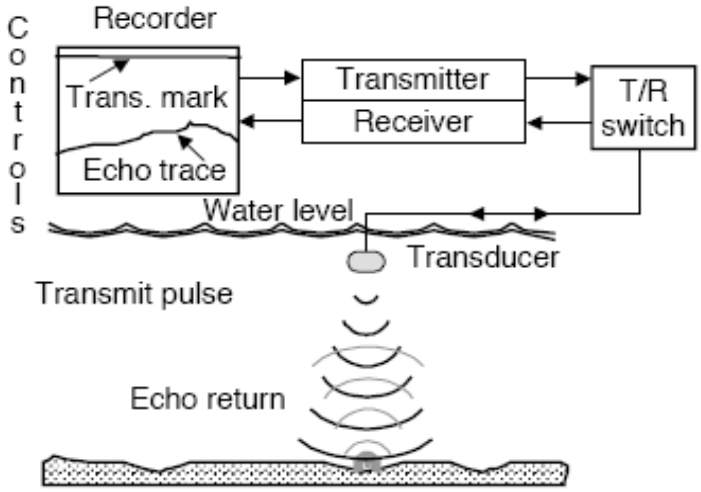


Figure 11.1: Basic echo sounder operation.

The transmitter is equipped with a quartz clock that oscillates in the range of 1-10 MHz, whose frequency is divided down to obtain the operating frequency of the transducer. The quartz clock is also used to measure time intervals between the transmission and the reception of acoustic signals. Modern echo sounders usually offer a choice of two to three transmitting frequencies, namely:

- Low frequency – effective for deep water because the attenuation is lower, but it required a large transducer.
- High frequency – the transducer can be compact but the range is more limited due to a higher attenuation.

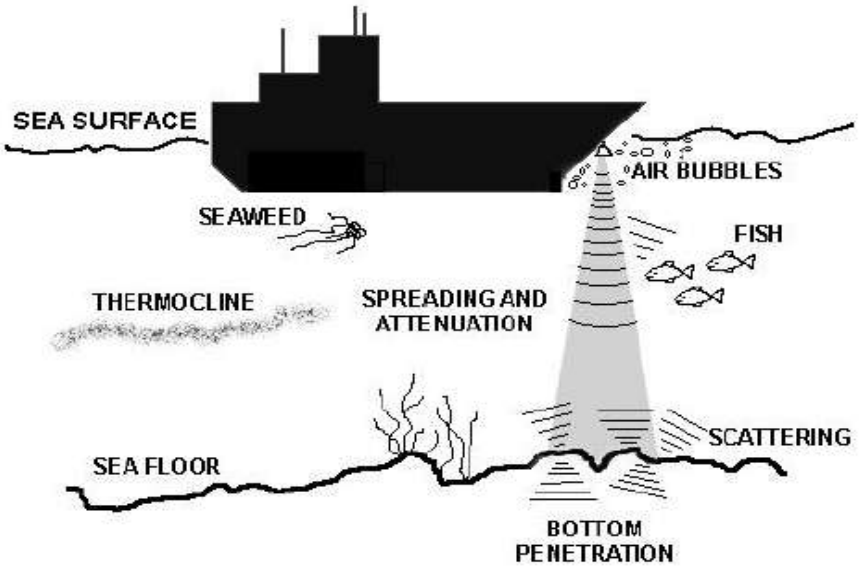


Figure 1-1 Sound Interaction in the Water Column

The resolution of an echosounder can define either its measuring precision or detection capabilities. It is a function of the following factors

- Pulse duration
- Angle of incidence of the acoustic wave front on the target
- Nature of the target
- Beamwidth of the transmission

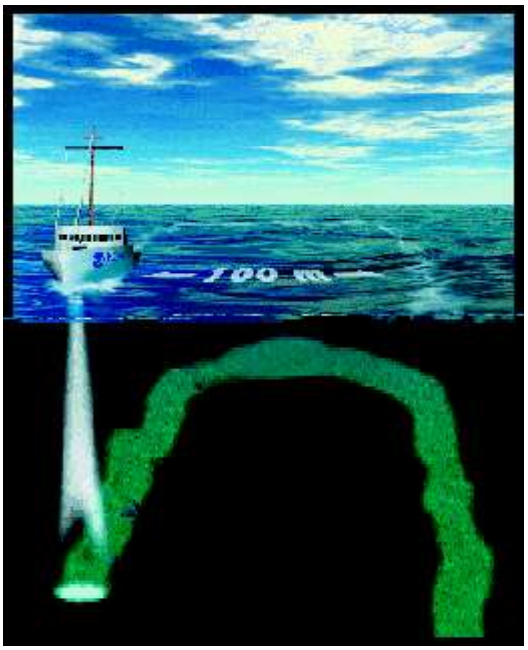
4.2.2 Single Beam Echo Sounder

The beam width of conventional single beam echo sounders (SBES) is usually of the order of 16°.

Operation of a narrow beam echo sounder requires the transducer to be mechanically or electronically stabilized for roll and pitch motion of the vessel.

Narrow beam echo sounders are used to:

- Obtain depths directly under the vessel, thus avoiding wide beam biases caused by underwater slopes. This depth is used either for safety of navigation or for sea floor mapping.
- Improve the quality of the data in terms of both resolution and accuracy. For instance, in order to meet the IHO Special and Order 1 requirement, a narrow or array of narrow beam echo sounders can b used.



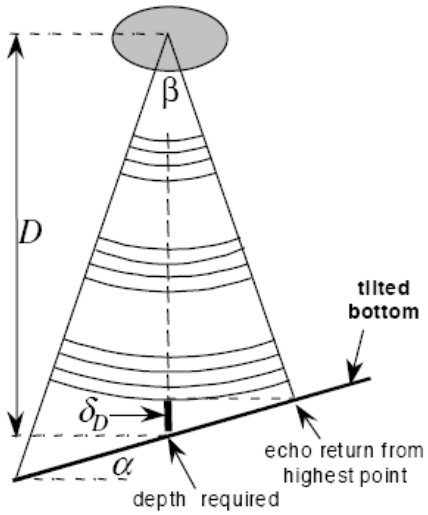


Figure 11.6: Effect of beamwidth due to tilted bottom.

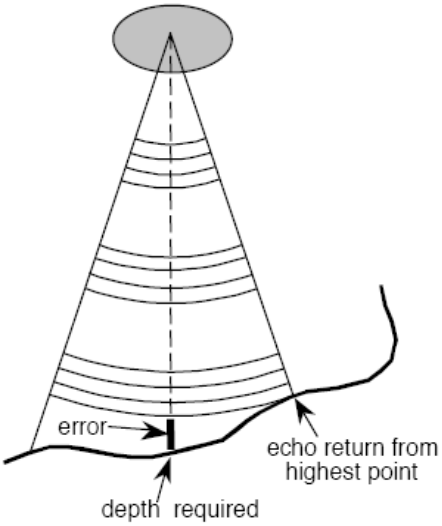


Figure 11.7: Effect of beamwidth due to irregular bottom.

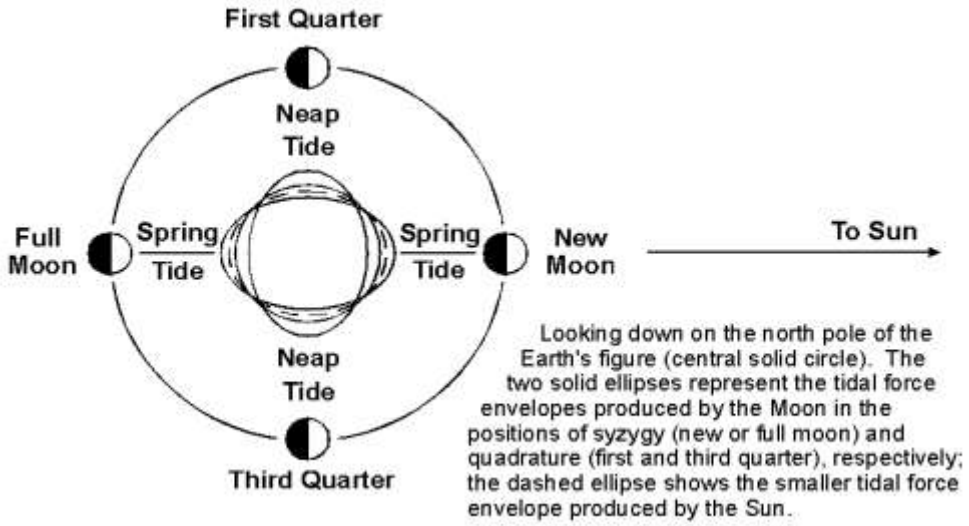
4.3 Tide

4.3.1 The Astronomical Tide-Producing Forces: General Considerations

At the surface of the earth, the earth's force of gravitational attraction acts in a direction inward toward its center of mass, and thus holds the ocean water confined to this surface. However, the gravitational forces of the moon and sun also act externally upon the earth's ocean waters. These external forces are exerted as tide-producing, or so-called "tractive" forces. Their effects are superimposed upon the earth's gravitational force and act to draw the ocean waters to positions on the earth's surface directly beneath these respective celestial bodies (i.e., towards the "sublunar" and "subsolar" points).

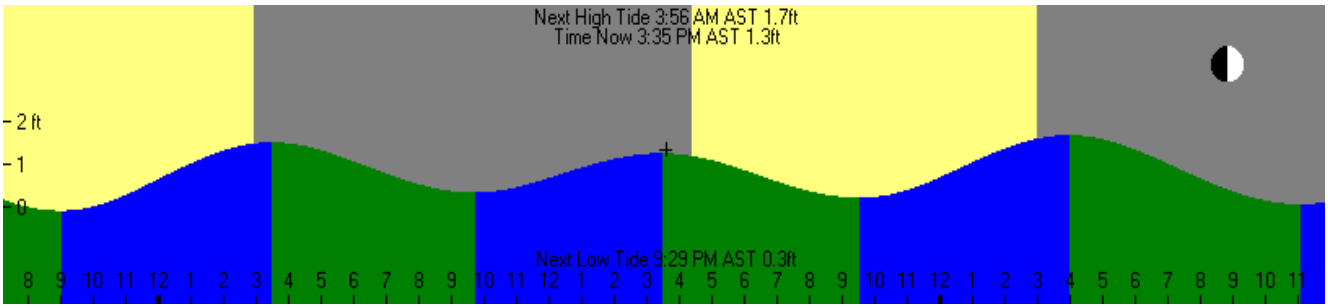
High tides are produced in the ocean waters by the "heaping" action resulting from the horizontal flow of water toward two regions of the earth representing positions of maximum attraction of combined lunar and solar gravitational forces. Low tides are created by a compensating maximum withdrawal of water from regions around the earth midway between these two humps. The alternation of high and low tides is caused by the daily (or diurnal) rotation of the earth with respect to these two tidal humps and two tidal depressions. The changing arrival time of any two successive high or low tides at any one location is the result of numerous factors later to be discussed.

The word "tides" is a generic term used to define the alternating rise and fall in sea level with respect to the land, produced by the gravitational attraction of the moon and the sun. To a much smaller extent, tides also occur in large lakes, the atmosphere, and within the solid crust of the earth, acted upon by these same gravitational forces of the moon and sun. Additional nonastronomical factors such as configuration of the coastline, local depth of the water, ocean-floor topography, and other hydrographic and meteorological influences may play an important role in altering the range, interval between high and low water, an times of arrival of the tides.



We measure water level for water level data range from hydrographic purposes for making nautical charts to absolute global sea level monitoring for better understanding the circulation of the ocean and its role in world climate.

Uses for water level data range from hydrographic purposes for making nautical charts to absolute global sea level monitoring for better understanding the circulation of the ocean and its role in world climate. National Ocean Service's modern water level measurement system allows for a variety of real-time, near real-time, and long-term applications. Real-time applications include hydrography, nautical charting, maritime navigation, and tsunami warnings. Near real-time applications include circulation surveys as well as hydrography and storm surge warnings. Long-term applications include marine boundary determinations, tide predictions, monitoring long-term sea level trends, coastal construction, oceanographic research, climate research and absolute sea level monitoring. In our discussion here we will concentrate on these three types of applications.



4.3.2 Vertical Datum

The elevation of a point can only be expressed with respect to the elevation of another point. It could be related to the center of the Earth, the mean surface of the ocean, the orbit of a satellite or simply a benchmark.

The chosen reference to which elevations are referred to is called a vertical datum. Currently there are about 100-200 vertical datums in the world.

Orthomeric heights are defined with respect to the geoid which is an equipotential surface approximated by Mean Sea Level (MSL). The elevation of MSL could only be determined by fitting a level surface to observations of the mean level of the sea surface over the oceans. The mean elevation of the sea surface at a particular location is thus not necessarily the same as the elevation of MSL. MSL experiences long-term variations due to isostatic and eustatic phenomenae.

It is useful to define various average tidal elevations that can be used in comparing tidal characteristics from place to place.

MWL:Mean Water Level is an average of all hourly water levels over the available period of record.

MSL: Mean Sea Level is the ideal equipotential surface that could be obtained by fitting a level surface to observations of the mean level of the sea surface.

HHWLT: Higher High Water, Large Tide is the average of the highest high waters, one from each of 19 years (period of regression of lunar nodes) of prediction.

HHWMT: Higher High Water, Mean Tide is the average of all the higher high waters from 19 years of prediction.

LLWMT: Lower Low Water, Mean Tide is the average of all the lower low waters from 19 years of prediction.

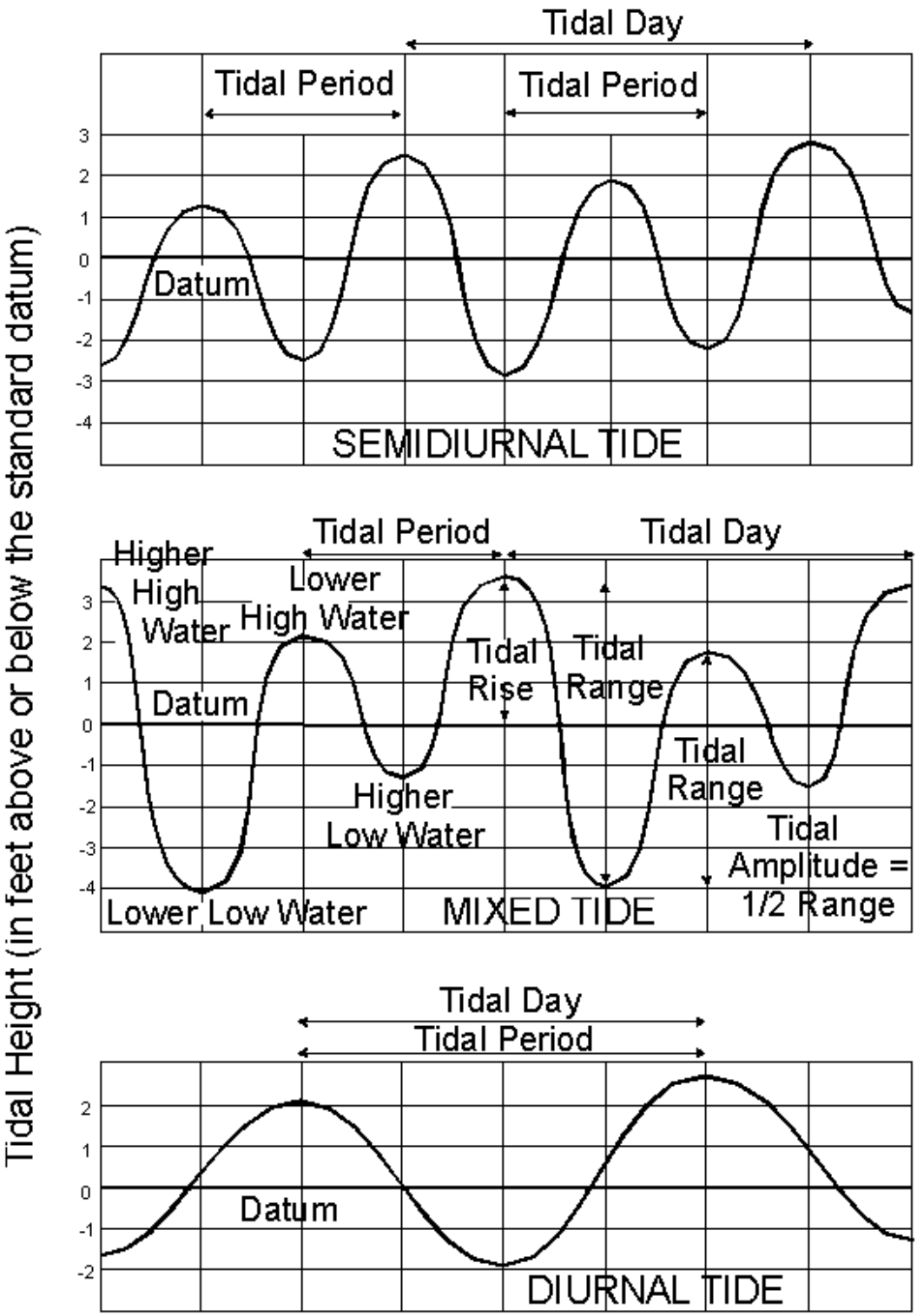
LLWLT: Lower Low Water, Large Tide is the average of the lowest low waters, one from each of 19 years of prediction.

LNT: Lowest Normal Tide is currently synonymous with LLWLT; on older charts, it may refer to a variety of low water Chart Datums.

MLLWS: Mean Lower Low Water Spring, the average of the lower low water heights over a period. It is so low that during average meteorological conditions the occurring depth will seldom be less than charted.

LAT: Lowest Astronomical Tide is not observed tide, but the lowest tide that can be expected to occur under average meteorological conditions and under any combination of astronomical conditions.

Distribution of Tidal Phases



5. TOPOGRAPHIC SURVEY

A topographic survey results in a detailed map of parcel of property showing elevation contours, surface features, and improvements such as utilities, buildings, and roadways.

Several different technologies are used in creating a topographic survey depending on the terrain, the size of the parcel, and the type of information required. The most common approach is to use aerial mapping via photogramatry to develop the actual contours and to augment the results of the aerial mapping with direct observations on the ground. Ground measurements are necessary to control the horizontal and vertical scale of the photographs. In some cases it may be more cost effective to gather all of the required information via direct observations on the ground using traditional stadia means, laser measurements, GPS.

Topographic surveying has been made possible using GPS techniques since portable base stations are linked to rover stations creating a network of GPS receivers linked by radio modem. A fast processing receiver is also needed for differential GPS to achieve calculation of real time co-ordinates. This is known as Real Time Kinematic (RTK) surveying and reduces observation times without any loss of accuracy. A constellation of eight satellites locked simultaneously to both the base station receiver and the rover receiver via radio is required for fast acquisition of highly accurate positions.

6. SURVEY PROCESS

The surveying process is divided into five major stages with each stage divided into a number of groups of instructions or procedures.

Five stages of the surveying process		
Stage	Group	Instruction or Procedure
Preparation	Planning	To extract current survey data from existing sources and plan observations.
	Calibration	To eliminate systematic errors from survey instruments prior to observations.
Data Gathering	Verifications	To ensure that instruments are gathering data to the correct standard during survey operations by comparison with other instruments.
	Observation	To make observations and check them on the Gathering line or in the field.
	Data Logging	To store observed data and transfer to a data processing system.
Data Processing	Editing	To ensure the removal of invalid data.
	Selection	To select values from valid data for further processing or rendering.
	Data storage	To store selected processed data in analogue or digital formats.
Data Analysis	Quality	To determine the quality of surveyed data and compare to the required standard.
	Coverage	To determine that sufficient valid data has been surveyed.
Data Rendering	Reports	To report dangers before the completed survey is rendered.
	Plots	To render data as graphics.
	ROS Digital	To write the report of survey.
	Data Field	To render digital data
	Record	To render field records

7. QUALITY CONTROL

Gulf Cobla LLC is ISO 9002 certified for its entire operations, which also includes its survey services.

7.1 Ensuring Accuracy in Survey

- Equipment/Instrument is calibrated/checked as required prior to any survey execution.
- Calibration is done according to Equipment/Instrument instructions.
- Required Accuracy is maintained.
- Results of calibration are recorded using appropriate forms.
- Forms clearly indicate the details of calibration and the achieved accuracies.
- Results of calibration are agreed to the Client's Satisfaction.
- Reports are produced with detailed information.

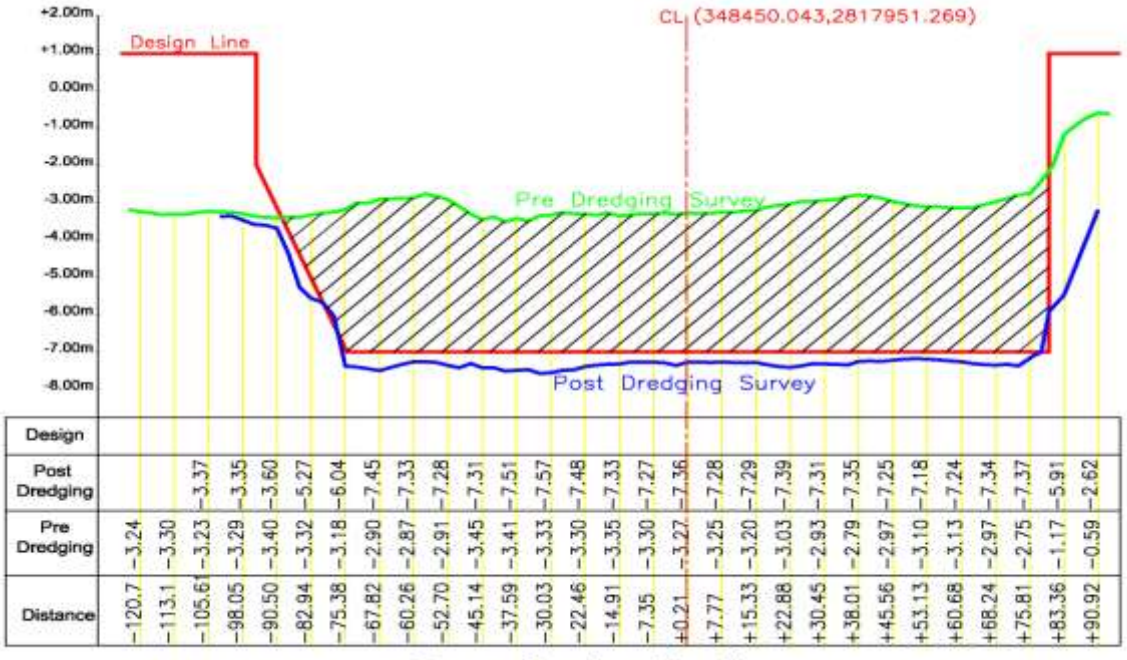
7.2 Survey Execution

- Surveys are executed as planned. (Subject to natural influences)
- The Client is generally present while the surveys are executed, if required.
- Data is recorded in electronic format.
- Drawings are provided in required format, and produced in appropriate scale as requested.
- As executed survey details are handed over to Client on the spot, if required.

7.3 Customer Satisfaction

Our Clients are provided with complete survey details:
Survey Execution Report comprising of

- The executed scope of works.
- The Survey Execution Report form of the actual execution on site.
- Drawings (to scale, as required)
- Survey Data
- As executed Survey Soundings
- Attachments of all Equipment/Instrument Calibration Sheets,
- (Detailing the calibration values and accuracy's as executed on site)
- All Drawings & Data are provided in Electronic format as required/requested.
- Specifications of used Equipment/Instrument.



Cross Section Profile

Attachment -1

CURRICULUM VITAE OF KEY PERSONNEL

GULF COBLA LLC – SURVEY SERVICES

Mohammed Akram Butt

Personal Details :

Position in firm	**Chief Surveyor**
Contact e-mail	mab@gulfcobla.com
Date of Birth	14th March 1952
Marital Status	Married
Nationality	Pakistani
Years in dredging industry	since 1975
Years with firm	since 1975

Education :

1969 - 1972 Diploma of Associate Engineer
Civil Technology of Government
Polytechnic Institute, Pakistan

Other Qualifications:

- Certification Survey Training Courses by Thales Geo Solutions
- Training course on GPS techniques, geodetic datums and projection method
- Well experienced with dredging and reclamation projects and specialized in survey.
- Equipment specific training for:
  - Leica DGPS-530
  - Total station TC-1800
  - Total station Sokkia Set 2C

Languages :

Urdu:	Mother tongue
English:	Fluent
Arabic:	Basic knowledge

Business Experience :

2000 - present GULF COBLA (L.L.C.), DUBAI, U.A.E.
Chief Surveyor
- Responsible for all dredger positioning control systems and supervision of all survey related activities.

1992 - 2000 *Chief Surveyor*
- Several projects in U.A.E., Oman, K.S.A. and Bahrain.

1977 - 1992 *Surveyor*
- Jebel Ali Harbour Project - Dubai
- South Peripheral Channel - Abu Dhabi
- Various small projects - Dubai and Abu Dhabi

1975 - 1977 *Asst. Surveyor*
- Creek Project - Dubai

1972 - 1975 *Surveyor,* Pakistan

GULF COBLA LLC – SURVEY SERVICES

Tareq Alobied

Personal Details :

Position in firm	**Project Manager**
Contact e-mail	tao@gulfcobla.com
Date of Birth	17 September 1976
Marital Status	Married
Nationality	Syrian
Years in dredging industry	since 2000
Years with firm	since 2000

Education :

1999	Diploma in Civil Engineering from Al Bath University, Homs, Syria (Faculty of Civil Engineering)

Other qualifications:

- Certification Survey Training Courses by Thales Geo Solutions
- Quality Management System Training Courses by Lloyds
- Advanced user of Auto Cad and survey data software

Languages:

Arabic:	Mother tongue
English:	Fluent

Business Experience :

2002 – present — GULF COBLA (L.L.C.), DUBAI, U.A.E.

Project Manager

- Amwaj School Island Project, Bahrain
- Fujairah Naval Base, Fujairah
- Hamriyah Offshore Dredging Inner Habour Project, Sharjah

2001 - 2002 — *Asst. Project Manager*

- Amwaj Island Development - Dredging and Reclamation, Bahrain.
- Development of Al Shamaliah Island, Abu Dhabi.
- Extension of Dhow Harbour & Marine Police Unit Berths, Abu Dhabi.
- Qarin Al Aysh project, Abu Dhabi
- Independent execution of surveys using specialized software in the UAE, Bahrain, Oman and Eritrea.
- Involved with production optimalization/calculations

2001 - 2002 — *Asst. QA / QC Manager*

- Assisting in maintaining the company's QMS system

2000 - 2001 — *Project Engineer*

- Involved with the preparation/execution of various dredging and survey projects, pre-post dredging surveys, quantity calculations.

Bram Boot

Personal details:

Position in firm	**Project Control Engineer**
Contact e-mail	brb@gulfcobla.com
Date of Birth	18th November 1978
Marital Status	Single
Nationality	Dutch
Years in dredging industry	One
Years with firm	since 2005

Education:

1998 - 2003	B.Sc. Civil Engineering, Higher Institute of Technology, Velp, The Netherlands

Other qualifications:

- Experienced with computer hardware and software
- Attended training course on survey equipment and software
- Certification of Safety Awareness for Operational Executives

Languages:

Dutch:	mother tongue
English:	fluent
German:	moderate
Spanish/French:	basic knowledge

Business Experience:

2005 - Present GULF COBLA (L.L.C.), DUBAI, U.A.E.

Project Control Engineer

- Involved with the preparation/execution of all Dredging, Reclamation and Survey projects, dealing with cut-fill plans, pre-post dredging surveys, quantity calculations and control by using specialized software, CAD programs and spread sheets.

GULF COBLA LLC – SURVEY SERVICES

Soman Anil

Personal Details :

Position in firm	**Assistant Surveyor**
Date of Birth	30th April 1957
Marital Status	Married
Nationality	Indian
Years in dredging industry	since 1979
Years with firm	since 1980

Education :

1974	Secondary School Leaving Certificate from Board of Public Examination, Kerala, India.

Other qualifications:

- Well experienced with Hydrographic and Topographic Survey works
- Able to handle all type of survey equipment, survey boat and other survey computer.

Languages :

Malayalam : Mother tongue
English : Fluent

Business Experience :

1998 - present — GULF COBLA (L.L.C.), DUBAI, U.A.E.
Assistant Surveyor

- Involved independently with the various Dredging and Survey projects.
  - Military Basin Works, Abu Dhabi
  - Jetty Basin for Oilfield Supplies, Abu Dhabi
  - Abu Dhabi Ship Building Dredging Works, Abu Dhabi
  - Dredging Project at Sitra, Bahrain
  - Bel Ghaylam Channel Project, Abu Dhabi
  - Amwaj Projects in Bahrain

1992 - 1998 — *Chainman*

- Responsible for day to day survey works on various sites such as:
  - Mamzar Project
  - Qarin Al Aysh Project

  and many other small projects.

1981 - 1992 — *Chainman*

- Dubai Creek
- Farasan, Saudi Arabia
- Abu Dhabi

1980 - 1981 — Joined as a *Deckhand*

- Worked as Deckhand on various dredgers at Jebel Ali Project.

GULF COBLA LLC – SURVEY SERVICES

Mohammad Anwar

Personal Details :

Position in firm	**Chainman**
Date of Birth	1st September 1957
Marital Status	Married
Nationality	Pakistani
Years in dredging industry	since 1976
Years with firm	since 1998

Education :

1974	Secondary.

Other qualifications:

- Well experienced and knowledge of Hydrographic Survey and independently handle Topographic Survey.
- Able to handle all various of survey equipment and survey boat.

Languages :

Urdu :	Mother tongue
English :	Fair

Business Experience :

1998 - present — GULF COBLA (L.L.C.), DUBAI, U.A.E.
Chainman

- Involved independently with various Dredging projects:
  - MIS Quay Expansion Project, Sharjah.
  - Al Yasat Dredging, Abu Dhabi.
  - Fujairah Desalination & Power plant project.
  - Fujairah Naval Port Project.

1995 - 1998 — *Chainman*

- Worked with Dutco Earth Works Division on their various projects in Dubai, U.A.E.

1992 - 1995 — *Chainman*

- Gulf Cobla recalled for their new project Dubai, U.A.E.

1982 - 1992 — *Chainman*

- Worked in Costain International Ltd., Saudi Arabia

1976 - 1982 — Joined as a *Chainman*

- Worked as Chainman with Jebel Ali Project and transferred to Saudi Arabia to their Farazan Project.

R. Gupta

Personal Details :

Position in firm	**Chainman**
Date of Birth	15th September 1968
Marital Status	Married
Nationality	Indian
Years in dredging industry	since 1992
Years with firm	since 1992

Education :

1985	Secondary.

Other qualifications:

- Well experienced in the field of Hydrographic Survey and able to handle various type of survey equipment and survey boat.

Languages :

Hindi :	Mother tongue
English :	Fair

Business Experience :

1992 - present GULF COBLA (L.L.C.), DUBAI, U.A.E.
Chainman-cum-Survey Launch Driver

- Involved with the various Dredging and Survey projects:
  - Hydrographic Survey off Musnouah Island, Abu Dhabi for Hyder Consulting
  - Bin Suroor Survey, Mussafah, for Halcrow International Partnership
  - Survey for Fujairah Port Authorities
  - Survey at Al Shahama Palace, Abu Dhabi
- Worked as a Helper/Launch Driver/Chainman with almost all small-scale survey contracts with Gulf Cobla all over Middle East.

Attachment -2

LIST OF SURVEY EQUIPMENT

- *Survey Vessels & navigation licenses*
- *Satellite position instrument for hydrographic survey purpose*
- *Other position for navigation / research purpose*
- *Echo sounders*
- *Transducers*
- *Heave Pitch and Roll compensator*
- *Total station*
- *Others*

Survey Vessels

Mercator Bay

Hondius Bay

Specification	***Mercator Bay***	***Hondius Bay***	***Dolphin Bay***
Power	180 Hp	150 Hp	180 Hp
Length o.a.	7.00 m	6.40 m	-- m
Breadth o.a.	2.80 m	2.45 m	-- m
Depth	1.40 m	2.30 m	-- m
Draught	0.38 m	0.40 m	0.40 m
Navigation License	Yes	No	Yes

Navigation licenses

UNITED ARAB EMIRATES
National Authority of Communications
Marine Affairs Department

دولـــة الإمارات العربية المتحـــدة
الهيئة الوطنية للمواصلات
إدارة الشؤون البحرية

ترخـيـص مـــلاحـــة
NAVIGATION LICENSE

Name of Vessel	: MERCATOR BAY	: مركاتور بيه	اسم السفينة
Name of Owner	: GULF COBLA (L.L.C)	: الخليج كوبلا (ش.ذ.م.م)	اسم المالك
Official Number	: 4500	: ٤٥٠٠	الرقم الرسمي
Port of Registry	: DUBAI	: دبي	ميناء التسجيل
Type of Vessel	: SURVEY BOAT	: قارب مسح	نوع السفينة
G.T.	: 1.9 Tons	: ١,٩ طن	الحمولة الكلية
N.T.	: 1.9 Tons	: ١,٩ طن	الحمولة الصافية
No. of Passengers / Workers	: ***	: ***	عدد الركاب / العمال
Number of Crew	: 2 CREW	: ٢ طاقم	عدد أفراد الطاقم

The Above Mentioned Vessel is Authorized for Navigation at Foreign Going / Coastal Areas / Inside Ports

يرخص للسفينة الموضحة بياناتها أعلاه بالملاحة في أعالي البحار / المناطق الساحلية / داخل الموانئ

Valid Until : 31/12/2007

ويسري هذا الترخيص لغاية : ٢٠٠٧/١٢/٣١

ويعتبر الترخيص لاغيا في الحالات التالية :

- مخالفة أحكام القانون الاتحادي رقم (٢٦) لسنة ١٩٨١ بشأن القانون التجاري البحري.
- تنفيذا لأحكام أو قرارات بتوقيع الحجز على السفينة أو الاحكام أو القرارات الخاصة بوقفها عن العمل.
- تنفيذا لطلب من السلطات العاملة بالموانئ إذا ارتكبت السفينة مخالفة تستوجب وقفها عن العمل.
- عدم توافر شروط السلامة الواردة بالاتفاقيات البحرية الدولية المصادق عليها.
- عدم توافر أو سريان شهادات السلامة والشهادات الاخرى التي يلزم توافرها بموجب الاتفاقيات البحرية الدولية المصادق عليها.

Date of Issue	: 31/01/2007	: ٢٠٠٧/٠١/٣١	تاريخ الإصدار
Receipt No.	: 291021267	: ٢٩١٠٢١٢٦٧	رقم الايصال
Receipt Date	: 31/01/2007	: ٢٠٠٧/٠١/٣١	تاريخ الايصال

مدير إدارة الشؤون البحرية
Director Of Marine Affairs Dept.

UNITED ARAB EMIRATES
National Authority of Communications
Marine Affairs Department

دولـــة الإمارات العربية المتحـــدة
الهيئة الوطنية للمواصلات
إدارة الشؤون البحرية

ترخـيـص مـــلاحـــة
NAVIGATION LICENSE

Name of Vessel	: DOPLPHIN BAY	اسم السفينة :	دولفين بيه
Name of Owner	: GULF COBLA (L.L.C)	اسم المالك :	الخليج كوبلا (ش.ذ.م.م)
Official Number	: 5047	الرقم الرسمي :	٥٠٤٧
Port of Registry	: DUBAI	ميناء التسجيل :	دبي
Type of Vessel	: SURVEY BOAT	نوع السفينة :	قارب مسح
G.T.	: 1 Tons	الحمولة الكلية :	١ طن
N.T.	: Tons	الحمولة الصافية :	طن
No. of Passengers / Workers	: ***	عدد الركاب / العمال :	***
Number of Crew	: 2 CRE	عدد أفراد الطاقم :	٢ بحارة

The Above Mentioned Vessel is Authorized for Navigation at Foreign Going / Coastal Areas / Inside Ports

يرخص للسفينة الموضحة بياناتها أعلاه بالملاحة في أعالي البحار / المناطق الساحلية / داخل الموانئ

Valid Until : 31/12/2007 — ويسري هذا الترخيص لغاية : ٢٠٠٧/١٢/٣١

ويعتبر الترخيص لاغيا في الحالات التالية :

- مخالفة أحكام القانون الاتحادي رقم (٢٦) لسنة ١٩٨١ بشأن القانون التجاري البحري.
- تنفيذا لأحكام أو قرارات بتوقيع الحجز على السفينة أو الاحكام أو القرارات الخاصة بوقفها عن العمل.
- تنفيذا لطلب من السلطات العاملة بالموانئ إذا ارتكبت السفينة مخالفة تستوجب وقفها عن العمل.
- عدم توافر شروط السلامة الواردة بالاتفاقيات البحرية الدولية المصادق عليها.
- عدم توافر أو سريان شهادات السلامة والشهادات الاخرى التي يلزم توافرها بموجب الاتفاقيات البحرية الدولية المصادق عليها.

Date of Issue	: 12/04/2007	تاريخ الإصدار :	٢٠٠٧/٠٤/١٢
Receipt No.	: 291022599	رقم الايصال :	٢٩١٠٢٢٥٩٩
Receipt Date	: 12/04/2007	تاريخ الايصال :	٢٠٠٧/٠٤/١٢

مدير إدارة الشؤون البحرية
Director Of Marine Affairs Dept.

Navigation / research

DGPS MAX

- **DGPS MAX** includes everything you need: GPS, WAAS, OmniSTAR, beacon, RTK, and more
- **DGPS MAX** delivers sub-meter 95% horizontal accuracy to meet demanding positioning requirements
- **DGPS MAX** supports position update rates up to 5 Hz for high performance applications
- ***New*** Real-Time Kinematic positioning achieves superior accuracy to standard C/A code processing
- ***New*** raw measurement data output provides all information required for post-processing
- ***New*** COAST™ technology allows DGPS MAX to operate using correction data up to thirty minutes old
- ***New*** Setup Wizard configures DGPS MAX in as few as three steps
- ***New*** user-defined profiles save receiver configurations for later use

Too much technology?

There's no such thing. DGPS MAX ensures that you have the features you need when you need them. Everything comes standard.

DGPS MAX delivers accurate differential GPS positioning using corrections from WAAS, OmniSTAR, DGPS beacon stations, or directly from an external RTCM SC-104 source. For high-accuracy applications, use the built-in Real-Time Kinematic engine or output raw measurement data for post-processing. Reconfigure the receiver smoothly and efficiently or load previously saved configurations at any stage of operation using the new Setup Wizard.

WAAS?

The American Federal Aviation Administration is currently testing its Wide Area Augmentation System (WAAS) in preparation for Initial Operational Capability. WAAS-compatible Space-Based Augmentation Systems are also under development throughout the world, including the European Geostationary Navigation Overlay System (EGNOS) and the Japanese MTSAT Satellite-based Augmentation System (MSAS). DGPS MAX is compatible with each of these *free* correction services.

OmniSTAR?

DGPS MAX is also capable of applying high-quality correction data from the OmniSTAR Worldwide DGPS Service. Drawing on information from its global network of reference stations, OmniSTAR uses Virtual Base Station algorithms to ensure that positioning accuracy is independent of distance from a base station. OmniSTAR offers competitive service rates to their subscription-based service.

Beacon?

Navigation authorities around the world have installed DGPS radiobeacon networks that broadcast *free* GPS correction information. DGPS MAX applies these differential corrections to deliver accurate, reliable positioning.

RTK?

CSI Wireless is proud to introduce our new Real-Time Kinematic positioning engine with the DGPS MAX. This robust L1 RTK solution achieves more consistent, accurate positioning than receivers processing only C/A-code position information. After a short initialization, DGPS MAX can deliver 5-cm horizontal accuracy (95% confidence) in real-time.

What is COAST™?

Using our new COAST™ technology, DGPS MAX can apply correction data up to ten minutes old without seriously affecting positioning accuracy. COAST™ ensures that DGPS MAX is less vulnerable to differential signal outages due to blockages, transmission difficulties, or interference. No other product offers this flexibility. None.

What's the warranty?

CSI Wireless is committed to our customers and products, and offers a limited one-year warranty on parts and labor.

Contact CSI Wireless today to discover how DGPS MAX will meet your positioning needs.

www.csi-wireless.com

csi wireless

DGPS MAX

www.csi-wireless.com

GPS Sensor Specifications

Receiver Type:	L1, C/A code, with carrier phase smoothing
Channels:	12-channel, parallel tracking (10-channel when tracking WAAS)
WAAS Tracking:	2-channel, parallel tracking
Update Rate:	1 Hz default, 5 Hz max
Horizontal Accuracy:	1 m 95% confidence (DGPS*) 5 m 95% confidence** (autonomous, no SA)
Cold Start:	1 min typical
Antenna Input Impedance:	50 Ω

L-band Sensor Specifications

Frequency Range:	1525 to 1559 MHz
Sensitivity:	-120 dBm for $<10^{-3}$ BER
Tuning Mode:	Manual or automatic
Adjacent Channel Rejection:	50 kHz spacing >25 dB, 1 MHz spacing >60 dB

Beacon Sensor Specifications

Channels:	2-channel, parallel tracking
Frequency Range:	283.5 to 325 kHz
Channel Spacing:	500 Hz
MSK Bit Rates:	50, 100, and 200 bps
Operating Modes:	Manual, automatic, semi-automatic
Cold Start Time:	< 1 minute typical
Reacquisition Time:	< 2 seconds typical
Demodulation:	Minimum shift keying (MSK)
Sensitivity:	1.5 µV/m for 6 dB SNR @ 200 bps
Dynamic Range:	100 dB
Frequency Offset:	± 10 Hz (~ 30 ppm)
Adjacent Channel Rejection:	65 dB ± 1 dB @ f_o ± 400 Hz

Communications

Serial ports:	1 full duplex, 1 RTCM input
Interface Level:	RS-232C
Baud Rates:	4800, 9600, 19200
CAN Bus:	CAN 2.0B
Correction Input / Output Protocol:	RTCM SC-104
Data Input / Output Protocol:	NMEA 0183
Raw Measurement Data:	Proprietary binary (RINEX utility available)
Timing Output:	1 PPS (HCMOS, active high, rising edge sync, 10 kΩ, 10 pF load)
Event Marker Input:	HCMOS, active low, falling edge sync, 10 kΩ, 10 pF load

Environmental

Operating Temperature:	-32°C to +74°C
Storage Temperature:	-40°C to +85°C
Humidity:	95% non-condensing
EMC:	FCC Part 15, Subpart B, Class B CISPR 22

Power

Input Voltage Range:	9.2 to 48 VDC
Reverse Polarity Protection:	Yes
Power Consumption:	< 6.5 W
Current Consumption:	< 550 mA @ 12 VDC
Load Dump Protection:	Up to 86 VDC
Antenna Voltage Output:	5 VDC
Antenna Short Circuit Protection:	Yes

Mechanical

Enclosure:	Powder-coated aluminum
Dimensions:	203 mm L x 125 mm W x 51 mm H (8.0" L x 4.9" W x 2.0" H)
Weight:	0.80 kg (1.76 lb)
Display:	2-line x 16-character LCD
Keypad:	3-button
Power Switch:	Push-button
Power Connector:	2-pin miniature
Data Connector:	DB9-socket
Antenna Connector:	TNC-socket

Pin-out

Main Port

Pin 2	Transmit data (TXD)
Pin 3	Receive data (RXD)
Pin 5	Signal ground

RTCM Input Port

Pin 2	Transmit data (TXD)
Pin 3	Receive data (RXD)
Pin 5	Signal ground
Pin 6	Event marker input
Pin 9	1 PPS

CDA-2 Antenna

GPS Freq. Range:	L1 (1575 MHz ± 10 MHz)
GPS LNA Gain:	28 dB
L-band Freq. Range:	1525 to 1560 MHz
L-band LNA Gain:	28 dB
Beacon Freq. Range:	283.5 to 325 kHz
Beacon LNA Gain:	34 dB
Dimensions:	129 mm dia x 98 mm H (5.08" dia 3.85" H)
Weight:	0.456 kg (1.0 lb)
Antenna Connector:	TNC-socket
Enclosure:	Powder-coated aluminum base, polycarbonate dome
Mounting Thread:	1-14-UNS-2B
Input Voltage:	4.85 to 15.0 VDC
Input Current:	50 to 60 mA
Operating Temp.:	-40°C to +85°C
Storage Temp.:	-40°C to +85°C
Relative Humidity:	100% condensing

* SVs > 5, HDOP < 2, RTCM SC-104 correction data from a dual frequency reference station, short baseline, and low multipath environment.

** Dependent upon ionospheric activity and multipath

Distributed by:
Navtech GPS Supply
6121 Lincolnia Rd. #400
Alexandria, VA 22312, USA
ph) 800-628-0885 or 703-256-8900
fax) 703-256-8988
gpsteach@navtechgps.com
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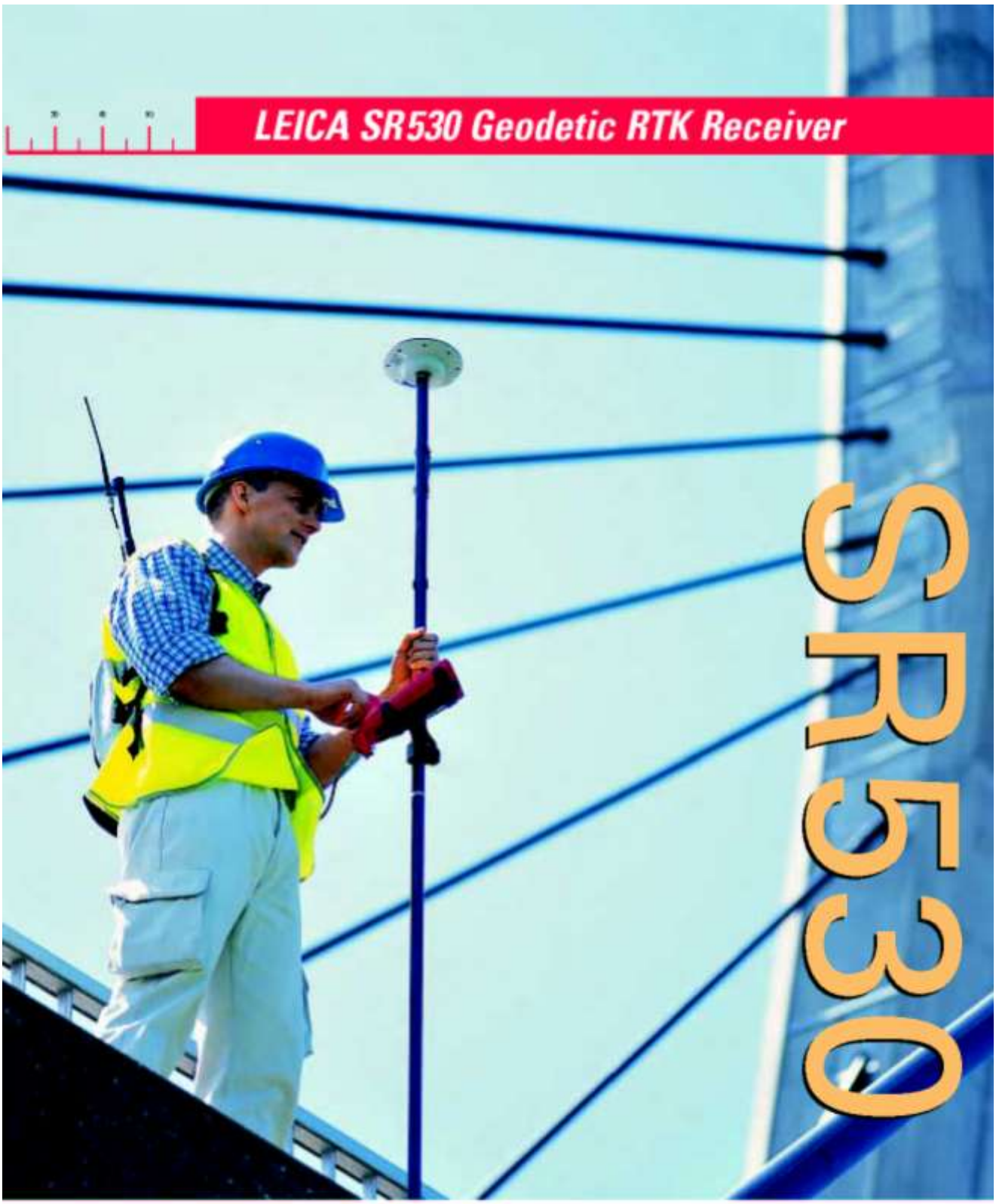
csi wireless



SR530 Dual-Frequency, Geodetic, Real-Time-Kinematic Receiver
SKI-Pro Professional Office-Support Software
GPS Surveying – System 500

Leica Geosystems

SR530 - geodetic, real-time receiver 12L1 + 12 L2, C/A-code, P-code, RTK

High technology

- ClearTrak™ dual frequency
- On-board RTK
- Perfect tracking
- Jamming resistant
- Multipath mitigation
- High update rate 10Hz
- Low latency < 0.05sec

Highest accuracy

- Fast, reliable ambiguity resolution on the fly
- cm-accuracy long-range RTK
- 5mm + 1ppm rapid static
- 3mm + 0.5ppm static

Modular hardware

- Small, light, rugged
- Easy to use
- Optional terminal
- Radio modem, GSM phone
- Choice of antennas
- Plug-in batteries
- PCMCIA flash cards

All measuring modes

- Real-time kinematic
- Static, rapid static
- Stop & go, kinematic
- On the fly
- DGPS
- Navigation
- Post processing

Easy interfacing

- Four communication ports
- NMEA output
- ASCII input
- PPS output and event input
- OWI commands

All applications

- Geodetic control
- Photo control
- Detail and topo surveys
- Cadastral surveys
- Seismic surveys
- Construction
- Engineering
- Setting out
- Mining
- Machine control
- Hydrographic survey
- GIS mapping
- Reference stations
- Monitoring
- Geodetic networks
- Aerial photography

Technical specifications: SR530 dual-frequency, geodetic, real-time-kinematic receiver

Modes and applications	Static, Rapid Static, Kinematic, On The Fly Real Time RTK, DGPS/RTCM, Post Processing
12 L1 channels	Full phase, C/A narrow code, precision code
12 L2 channels	Full phase, P code, P-code-aided under AS
Power and weight	Nominal 12VDC. 7W for SR530 + terminal. Wt. 1.25kg
AT502 antenna	L1/L2 microstrip, built-in groundplane, 0.4kg
Baseline rms with RTK	Stationary, after initialization: 5mm + 2ppm (rms) Moving, after initialization: 10mm + 2ppm (rms)
Baseline rms with post processing using SKI-Pro software	Static, long lines, long observations: 3mm + 0.5ppm (rms) Rapid static: 5mm + 1ppm (rms) Kinematic/moving after initialization: 10mm + 1ppm (rms)
Baseline rms DGPS/code	DGPS/RTCM and code only: typically 30cm (rms)
Note on baseline rms **Figures are for normal to favorable conditions**	Baseline rms = accuracy in position Accuracy in height = 2 x accuracy in position Figures also depend on number of satellites, geometry, observation time, ephemeris, ionosphere, multipath etc.
On The Fly RTK initialization	Time: typically 10 secs. Reliability better than 99.99%. Range: typically 10km with low-power radio. Up to 30km with high-power radio or GSMphone in favorable conditions
TR500 terminal	Display: 12 lines of 32 characters. Weight 0.4kg
Data recording, selectable 0.1 to 60 secs. rec. rate	PCMCIA ATA flash cards: 8MB, 16MB, 85MB Optional internal memory: 8MB, 16MB
16MB capacity (Divide/2 for 8MB; Multiply x 5 for 85MB)	About 625 hours at 15 sec rate, 2500 hours at 60 sec About 16 000 real time positions
GEB121 battery, 2 batteries plug into SR530 External power supply	3.6Ah/6V. 2 GEB121 power SR530 + terminal for about 6 hours. GEB121: weight, 0.35kg GEB71 7Ah/12V external battery or any 12V source
Operation without terminal	Automatic on switching ON, 3 LED status displays
Operation with terminal	Menu driven, two-level operating system
Operating modes	Survey, stakeout, navigation, RTK, RTCM, timer
Coordinate displays	Geog: Lat, Long, Ht Cartesian: X, Y, Z Grid: E, N, Ht
Stakeout display	Graphical with zoom. Digital. Polar and orthometric.
Stakeout accuracy	10mm + 2ppm at 10Hz (0.1sec) update rate
Position update rate	10Hz (0.1 sec). Latency <0.05sec.
Standard programs	Coordinate geometry. Areas. Lines/grids/slopes. Hidden point.
Optional programs	RoadPlus, Quick Slope, DTM Stakeout
Coordinate systems	Ellipsoids, projections, transformations, geoidal models
Environmental: **Receiver, terminal etc** **Antenna**	Operation / Storage - 20 deg. C to +55 deg. C - 40 deg. C to +70 deg. C - 40 deg. C to +75 deg. C - 40 deg. C to +75 deg. C
SKI-Pro software	Professional Office Support Software
Not protected, run without software-protection key	Planning, management, transfer, ASCII import/export, view/edit, coding, reporting, help
Protected options, need software-protection key	Data processing, datum/map/tranformation, design/adjustment, GIS/CAD export, RINEX import

CLEARTRAK ON BOARD

TQM

Total Quality Management is our commitment to total customer satisfaction.

For more information about our TQM program, ask your local Leica Geosystems agent.

Leica Geosystems

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GBX-PRO

High Accuracy GPS/Beacon Receiver

Combination GPS/Beacon Receiver

FEATURES

- Real-time sub-meter accuracy
- 12-Channel all-in-view GPS satellite tracking
- 5 Hz NMEA position update rates
- Dual channel beacon receiver
- State-of-the-art digital architecture
- 2-line by 16-character LCD display and 3-switch keypad
- GPS and beacon status information
- Fast satellite and beacon acquisition
- 1 PPS timing signal
- External RTCM input
- Global beacon listing
- Wide input voltage range
- Low power consumption
- Automatic and manual beacon modes
- Single "Smart" port for GPS and beacon receiver configuration

Real-Time, Performance

The CSI GBX-PRO differential GPS receiver combines the performance of CSI's third generation digital beacon receiver technology with the proven Ashtech G-12 GPS Board™ in a single high performance package.

The GBX-PRO utilizes free GPS satellite and 300 kHz beacon signals to calculate differentially corrected 3D positions with a horizontal accuracy of less than one meter (95%). The internal beacon receiver supplies differential GPS corrections to the GPS engine in the RTCM SC-104 format. Various authorities around the world broadcast free differential correction information on radiobeacon transmissions that meet the stringent integrity and reliability requirements mandated by the International Association of Light House Authorities (IALA).

The GBX-PRO also provides the facility for correction input from an external RTCM source. The GBX includes a second differential input port so that external RTCM input does not interfere with bi-directional communications on the main serial port.

Ease of Operation

The GBX-PRO receiver is designed with ease of operation in mind, incorporating a 2-line by 16-character LCD display and 3-switch keypad for configuration and operation of the internal beacon and GPS receivers. A "Smart" data port on the back panel provides access to both internal devices, through the same serial connector.

CSI's MGL-3 Combination GPS/Beacon Loop antenna simplifies installation by combining an L1 GPS patch antenna, ground plane, and an H-field beacon Loop antenna in one package. For added flexibility, you may use separate GPS and beacon antennas in conjunction with CSI's External Signal Combiner which converts two antenna outputs into a single input to the GBX-PRO.

Advanced Beacon Receiver Technology

Advanced digital signal processing techniques are the mainstay of CSI's beacon receiver products. The GBX-PRO will operate reliably in the noisy environments characteristic of many DGPS installations.

The GBX-PRO is able to operate in automatic or manual beacon tune modes. In automatic mode, the two channels of the internal beacon receiver cooperatively construct and maintain a table composed of available radiobeacons in your area. The receiver automatically locks to the station with the highest quality signal.

Configuration Software

CSI offers custom Windows 95® software for GPS and beacon receiver configuration and monitoring of receiver status. Data logging capability and a terminal interface are also included.

Warranty

CSI is committed to supporting its products and offers a one-year warranty on parts and labor.

Contact us to discover how the GBX-PRO can meet the positioning requirements of your application.

GBX-PRO – *High Accuracy GPS/Beacon Receiver*

Optional GPS Features

- 10 Hz and 20 Hz position update rates
- R.A.I.M.
- Strobe Correlator™
- Geoidal height and magnetic declination
- Base station

GPS Receiver Specifications

Channels:	12-Channel L1 C/A Code, carrier smoothed
Horizontal Diff. Accuracy:	< 1 m (95% confidence)
Differential Input:	RTCM SC-104
Input/Output Messages:	NMEA 0183
Position Update Rate:	up to 5 Hz
Raw Data Output Rate:	up to 2 Hz (code and carrier)

- Please contact CSI for detailed Ashtech G-12 GPS™ specifications

Beacon Receiver Specifications

Channels:	2 independent channels
Frequency Range:	283.5 to 325.0 kHz
Channel Spacing:	500 Hz
MSK Bit Rates:	50, 100, and 200 bps
Cold Start Time:	< 1 minute
Warm Start Time:	< 2 seconds
Demodulation:	Minimum shift keying
Sensitivity:	2.5 µV/m for 10 dB SNR
Dynamic Range:	100 dB
Frequency Offset:	± 5 Hz
Adjacent Channel Rejection:	60 dB @ f_o ± 500 Hz

GBX-PRO Communications

Interface Level:	RS-232C
Baud Rates:	2400, 4800, 9600
Correction Output Protocol:	RTCM SC-104
Input/Status Protocol:	NMEA 0183
Timing:	1 PPS ± 190 ns

GBX-PRO Environmental Specifications

Operating Temperature:	-30°C to +70°C
Storage Temperature:	-40°C to +80°C
Humidity:	95% non-condensing
EMC:	EN 60945, EN 50081-1, EN 50082-1 FCC: Part 15, sub-part J, class A digital device

GBX-PRO Power Specifications

Input Voltage:	9 - 40 VDC
Nominal Power:	4.8 W
Antenna Voltage Output:	10 VDC (5 VDC optional)

GBX-PRO Mechanical Specifications

Dimensions:	163 mm L x 125 mm W x 51 mm H (6.4" L x 4.9" W x 2.0" H)
Weight:	1.75 lb
Display:	2-line by 16-character LCD
Keypad:	3-key switch membrane
Power Connector:	2-pin circular locking
Data Connector:	DB9-S
Antenna Connector:	BNC-S

GBX-PRO Operating Modes

GBX-3 Mode (Default)	GBX outputs GPS NMEA messages (Default Mode)
MBX-3 Mode:	GBX outputs RTCM for use by an external GPS receiver
GBX-E Mode:	Correction input from an external RTCM source

Pin-Out, RS-232C

DB9 Pin #	Description
2	TXA, GBX NMEA 0183 output
3	RXA, GBX NMEA 0183 input
5	Signal return
8	RXB, external RTCM input
9	1 PPS output (TTL logic level, 75Ω)

GBX-PRO Accessories

Antenna:	MGL-3
Power Cables:	Various
Antenna Cables:	Various
Data Cables:	Various
CSI GPS Command Center:	MS Windows 95® GPS control software
CSI Beacon Command Center:	MS Windows 95® beacon control software

MGL-3 Combination Antenna

Beacon Frequency Range:	283.5 to 325.0 kHz
Beacon LNA Gain:	34 dB
GPS Frequency Range:	L1 (1575 MHz)
GPS LNA Gain:	30 dB
Dimensions:	128 mm square x 84 mm H (5.1" square x 3.3" H)
Weight:	0.45 kg (1.0 lb)
Antenna Connector:	TNC-S
Enclosure:	PVC plastic
Mount:	1-14-UNS-2B (marine std.)
Input Voltage:	4.9 to 13.0 VDC
Input Current:	50 to 60 mA
Operating Temperature:	-30°C to +70°C
Storage Temperature:	-40°C to +80°C
Relative Humidity:	100% condensing

CSI Authorized Dealer

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1200 – 58th Avenue S.E., Calgary, AB, Canada, T2H 2C9
Phone: (403) 259-3311 Fax: (403) 259-8866
Web: www.csi-dgps.com e-mail: info@csi-dgps.com

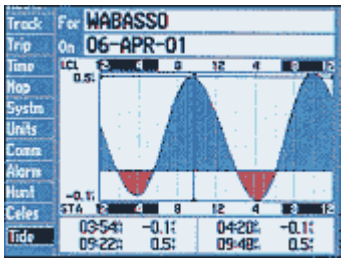
General Navigation / Research

Garmin GPSMAP 176C

With the Garmin GPSMAP 176C, you'll get a clear picture of where you are and where you're going. This chartplotter takes up a small footprint, yet features a large, 16-color transflective screen. The Garmin GPSMAP 176C offers excellent map detail and accepts additional data from MapSource CD-ROMs* including BlueChart* marine cartography and MetroGuide* for address level city street detail.

Map Page

Load enhanced map detail with optional BlueChart and other MapSource CD-ROMS and data cards.

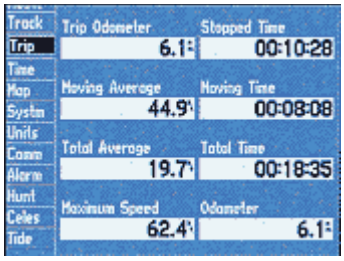


Tide Tables

Built-in U.S. tide data provides tide information by date and location

Navigation Page

Shows direction to destination, speed, distance and much more.



Trip Computer

Displays navigation information for your travels on land or sea

GBS Etrex

Truly a small wonder, the eTrex takes the best features of a 12 parallel channel GPS receiver and put them into a six ounce package that is only four inches high and two inches wide. The result is a unit that will literally fit in the palm of your hand.

Inside the eTrex, you will find the proven performance of a 12 parallel channel GPS receiver that will run for 18 hours on just two AA batteries. No need to worry about dense tree canopy with this unit, the eTrex will continue to maintain a tight satellite lock even while operating in forest-like conditions. The eTrex will store up to 500 user waypoints with graphic icons.

Garmin e-Trex Features

- **Receiver**: Differential-ready, 12 parallel channel GPS receiver continuously tracks and uses up to 12 satellites to compute and update your position
- **Acquisition Times**
  Warm: approx. 15 seconds
  Cold: approx. 45 seconds
  AutolocateTM: approx. 2 minutes
- **Update Rate**: 1 second, continuous
- **Accuracy**: Position, 15 meters (49 feet) RMS*
- **Velocity**: 0.1 knot RMS steady state
- **Dynamics**: 6g's
- **Interfaces**: RS232 with NMEA 0183, RTCM 104 DGPS data format.
- **Antenna**: Built-in patch (does not support external antenna)
- **Display:** 1.1"W x 2.1"H, high-contrast LCD with bright backlighting
- **Waypoints**: 500 with name and graphic symbol
- **Track Log**: Automatic track log; 10 saved tracks
- **Route**: 1 reversible route with up to 50 waypoints
- **TracBack**[a]: Navigate saved tracks
- **Map Datums**: More than 100
- **Position format**: Lat/Lon, UTM/UPS, Maidenhead, MGRS, and other grids.

Echosounder
Navisound 200 Series

- Portable, highly compact, lightweight unit
- Broadband frequency agile
- Multiple bottom digitizing with single frequency for sediment and vegetation surveys
- Supports single or alternating channel operations
- High-performance, easy-to-operate, and very reliable

RESON's NaviSound 200 Series are highly portable, single-beam echosounders that offer a range of high-performance features. With a selection of models, the NaviSound 200 Series supports a wide range of hydrographic survey applications.

NaviSound 200 echosounders provide reliable depth measurements in a convenient, easy-to-operate unit. Advanced features include multiple bottoms digitizing with a single frequency for sediment and vegetation surveys. Besides its compact size and low weight, the Navisound 200 enclosure provides the highest possible water resistance.

An affordable side-looking sonar (SLS) option that records dual-sided imagery is also available for selected NaviSound 200 models.

Individual NaviSound 200 models are as follows:

NaviSound 215: Enhanced single-beam echosounder that uses one receiver channel to operate two transducers in true real-time, alternating frequency operation

NaviSound210: Basic, one-channel, single-beam echosounder for hydrographic survey operations

TECHNICAL DETAILS

Frequencies:	**User-selectable frequencies from 15-600 kHz. Standard 28-35 and 190-225 kHz.**	*Sound velocity calibration*	**1350-1600m/sec in 1m/sec steps**
Impedance:	**100 Ohm (others on request)**	*Transducer draft comp:*	**0-99.99m**
Max power:	**300 W**	*Graphics:*	
Power control:	**Manual or automatic**	*Recording:*	**11 cm wide thermal paper recorder**
Pulse length:	**Manual, 5 steps**	*Resolution:*	**800 pixels (gray shades)**
Units:	**Meters and feet**	*Transfer speed :*	**20 lines/sec**
Resolution:	**1 cm (NaviSound 210 and 215)**	*Serial interfaces:*	**1: Communication,**
	1 dm (NaviSound 205)		**2: Heave input,**
Accuracy:	**1 cm at 210 kHz (1 sigma),**		**3: Auxiliary input (DGPS)**
	7 cm at 33 kHz (1 sigma)		**4: Repeater output**
	(assuming correct sound velocity and transducer draft)	*Dimensions*	**273 x 278 x 115mm (11 x 11 x 4.5 inches)**
TVC detection level:	**20 Log (depth)**	*Weight:*	**5.5 kg (12 lbs)**
Additional feature:	**Built-in barcheck utility**	*Supply voltage:*	**10-28 VDC (external AC converter available)**
		EMC radio noise:	**CE approved**

MODEL COMPARISON			
NaviSound	205	210	215
Output resolution:	**dm**	**cm**	**cm**
Depth ranges:	**0.5-100m**	**0.2-600m**	**0.2-600m**
Channels/transducers:	**1/1**	**1/1**	**1/2**
Max sounding rate (PRF):	**5 Hz**	**20 Hz**	**02/10 Hz**
Heave input:	**-**	**X**	**X**
NMEA output:	**X**	**X**	**X**
DESOxx output protocol:	**-**	**X**	**X**
Supports SLS option:	**-**	**X**	**X**
AC converter option	**X**	**X**	**X**

Navisound 2000

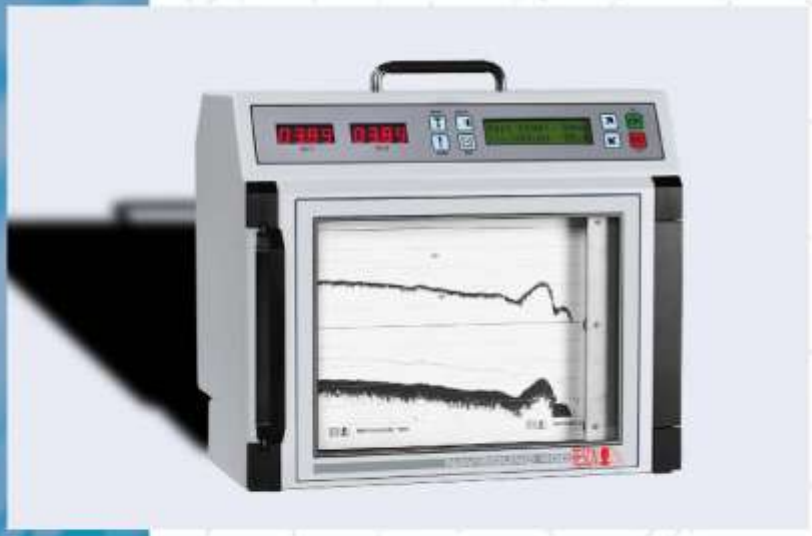
Depth Range:	0 – 650 m
Channels :	1 or 2
Operating Frequency :	30 kHz band and 210 kHz band (tunable)
Depth Display :	2 x 4 digits numeric LCD display
Transmission Power :	300 W, 600 W and 1000 W
Impedance :	100 Ohm
Resolution :	1 cm
Accuracy :	Better than 10 cm at 30 kHz Better than 1 cm at 210 kHz
Sound Velocity Compensation :	1400 – 1600 m/s, resolution 1 m/s
Trans. Draft Compensation :	0-9999 cm
Pulse Reception Frequency :	1-20 Hz
Recorder Type :	Thermal, 1400 pixels per line in a 4 step gray scale (8 steps possible)
Paper Width :	20.0 cm (7.9 in)
Control :	Recorder range Depth range Time gate Approval Normal/Decreased Recorder Mode Single multifunction rotary control of all other parameters
Display of Settings :	2 x 16 character alpha numeric LCD display
Additional Features :	Bar check External Marker
Annotation :	RS-232C, RS-422 or GP-IB (IEEE 488)
Repeater Output :	RS-232C, RS-422
Interfacing :	RS-232C, RS-422 or GP-IB (IEEE 488)
Consumption :	Less than 100 VA
Operating Temperature :	0 – 50° C, 32 – 122° F
Humidity :	5 – 90% relative non condensing
Dimensions :	Height : 312 mm 12.3 in (7PU) Width : 485 mm 19.0 in Depth : 335 mm 13.2 in
Installation :	19 inch rack mountable or free standing

Navisound 420

NaviSound 420 DS

PRODUCT SPECIFICATION

DEEP SEA HYDROGRAPHIC SURVEY SINGLE-BEAM ECHOSOUNDERS



- *Built-in thermal printer*
- *High performance and easy operation*
- *Selectable 11,15, 33 and 200 kHz sounding frequency*
- *Simultaneously support for dual channel operation*
- *Supports depths up to 6000m*
- *Universal power supply*
- *Portable, 19-inch rack mountable design*

The NaviSound 420 DS Deep Sea Echosounder provides high-quality soundings at operational ranges of 6,000 meters packaged in a rugged, portable design. The easy-to-use echosounder was developed in cooperation with Navitronic Systems, and builds on the capabilities of the widely used, reliable NaviSound 420 single-beam echosounder.

The NaviSound 420DS Echosounder includes an enhanced 2 kW transmitter module as well as an enhanced receive module. The NaviSound 420DS has expanded TVG control when compared to the NaviSound 420 TVG function.

While simultaneously supporting dual-channel operation, the system is capable of operating at a frequency range of between 11 - 600 kHz. The echosounder is designed for hydrographic applications, pre- and post-surveying, and dredging operations. An optional connection for single and dual side looking sonars is available.

RESON

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www.reson.com

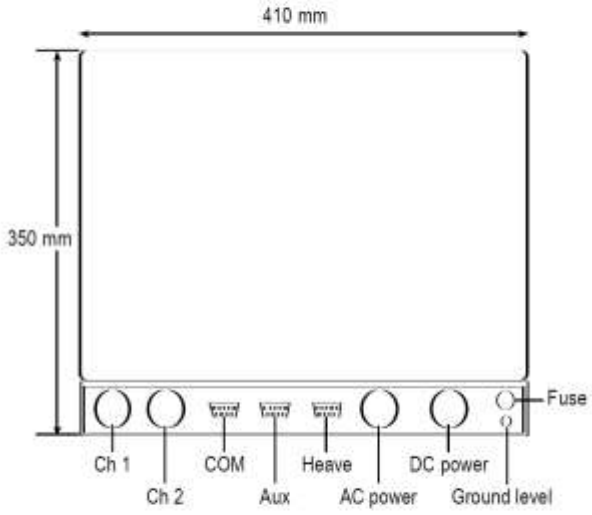
NaviSound 420 DS System Specifications

TECHNICAL DETAILS

Frequencies:	Channel 1 frequency is 11kHz or 15kHz (selectable) Channel 2 frequency is 33kHz or 200kHz (selectable)
Channels:	2
Depth range:	0.2 - 2000/6000 meters (frequency dependent)
Impedance:	100 Ohm (others on request)
Max Sounding Rate:	20 Hz
Max Power:	2kWatt, Channel 1 300Watt, Channel 2
Power Control:	Manual or automatic
Pulse Length:	Manual, 5 steps
Units	Meters & feet
Resolution:	1 cm
Accuracy:	1 cm at 210 kHz, 7 cm at 33 kHz (assuming correct sound velocity, transducer draft)
TVC detection level:	20 Log (depth)
Sound velocity calibration:	1350-1600 m/sec in 1 m/sec step
Add'l features:	Barcheck utility option NMEA output DESOxx output
Compatible transducers:	RESON, Atlas, Simrad, Sonar research types in the operating frequency range
Transducer draft comp:	0-99.99m

Graphics:	
Recording:	21 cm wide thermal paper recorder
Resolution:	1400 pixels (5 gray shades)
Transfer speed:	15 lines/sec
Serial I/F:	1: Communication 2: Heave input 3: Auxiliary input (DGPS)
Dimensions:	350 x 410 x 255 millimeters (14 x 16. x 10 inches)
Weight:	15 kg (33 lbs)
Supply voltage:	24 VDC, 115-230 VAC
EMC radio noise:	CE approved

REAR VIEW



Scope of delivery: NaviSound 400 Series User's Manual, DC power cable, AC Power Cable, RS-232C communication cable, 19" rack mount kit, Transducer Connector(s),spare paper, fuses, & thermal head cleaning kit

RESON

Version: B059 030903

Knudsen 320M

Operational Parameters	
Phased Ranges:	Multiple 50% overlapped phases of each range, (20% overlap optional), manual or automatic selection.
Depth Display:	Two LCD (backlit) 4-digit displays for High and Low frequency.
Sound Velocity:	1300 - 1700 m/s Resolution 1 m/s, 4265 - 5577 ft/s Resolution 1 ft/s, 710 - 929 fm/s Resolution 1 fm/s
Depth Resolution:	1 cm (0-99.99), 1 dm (100-999.9), 1 m (>1000)
Pulse Length:	Automatically selected, with operator override.
Gain Controls:	AGC, TVG and manual receive gain for each frequency.
Draft:	0 - 100 m Resolution 1 cm, 0 - 328.08 ft Resolution 0.01 ft 0 - 54.68 fm Resolution 0.01 fm
TX Blanking:	Manually Controlled 0 - 300 m. Resolution: 0.1 m, 0 - 984.3 ft. Resolution: 0.1ft, 0 - 164.0 fm Resolution 0.1 fm
Interfaces / Connections	
Frequencies:	3.5 KHz to 250 KHz Standard frequencies Include:3.5, 12, 24, 28, 30, 33, 50, 200, 210
Clock:	Internal battery backed time and date clock.
Heave:	TSS and Seatex compatible.
Position:	Compatible with all popular GPS receivers.

Multibeam SeaBat 8101

SeaBat 8101

- **Phase and amplitude bottom detection**
- **150° swath coverage (upgradeable to 210°)**
- **240kHz frequency**
- **Up to 600m swath width (with Option 040)**
- **Meets IHO & USACE Class 1 standards**

The SeaBat 8101 Multibeam Echosounder measures discrete depths, enabling complex underwater features to be mapped with precision. Dense coverage is achieved utilizing up to 4,000 soundings per second for a swath up to 600 meters in width, even as the survey vessel travels at speeds in excess of 12 knots.

With high accuracy and a measurement rate of up to 40 profiles per second, the SeaBat 8101 enables surveys to be completed faster and in greater detail than previously realized.

The SeaBat 8101 transducer is available for operating depths of 120, 300, 1500, and 3,000 meters. Small and lightweight, it can be mounted on under-water vehicles (ROV or towed) and transported to locations where accurate measurements are required.

SeaBat 8101

Multibeam Echosounder

SYSTEM PERFORMANCE		
Operating Frequency:	240kHz	
Swath Coverage:	150°	(upgradeable to 210°)
Max Range:	300m	
	450m max range available with ER option	
Number of Beams:	101, beamspacing 1.5°	
Along-Track Beamwidth:	1.5°	
Across-Track Beamwidth:	1.5°	
Max. Update Rate:	40	
Operational Speed:	Up to 18 knots	

PROCESSOR SPECIFICATIONS		
Power Required:	100/240VAC, 47/63Hz, 100W maximum	
Data Uplink:	High-speed digital coax with fiber-optic option	
Computer Interface:	10MB Ethernet and RS232C	
Data Downlink:	Serial, 19.2k baud	
Display Video Out:	SVGA: 800 x 600;	
	Refresh Rate:	~72Hz
Graphics Colors:	Sonar Image:	256 Colors
	Other Graphics:	8-bit RGB
Input Device:	3-Button Trackball	
Dimensions (HWD):	177 x 483 x 417mm	
Mounting:	19in. rack mountable	
Temperature:	Operating:	0° to +40°C
	Storage:	-30° to +55°C
Weight:	20kg (44 lbs.)	

DISPLAY SPECIFICATIONS	
Screen Size:	14" diagonal
Display:	SVGA High-Resolution, Color Monitor
Power Consumption:	80W
Weight:	11.2kg (24.6lbs.)

SONARHEAD SPECIFICATIONS		
Power Requirements:	24VDC, 2 amps max. (Power available from Processor.)	
Operating Depth:	120m (300,1500, and 3000m available)	
Dimensions:	266 x 320mm (W / D) excluding projector	
Temperature:	Operating:	-5° to +40°C
	Storage	-30° to +55°C
Weight (aluminum):	Dry:	26.8kg (59lbs.)
	Wet:	4.8kg (10.6lbs.)
Weight (titanium):	Dry:	40kg (88lbs.)
	Wet:	18kg (39.6lbs.)

OPTIONS	
Sidescan ugrade	Mounting plate assembly
Fairings	Spares kit
Titanium housing	210° swath
Extended-Range (ER) projector	Coax to fiber optic interface unit
Increase sonar head depth rating	

*Option 049: 274mm

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Transducer TC2024

Transducers
Hydrophones

TC2024

General purpose 200 kHz echo-sounder transducer for shallow water applications: 0-100m

The TC2024 is ideal for navigation, hydrographic echosounding in shallow waters, and high resolution distance measurements.

For outboard mounting, RESON steel housing mounts are available. The standard housing of the TC2024 is also compatible with ATLAS SW 6014 mounts.

FEATURES

- **200 kHz transducer.**
- **Compact design.**
- **Excellent performance.**
- **Robust piezo ceramic.**
- **Electrical compatible with most echo sounder systems.**

TECHNICAL SPECIFICATIONS

Resonant Frequency:	200 kHz ± 10 kHz
Transmitting Sensitivity:	173 dB ±3 dB re 1µPa/V at 1 m
Receiving Sensitivity:	-187 dB ±3 dB re 1V/µPa
Impedance :	100 ohm ±30% at 200 kHz
Beam width:	9.5°, Conical
Max input power:	450 W at 1% duty cycle
Operating depth:	30 m
Survival depth:	50 m
Operating temperature range:	-2°C to +30°C
Storage Temperature:	-30°C to +50°C
Cable (length and type):	Supplied with 20m shielded cable
Housing:	PVC
Weight (air) incl. Cable:	2.3 kg

RESON

ff

Transducer PE4/33 – D1/210

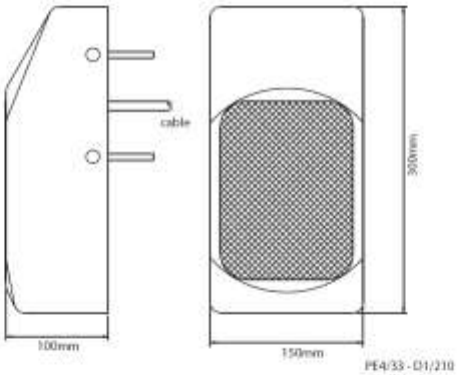
acoustic equipment guide SRD

PE4/33 - D7/210 (left) and PE4/33 - D1/210 (right)

dual frequency array

Our range of dual frequency transducer arrays is available ex-stock and compatible with many echo sounder systems on the market today.

The element technology ensures excellent beam patterns whilst the rugged construction gives long term protection against the harsh environment for which it is intended. The unit can be mounted permanently in the hull or used on temporary deployments with an over-the-side rig.



PE4/33 - D1/210

dual frequency array

typical specifications

	PE4/33 - D1/210		PE4/33 - D7/210		
	low	high	low	high group	high single
frequency (kHz)	33	210	33	210	210
source level (dB re. 1uPa/V at 1m)	170	170	170	170	170
bandwidth (kHz)	3	10	3	10	10
beamwidth(°)	22	8	22	3	8
max. input power (W)	3K	600	3000	3500	600
depth rating (m)	750	750	750	750	750
in-water impedance (Ohm)	100	250	100	30	230
dry weight (kg)	7.3			7.3	
cable length (m)	10			10	
connector	cables left unterminated				
comments	wiring diagram included with transducer				
storage temperature (°C)	all dual frequency arrays have a storage temperature of -20 to +55				
operating temperature (°C)	all dual frequency arrays have an operating temperature of -5 to +33				

Other versions can be manufactured to suit individual requirements.

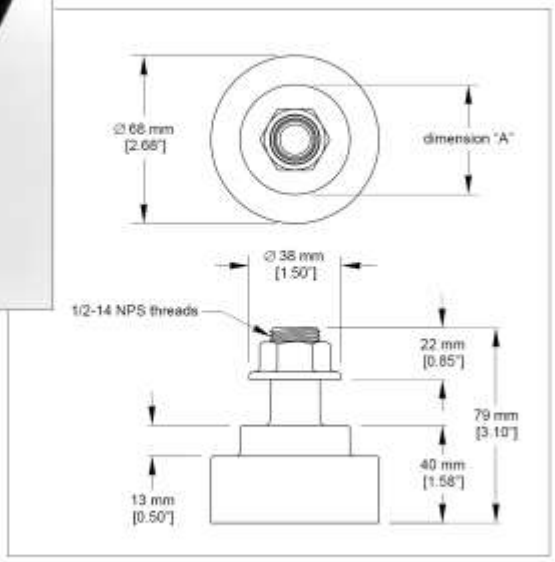
Transducer *B203*

NAVIGATION & SURVEY • Portable Mount

B203
SS503

200 kHz, 208 kHz, 210 kHz

Small housing with short stem used primarily for navigation and survey applications. This model is usually mounted on an extension tube but is adaptable to portable survey and navigation systems. It contains a transformer which can be used to match the impedance of the echosounder or allow the use of longer cables. The transducer is available in either a bronze or stainless steel housing.



Model	Dimension
B203	46 mm (1.80")
SS503	43 mm (1.69")

PERFORMANCE DATA

Frequency[1] – Airmar Piezoceramic Designator[2]	200 kHz – G	208 kHz – A	210 kHz – C
Element Material[3]/Diameter (mm)	BT / 51	BT / 51	BT / 51
Element Configuration (not to scale)	○	○	○
Beam Width at –3 dB	8°	8°	8°
Q (fr/Δ f @ –3 dB)[4]	25	7	27
Rated RMS Power (W)	600	600	600
Voltage Responses: Transmit/Receive[5] (dB)	173/–183	177/–190	173/–180
Figure of Merit (Insertion Loss)[6] (dB)	–13	–13	–12
Balanced Impedance[7]: Resistance, Rp (ohm)	85[12]	50[12]	100[12]
Capacitance,Cp (pF)	0	0	0
Series Impedance [R – jX][8] (ohm)	85 – j0	50 – j0	100 – j0
Acoustic Window Material	Urethane	Urethane	Urethane

Note: See page n 1 for footnotes.

AIRMAR TECHNOLOGY CORPORATION
2000 #17-1205
35 Meadowbrook Drive, Milford, New Hampshire 03055-4613 USA
Tel (603) 673-9570 • Fax (603) 673-4624 • e-mail: sales@airmar.com

Heave Pitch and Roll Compensator

MAHRS SURFACE

Meridian Attitude & Heading Reference System

VT TSS

Features:

- Innovative design with state-of-the-art motion sensors and DTG elements
- Attitude and heading in all dynamics
- Small, lightweight and versatile
- Fast 40 minute settling time
- 0.1° heading accuracy
- 0.03° roll and pitch accuracy
- Maintenance-free dry element
- MTBF >35,000 hours
- Dynamic turn rates of up to 200° per second

VT TSS Ltd combines 85 years of gyro experience with new innovative motion sensor design to create the Meridian Attitude and Heading Reference System (MAHRS).

MAHRS is a master heading reference instrument employing the characteristics of a dynamically tuned gyro (DTG) and the effect of gravity and the earth's rotation to produce a true north reference. The DTG provides exceptional heading performance on almost any vehicle to a level unmatched by even the latest fibre optic designs. This is combined with a TSS Dynamic Motion Sensor (DMS) to provide very accurate heave, roll and pitch.

MAHRS has been designed to provide reliable, maintenance free operation with a computed MTBF of 35,000 hours. The remarkably stable heading provided by MAHRS can be maintained for turn rates in excess of 200° per second making the system ideal for use on fast survey craft and in river/harbour environments.

MAHRS features a unique new algorithm that closely couples the motion sensor and gyrocompass. Deck plane correction enables real-time correction of the heading solution during vessel dynamics. As a result trials have demonstrated an increased heading performance of less than 0.1 making MAHRS the most accurate stand-alone heading solution available.

Backed by the largest global support network of any manufacturer, VT TSS has complete repair, test and calibration facilities in the UK and USA aided by factory-trained service engineers on every continent.

By closely coupling the two sensors, the MAHRS becomes a simple and fast method of providing accurate heading and attitude data.

TSS S G Brown

MAHRS SURFACE

TECHNICAL SPECIFICATIONS		
Settle point error	±0.1° RMS secant latitude	
Static error	±0.05° RMS secant latitude	
Dynamic accuracy	±0.1° RMS secant latitude	
Settle point repeatability	±0.1° RMS secant latitude	
Follow-up speed	200° / second	
Settling time	<45 minues within 0.7°	
Gimbal limits	45° pitch and roll	
Digital outputs	2 serial ports, RS232 or RS422, baud rates 1200, 2400,4800, 9600, 19K2, 38k4	
Data output rate	Digital – up to 200 Hz Analogue – 500 Hz (heave, roll and pitch) – optional	
Digital data output formats	TSS HRP, TSS1 +NMEA HDT; TSS1 default; TSS1 with remote heave; TSS3; Simrad EM1000; Simrad EM1000 with remote heave; Simrad EM3000; Simrad EM3000 with remote heave; NMEA PRDID; BMT1; Polled, user configurable; NMEA HDT; NMEA ROT; S G Brown (1/6th); S G Brown (1/10th); Robertson	
Dimensions	242mm x 430mm x 232mm including base plate	
Weight	20 Kg	
Ambient operating temperature	-10°C to +55°C	
Power requirement	24V DC, 5A at switch on, 2.5A operating	
Compensation	Latitude	80N to 80S
	Speed	0 – 90 Knots
Pitch and roll	Resolution	0.01°
	Range	±90°
	Accuracy	0.03° (for a 5° amplitude)
		0.05° (for a 45° amplitude)
Heave	5cm or 5% whichever is greater (period 0 to 20s)	
Shock (survival)	10g	
Housing	IP65	
Warranty	15 months international warranty including parts and labour	
	Due to continuous development, specifications may vary from those listed above.	

VT TSS
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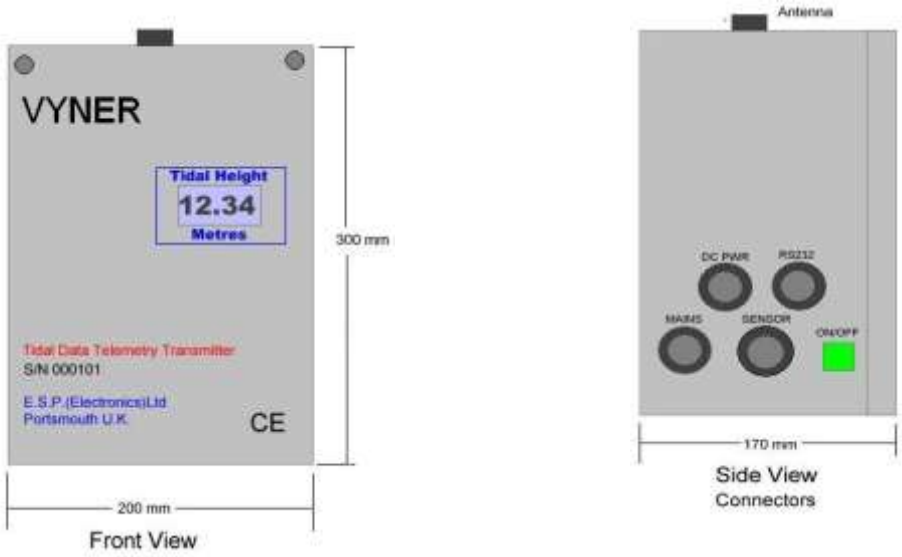
Aberdeen: 10 The Technology Centre, Aberdeen Offshore Technology Park, Claymore Drive, Bridge of Don AB23 8JD, UK
Tel: +44 (0)1224 707081 Fax: +44 (0)1224 707085 Email: tssmail@vttss.com
Houston: 10801 Hammerly Blvd, Suite 128, Houston TX 77043, USA
Tel: +1 713 461 3030 Fax: +1 713 461 3099 Email: sales@vttss.com

Total Station
Leica TC 1800

Angle measurement	1", 0.3 mgon
Distance measurement	1mm ± 2ppm
Measuring time	3 s
Built-in programs	Orientation and height transfer, Resection, Tie-distance, Stakeout
Range*	2.5 / 3.5 km
Magnification	30 x
Laser plummet	Located in alidade, turning with the instrument, Accuracy 1.0 mm at 1.7 m

Others Tide Gauge



Tide Gauge Transducer/ *Receiver* Unit

Outputs.

Display of Tidal Data	Range -9.99 mtrs thru 25.00 metres
Resolution	00.01m
Accuracy	+/- 0.25%
LCD 0.5" High, 7 Segment, Back lit	Tidal Data
LCD 4 line * 16 Alpha-Numeric	Operator Parameters, Tide, Date & Time

Inputs.

Water Pressure Sensor Types	4 to 20 ma or 0 v to +5 volt
Battery Power	+10v thru +30v, Nominal 10 Watts

Notes:
1. Tide Height always measured at 1 second Interval.
2. The Date, Time, S, A, R and Channel # are Recorded at Log Start and are Downloaded at RS 232 Data download.

Pressure Sensor Transducer

Maximum measuring span.	0-2.5 bar
Characteristic	linear
Non-linear hysteresis & non-repeatability	+/- 0.2 5%fro
Long term drift (per annum)	< 0.1%
Atmospheric correction	vented cable
Combined thermal zero & sensitivity error	+/- 0.02% fro per deg C
Temperature operable	-55 C to 120 C
Overload rating	x5 pressure range
Wetted parts	Iconel 625 seawater compatible
Connection cable	conforms to IP68

Others: Micro Ranger

Vyner M2500 MICRORANGER Laser Rangefinders

SPECIFICATION

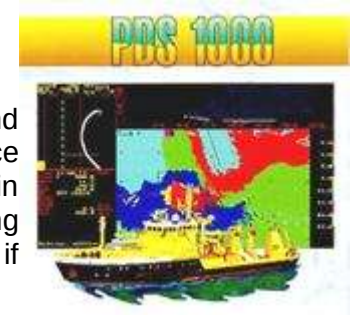
Model:	**M2500 MicroRanger**
Range: - prisms:	**2500 meters**
Range: - diffuse targets	**100 meters**
Resolution:	**0.1 meters**
Accuracy:	**± 0.5 meters or 0.1% of range**
Measuring time:	**0.2 seconds**
Wavelength:	**904nm**
Peak power output:	**nominal 30w**
Pulse length:	**25ns**
Pulse repetition rate:	**400pps**
Beamwidth:	**8mrads**
Display:	**LCD 5 digits**
Power input:	**11-32vdc**
Consumption:	**nominal 5w**
Battery (12v 3Amp/hr):	**4 hrs continuous ranging**
Dimensions:	**105 x 72 x 200 (H x W x L)**
Weight:	**1.2 kgs**
Eye safety:	**conforms to Class 3 BS7192:1989**

Attachment-3

LIST OF SPECIALIZED SURVEY SOFTWARE

PDS1000

System Overview



PDS1000 is a PC based software package for Hydrographic Survey and Dredge Operations. The program comprises data collection, vessel guidance and data processing. The package was designed to assist a surveyor in carrying out a complete survey from planning to final charting, including preparation of dredge guidance data to support dredge operations if applicable.

The package supports a wide range of sensors and is permanently updated for new sensor types when these become available. It can be configured for simple survey-only applications up to extensive multi-beam surveys with ROV support and complex dredge projects. Special attention has been given to the user interface, which is consistent throughout all modules and easy to learn.

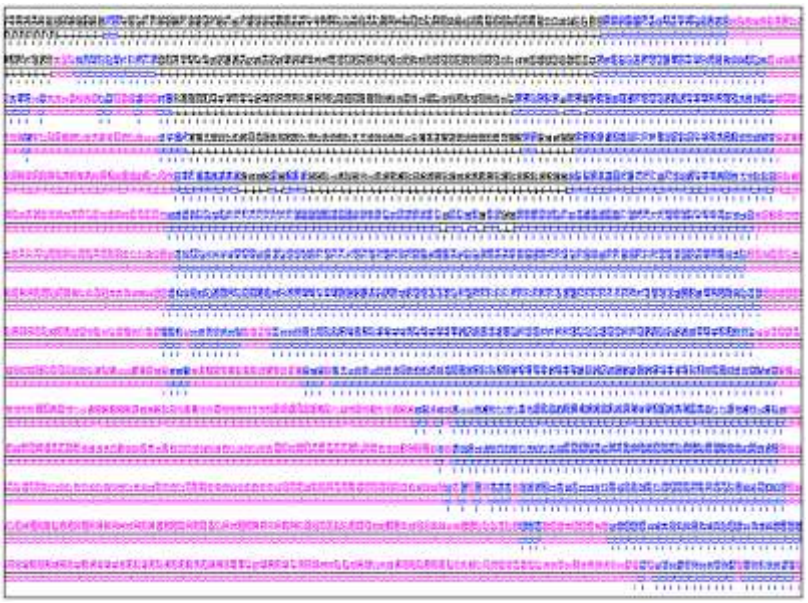
The package is modular by design. A separate module performs each main task of the survey or dredge operation. This makes the use of PDS1000 very flexible. Those who use only a part of PDS1000 can concentrate on the appropriate module.

PDS1000 in its current appearance was put on the market as early as 1989. At that time it was already based on Thales GeoSolutions's lengthy experience with earlier hydrographic software systems. Since 1989, the system has been improved, adjusted and extended in order to keep up with contemporary survey requirements. It makes it an effective and flexible tool for hydrographic survey and dredge operations.

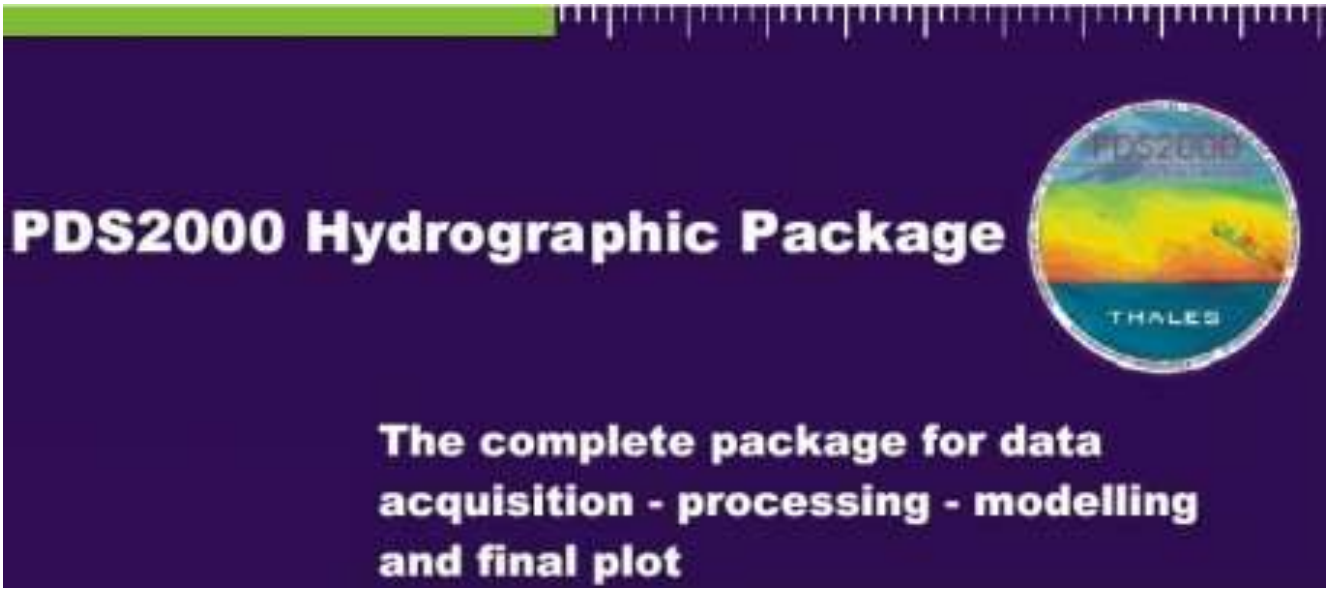
Applications

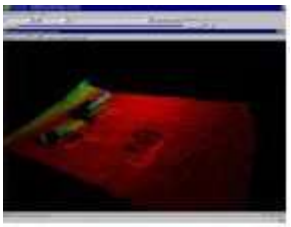
Over 450 users have used PDS1000 in many different applications. Some of these are named here:

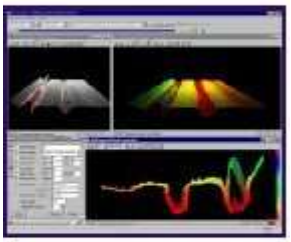
1- Hydrographic Surveys
2- Multibeam echosounder surveys
3- Maintenance dredging
4- Land reclamation projects
5- Pipeline/trench construction
6- Harbour maintenance and construction
7- Environmental dredging.



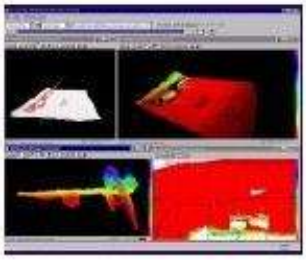
PDS2000

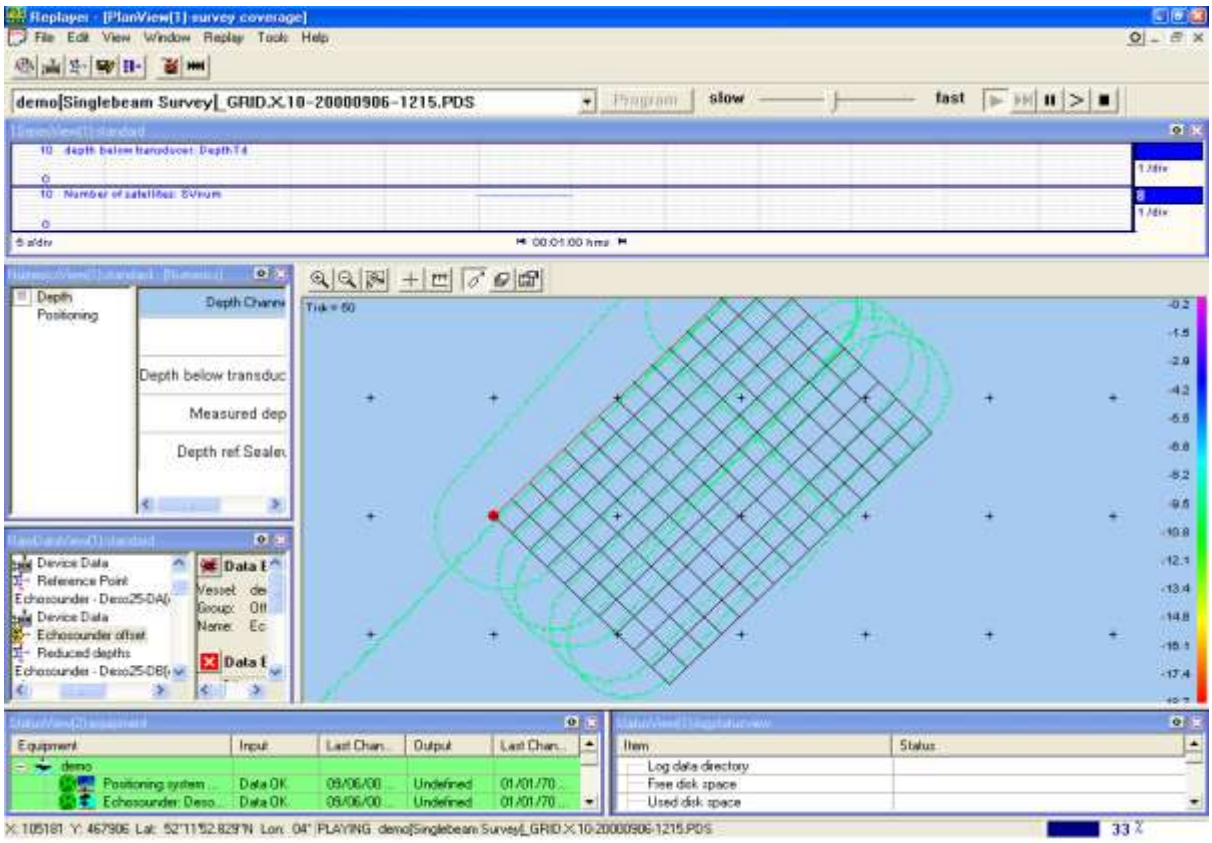


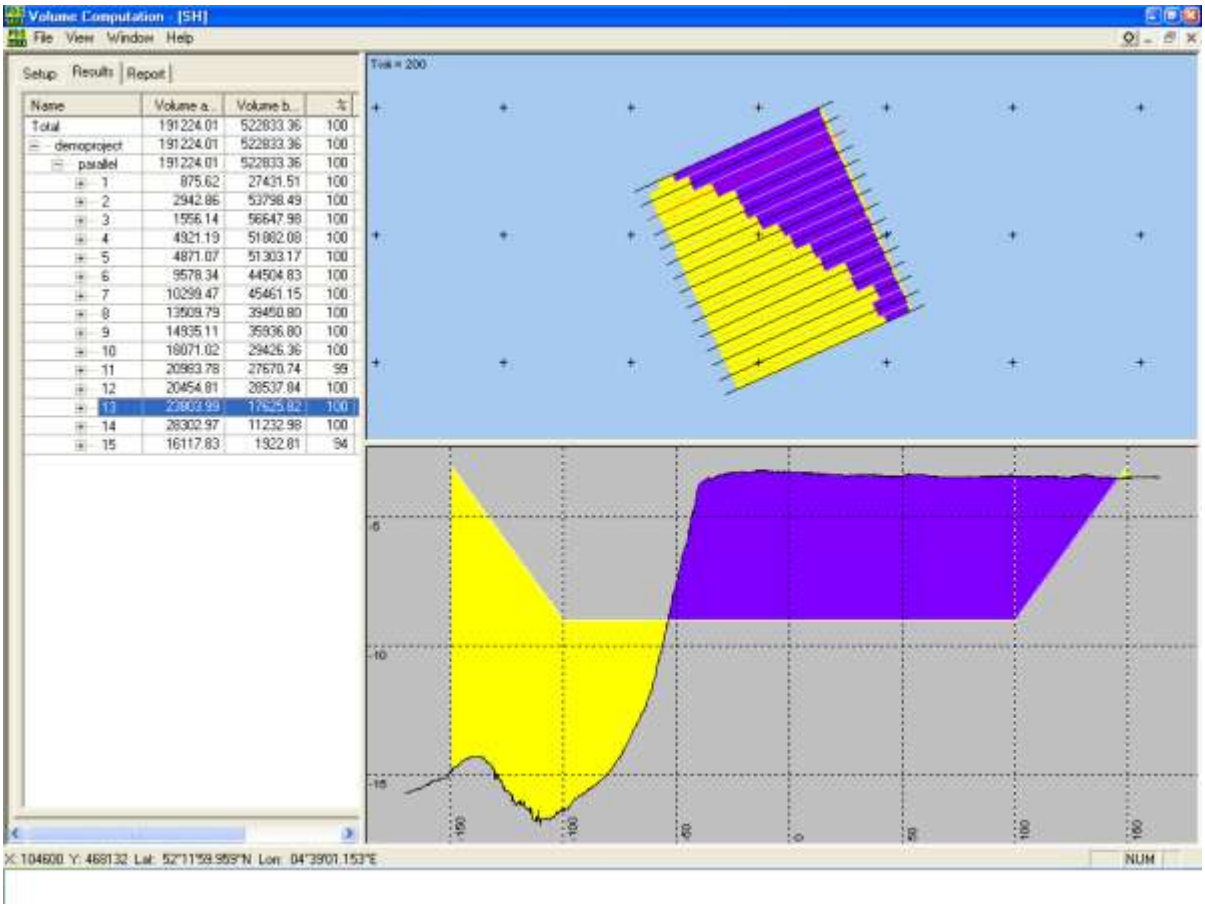




- Shallow water to full ocean depth surveys
- Real-time processing for multibeam data
- High standard On-line QC displays
- Synchronised processing : running through data sets with full control / view over the entire set
- Processing of data is fast, easy, accurate and fun
- Instant 2D and 3D visualization
- Ability to instantly edit data
- Processes megabytes of data in minutes
- Used by Survey and Dredging Companies, Construction Companies, Port Authorities




Replayer - [PlanView(1) survey coverage]
File Edit View Window Replay Tools Help
demo[Singlebeam Survey]_GRID.X.10-20000906-1215.PDS
slow
fast
Depth
Positioning
Depth below transduc
Measured dep
Depth ref Sealev
Device Data
Reference Point
Echosounder offset
Reduced depths
Equipment
Input
Last Chan...
Output
Item
Status
Log data directory
Free disk space
Used disk space


Volume Computation - [SH]
File View Window Help
Setup
Results
Report
Name
Volume a...
Volume b...
Total
demoproject
parallel

Attachment-4

INFORMATION & CALIBRATION SHEETS

THE MENAS DIFFERENTIAL GPS SYSTEM FOR THE ARABIAN GULF

The MENAS Differential GPS System will provide a navigational service as follows:

Station Name	I.D. Numbers		Position	Nominal Range		Status	Integrity Monitoring	Message Type	Frequency	Bit Rate
	Reference Station(s)	Tx Station		Nm	At UV/m					
Bahrain	480 + 481	140	26 07N 050 39E	250	75	Operational	Yes	367916	298	200
Kuwait	482 + 483	141	29 07N 048 08E	250	75	Operational	Yes	367916	295	200
Ras Al Khaimah	484 + 485	142	25 59N 056 04E	250	75	Operational	Yes	367916	292	200
Abu Dhabi	486 + 487	143	24 06N 052 56E	250	75	Operational	Yes	367916	314	200

D.G.P.S

Client/Empolyer:

Consultant:

Main Contractor:

Project:

Date of Survey:

Type of Survey: *Predredge* *Intermediate* *Check* *Postdredge*

Type:	Accuracy:
1 NOVATEL	**0.20 m**
2 GBX PRO	**0.50 m**
3 LEICA 530	**0.05 m**

Instructions:

A. Agree 3 established stations with Easting, Northing and Elevation.

	Easting	Northing	Elevation
Station No. 1			
Station No. 2			
Station No. 3			

B. Setup GPS fix (shore) station on station No 1.
C. Setup GPS mobile station on the survey vessel and establish radio data link between shore and mobile station.
D. Establish a healthy satelite reception and a differential global position.
E. Sail survey vessel near agreed station No. 2 and monitor output position.
F. Measure distance from satelite antenna to station No. 2.
G. 'Calculate position and check with station coordinates.

	System output coordinate	Actual distance	Observed distance
Easting [m]			
Northing [m]			

' For details on equipment accuracy refer to user manual.*

'Approval for calibration of satelite positioning sytstem and further use:

For Client/Consultant For Main Contractor For Gulf Cobla

TOTAL STATION

Client/Empolyer:

Consultant:

Main Contractor:

Project:

Date of Survey:

Type of Survey: *Predredge* *Intermediate* *Check* *Postdredge*

Type:	Accuracy:
1 LEICA TC 1800	**0.05 m**
2 SOKKIA SET 2C	**0.05 m**

Instructions:

A. Agree 3 established stations with Easting, Northing and Elevation.

	Easting	Northing	Elevation
Station No. 1			
Station No. 2			
Station No. 3			

B. Setup total station on station No. 1.
C. Measure distance from 1 to 2, 1 to 3 and check with calculated distance.
D. Set up base bearing 1 - 2.
E. Measure bearing 1 - 3 and check with calculated bearing.

		Actual calculations	Observed readings
Distance 1 - 2	[m]		
Distance 1 - 3	[m]		
Bearing 1 - 3	[degr.]		

** For details on equipment calibration refer to user manual or QMS.P.110*

Approval for calibration of total station and further use:

For Client/Consultant For Main Contractor For Gulf Cobla

ECHO SOUNDER

Client/Empolyer:

Consultant:

Main Contractor:

Project:

Date of Survey:

Type of Survey: *Predredge* *Intermediate* *Check* *Postdredge*

	Type:		Accuracy:	Frequency:
1	**Navisound**	**210**	**0.05 m**	**210 kHz**
2	**Navisound**	**215**	**0.05 m**	**210 kHz/ 33kW**
3	**Navisound**	**2000**	**0.05 m**	**210 kHz/ 33kW**
4	**Navisound**	**420**	**0.05 m**	**210 kHz/ 33kW**
5	**Knudsen**	**320M**	**0.05 m**	**210 kHz/ 33kW**

Instructions:

A. Installation of echo sounder, transducer and cable connections.
B. Setup software settings.
C. Barcheck plate will be lowered at below mentioned depths.
D. Echosounder readings are being monitored.
E. Settings adjusted to confirm the echosounder readings with the physical depths of the barcheck plate.

Calibrate barcheck lead [m]. Measurement starts from top of bar plate.

	Actual	Measured		Actual	Measured
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

No.	Depth barcheck plat [m]	Observed depth reading [m]	No.	Depth barched plat [m]	Observed depth reading [m]
1			7		
2			8		
3			9		
4			10		
5			11		
6			12		

** For details on equipment calibration refer to user manual or QMS.P.110*

Approval for calibration of total station and further use:

For Client/Consultant For Main Contractor For Gulf Cobla

TIDE READINGS

Client/Empolyer:

Consultant:

Main Contractor:

Project:

Date of Survey:

Type of Survey: *Predredge* *Intermediate* *Check* *Postdredge*

- Depth calibration by means of standard barcheck procedure with barcheck plate.
- Position calibration by means of satellite position output and coordinates provided by Consultant or as set up by Gulf Cobla.
- Tide readings taken on the spot are related to _____ Datum

Time	Tide	Time	Tide

For Client/Consultant For Main Contractor For Gulf Cobla

Attachment-5

PROJECT EXECUTION CHART

Gulf Cobla L.L.C

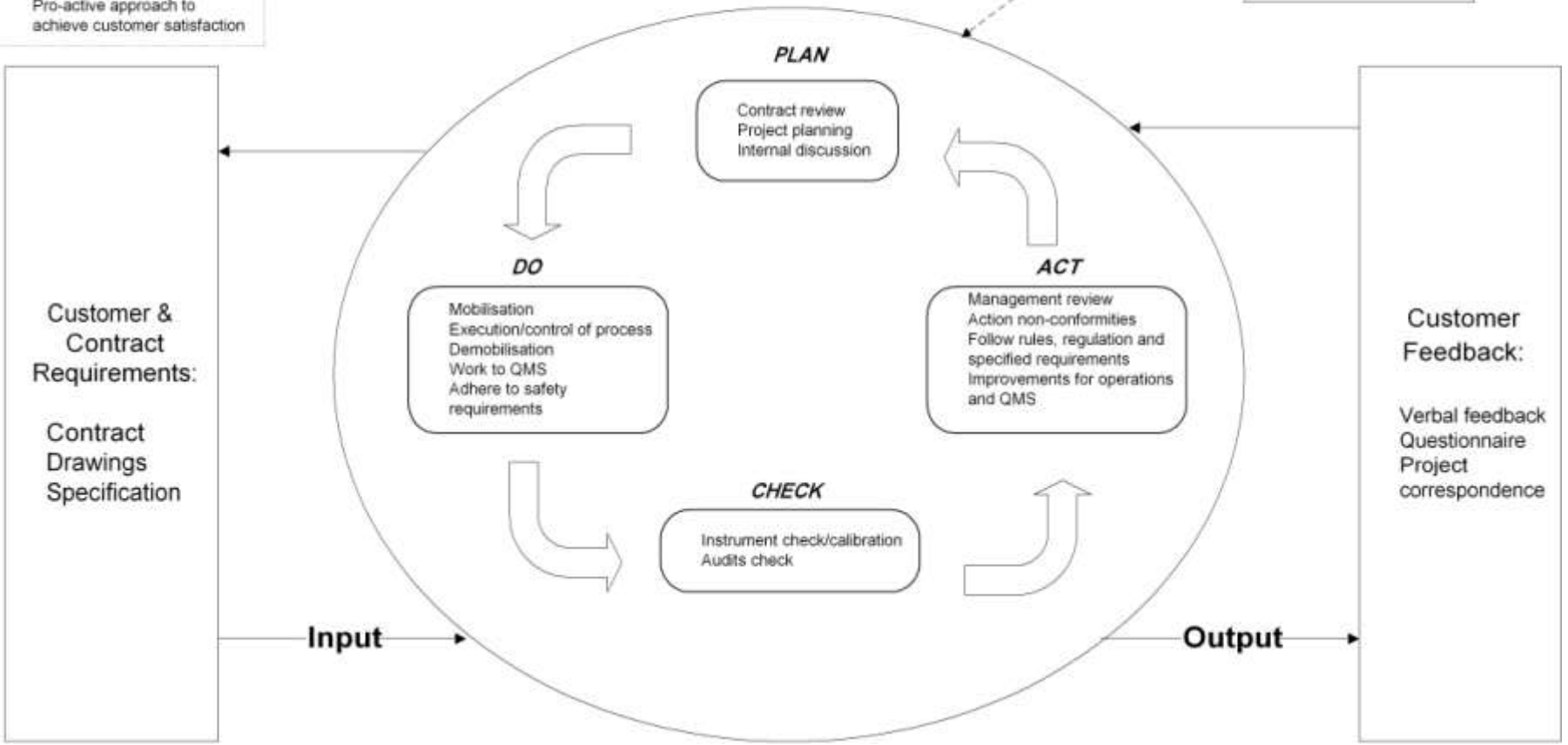
Survey Process

Objectives

Meet survey specification and requirements
Efficient planning and execution of works
Professional presentation of results
Control & maintain calibration status of instruments
Pro-active approach to achieve customer satisfaction

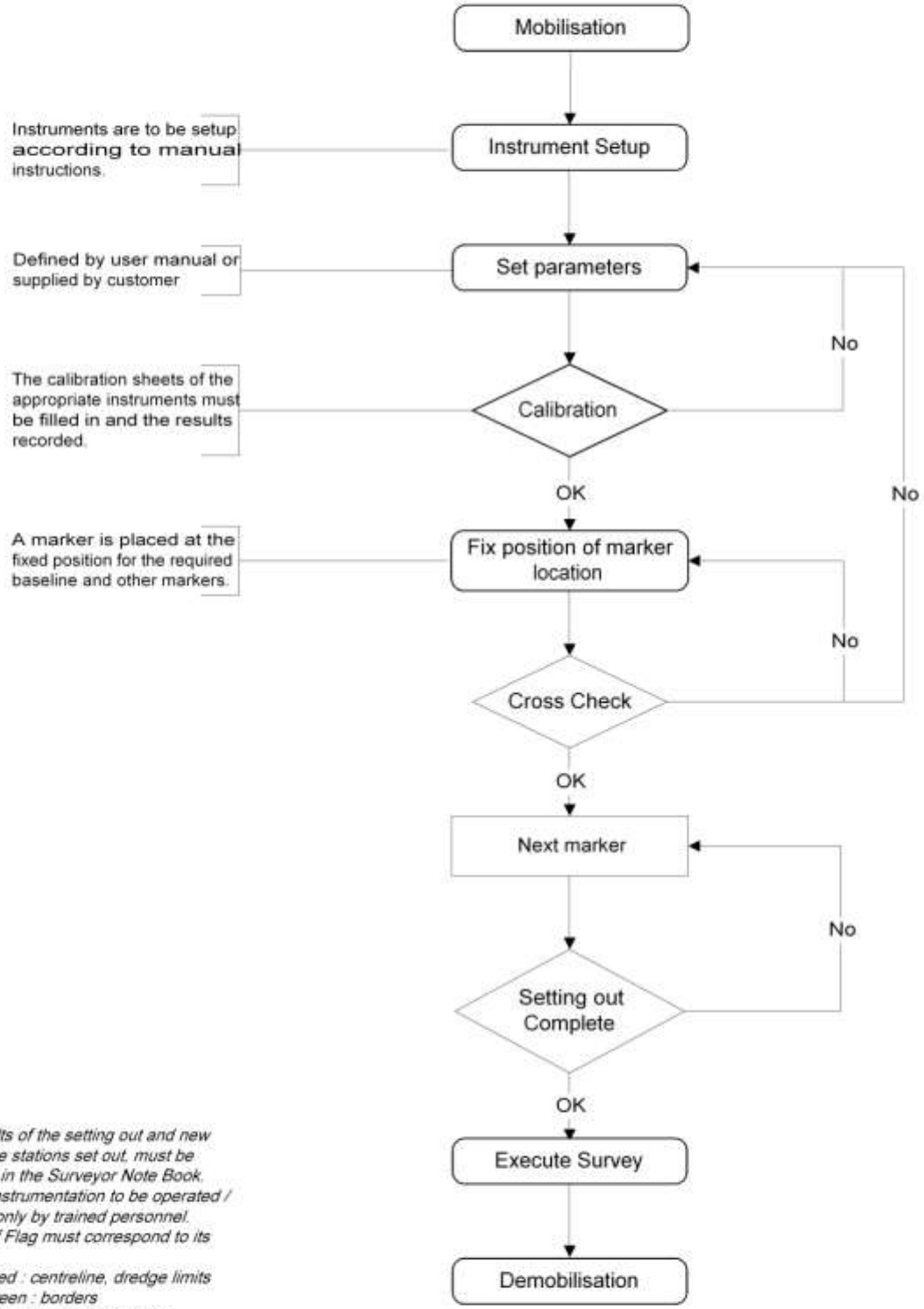
Support Activities

- Maintenance
- Purchasing
- Storage
- Training



GULF COBLA LLC – SURVEY SERVICES

SURVEY SETTING OUT

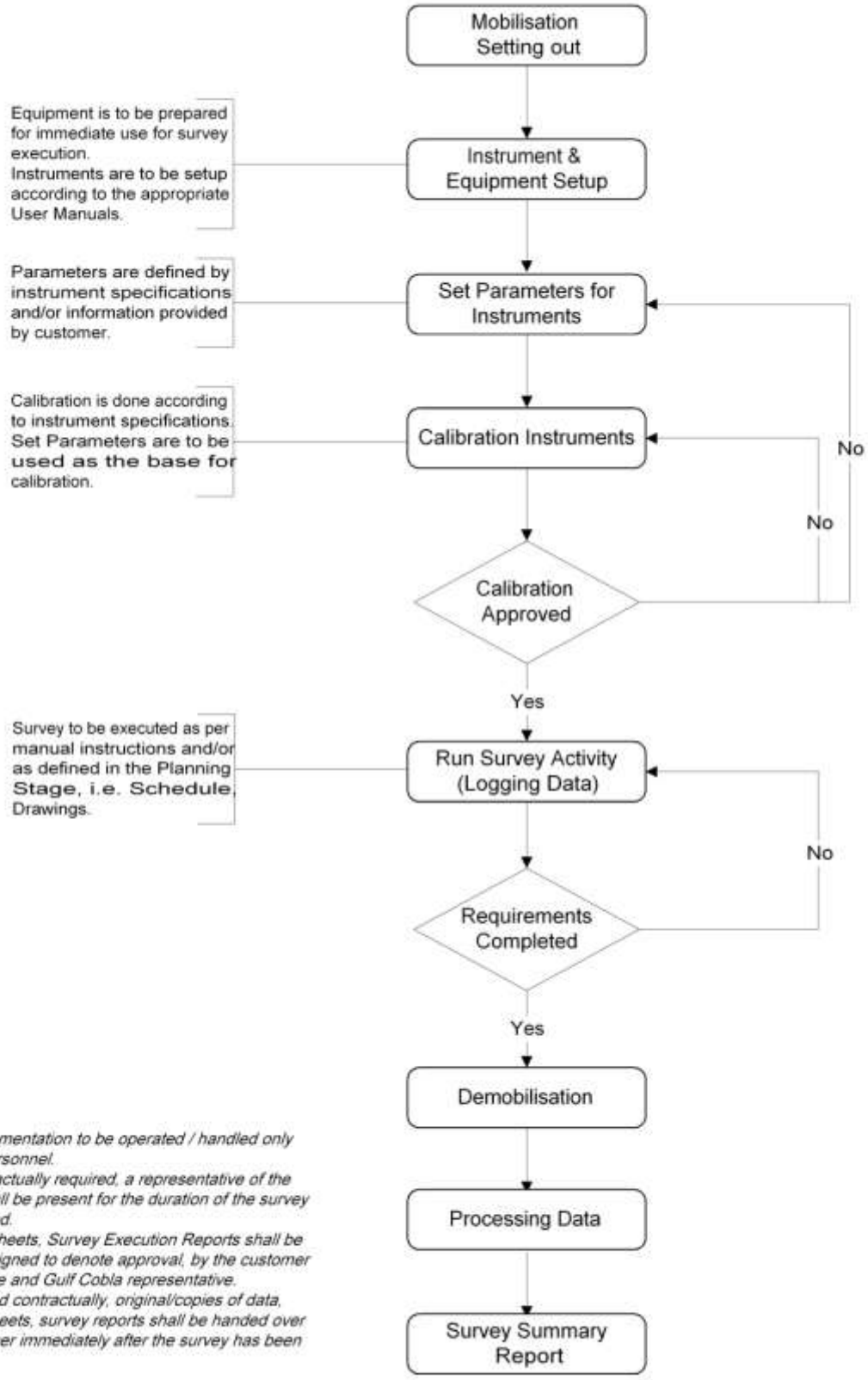


Note:

1- *The results of the setting out and new coordinate stations set out, must be recorded in the Surveyor Note Book.*
2- *Survey instrumentation to be operated / handled only by trained personnel.*
3- *Colour of Flag must correspond to its purpose*

Red : centreline, dredge limits
Green : borders
Yellow : reclamation limits
Red/Yellow : Sextant Markers

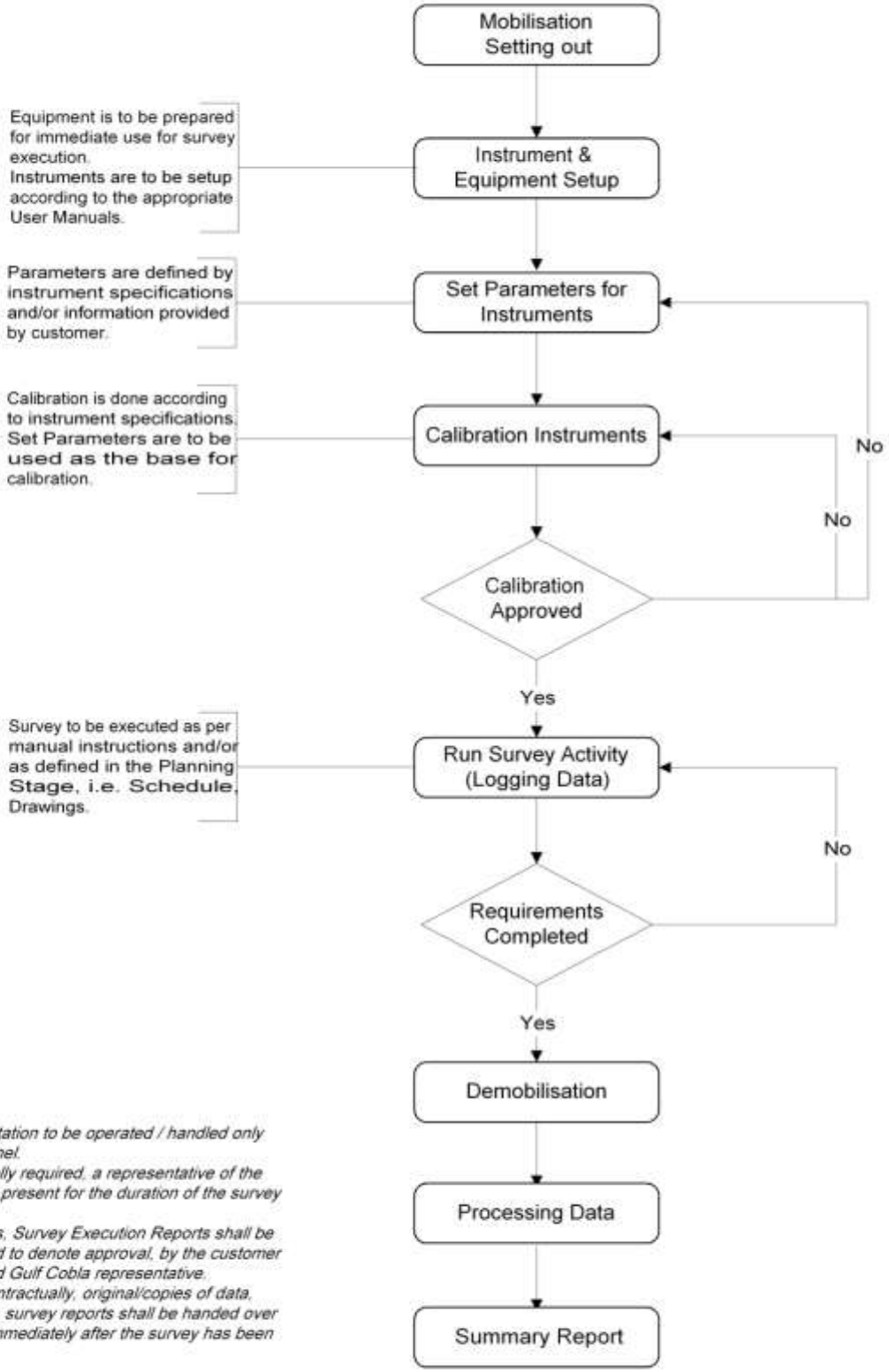
HYDROGRAPHIC SURVEY EXECUTION



Not:

1- *Survey instrumentation to be operated / handled only by trained personnel.*
2- *Where contractually required, a representative of the customer shall be present for the duration of the survey to be executed.*
3- *Calibration Sheets, Survey Execution Reports shall be agreed and signed to denote approval, by the customer representative and Gulf Cobla representative.*
4- *Where agreed contractually, original/copies of data, calibration sheets, survey reports shall be handed over to the customer immediately after the survey has been executed.*

LAND SURVEY EXECUTION



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Attachment-6

LIST OF RECENT WORKS

GULF COBLA LLC – SURVEY SERVICES

GULF COBLA (L.L.C.)			Survey			List of Projects Executed
HS= Hydrographic Survey **TS= Topographic Survey**						
GC Name	*Location*	*Country*	*Client*	*Type*	*Consulting Engineers*	*Date*
Vopak Fujairah Terminal	Fujairah	U.A.E	Vopak Horizon Fujairah	HS	N/A	Jun-07
Design survey Djibouti	Djibouty City	Djibouti	Al Boom Holdings	HS	Style Consultants	Jun-07
Al Raha Beach survey	Abu Dhabi	U.A.E.	Soletanche Bachy & NSCC	HS/TS	N/A	Mar-07
Survey at Qaffay Island	Abu Dhabi	U.A.E.	Dutco Balfour Beatty LLC	HS	N/A	Jan-07
Dubai Festival City Project	Dubai	U.A.E.	Dutco Balfour Beatty LLC	HS	N/A	Dec-06
Dubai Marina at Mina Seyahi	Dubai	U.A.E.	Dutco Balfour Beatty LLC	HS	N/A	Nov-06
Dubai Drydocks Safina Project	Dubai	U.A.E.	N.S.C.C.	HS	N/A	Sep-06
Palm Jumirah Monorail	Jumeirah	U.A.E.	Palm Jumeirah Monorail	HS	N/A	Aug-06
Sohar Port	Sohar Port	Oman	Van Oord FZE	HS	N/A	Jul-06
Dubai Drydock Safina Project	Dubai	U.A.E.	N.S.C.C.	HS	N/A	Jun-06
Al Ygalat Fishing Harbour	Fujairah	U.A.E.	Port of Fujairah	HS	N/A	Feb-06
Dry Dock Safina Project	Dubai	U.A.E	NSCC	HS/TS	N/A	Nov, Dec - 05
Vopak Fujairah Terminal	Fujairah	U.A.E	Vopak Horizon Fujairah	HS	N/A	Oct- 05
Fujairah Port & Naval Base	Fujairah	U.A.E	Fujairah Port Autorities	HS	N/A	Oct- 05
Palm jumairah Island Survey	Dubai	U.A.E	Taisee	HS	Parson	Aug- 04
Khasab Valuation Survey	Khasab port	Oman	Dharti dredging & contracting Ltd.	HS	W.S.Atkins International & Co.	May, Apr, Mar / 04
Survey Service DUBAL	Dubal, Dubai	U.A.E.	Dubai Aluminum Co. Ltd	HS	Halcrow International Partnership	Apr- 04
MQE Survey Rental	MIS Project, Sharjah	U.A.E.	N.S.C.C.	Survey services	Halcrow International Partnership	Dec- 03
Setting Out Survey	Mussafah, Abu Dhabi	U.A.E.	Arab Contractors	Setting out survey	Halcrow International Partnership	Aug- 03
Survey Mussafah Bridge	Abu Dhabi	U.A.E.	Arab Contractors	HS	Halcrow International Partnership	Aug- 03
Musnouah Island	Abu Dhabi	U.A.E.	Hyder Consulting Limited	HS	Hyder Consulting Limited	May- 03
Mina Manama Survey	Manama	Bahrain	Al Matrook Enterprises	HS	N/A	May- 03
Bin Suroor Survey Mussaffah	Abu Dhabi	U.A.E.	Bin Suroor International Contracting	HS & TS	Abu Dhabi Municipality	Mar- 03
Survey at Sharm	Fujairah	U.A.E.	Port of Fujairah	HS & TS	N/A	Feb- 03
Survey at Al Yasat Aali Island	Abu Dhabi - Sila	U.A.E.	Dubai Municipality	HS	Halcrow International Partnership	Jan- 03
Sharm Survey	Fujairah	U.A.E.	Port of Fujairah	HS & TS	N/A	Jan- 03
Survey in Dubai Marina	Dubai	U.A.E.	Dutco Construction Company L.L.C	HS	Hyder Consulting Limited	Dec- 02

Survey Al Mamzar	Dubai	U.A.E.	Dubai Municipality	HS & TS	Maunsel Consultancy	Dec- 02
Al Shahama Palace Survey	Abu Dhabi	U.A.E.	Al Shahama Palace	HS	N/A	Oct- 02
Survey at NMDC Basin	Abu Dhabi	U.A.E.	China Harbour Engineering Co. LLC	HS	Frederic R. Harris, Inc.	Sep- 02
Survey Shuweihat Power Station	Abu Dhabi	U.A.E.	Six Construct Co. Ltd	HS	N/A	Jul-02
Survey at Port Khalid	Sharjah	U.A..E	Dutco Balfour Beatty	HS	Halcrow International Partnership	Apr- 02
Hydrographic Survey for rehabilitation of Port of Massawa	Massawa	Eritria	United Nations	HS	Keangnam Enterprises Ltd	Feb- 02 May- 02
Survey at Al Yasat Island	Abu Dhabi	U.A.E	Dutco Balfour Beatty	HS & TS	Halcrow International Partnership	May- 02
Bathymetric Survey Fujairah	Port of' Fujairah	U.A.E	Port of Fujairah	HS & TS	N/A	Feb- 02
Bathymetric Survey Umm Al Nar	Abu Dhabi - Umm Al Nar	U.A.E	SIX Construct Ltd.	HS	Render Palmer & Tritton	Jan- 02
Survey NMDC Facilities	Abu Dhabi - Mussaffah	U.A.E	China Harbour Engineering Co. LLC	HS	Frederic R. Harris, Inc.	May- 01
Invest. Survey Khalid Lagoon	Sharjah	U.A.E	Halcrow International Partnership	HS	Halcrow International Partnership	Jan- 01
Survey at U.A.N Refinary	Abu Dhabi - Umm Al Nar	U.A.E	Abnormal Load Engineering	HS	N/A	Jan- 01
Offshore Fish Hides Survey	Abu Dhabi - Qarin Al Aysh	U.A.E	Public Works Department	HS	Halcrow International Partnership	Dec- 00
Survey at Al Seef and Al Shamal	Dubai Creek	U.A.E	Overseas AST CO. LLC.	HS & TS	Maunsell	Sep- 00
Hydrographic Survey at Taweelah	Abu Dhabi - Taweelah	U.A.E	Square General LTD	HS	N/A	Jun- 00
Offshore Fish Hides Survey	Abu Dhabi - Qarin Al Aysh	U.A.E	Public Works Department	HS	Halcrow International Partnership	Jun- 00
Survey at Al Mamzar	Dubai - Al Mamzar Corniche	U.A.E	The Arab Contractors	HS	Maunsell	Apr- 00
FAL Shipping	Sharjah Port	U.A.E	FAL SHIPPING CO. LTD	HS	N/A	Nov- 99
Khussifa Channel Dredging	Abu Dhabi - Khussifa	U.A.E	HAM Dredging Company	HS & TS	Halcrow International Partnership	Sep- 99
Survey at East Coat	Fujairah - Dibba	U.A.E	Dutco Construction Co. LLC	HS	N/A	Sep- 99