00751

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510

00701

REPLY TO
ATTENTION OF:

NAOEN-WW

30 January 1981

Mr. Howard Zar
U. S. Environmental Protection Agency
Enforcement Division
230 S. Dearborn Avenue
Chicago, Illinois 60604

Dear Mr. Zar:

As a follow-up to your recent telephone conversation with Mr. Richard Klein, of my staff, I have inclosed a copy of the feasibility report (Inclosure 1) for our proposed Maintenance Dredging Demonstration Project in the Lower James River, Virginia. The purposes of this project are twofold; to accomplish necessary maintenance of the Federal navigation channel, and to demonstrate a proposed method of removing contaminated sediments at nearly in situ density and with nearly one-hundred percent containment. I hope the report contains information of use to you and others in your agency involved with the dredging of contaminated sediments.

As Mr. Klein mentioned to you, we are very interested in the dredging and PCB clean-up operation the Environmental Protection Agency is planning for Waukegan Harbor on Lake Michigan, which we learned about from an article in the New York Times (Inclosure 2). We would appreciate receiving from you any additional information or reports regarding the Waukegan Harbor Project which you could make available to us now or at a later date. To further this exchange of information, I will also send you any future reports resulting from our project in the James River.

Sincerely,

JACK G. STARR
Chief, Engineering Division

2 Incl
As stated

JAMES RIVER DEMONSTRATION PROJECT

INDEX

Incl 1

I. FOREWORD

FOREWORD

The hazard of highly persistent, toxic substances contaminating large land and water areas is a world wide problem. The problem of kepone contaminated silt in the James River is a "case in point." Studies indicate that there are 9,000 to 17,000 kilograms (20,000 to 38,000 lbs.) of kepone in the top one foot of silt in the James River.

The U.S. Army Corps of Engineers published in June, 1978, "The EPA Kepone Mitigation Feasibility Project Report, Appendix B." This Appendix addressed itself to the problem, amongst others, of removing kepone contaminated silt from the James River.

In June, 1979, Amalgamated Dredge Design, Inc., a Philadelphia based organization specializing in the design of all types of dredges, submitted an Unsolicited Proposal entitled "A Proposed Method for Removal of Contaminated Soils from Marine Estuaries and Waterways by an Adoption of Conventional Dredging Methods" to U.S. Army Corps of Engineers Norfolk Division.

A meeting was held at the offices of the Norfolk Division of the U.S. Army Corps of Engineers in August, 1979 to discuss the unsolicited proposal and to carry out an inspection of the James River, firstly by helicopter survey of the source of the contamination, i.e., Bailey Creek-Bailey Bay-Gravelly Run and a general overflight of the James River. A second inspection was carried out by survey vessel in the area of Jamestown Island-Dancing Swan Point Shoal.

One sample of bottom silt was obtained from Dancing Swan Point Shoal for visual examination. At a meeting held on board the survey vessel and continued the following day, it was agreed that a dredging test utilising a contractor's dredge would be carried out in the James River in the zone of maximum turbidity. This test, using standard equipment, would investigate various methods of dredging with the aim of minimising dredge induced turbidity and of achieving maximum containment of the contaminated silt at or as near in place density as possible.

Further correspondence after this meeting resulted in the production of the following scope of work for Phase One of the projected test programme.

SCOPE OF WORK
FOR
DEMONSTRATION PROJECT IN JAMES RIVER, VIRGINIA

Phase One

1. The Contractor shall prepare a draft Plan of Study outlining the necessary action for conducting a demonstration dredging project in the James River. The purpose of the demonstration project is to compare the efficiency, plant output, and environmental impacts of the typical hydraulic dredge with a cutterhead and a Dustpan dredge.

2. Input into the Plan of Study will be by Waterways Experiment Station in Vicksburg, Mississippi, and the Norfolk District. The Norfolk District will prepare a history of dredging in the James River, from the mouth to Jordan Point located at Hopewell, Virginia. This will include the areas dredged, amount of material removed, and location of disposal areas, along with the type of dredge

used. When discussing the type of dredge, the Norfolk District should provide a physical description including such items as the dredge size, elevation of lift, type of discharge unit used, pump, horsepower, horsepower of swinging winches, horsepower of cutter, size of drums, size of cables, draft, description of runners, etc. In addition, the Norfolk District will provide necessary hydrologic data such as flood discharges, velocity profiles, tidal ranges, and background sedimentation and turbidity information throughout preparation of the Plan of Study and during the demonstration project. The Norfolk District will negotiate with the State of Virginia concerning disposal areas. Also, the Norfolk District will obtain sediment samples and perform a complete soil analysis including the moisture content, liquid limit, plastic limit, and in-place density.

3. The Buffalo District will be contacted by Norfolk District regarding utilization of the density probe developed by Mr. Lee Hare. Hydrometer tests will be performed and a chemical analysis of the sediment samples obtained conducted. The Waterways Experiment Station will provide a list of tests that will be conducted during the demonstration project, along with a detailed list of information required concerning background conditions.

4. The Plan of Study will present a description of the Dustpan head and the Cutterhead, how each functions, and the differences between the two. A trip to the Lower Mississippi Valley Division will be made by the Contractor for an onsight inspection of the Dustpan head and discussions with appropriate personnel concerning the operation of the dredging equipment. Preliminary and Conceptual plans will be prepared for modifying a typical dredge to accomodate the Dustpan head, including such things as modification of winches, cables, motors, the dredge ladder, etc. Consideration will be given to using the

Dustpan head "as is" versus installing augers, water jets, or vibration units to ease dredging. Such costing as is obtained during the course of the above study will be provided.

5. The Contractor shall provide a list of the testing equipment necessary and describe how it will be installed on the modified dredging plant. The demonstration project will be performed within the turbidity maximum zone of the James River and dredging should be associated with maintenance of the existing Federal navigation project. A monitoring program will be developed, setting out basic requirements for the testing programme, listing physical and chemical analyses that must be performed during the actual dredging operation, and how much turbidity is being created at the dredging head and what instrumentation should be rented/acquired to perform the demonstration project.

6. The Contractor shall submit to the Norfolk District by 1 December 1979 a draft of the Plan of Study.

II. INTRODUCTION

Introduction

The proposed dredging test to be carried out in the James River will take place in the zone of maximum turbidity in 1980.

The zone of maximum turbidity in an estuary is a feature of the natural dynamics of the estuary. This zone is the area of mixing of salt and fresh water and its position is therefore determined by river velocity variation due to rainfall and also by the cyclic variation of the tidal rise and fall with the periodic variation of spring and neap tides.

The fine sediments that are captured by the zone of maximum turbidity can exist in three states:

(a) Mobile Suspensions, which develop naturally in high turbidity estuaries and move regularly in response to the tidal circulation. These suspensions evolve into static suspensions during periods of low tidal circulation. In low turbidity estuaries, these suspensions are intermittently generated by storms, deep draft traffic and dredging and evolve into static suspensions.

(b) Static Suspensions can usually be detected by echo sounders and are usually referred to as "fluid mud" or "fluff." These suspensions eventually settle to form settled silt.

(c) Settled Silt is a skeletal soil framework formed by the consolidation of static suspensions.

The following proposals assume the presence of mobile suspensions and sampling and instrumentation will be specified accordingly.

In the absence of information in Phase One on the characteristics of the contractor's cutter dredge, the preliminary study will be based on the characteristics of a known dredge and modification to the study will be made when the dredge to be used in the proposed test has been selected.

The "known" dredge characteristics have been selected to agree as closely as possible with the dredges available in the Norfolk area, i.e., a 20 inch discharge pipeline dredge.

This "known" dredge has the following characteristics:

<u>Hull</u>	
Length	40.00 meters
Breadth	12.50 meters
Depth	2.50 meters
Cutter	400 H.P.
Swing Winch	80 H.P.
Swing Winch Pull - 1st Layer	23.4 tonnes
Rope Speed - 1st Layer	12 m/min.
Barrel Dia/Ctrs Rope- 1st Layer	0.737 m.
Max. Barrel Torque	8620 kg.m.
Barrel R.P.M.	5.17
Rope Size	32mm x 250 meters
Suction Frame Hoist Winch	- Same as swing winch
Suction Frame Hoist Rope	32mm x 105 meters
Dredging Depth	15 meters

III. CUTTER SUCTION/DUSTPAN DREDGING

CUTTER SUCTION DREDGING/DUSTPAN DREDGING

(1) Cutter Suction Dredging

The cutter suction or radial cutting dredge would appear to be the ideal dredge for removal of contaminated silt. For this application it possesses the following advantages:

(a) Positive anchorage
(b) Accurate and positive movement over dredging area
(c) Positive means of excavating cohesive soil, i.e., a rotary cutter
(d) Means of discharging material over long distances by pipeline
(e) Accurate control of dredging depth
(f) Accurate control of output, i.e., by variation of cutter and swing winch speeds

When dredging contaminated silt the cutter suction dredge has the following disadvantages:

(g) Rotary cutter resuspends settled silts and creates unacceptable levels of turbidity. The cutter also bulks the material, thus increasing the water content of the silt, reducing output of solids and creating water disposal problems on the deposit grounds.
In contaminated silts this action of resuspension disperses contamination rather than contains it.
(h) The geometry of the radial cutting action is such that the radial

width of cut varies proportionately with the angularity of the dredge about the centreline of the cut. Figure 1 shows that utilising a cutter head of 4 units of length, the radial width of cut would be 4 units only on the first swing; thereafter, the radial width of cut would vary from 4 units on the centreline of the cut to 2.828 units at an angle of 45^{o} to the centreline of the cut.

This variation in width of cut would result in the ingress of water through the area not blanked off by material, i.e., a radial width varying from zero on the centreline of the cut to 1.172 units at an angle of 45^{o} to the centreline of the cut.

This smooth change of radial width of cut from 4 units to 2.828 units would only be true if a modern cutter suction dredge with a travelling digging spud was utilised. If a cutter suction dredge having two fixed spuds was utilised, then the resultant cut would show considerable change and irregularity over the dredging area contained within the "step ahead" angle.

The difficulty posed in (g) above could be overcome by fitting a shoe type head instead of the cutter on the cutter suction head. This head would work somewhat like the trailing head on a hopper dredge and would be designed to dredge in both directions. This head could dredge by suction alone, be fitted internally with augers or cutters or could utilise vibration to fluidise the settled silt.

The difficulty posed by (h) above could be overcome by arranging for the width of the "shoe" type head to vary with the angularity of the dredge about the centreline of the cut. This variation would require a movable skirt on the side of the head nearest the dredge, this skirt being controlled by a signal from a gyroscopic compass mounted on the dredge. The design of a variable width head as described above is within the present state of the art and the only problems to be anticipated would be the initial proving and adjusting period plus the additional maintenance.

(2) Dustpan Dredging

The dustpan dredge operates on the "straight line" method of dredging as opposed to the radial method of the cutter suction dredge.

Existing dustpan dredges are designed for high outputs in granular materials. These high outputs are obtained by using a very wide head forced against a bank of granular material. By injecting pressure water through a multiplicity of nozzles at the "toe" of the slope, a continually collapsing face is created. The effect of gravity and bulking, created by increased pore pressure, creates a fluidised dredging zone at the entrance to the head enabling very high outputs to be obtained. A nominal rate of advance for this type of head would be 300 feet per hour with approximately 20 per cent solids being dredged.

When dredging contaminated silt, the dustpan dredge would have the following advantages:

(a) Straight line method of advance, therefore constant width of cut.

(b) Constant dredging speed at constant winch speed.

(c) Accurate control of dredging depth.

When dredging contaminated silt in tidal estuaries, the dustpan dredge would have the following disadvantages:

(d) Accurate dredging more difficult in soft materials.

(e) Necessity for stern anchor during flood tide.

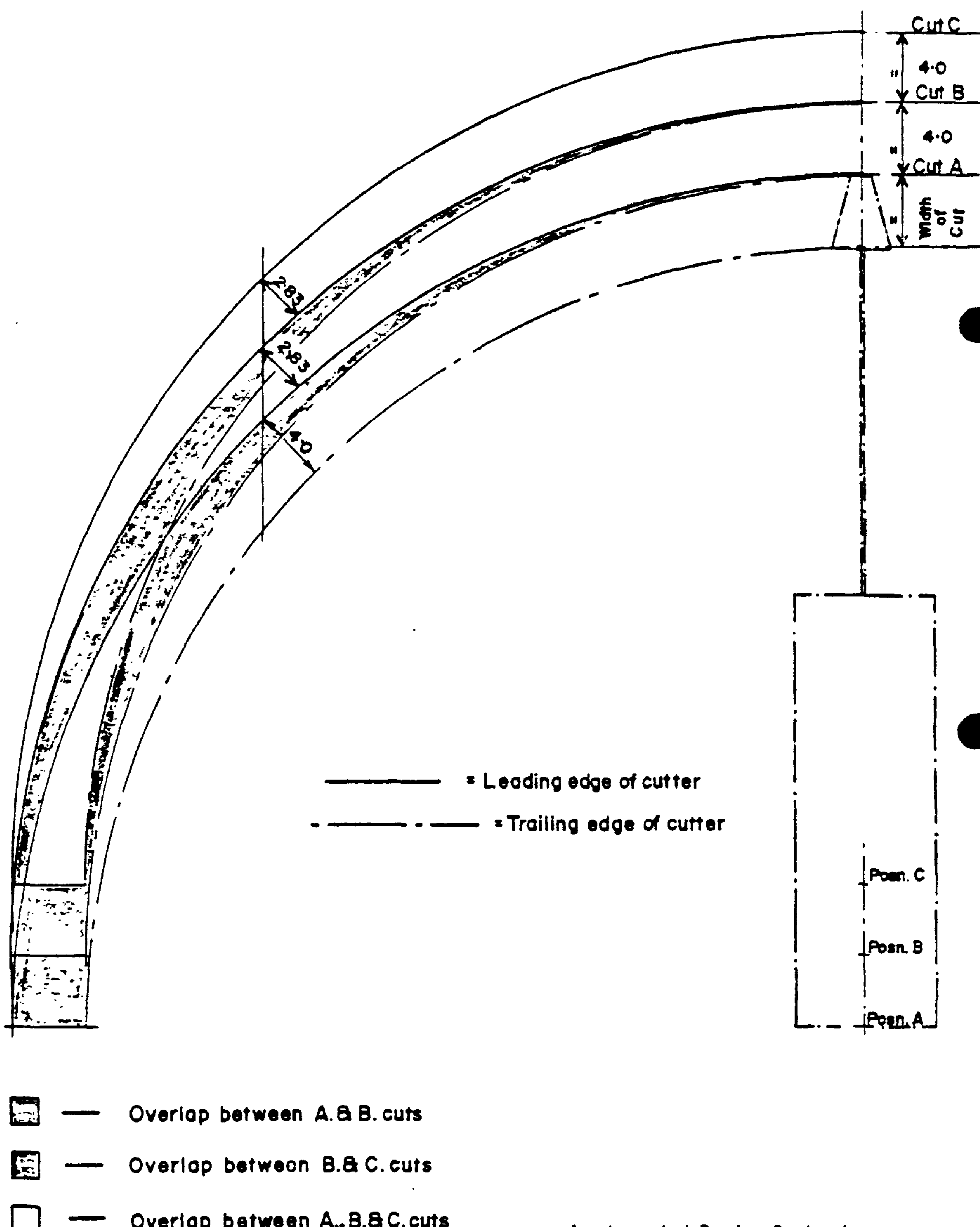
(f) Existing excavating method is high velocity water jets, which is most certainly unacceptable when dredging contaminated silt which already has a water content of approximately 200%.

(g) Possibility of choking in compacted cohesive material due to tapered inlet, parallel top and bottom plates of inlet would almost certainly accentuate this tendency.

(h) Velocity pattern in head when dredging homogeneous suspensions under laminar flow will probably induce "plug flow" conditions effectively reducing width of head for dredging and probably causing "spills" of contaminated material over the outer ends of the dustpan head.

Fig. 1

Radial Dredging of Contaminated Silts



Amalgamated Dredge Design Inc.

Manoevring Wires

As a dustpan dredge operates on headwires, it is important that the maximum length of wire rope can be accomodated on the winch barrels.

The dredging test will be carried out using a 20" cutter suction dredge. The "known" cutter suction dredge has a line pull of 23 tons and a one inch diameter rope 1000 feet long.

The above line pull is necessary to take account of the cutter load and the angularity of the anchor to the dredge centreline when cutting at the extreme angular limits of cut.

However, the headwire of a dustpan dredge is designed to resist the pressures on the hull for the river current, the wind resistance and the pull required to force the very wide dustpan dredge into the material. Of these three loads the highest is that required to force the dustpan head into the material, under normal circumstances when dredging sand.

The resistance graphs give the theoretical loads imposed on the dredge hull, and thus the headwires, by a series of wind speeds and river and tide velocities.

Assuming a river current of 3 knots and a wind speed of 19 knots, then the combined load would be 2.2 tons.

The load to force the dustpan head through the deposited silt is conjectuoral until actual tests are carried out. It is felt that the depression across the dustpan head will be sufficient to take care of the friction losses at the head moving through the deposited silt.

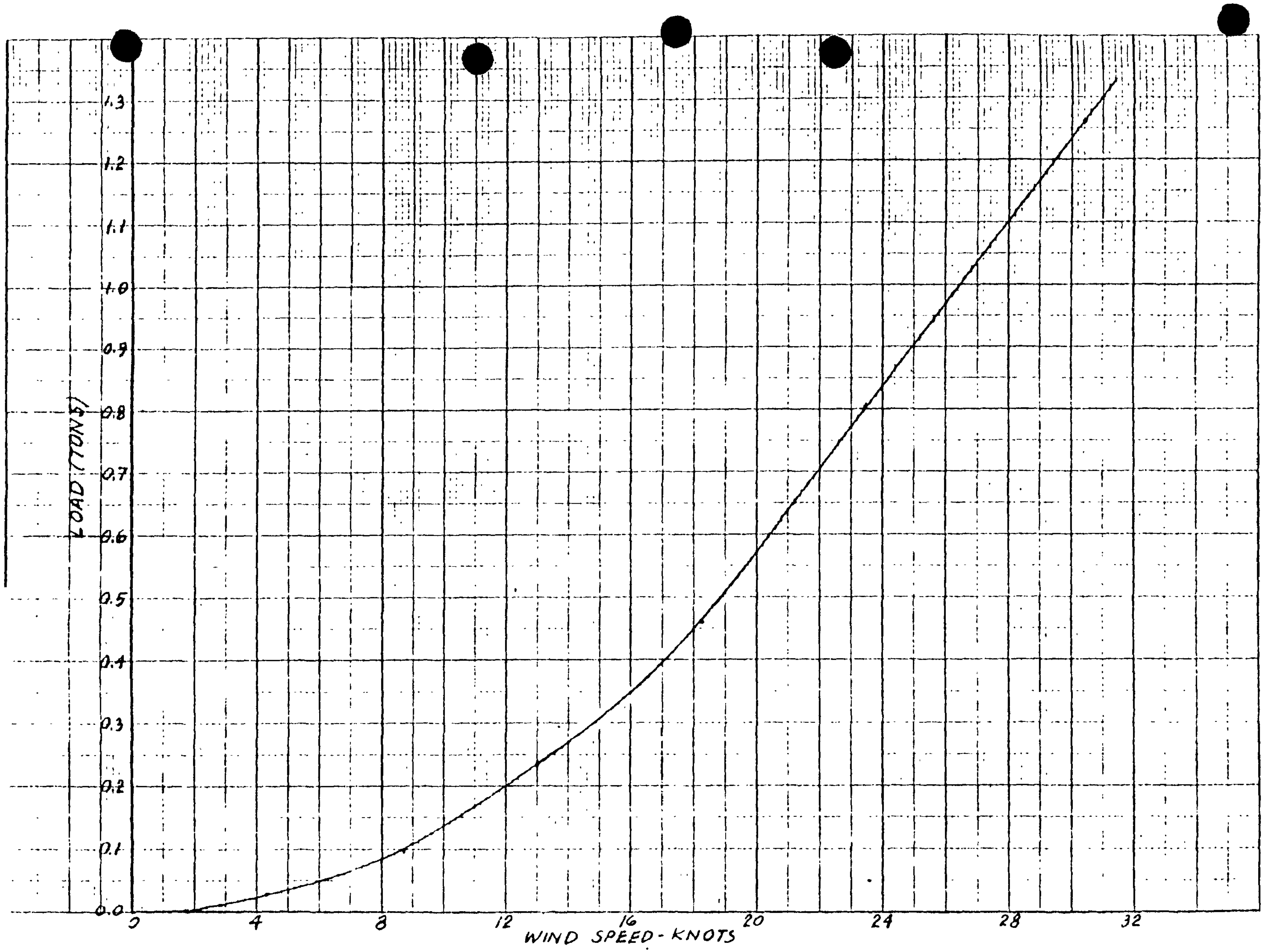
Assuming the head must be pulled through the deposited silt, of the same consistency of the sample obtained at Dancing Swan Point Shoal, then the added load should be no more than 0.5 tons. The total operating load at 3 knot water velocity, 19 knot wind velocity, plus the 0.5 tons assumed above should then be 2.7 tons.

Assuming that 1/2 inch ropes were used as head wires and the strand material was 110/120 tons per square inch, with a 6/37 construction, then the total breaking strength of two headwires would be 15.66 tons. Using the normal total load calculated above, then two 1/2 inch wires would have a safety factor of 5.67 and one 1/2 inch wire would have a safety factor of 2.83.

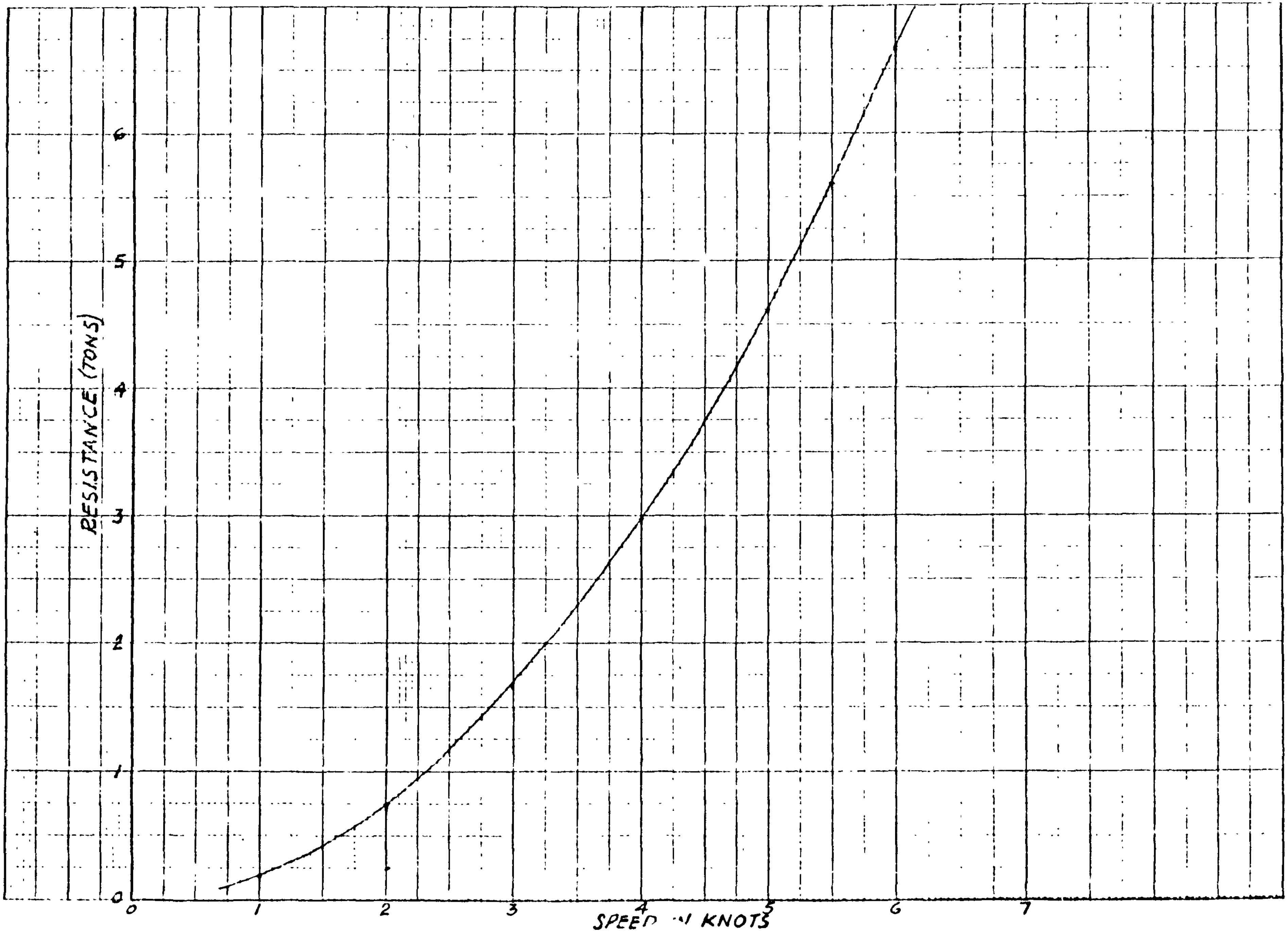
These factors should be adequate for normal dredging. In extreme conditions or during adjustments or repairs, the dustpan head can be used as a safety anchor.

If 1/2 inch wires can be used, then the above barrel capacity could be increased to 4000 feet, thus avoiding the necessity of using special winches.

Obviously, all of the foregoing applies to the known dredge and the final figures will not be available until the dredge to be used in the test has been decided and surveyed to establish wind and water resistance co-efficients.



LOAD (TONS)
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
28
32
WIND SPEED - KNOTS


RESISTANCE (TONS)
0
1
2
3
4
5
6
0
1
2
3
4
5
6
7
SPEED KNOTS

IV. FLOW CONTROL

Flow Control

When dredging relatively thin layers of fine sediments, it is important that the velocity of the material flow to the dredging head is maintained at a level which prevents entrainment of added water over and above that already contained in the material at in place density.

The flow of material is a function of the suction pipe velocity which is a function of the pump speed and pipeline resistance. In pipeline dredges, the pump speed and impeller diameter are designed to absorb the power of the pump drive at maximum discharge pipeline length. At this length the pipeline velocity will be at the practical minimum for conveying material. As the pipeline is shortened, the velocity increases until the suction losses due to friction are unacceptably high and then the speed of the pump is reduced to maintain an acceptable level of velocity in the system.

When a reduction of 30% of maximum pump speed is reached, it is common practice to change to a smaller impeller and increase the pump drive to maximum speed again to have maximum horsepower once again available and to avoid overheating if the pump drive is a turbo-charged diesel engine.

However, when very short pipelines must be used, because it is impractical to reduce the impeller diameter below a diameter twice that of the suction inlet, it is usual in pipeline dredges to fit a nozzle at the end of the discharge pipe. This is especially the case when a reclamation dredge must discharge to two or more branch lines with large length variation.

In the proposed dredging, a contractor's pipeline dredge will be used and, as the discharge will be close to the stern of the dredge, it will be necessary to fit a nozzle or an orifice to the pipeline to enable the suction velocity to be controlled within fine limits.

If the material to be dredged was abrasive, the only solution would be a renewable nozzle at the terminal end of the pipeline. However, high concentrations of fine silts in laminar flow due not tend to be highly abrasive so it is suggested that an orifice is fitted in the discharge line with a mercury manometer across the orifice.

By testing the dredge pump in water against the orifice, a set of head/capacity curves for the dredge pump in the "as is" condition will be obtained. The orifice results can be cross-checked by measuring the head loss over a measured length of the discharge pipe and these results used later to correlate head loss against mixture density in the system.

These tests, when correlated with engine power output, will enable the effect of mixture density on pump efficiency to be obtained. These figures are obviously very important if it is intended to pump the material ashore at a later date.

Homogeneous Mixtures: Non-Newtonian Liquids

When pumping homogeneous mixtures of fine silts and clays, the majority of these suspensions exhibit non-Newtonian properties, i.e., their viscosity is not constant but varies with the rate at which they are sheared. In dredging the most common flow property encountered is the "Bingham plastic" flow.

A Bingham plastic can be regarded as a mixture requiring a minimum shear stress to begin movement after which the shear stress is a linear function of rate of shear, the slope of which is defined as "plastic viscosity."

The important feature of the "plastic" mixtures is that, unlike normal dredged mixtures, laminar flow conditions can exist up to the normal operating velocities of pipeline dredges.

Figure 1 illustrates the distribution of shear stress and velocity for the laminar flow of Newtonian and non-Newtonian liquids.

For a Newtonian liquid where $\tau = -\mu \, dV/dy$, integration yields for circular pipe $PD/4L = 8\mu V/D$, i.e., the Poiseville equation. P = pressure drop in length L, D = pipe diameter, V = mean velocity, μ = viscosity where $PD/4L$ is the shear stress at the wall, and $8V/D$ is the corresponding rate of shear.

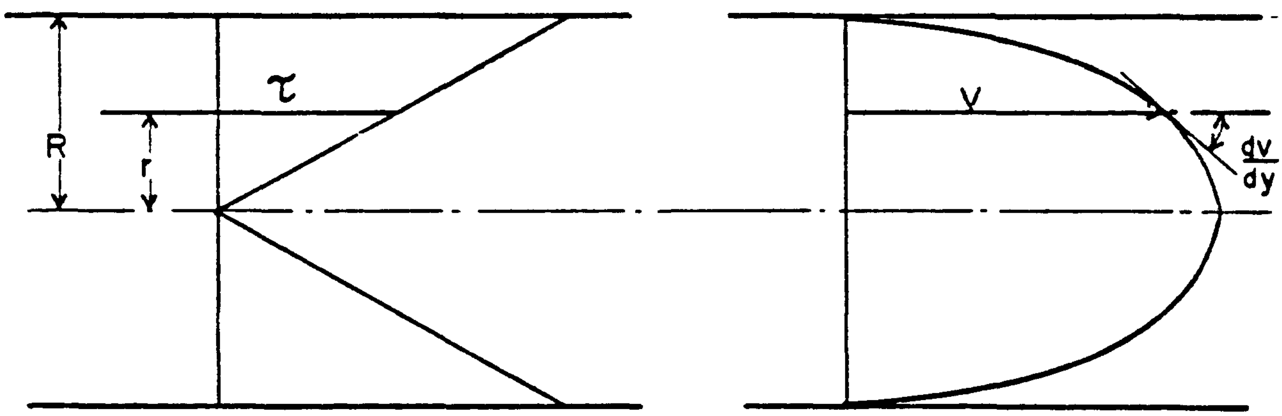
The shear stress distribution for the plastic material remains the same, a maximum at the wall, and zero at the centre. Assuming the maximum stress exceeds the yield stress, then a velocity gradient will exist near the pipe wall. At the smaller radius, the shear stress will have fallen below the yield stress and thus the velocity gradient will become zero. As shown in Figure 1, this results in the persistance of plug flow in the central region of the pipe, the relative diameter of the plug being a function of the excess of the maximum shear stress over the yield stress.

The attached photocopy of Photograph No. 5 taken of the discharge from the pipeline of the Japanese dredge "Taian Maru" illustrates the laminar flow of the silt/clay being dredged. The Photocopy of Photograph No. 6 demonstrated, as the flow does not fill the pipe bore at the atmospheric point, that plug flow, to some extent, must exist in the pipeline.

Fig.1

Laminar Flow Characteristics

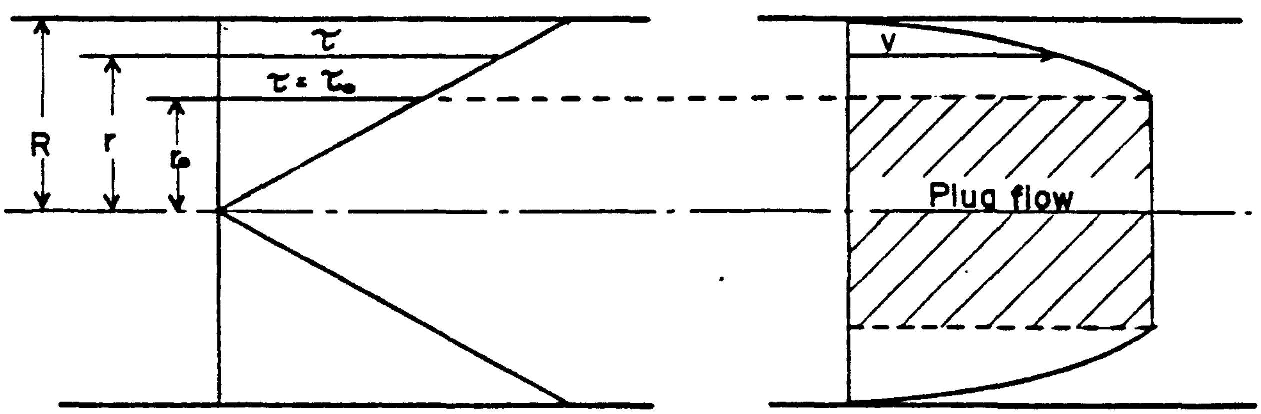
a) Newtonian



Stress distribution

Velocity distribution

b) Non-Newtonian



Stress distribution

Velocity distribution

Amalgamated Dredge Design Inc.

Photo 5 Photos (a) and (b) were taken at Iyo Mishima.

(a) Sludge flowing out of the discharge pipe (as seen from above)

(b) Sludge flowing into a sedimentation pool.

(2) Dredging of clayey silt (See Table 5 and Photo 6.)

TABLE 5

Item \ Samples of sludge		Sludge on seabed	Dredged sludge
Work period			Nov '74
Specific gravity of particles		2.78	2.76
Unit weight (g/cm^3)		1.23 1.24	1.20 ~ 1.21
Water content (%)		145 ~ 150	180 ~ 190
Void ratio		4.258	5.46
Composition (%)	Gravel	0	0
	Sand	2	2
	Silt	62	64
	Clay	36	34
	Classification	Clayey silt	
Sludge [illegible]		300	
[illegible] apparent Vol. ( )		96	
[illegible]		300	

Photo 6 (At Hakata)

V. INLET CONDITIONS

Inlet Conditions

When dredging silts at in place densities, the optimum inlet conditions are similar to a clear water inlet with a shallow submergence, i.e.,

(a) The flow to the dredging head must be as uniform as possible. The velocity of material to the head and the velocity of the head through the material must be such that added water is not drawn into the head by too low a velocity through the material or that material is not spilled over the head by too high a velocity through the material.

(b) The submergence of the head in the material must be such that the material will flow to the head under the influence of the hydrostatic head difference over the inlet. If this hydrostatic difference, controlled by the dredge pump speed, is too high for the submergence as set, then vortexes will form along the leading edge of the dredge head. These introduce water into the head without entraining solids and thus reduce dramatically the density of the mixture being dredged.

Figure 1 illustrates typical water velocities in the dustpan head, of the ACOE Dredge Jadwin, established using a small scale model at the ACOE Waterways Experimental Station.

The effect of side wall friction is evident in these tests and this effect will also be present when dredging. Due to the higher viscosity of the dredged material and the probability of laminar flow, the possibility of plug flow along the centre portion of each part of the double head is almost certain.

This flow pattern could be modified by fitting splitters inside the head and these might need to be fitted after the preliminary dredging tests.

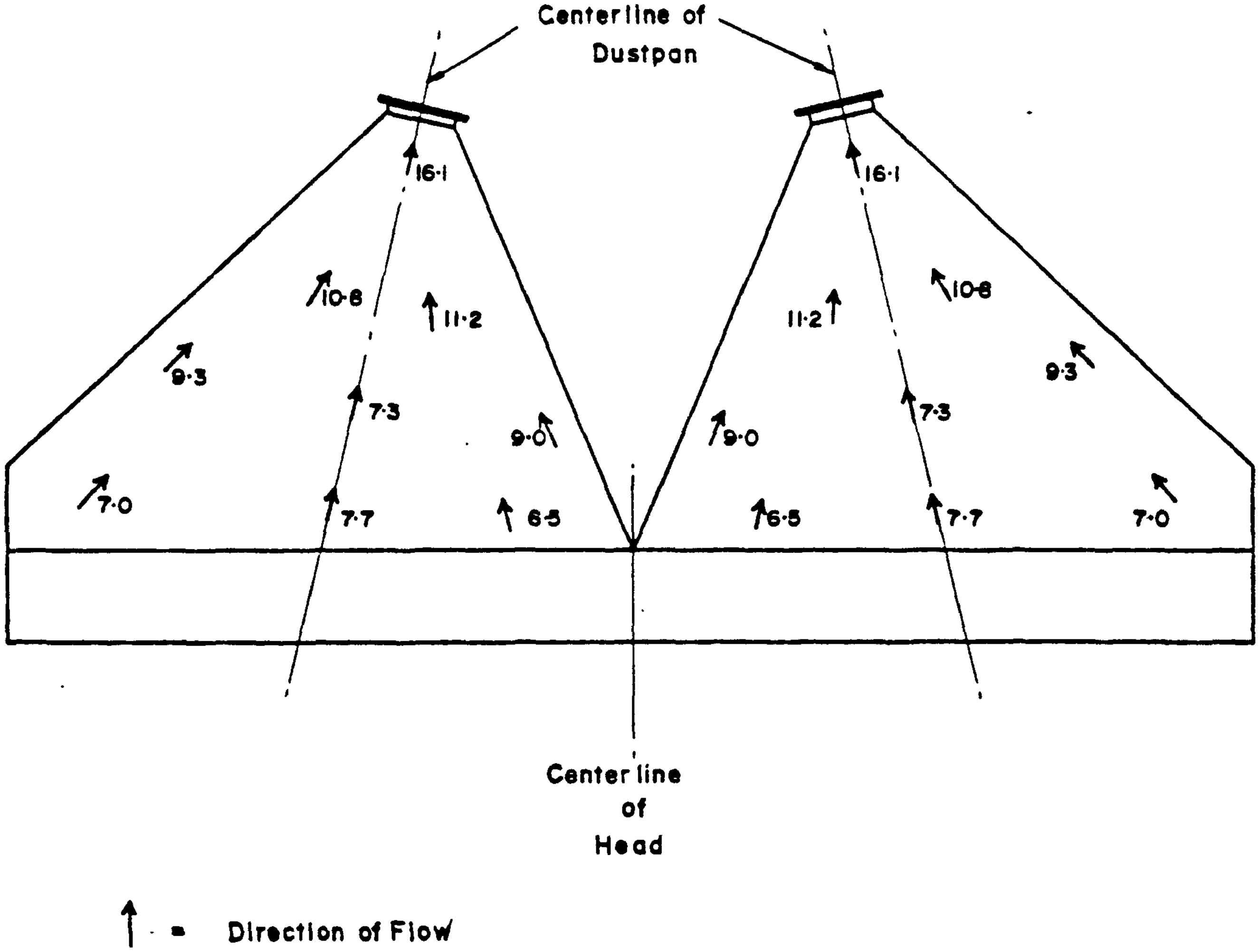
In order to minimise the production of vortexes at the entrance to the dustpan head, an area between the double heads must be plated over and a "roll over" bar fitted across the full width of both heads.

This "roll over" bar is a shaped plate designed to maintain the necessary head of material over the top edge of the mouthpiece and also to prevent overspill of material over the head by rolling the material forward on top of the existing deposit.

The shape of this plate must be such that added turbidity is kept to a minimum and overspill is prevented. This plate is indicated in Figure 2.

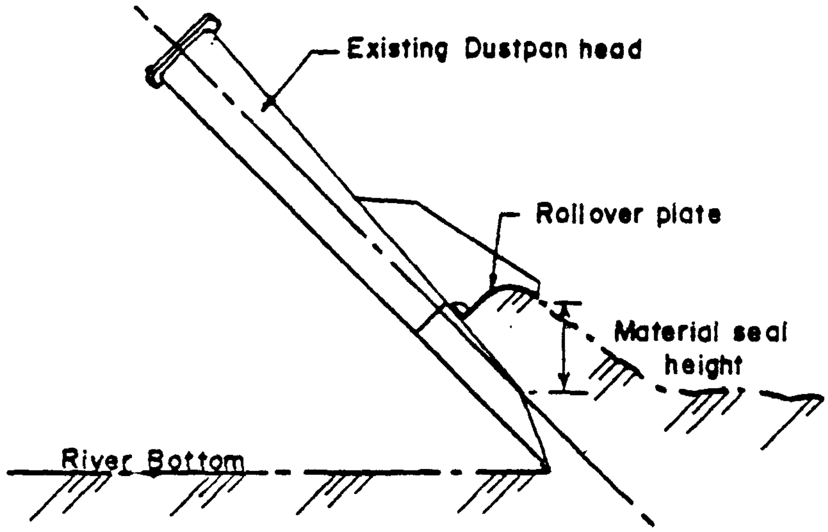
Fig. I

Inlet Conditions

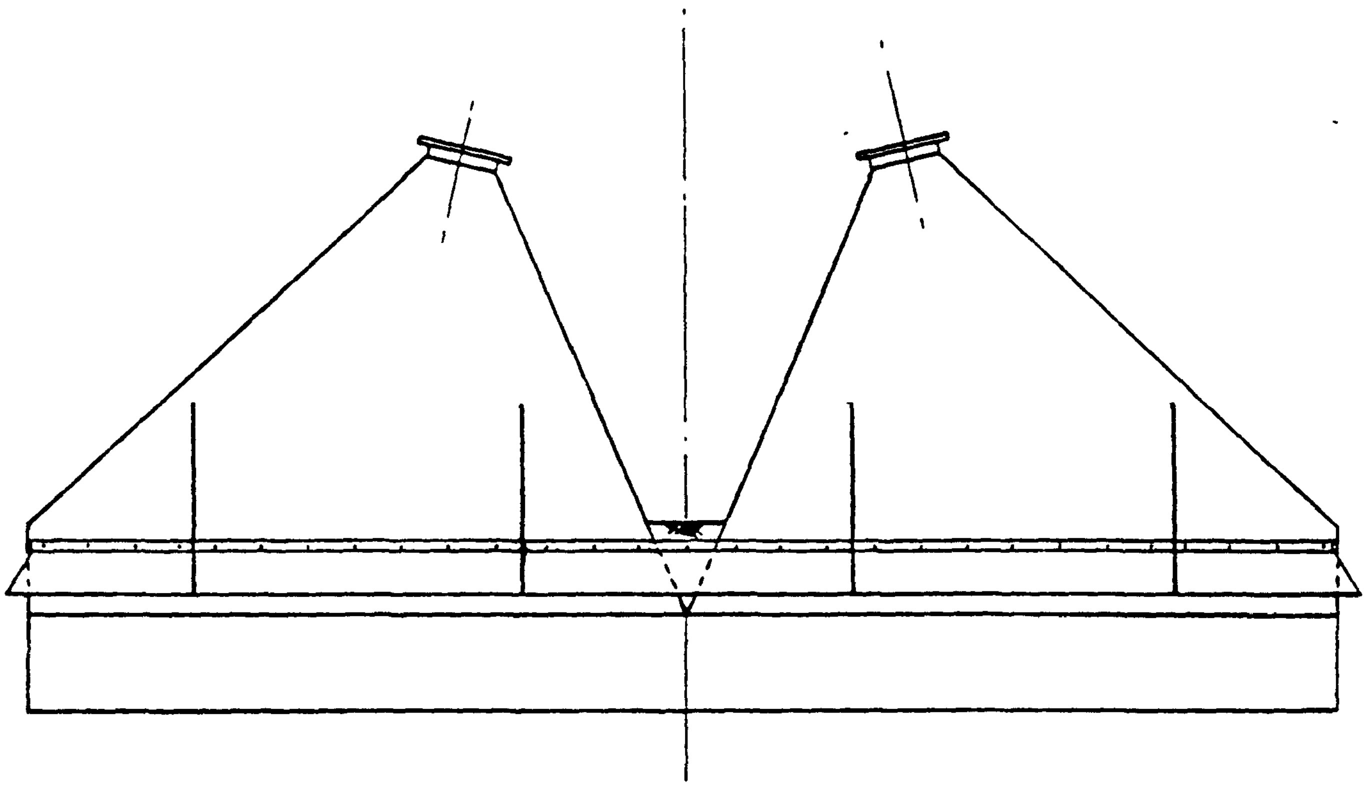


Note : All Velocities shown in Ft. per sec.

Fig. 2



Profile



Plan View

VI. EFFECT OF VIBRATION ON CEMENT SURRY

Vibration as an Assist to Viscous Flow

Following the investigation of inlet conditions and the conclusion that "plug" flow in the dustpan head was a distinct possibility, a search was made through research journal to establish the effect of vibration on Bingham Plastic.

The following pages illustrate the settling behavior of cement slurries. Fig. 4 illustrates how vibration hinders settling and the text of the research paper points out that vibration after settling caused the settled material to change to a suspension.

It is proposed that provision should be made in the head for the insertion of a poker type vibrator so that vibration testing can be carried out if "plug" flow should become a reality.

EFFECT OF VIBRATION ON CEMENT SLURRY (BINGHAM PLASTIC)

The attached sheet, D2-40, from a paper entitled "The Formation of Structure in Cement Slurries" by Dr. J. F. Raffle, read at Hydrotransport, 1 September 1970 illustrates one of the few examples available of the effect of a horizontal vibration force of 0.1g applied to a Bingham Plastic.

Excess pressure, as recorded on the vertical axis of Figs. 1-3-4, is a measure of settlement, the highest pressure being the liquid phase and the lowest pressure the fully settled phase.

Fig. 1 Illustrates the settlement that would be expected of fine sands, i.e., Newtonian Fluids. Of note here is the result that, irrespective of the initial height of the column of mixture and the specific gravity of the mixture, full settlement takes the same time, i.e., approximately 18 minutes for the six examples shown.

Fig. 2 Illustrates the settling plus freezing of cement slurries.

Fig. 3 Illustrates the effect of vibration. Of note here is the long duration of the liquid phase, approximately 130 minutes. This relatively weak vibration has the effect not only of hindering settlement but when settlement was complete a short period of vibration caused the measured excess pressure to rise back to nearly its starting value.

This test demonstrates that high concentration of cement slurries which exhibit Bingham Plastic properties can be liquidified by relatively weak vibratory forces.

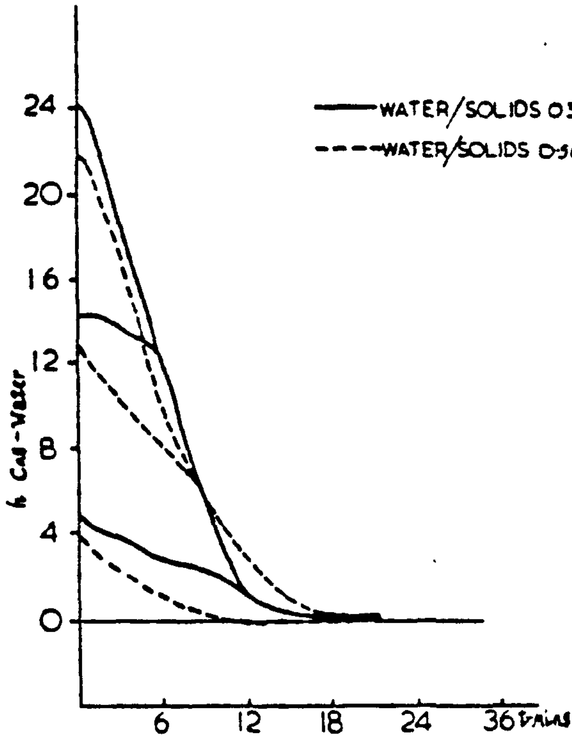


FIG 1 VARIATION OF EXCESS PRESSURES GLASS BEADS/WATER

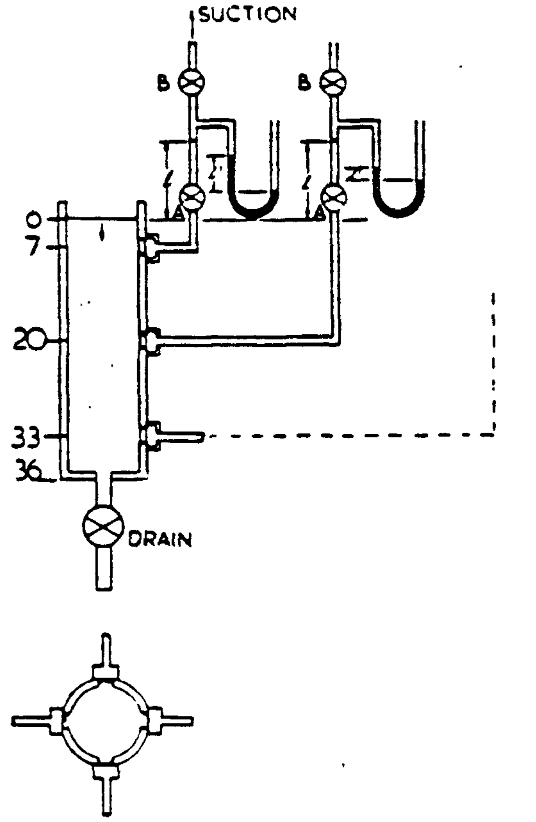


FIG 2 PRESSURE MEASUREMENT SYSTEM.

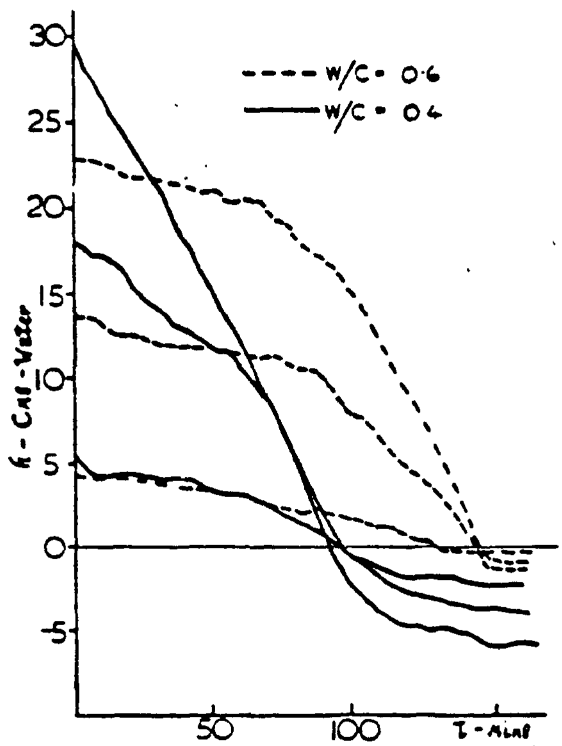


FIG 3 VARIATION OF EXCESS PRESSURES W/C SLURRIES.

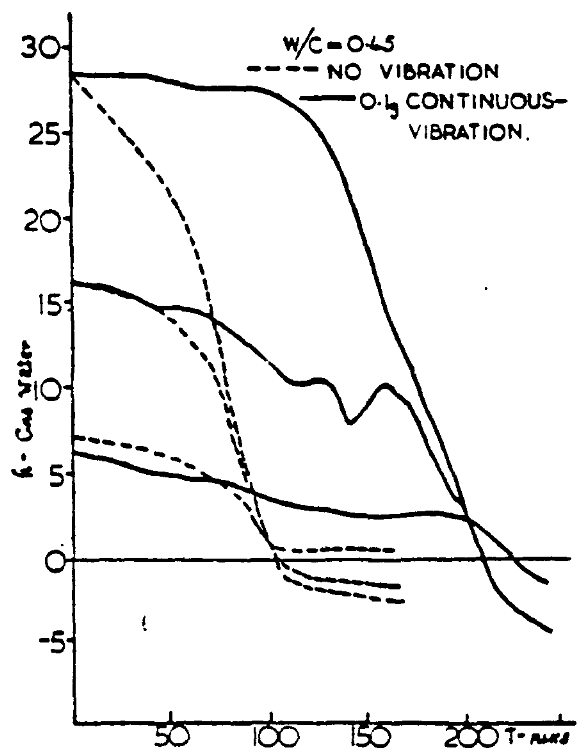


FIG 4 EFFECT OF VIBRATION ON VARIATION OF EXCESS PRESSURES.

VII. INSTRUMENTATION

INSTRUMENTATION

Velocity/Density Measurement

The most commonly used measuring device, in dredge operation, for determining velocity and density is the integrated radioactive density-electromagnetic velocity meter.

The signals from the density and velocity sensors are integrated to give rate of discharge of dry solids and total quantity over a period of time.

Attached are quotations from Dredge Technology Corporation of New York and Texas Instruments, Inc. The first is manufactured by IHC Holland and the latter is of 100% American origin.

Due to the relatively short period of the proposed dredging test, it has not been possible to persuade either of these firms to hire this equipment.

As a low cost alterantive to radioactive density meters it is suggested that an acceptable alternative would be a Dynatrol Density meter. In the Dynatrol systems some of the dredged material is bye passed to flow through a relatively small bore "U" tube. Attached is a copy of quotation from Messrs. Automation Products.

This "U" tube is vibrated electrically. The drive coil is electrically excited by a pulsating current which drives the "U" tube into mechanical vibration. The vibration becomes a function of the mass contained in the "U" tube. If the density or specific gravity of the dredged material is increased, the effective mass of the "U" tube increases, conversely if the density decreases the effective mass of the "U" tube decreases.

This vibration is sensed by a pick-up consisting of an armature and coil arrangement. The vibration of the pick-up armature induces an A-C voltage in the pick-up coil. This output from the pick-up coil is a function of the density, specific gravity or % of solids in the mixture.

In general dredging of abrasive materials, this device has obvious limitations due to the heterogeneous nature of the mixture. However, when dredging homogeneous mixtures of fine silts and clays, the bye passed sample is representative of the total flow.

This instrument has a high degree of accuracy and thus is very suitable for the proposed test where the relationship between in-place density and dredged density will be the measure of success or otherwise of the dredging method.

The sample being bye passed can be obtained by a sampling pump, by fitting the device at the end of the pipeline or by fitting it across an orifice. The latter would seem to be the most satisfactory solution for the proposed dredging test.

Dredge Technology Corporation

Affiliated with
John J McMullen Associates, Inc. and IHC Holland

October 2, 1979

Amalgamated Dredge Design, Inc.
842 Public Ledger Building
Independence Square
Philadelphia, PA 19106

RECEIVED
OCT
AMALGAMATED DREDGE

ATTENTION: Mr. A. D. Manwell

SUBJECT: <u>DREDGE INSTRUMENTATION</u>

REFERENCE: ADD 115
DTC 3005F

Gentlemen:

In reply to your letter of 13 September 1979, DTC is pleased to quote as follows:

A) 1 IHC Holland integrated radio active density - electro magnetic velocity pick-up, consisting of an 'Altoflux' velocity pick-up with built-on density pick-up. (Sheet C.C.2.3.1/2)

- Internal Diameter : 20 inches F.G. 500 mm.
- Measuring Tube : Stainless Steel
- Internal Lining : 35 mm. Polyurethane - Fixed
- R.A. Isotope : Cobalt 60
- Electrodes : Stainless Steel
- Coils : Insulation Class E
- Power Supply : 110/220 V - 50/60 HZ - abt. 2 KVA.
- Tube Length : 600 mm.
- Flanges : According to DIN - ND10 - NW/ASA 150 lbs.

PRICE: <u>$44,620.00</u>

B) Alternative for Item 'A)':

1 IHC Holland integrated R.A. density-/E.M. velocity pick-up, as described above, however with a replaceable lining. (Sheet C.C.2.3.1/2).

- Internal Diameter : 20 inches E.G. 500 mm.
- Measuring Tube : Stainless Steel
- Internal Lining : Replaceable Rubber Lining, with Wear-Alarm Transducer.
- R.A. Isotope : Cobalt 60
- Electrodes : Carbon Rubber
- Coils : Insulation Class E.
- Power Supply : 110/220 V - 50/60 HZ - abt. 2 KVA.

One World Trade Center, Suite 3047
New York, N.Y. 10048

Telex: 222731 R.C.A.
422043 I.T.T.
66133 W.U.I
7105815388 TWX

(212) 775-0567

Dredge Technology Corporation

- Tube Length : 800 mm.
- Flanges : According to DIN - ND10 - NW/ASA 150 lbs.

PRICE: $57,850.00

C) 1 Spare Liner for the above indicator.

PRICE: $7,650.00

D) 1 Tool for Replacement of the Liner.

PRICE: $1,100.00

E) 1 IHC Holland Production Indicator for calculation, indication and totalization of the amount of dry solids, transported through a dredging delivery pipeline. The production indicator is housed in a cabinet for wall mounting (Sheet C.C. 2.4.1/4).
- Power Supply : 110/220 V - 50/60 HZ - abt. 2 KVA.

Price: $12,525.00

F) 1 set of three (3) separate repeater indicators for use with the production indicator, calibrated in equalling scale values, to be mounted in the dredge masters desk. Size: 96 X 96 mm., for velocity, density and cubic meters per second.

Price: $650.00

G) 1 yield indicator with cross needle system. The yield indicator is meant to be used with the production indicator system. The yield indicator is meant to be built-in the dredge masters desk.
Size: 240 X 240 mm.

Price: $1,970.00

H) 1 IHC Holland Electr. vacuum indicator consisting of: (Sheet C.C.2.8.1/2).

- Vacuum Transducer 'V.M.T.-100'.
- Amplifier Type 'M.V./P.M.'.
  Power Supply : 110/220 V 50/60 HZ - abt. 10 VA.
- Remote Indicator - Size: 96 X 96 mm.

Price: $3,920.00

Dredge Technology Corporation

I) 1 IHC Holland Electr. Pressure Indicator consisting of:
(Sheet C.C.2.8.1/2).

- Pressure Transducer "P.M.T.-400'.
- Amplifier Type 'M.V./P.M.'.
  Power Supply: 110/220 V - 50/60 HZ - abt. 10 VA.
- Remote Indicator - Size: 96 X 96 mm.

Price: $3,920.00

Import duties are included in the prices quoted. However, no other U.S. taxes that may be required due to the supply of the above equipment or any other affiliated services are included.

Delivery: C.I.F. East Coast U.S.A. Port.

Delivery Time: About 5 months after receipt of order.

Payment: 50% with order,
50% on delivery, within 30 days after date of invoice.

Validity: Until 27 October 1979

Conditions: 'IHC General Conditions' as attached will apply.

The sheet numbers shown in parenthesis (e.g. C.C.2.8.1/2) are attached to provide an exact technical description of our scope of supply.

Please let us know if we can be of further assistance on this project.

Very truly yours,

DREDGE TECHNOLOGY CORPORATION

John P. Martin
President

JPM:tl
Encl.

cc: Mr. S. B. Field
Mr. J.J.C.M. van Dooremalen

REC

Texas Nuclear Division

Quotati

Ramsey Engineering Company
Box 9267
Austin, Texas 78766 USA
Telephone (512) 836-0801
Telex 77-6413

To:

Amalgamated Dredge Design, Inc.
856 Public Ledger Buidling
Independence Square
Philadelphia, Pennsylvania 19106

Attention: Mr. A. D. Manwell

Date ~~October 30,~~ 1979

Quotation No. F-10-044-79

Please give this quotation number when ordering

Your inquiry reference

Your Reference ADD.115

Your Letter dated October 11, 1979

We are pleased to submit the following quotation:

Quantity	Description	Delivery	Unit Price	Total
1	Production Monitoring System System includes: (1) SG Series Density Gauge Density Gauge System No. SGF202M24437M22AEFOXS Sytem includes: -Amplifier/detctor in a NEMA IV enclosure -Detector in a NEMA IV housing -24 inch pipe saddle -4000 mCi Cesium 137 source -Source head with three position shutter (open, closed,standard) lockable in each position -4-20 mA linear density output -4-20 mA linear mass flow output -Totalizer driver with integral 6-digit non-resettable totalizer -Signal Linearizer -Mass flow multiplier (accepts 4-10 mA flowmeter signal) -Automatic Source Decay Compensator (1) Foxboro 2800 Series Flowmeter (1) Foxboro E-96 Flow/Current Convertor (1) Crossed Point Display Lot Price for System..................			$50,993.00
	OPTIONS: -D.C.Heater Package ADD		$ 750.00	
	-Three channel recorder ADD		$2469.00	
	Delivery: as outlined in proposal.			

Austin, Texas Shipping Charges: Collect

By R J Fredricks

Title Roger J. Fredricks, Regional Sales Manager

…s: Net 30 days See other side for terms and conditions

This quotation firm for 60 days after above date

Page 1 of 1

SYSTEM OFFERED, PERFORMANCE AND WARRANTY

INTRODUCTION

Texas Nuclear radiation denstiy gauges provide precision and reliable measurement and indication of process conditions in thousands of installations throughout the world. Applications include the measurement of density and/or solids flow in chemical streams, slurry lines, and sewage sludge lines. Interest in nuclear gauging for dredging applications has lead to the use of density-measuring equipment aboard various types of dredges, when the density equipment is combined with flow-measuring equipment, density, velocity, and solids flow may be continuously measured and displayed at the dredge operator's station, allowing the lever man to more precisely control the dredging operation in terms of these parameters.

Regardless of quality and accuracy of the sensors involved, the inherent nature of the dredging application makes absolute measurement of the density, velocity, solids flow, and total solids dredged, highly dependent on the application and operating conditions. For this reason, it is EXTREMELY IMPORTANT to read and understand the sections which follow, in order to know, prior to installation, the advantages and limitations of the equipment offered.

EQUIPMENT OFFERED

Texas Nuclear Type SGF Nuclear Density Gauges for on-line non-contacting measurement of process fluid density. This gauge consists of an amplifier indicator unit, to be located in the deck house, a radiation source assembly, and a radiation detector. These latter two items are mounted by means of a saddle on the process line.

Texas Nuclear Crossed Pointer Display for simultaneous display of the density and velocity signals. This unit mounts near the lever man's station.

The unique, multiple-scale display also indicates relative mass flow rate by the intersection of the two pointers; this feature allows the lever man to optimize throughput by operating for a maximum height of the pointer intersection. The crossed pointer display unit also contains a resettable totalizer for indication of solids moved.

Foxboro Type 2800 Magnetic Flowtube and Foxboro Type E96 Magnetic Flow Transmitter for measurement and transmission of process fluid velocity. The flowtube is mounted in the process line and the flow transmitter is usually located nearby. The flowtube will utilize an oversize pipe lined to the inside diameter of the user's process line. The lining is made considerably thicker than the flowmeter manufacturer's standard, in order to provide improved life under harsh dredging conditions. Because of the custom-fabricated nature of the flowtube, this item is non-cancellable and non-returnable when purchased through Texas Nuclear.

Foxboro Three-Channel Strip Chart Recorder (Production Recorder) for indication and logging of the density, velocity and solids flow signal. (Offered as an option.)

Texas Nuclear DC Heater Package (Optional) for battery operation of the detector heater. This optional feature permits continued operation of the heaters during shut-down of the main power on the dredge. It is generally required in applications where dredging operation is intermittent, and where AC power is not available when the dredge is not operating. When the DC heater package is used, it draws its operating power from the 24-volt batteries used for starting of the dredge's diesel engines. The user should assure that adequate battery capacity exists to maintain heater operation extended periods, and to re-start the engines after those periods.

SYSTEM PERFORMANCE

Overall system performance is subject to a number of variables. As outlined earlier, the density-mass flow system provides valuable feedback to the operator as to the condition of density, velocity, and solids production rate in the discharge line. However, the absolute accuracies of the measurements involved are highly dependent on the particular application. In order to understand the capabilities and limitations of the system, it is important to understand how the density and velocity measurements are accomplished.

The density measurement employs a gamma ray beam which passes from one side of the pipe to the other, normally along a diameter of the pipe. This beam is conical in shape starting at about one-inch in diameter on the source size and diverging to three to six inches on the detector side. The gauge provides an accurate average of the density of the material which passes through this beam but does not "see" any of the material not passing through the beam. Thus, the absolute accuracy of the density gauge output depends on whether the relatively small sample of material "seen" by the gauge is representative of all the material at that point in the discharge pipe.

If one is dredging fine sand and maintaining a high slurry velocity, the sand may be well enough distributed to make a density measurement with a high degree of absolute accuracy. As the dredged material becomes more coarse, it is no longer possible to maintain a uniform distribution, particularly in a horizontal run of pipe. Under such conditions, the absolute accuray of the density measurement will be deteriorated. Even under these conditions, however, the density signal will provide a qualitative indication of material density, and will still be a valuable tool for maximizing solids production.

Similarly, inhomogeneous distribution of solids can also affect the output of the magnetic flowmeter supplied with the Production Monitoring System. The magnetic flowmeter is essentially a short section of pipe, lined with polyurethane, and surrounded with field coils which produce a magnetic field inside the pipe. When a conductor, such as the material flowing in the discharge pipe, moves through the magnetic field in the flow tube, a small voltage is produced which is proportionaly to the average velocity of the material in the pipe.

When solids slippage, i.e., a condition of water moving faster than solids, occurs, the flowmeter output will indicate a velocity somewhere between that of the solids and that of the water. This does not diminish its value as a production monitoring device, and the flowmeter will still provide fast indication of impending line plugs, thus preventing costly downtime.

Many of the effects mentioned above can be minimized by properly locating and orienting the nuclear density gauge and flowmeter in the discharge line. Texas Nuclear has application engineers with considerable work experience in this area.

PERFORMANCE GUARANTEE

Texas Nuclear Density Gauge

Texas Nuclear verifies proper performance of its nuclear density gauge with clear water in the pipe to establish a zero solids reference, and by imposing known absorbers in the radiation beam to simulate a slurry of homogeneous solids distribution at the typical dredge operating density level. Density gauge performance is based on these conditions:

Pipe I.D.	20 inches
Pipe Wall Thickness	0.75 inches steel
Maximum Slurry Density	1.6 SGU*
Solids Density	2.6 SGU
Gauge Response Time Constant	5 seconds
Operating (Typical) Slurry Density	1.2 SGU
Radiation Source Size	Cesium 137

*Specific Gravity Units.

Under these conditions, we will guarantee precisions of:

± SGU at 1.0 SGU (Clear Water)

± SGU at .005 SGU (Typical operating density simulated by imposing absorbers in the radiation beam with clear water flowing in the discharge pipe.)

Foxboro Magnetic Flowmeter

The magnetic flowmeter is manufactured by the Foxboro Company, Foxboro, Massachusetts. All flowtubes are pressure tested and hydraulically flow calibrated. A flow calibration data sheet is supplied with each flowtube. The manufacturer's specifications are:

Accuracy: ±1% of full scale

Precision: ±0.25% of full scale

when operated at the conditions under which calibrated.

Solids Flow

The solids flow signal is derived from the density and flow signals. Proper operation of the solids flow rate and totalizing circuitry is verified with a density signal which is produced with clear water in the pipe and a known absorber in the radiation beam to simulate nominal operating density. The flow signal is that produced by the flowmeter with clear water in the pipe and with the pump being operated at constant RPM. Under these conditions, we will demonstrate:

Solids flow indication: ±5% of calculated value

Total solids indication: ±5% of calculated value.

Crossed-Pointer Display

The Crossed-Pointer Dislay has an accuracy of ±2% of full scale on the velocity and density indications.

Strip Chart Recorder (Production Recorder)

The strip chart recorder has an accuracy of ±1% of scale on each of its inputs.

AUTOMATION PRODUCTS, INC.

MANUFACTURER OF INDUSTRIAL PROCESS INSTRUMENTS

TELEPHONE (713) 869-0361

3030 MAX ROY STREET, HOUSTON, TEXAS 77008

Amalgamated Dredge Design, Incorporated
856 Public Ledger Building
Philadelphia, Pennsylvania 19106

Attention: A. D. Manwell

Quotation No. 27-40119D
Date November 1, 1979
Reference Letter dated 9/14/79
10/16 Phone Conversat

Gentlemen. We are pleased to submit the following quotation for your consideration.

ITEM	QUANTITY	DESCRIPTION	DELIVERY	UNIT PRIC
1	1	Type CL-10HY Dynatrol Cell, similar to Type CL-10TY per Bulletin J-67D except having Stainless Steel U-Tube and connections per Drawing CL-10-216, sealed construction, and Type EC-212GA-4 Converter having 4-20 MADC output signal into 0-650 ohms max.	10 Weeks	$3400.

SERVICE CONDITIONS:

Media	Dredging Slurries
Classification	Slurry
% Concentration	0-40% Solids at 1.2 - 1.6 S.G.U.
Pressure	Less Than 1000 psig
Temperature	Ambient

NOTES:

With the above unit, accuracy of measurement would be ± .0005 S.G.U.

If media temperature compensation is required, specify above Cell complete with integral temperature compensation and Type EC-213GA-4 Converter in place of Type EC-212GA-4 Converter for $300.00 extra net.

Above Converter is available with either 1-5 MADC output into 0-2600 ohms max., or 10-50 MADC output into 0-260 ohms max., at no additional charge.

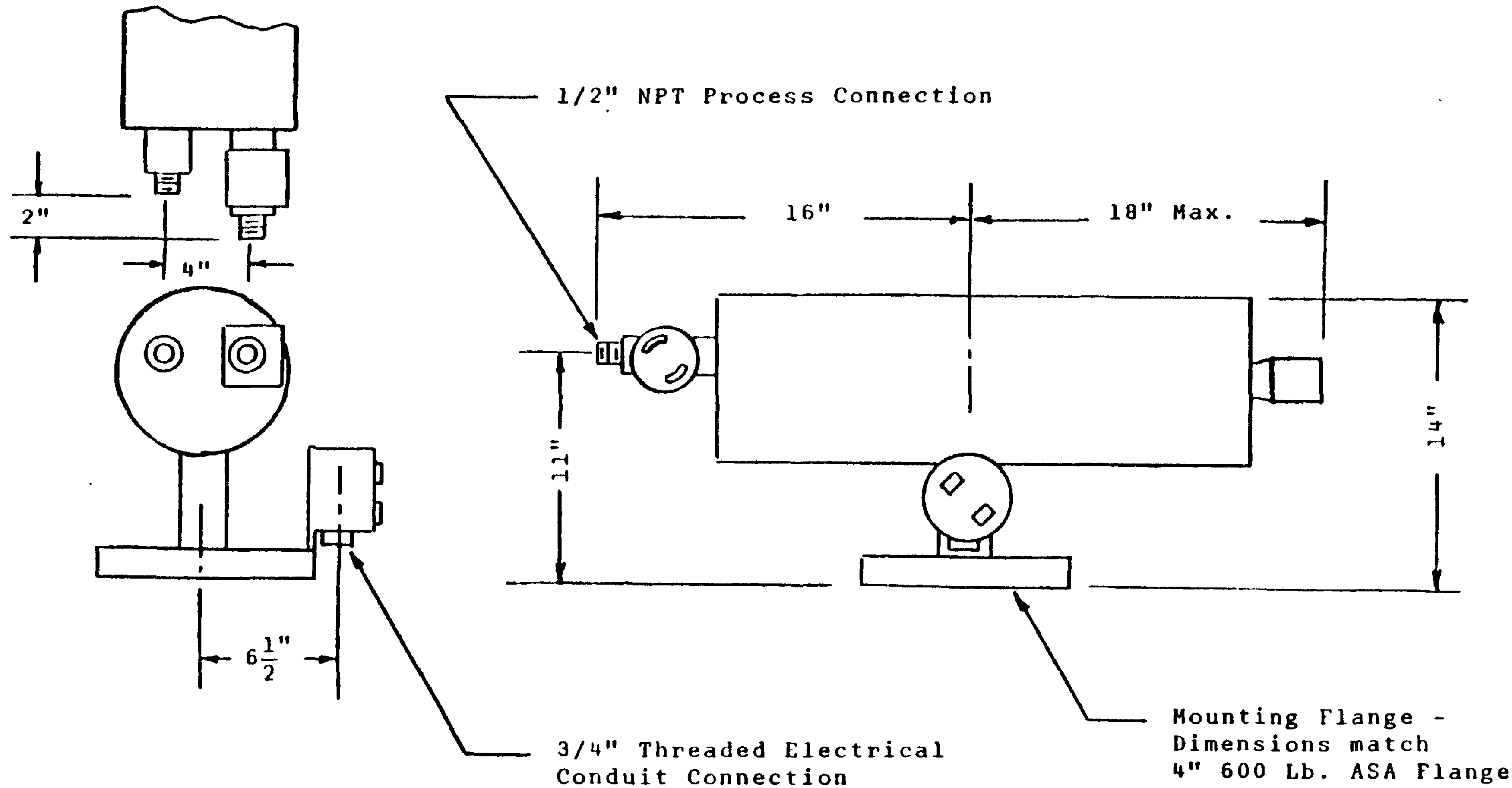
When placing order, please advise complete service conditions as outlined on the enclosed Quotation Data Forms.

B FACTORY @ HOUSTON, TEXAS
..MS. ½% 10 DAYS NET 30 DAYS
IECT TO CONDITIONS STATED ON REVERSE SIDE.

AUTOMATION PRODUCTS, INC.

BY [signature]

Bernie Hartman
Phone (713) 869-0361



REVISIONS			
NO.	DATE	DRN BY	CKD BY
6	4/27/71	RHA	WBB

AUTOMATION PRODUCTS, INC.
HOUSTON, TEXAS

MOUNTING DIMENSIONS
CL-10HY DENSITY CELL
WITH INTEGRAL TEMP. COMP.

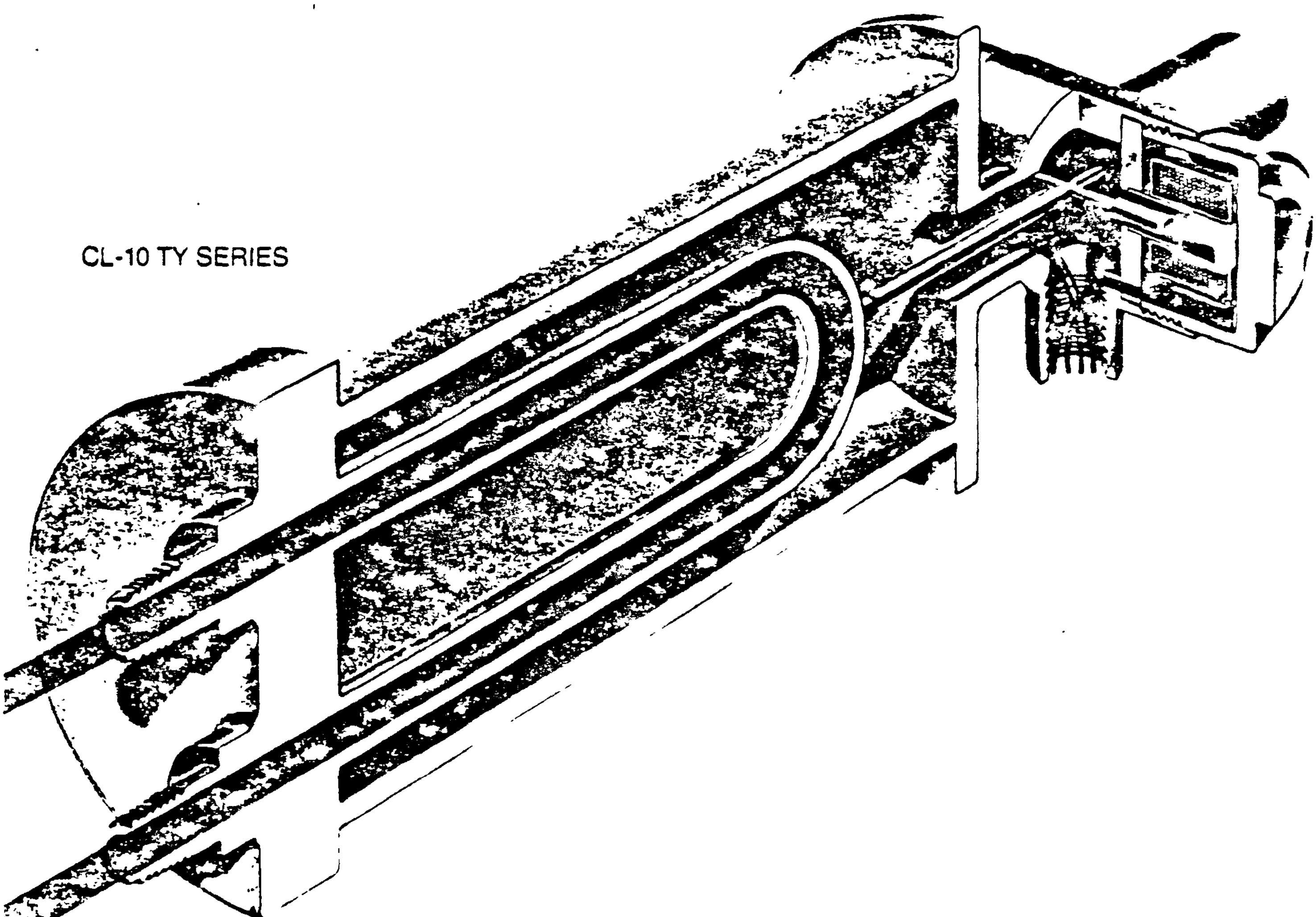
DRAWING NO CL-10-216
SCALE ------
DRAWN BY RHA
DATE 11/1/66
CHECKED BY

BULLETIN NO. J-67 DA

Dynatrol®

DENSITY — SPECIFIC GRAVITY — % SOLIDS CONTROL
FOR LIQUIDS AND SLURRIES

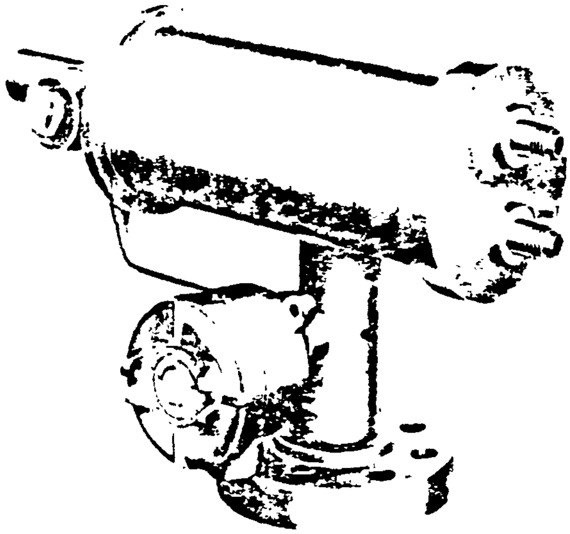
CL-10 TY SERIES

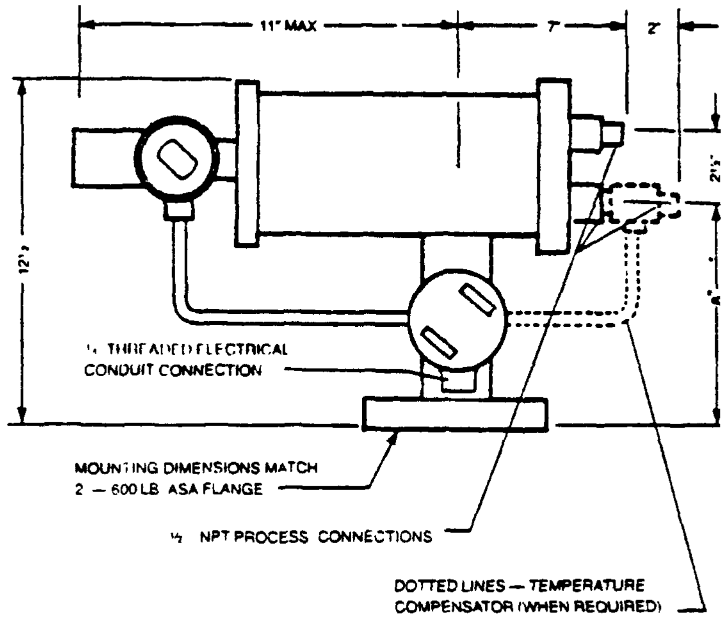


AUTOMATION PRODUCTS, INC.

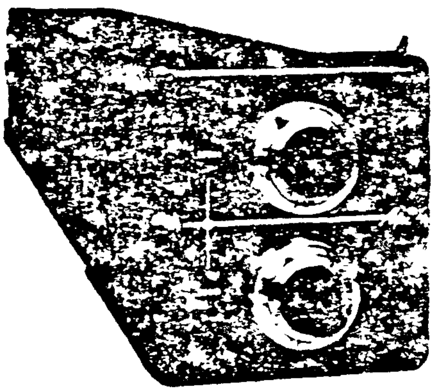
3030 MAX ROY STREET HOUSTON, TEXAS 77008 PHONE 713-869-0361

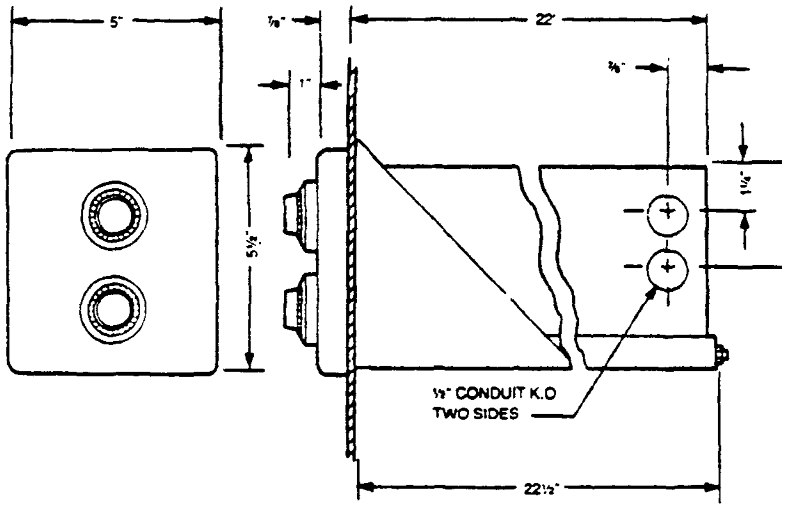
CELL



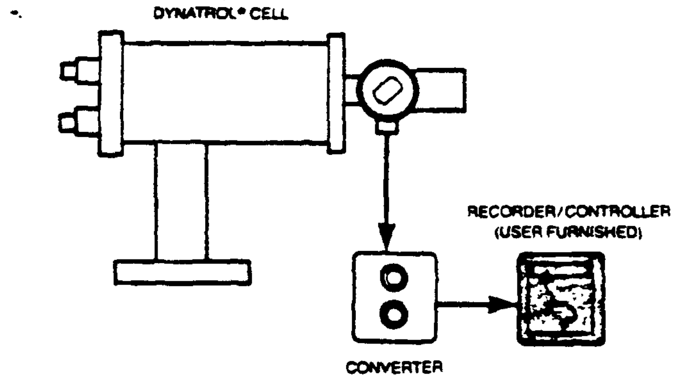


CONVERTER

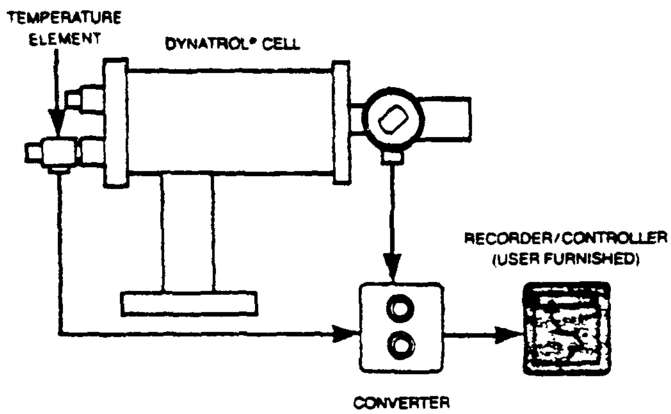




AUTOMATION PRODUCTS, INC.
3030 MAX ROY STREET HOUSTON, TEXAS 77008 PHONE 713-869-0361



COMBO SERIES 200 GA



COMBO SERIES 300 GA

CONVERTER

The output signal from the Dynatrol® Cell is fed into the all solid state Converter where it is converted into a 4-20 MADC signal* compatible with 4-20 MADC* electronic recorders and controllers. (*Other outputs are available, such as 1-5 or 10-50 MADC, millivolt, or voltage outputs. Contact factory for your special requirements.) The Converter also contains a power supply which provides regulated power to the Dynatrol® Cell.

Front panel Span and Zero controls are located at the Converter where full scale output from the Converter can be obtained **for any 10% up to 100%** of the Dynatrol® Cell signal range.

TEMPERATURE COMPENSATION

Compensation for changes in process media density due to variations in process temperature can be provided. Temperature compensation is accomplished through circuitry in the Converter and through use of a temperature sensitive resistance element which is an integral part of the U-Tube. Temperature Compensation cancels the effect of temperature changes on density. This results in a density measurement which has been corrected for variations in process operating temperature.

Combo Series	Function	Base Range	Span	Detector Series	Converter
200 GA	Measures Density at Process Temperature	Any .5 SGU	Any .05 to .5 SGU within Base Range	CL-10 TY	EC-212GA
300 GA	Measures Specific Gravity Compensated for Changes in Process Temperature	Any .5 SGU	Any .05 to .5 SGU within Base Range	CL-10 TY	EC-213GA

SPECIFICATIONS

DYNATROL® CELL, CL-10TY SERIES

Explosion Proof: Class 1, Group D, Division 1

Pressure Rating: 1,000 PSIG @ 100°F. (Standard)*

Temperature Rating: 300°F. (Standard)*

Process Connections: ½" NPT Male

Conduit Connection: ¾" NPT

natrol Cells are also available for operation at **elevated temperatures and pressures** and for **highly corrosive services.** Please contact factory

CONVERTER, Type EC-212GA or EC-213GA ALL SOLID STATE CIRCUITRY

Power Input: 118V, 60 Hz, 25 VA (50 Hz Available — Contact Factory)
Enclosure: General Purpose, Panel Mount, NEMA 1 (for remote mounting)
Explosion Proof: Class 1, Group D, Division 2
Temperature Rating: 125°F Max.
Span & Zero Suppression: Adjustable over base range of Cell
Output Signal: 4-10 MADC into 0-650 ohms max.
1-5 MADC into 0-2600 ohms max.
10-50 MADC into 0-260 ohms max.

NOTE: Millivolt and volt outputs are also available where required. The Dynatrol® Converter is normally grounded at recorder/controller, etc. **Floating output signals available for computer inputs, etc.**

Dynatrol® DENSITY - SPECIFIC GRAVITY - % SOLIDS CONTROL
FOR LIQUIDS AND SLURRIES

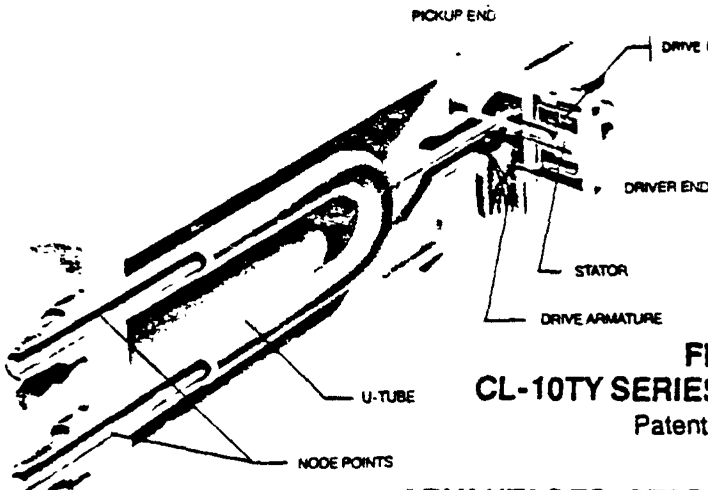


FIG. 1
CL-10TY SERIES DYNATROL® Cell
Patents Pending

GENERAL

Dynatrol® Systems are designed for measurement of density, specific gravity, or % solids at process conditions. Response is immediate and continuous. Dynatrol® Cells meet a wide range of process requirements. They are applicable to both liquids and slurries, are not sensitive to changes in ambient temperatures, viscosity, pressure, or flow velocity.

The Dynatrol® is highly respected and relied upon by industry and is a **well proven, extremely versatile process tool.** Dynatrols® are being utilized throughout the process industries, such as **Chemical, Refineries, Pipelines, Oil Production, Nuclear and Fossil Power Plants, Dairy, Water and Waste, Brewing and Beverages, Pulp and Paper Mills, Mining, Foods, Pharmaceutical, Sugar Factories, Steel, Textile, Rubber, Tobacco, Manufacturing Plants,** etc.

THE DYNATROL® CELL (See Fig. 1)

The product to be measured flows through the U-Tube section. This U-Tube is approximately ½" diameter and is welded at the nodes.

The drive coil is electrically excited by a pulsating current which drives the U-Tube into mechanical vibration. The vibration becomes a function of the mass of the media contained in the U-Tube. If the density or specific gravity of this media is increased, the effective mass of the U-Tube increases; if the media density decreases, the effective mass of the U-Tube decreases.

This vibration is sensed in the pick-up end. The pick-up end consists of an armature and coil arrangement which is similar to that of the driver end. The vibration of the pick-up armature induces an A-C voltage in the pick-up coil. This output from the pick-up is a function of the density, specific gravity, or % solids of the process media.

SERVICE CONDITIONS REQUIRED:

Media, Classification (Liquid, Pulp, Slurry), Density, Specific Gravity, or % Solids Range @ Process Temperature, Pressure, Process Temperature, Temperature Variation, Whether Process Temperature Compensation Required, Corrosive Condition.

ADVANTAGES: STABLE — ACCURATE — EASILY INSTALLED — RUGGED

There are no moving parts to foul or wear out, resulting in long-term stability and nil maintenance requirements.

Dynatrol® Cells are easily installed, usually across a main line transfer pump with a small stream circulated through the U-Tube. They can also be installed across an orifice or other pressure drop point, or a small recirculating pump may be used.

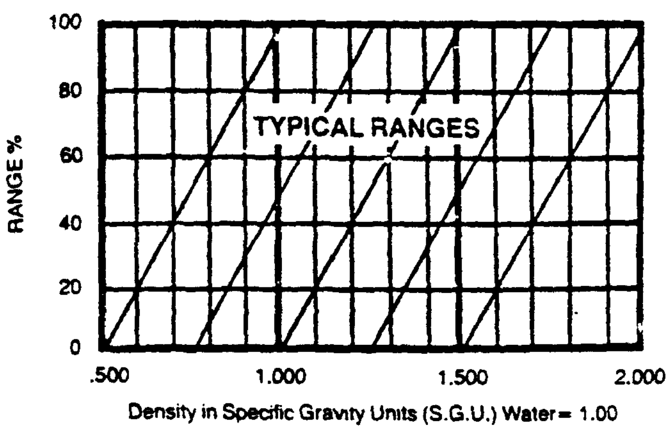
Output is **linear and directly proportional** to density or specific gravity.

Dynatrol® Cells are available in a wide number of ranges to meet practically any application requirement.

A wide variety of **corrosion resistant metals** are available as required.

The Dynatrol® Cell is rugged, and has proven to be a **unique and versatile process tool** throughout industry.

FIG. 2
CL-10TY SERIES
***TYPICAL RESPONSE CURVES**
*Shown below are just typical base ranges. Other base ranges and broader ranges are available as required.



VIII. SAMPLING TECHNIQUE

Sampling Technique

The proposed dredge test will take place in the zone of maximum turbidity. It will be necessary, therefore, to establish background turbidity before commencing dredging tests.

It is proposed that the sampling technique is based on a single sensing instrument mounting in a sample receiving tank on the main deck of the dredge. This tank would be hopper shaped in the bottom for ease of washing out any deposits of sediment and would be fitted with washing connections from the sampling pump.

The sampling pump would be a 3/8" bore water pump, preferably fitted with a rubber or plastic impellar. A Jabsco Model No. 2187-1101 for 110 Volt DC operation or Model No. 12210-0001 for 115 Volt AC operation, or similar, would be suitable. If necessary, gasoline engine driven or low voltage versions of these pumps are available. See attached leaflet.

On the suction side of the pump a manifold would be fitted having 13 3/8" valves, of these 12 would connect to 3/8" bore nylon reinforced plastic sampling hoses. The 13th valve would be a clean water suction, from a settling tank, if necessary, for flushing out the sample receiving tank. The twelve sampling hoses, suitably supported would pass down the suction frame to connect with the sampling pipes.

The sampling pipes would be 1/2" bore steel tubes, 5 foot and 7 foot long, depending on their position and duty. A goal-post type gantry constructed of standard slotted or drilled angle iron would be fitted across the upper surface of the dustpan head as shown in the attached sketch, Figure 1.

These sampling points would be used in the first instance to sample the background turbidity.

The proposed initial sampling configuration is shown in Figure 2 with the dustpan head maintained at a level of 6 feet above the depth shown on the echo sounder.

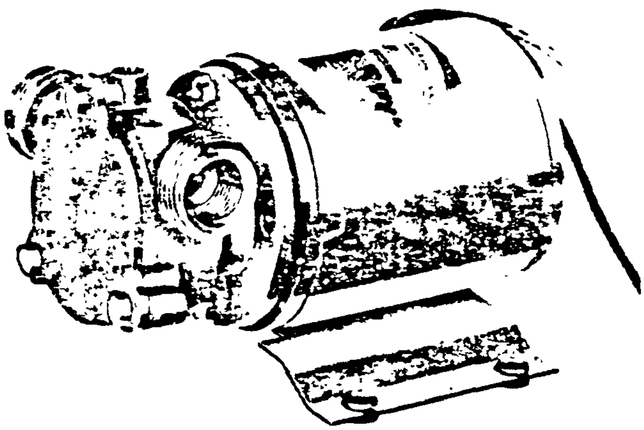
The proposed second configuration is shown in Figure 3 with the bottom edge of the dustpan head maintained at the depth shown on the echo sounder.

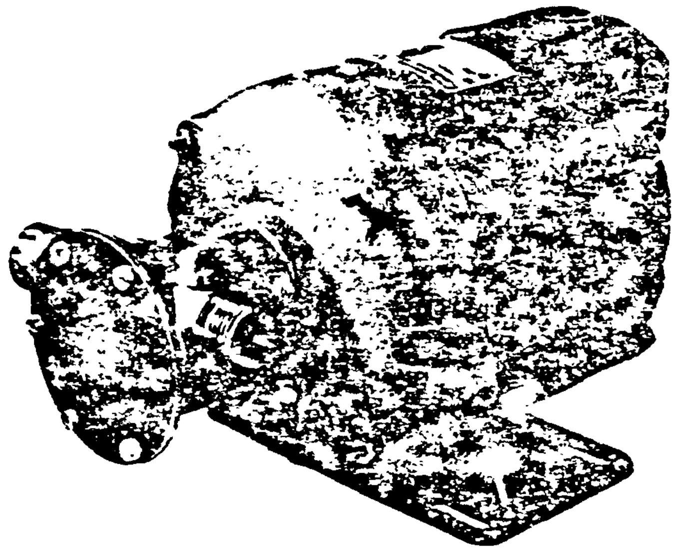
The final configuration shown in Figure 4 would be used firstly at the same depth as shown in Figure 3, whilst pumping water only; thereafter, pumping mixture without movement of the dredge and finally during the dredging trials.

The 3 spare sampling lines would be used either on the suction frame or dredge hull as found necessary for sampling remote from the dustpan head.

JABSCO FLEXIBLE IMPELLER PUMPS

Bronze Motor Pump Units





PUMP MODEL NO.	6360-0001
FLOW. 10 Ft. Head, H_2O	3.7 GPM
PORT SIZE	⅜" IPT / ¾" Garden Hose Thread
VOLTAGE / Amp Draw	12 Volt DC / 6.5 Amps
IMPELLER	Nitrile
SHAFT SEAL	Lip Type
MOTOR SHAFT MATERIAL	Stainless Steel
MOTOR TYPE	Enclosed; Permanent Magnet
SIZE (Height x Width x Length)	3" x 4" x 6⅞"
WEIGHT (Approx.)	4½ lbs.

Variations Available
Model 6350-0001-6 Volt DC
Model 6370-0001-24 Volt DC
Model 6380-0001-32 Volt DC
Available Separately
Pump Head Only Nitrile 7440-0001
Note. Model 6360-0001 and variations are not designed for reversing—always connect red lead to positive (+) side of power source.

Head vs. Flow Table

6360-0001

TOTAL HEAD		
PSI	FT. OF WATER	GPM
Free Flow	Free Flow	5.0
2.1	5	4.6
4.3	10	3.7
8.7	20	1.7

PUMP MODEL NO.	2187-1101
FLOW: 10 Ft. Head, H_2O	9.5 GPM
PORT SIZE	½" IPT / ¾" Garden Hose Thread
VOLTAGE / Amp Draw	110 Volt DC / 2.8 Amps
IMPELLER	Nitrile
SHAFT SEAL	Rotary Face Type
MOTOR SHAFT MATERIAL	*Steel
MOTOR TYPE	Open, Drip proof-¼ HP
SIZE (Height x Width x Length)	6½" x 6⅝" x 11½"
WEIGHT (Approx.)	38 lbs.

Variations Available
Model 2187-0321-32 Volt DC
Available Separately
Neoprene impeller No. 2232-0001
Pump Head Only 4008-0003
*Seal and impeller ride on bronze shaft sleeve. Liquid pumped does not contact motor shaft.

Head vs. Flow Table

2187-1101, 2187-0321

TOTAL HEAD		
PSI	FT. OF WATER	GPM
4.3	10	9.5
8.7	20	7.6
13.0	30	6.0
17.3	40	4.2

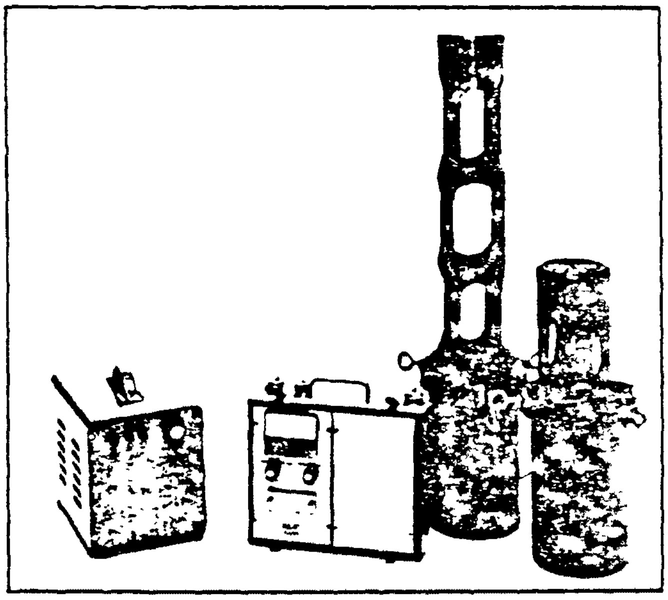
For Metric conversion of flows and dimensions refer to Engineering Data.

Tables show approximate flow in U.S. Gallons Per Minute for a new pump

MARTEK MODEL XMS *IN SITU* TRANSMISSOMETER

MARTEK INSTRUMENTS, INC. MANUFACTURERS OF ENVIRONMENTAL INSTRUMENTATION

. . . for portable field measurements of beam attenuation coefficient "alpha" to 300 meter depths in salt or fresh water bodies.



DESIGN AND PERFORMANCE FEATURES

- Direct in situ operation – salt or fresh water bodies to 300 meters
- Fixed optical alignment.
- Temperature stable circuitry.
- Light source electronically stabilized.
- Insentivity to ambient light.
- Portable operation from internal rechargeable batteries or external 12 DC or AC power.
- Rapid simultaneous data readout and recording capabilities.
- Adaptable to onshore and shipboard installations, pumped sample systems, and industrial monitoring applications.
- Virtually no hysteresis effect in downwelling and upwelling.
- Rugged marine construction for dependable field use.

INTRODUCTION

The Model XMS In Situ Transmissometer is a portable, research-quality instrument specifically designed for optimum underwater measurements of turbidity by determining the percent transmission of a light beam through a known path length in the water. It provides high accuracy, ± 1.0% over a wide alpha measurement range (0.1 to 4.6 meters $^{-1}$ for 1 meter path length and 0.4 to 18.4 meter $^{-1}$ for ¼ meter path length). State of the art electronic circuitry and a unique optical design, originally developed at the Visibility Laboratory at Scripps Institution of Oceanography, are combined with rugged packaging for reliable use in water bodies by non-technical personnel. (0.1 to 4.6 meters $^{-1}$ is roughly equivalent to 0.1 to 6 JTU.)

DESCRIPTION

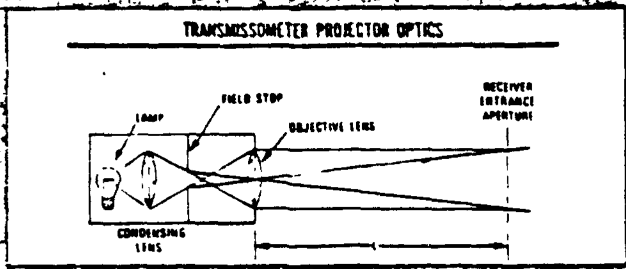
The Model XMS system consists of a solid state electronics deck readout module with self-contained AC/DC power supply; up to 300 meters of multiconductor underwater cable with molded waterproof connectors; and an underwater folded path one meter or ¼ meter sensor with associated electronics and waterproof connectors.

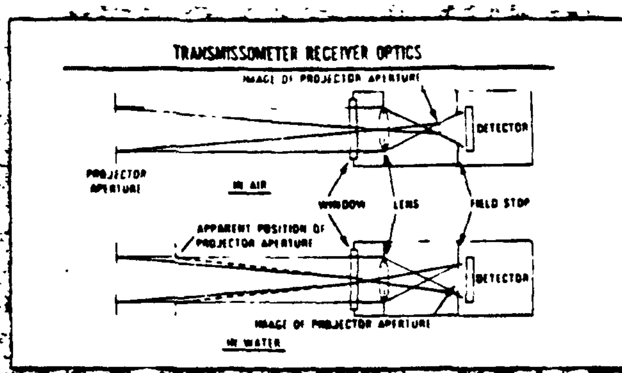
The optical system of the underwater sensor is different from a collimated system in that it produces a cylindrically limited beam rather than a diverging collimated beam. By confining the beam from the projector to a cylindrical volume and limiting the field of view of the receiver to a cylinder closely matching the illuminated volume, the error due to forward scattering is reduced. A porro prism is used to fold the water path thus shortening the instrument and making it more convenient to handle. A blue green filter peaking at 493 millimicrons is standard. Optional filters with peaks at 447, 528, 566 and 604 millimicrons are available.

The Transmissometer readout module is housed in a compact, splashproof, steel carrying case with detachable lid and canted control panel to permit moisture runoff and efficient viewing angle. Readout of the light transmittance measurement is obtained instantaneously on a high resolution, 1% mirrored panel meter, with ranges of 0-10%, 0-25%, and 0-100% Transmittance. A recorder output permits on-site or telemetry recording of the percent transmission measurement. Continuous records of percent transmission versus temperature and/or depth may be obtained by using the optional Model TMS Temperature Measuring System and/or Model DMS Depth Monitoring System and X,X-Y type recorder.

APPLICATIONS

The Model XMS may be utilized for turbidity, productivity, and sedimentary studies. The Transmissometer provides an accurate and reliable means of determining one of the fundamental optical properties of water, the beam attenuation coefficient α Inasmuch as the coefficient α is a determinant of water clarity, it is used extensively in scheduling underwater photography, television and diving operations. Marine biologists use the Transmissometer as a plankton locater, since plankton absorbs and scatters light which results in high attenuation and a resultant high concentration of the organisms. Another application is in the field of descriptive oceanography, where the instrument can be used to study the distribution, both by area and by depth, of scattering and absorbing layers in the oceans, and for determining river outflows.





MODEL XMS SPECIFICATIONS

SYSTEM PERFORMANCE

Useful range of alpha measurements: 0.1 to 4.6 meters^{-1} for 1 meter path length and 0.4 to 18.4 meter $^{-1}$ for ¼ meter path length.

Display Range: 0-10%, 0-25%, and 0-100% transmittance.

Ambient Light Interference: Negligible.

Operating Temperature: -2° to 40°C.

Operating Depth: 0-300 meters.

Overall System Accuracy: ± 1.0%

Operating Power: Regulated self-contained; 105 - 125 VAC (50/60 Hz) or 12 VDC primary input. Internal, rechargeable battery pack with built-in charging circuit supplied as normal DC source. Battery life 3 hours of continuous system operation between charges.

SYSTEM ASSEMBLIES

Sensor: Photometer with one meter or ¼ meter folded path length.

Fittings: Bulkhead type, 6 pin, plastic waterproof connector (male) with locking sleeve.

Dimensions: Approximately 8 inches diameter by 36 inches long for one meter and 8 inches x 20 inches long for ¼ meter sensor.

Weight: Approximately 36 pounds.

Readout Unit: Portable, self-contained deck readout module with panel meter, controls, power supply, recorder-output connection, sensor-input receptacle, and associated solid-state electronic circuitry for remote monitoring of submerged sensor.

Panel Meter: Precision (1%) taut-band type with 3.5-inch mirrored scale and knife-edge dial-pointer; 0-1 milliampere movement; moisture sealed; direct reading scale of 0-10%, 0-25% and 0-100% Transmittance.

Recorder Jack: 0 - 0.5 volt DC signal (full scale).

Controls: 2 rotary switches. Power function: OFF, AC, BATTERY, CHARGE. Control function: CALIBRATE, OPERATE.

Housing: Epoxy-coated steel carrying case with removable panel cover; specially treated aluminum control panel.

CABLE ASSEMBLY

Construction: 12-conductor, waterproof, polyurethane jacket.

Fittings: Input plug for readout unit, molded underwater breakout with sensor connectors.

Diameter: 0.5 inch

Weight: 13 pounds/100 feet (excluding fittings).

Breaking Strength: 625 pounds approx. (100 foot length).

ORDERING INFORMATION

PART NUMBER	DESCRIPTION
300-XX	Model XMS In Situ Transmissometer Monitoring System, including 300-10 Readout Module XMS (w/carrying case), 300-20 XMS Underwater Sensor, one meter or ¼ meter folded path length and ______ feet of cable
300 TMS	Same as Part Number 300 but including Model TMS Temperature Monitoring System and ______ feet of cable.
300 DMS	Same as Part Number 300 but including Model DMS Depth Monitoring System and ______ feet of cable.
300-EBT	Same as Part Number 300 but including Model TMS Temperature and Model DMS Depth Monitoring Systems and ______ feet of cable.

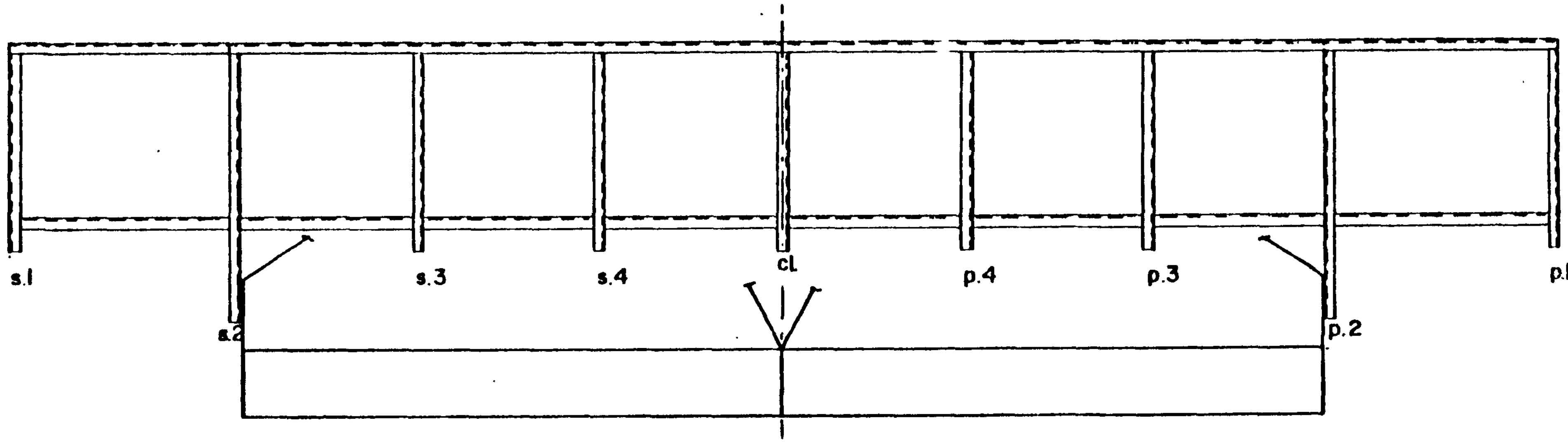
Note: XX Specify 100 for one meter cell path for clear and turbid waters and 25 for 25 cm cell path sensor for very turbid waters.

All prices F O B Irvine, California, including 12-month product warranty against defects in material and workmanship (Prices and specifications subject to change without notice.)

MARTEK INSTRUMENTS, INC.

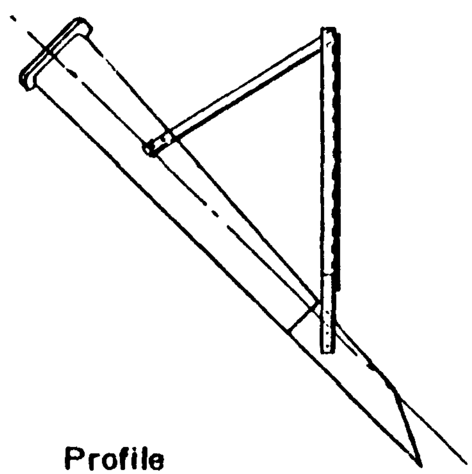
17302 DAIMLER STREET, IRVINE, CALIFORNIA 92713 PHONE (714) 540-4435 TELEX 692 317

PRINTED IN U.S.



Partial Elevation
(showing argt. of Goal post)

Plan View
(sampling pipes designations)



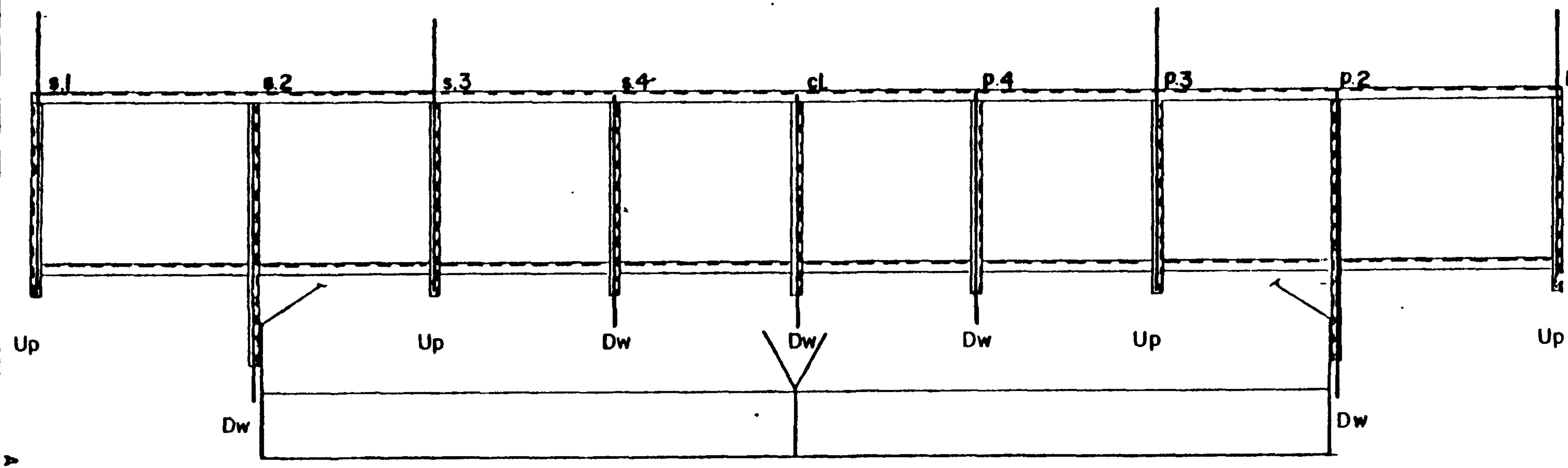
Profile

Fig.1

Notes! 1) Goal post to be adequately braced and secured to dustpan head.

2) Sampling pipes to be secured to goal post by means of clamps

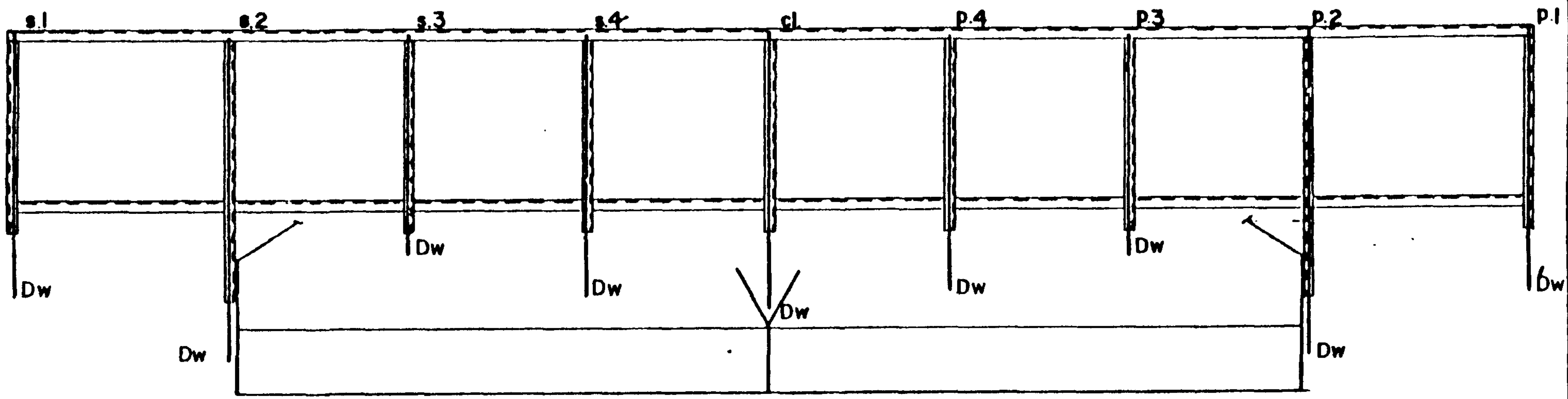
Amalgamated Dredge Design Inc.



Partial Elevation
(sampling pipes - designations)

Fig. 2
Head 6 ft. above bottom

Amalgamated Dredge Design Inc.

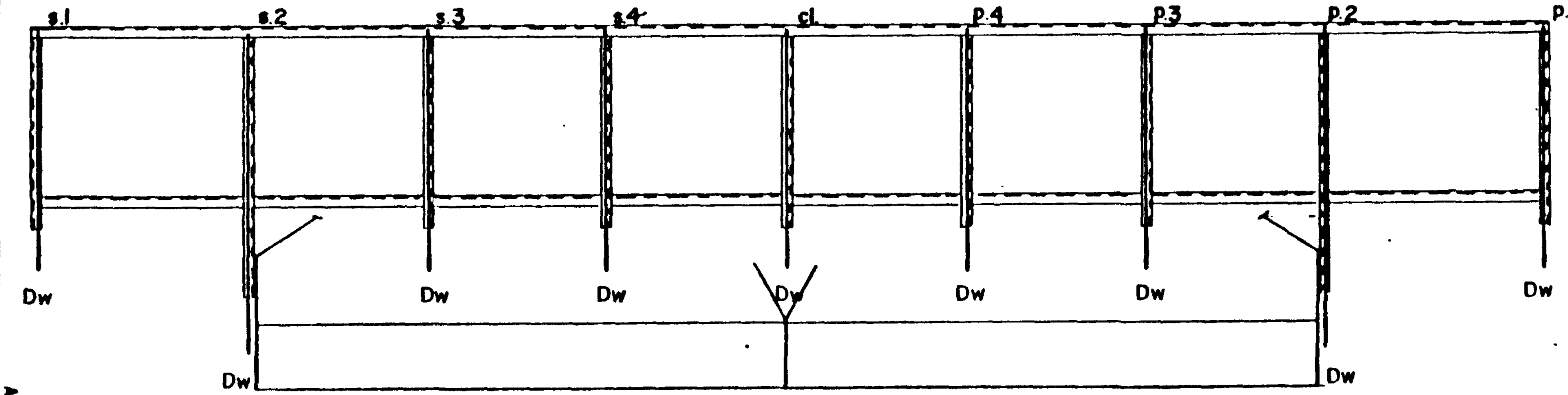


Partial Elevation

(sampling pipes -- designations)

Fig.3

Amalgamated Dredge Design Inc.



Partial Elevation

(sampling pipes – designations)

Fig.4

Amalgamated Dredge Design Inc.

IX. DEPTH MEASUREMENT

Depth Measurement

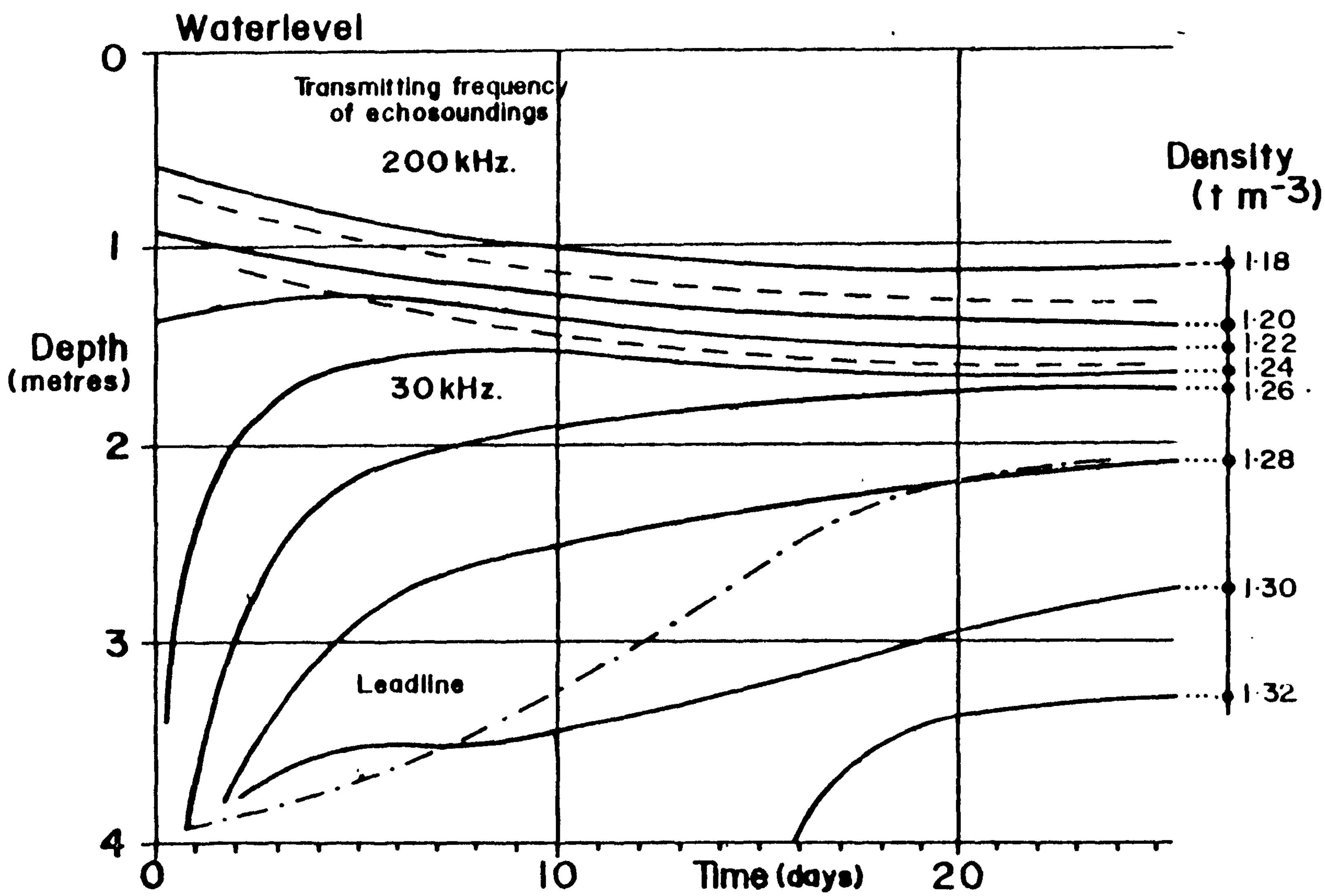
As the dredging test will be carried out in the zone of maximum turbidity, the material to be dredged will probably exist in three states, i.e., Mobile Suspensions - State Suspensions - and Settled Silt.

From laboratory studies using echo sounding techniques, it would appear that densities lower than 1.19 ton/m^3 are not easily detectable by the use of echo-sounders. At this density the solids in suspension are of the order of 10%, so the sampling pump should be capable of handling up to this concentration.

The results of the laboratory tests are shown in Figure 1 where the depth soundings given by 200 kHz and 30 kHz echosounders and a standard leadline are illustrated.

If we assume that all concentration higher than 1.28 (approx. 80 lbs/cubic foot) are settled silt, then a dual frequency echo-sounder, supplemented by the sampling pump, should delineate the density profile of the material and ensure that the submersion of the dredging head in material is sufficient to ensure an adequate clean-up of the cut without spill over the head due to over submersion or too great a speed of advance.

Attached are descriptive brochures of suitable equipment.



Changes in density structure in laboratory settling experiment showing penetration of leadline and positions of echoes from 200 to 30 KHz echosounders. From investigations sponsored by the Municipality of Rotterdam.

PIANC 1977 (Leningrad) Sect 2(5)

DECCA

ITT DECCA MARINE, INC.

TELEPHONE 904-445-2400
TWX 810-824-2089 TELEX 564364

US RT 1 & ST JOE ROAD - PO BOX G
PALM COAST FLORIDA 32037

November 6, 1979

Amalgamated Dredge Design, Inc.
856 Public Ledger Building
Philadelphia, PA

Attention: Mr. A. D. Manwell

Dear Sir:

We are pleased to quote you as follows on IDM Quotation No. 75 for the high-frequency depth sounder system you are interested in:

To meet your specifications we would like to recommend the following choices:

1. LAZ 72/LVG59 with transducers LSE 132/140 for dual frequencies of 30 KHZ and 200 KHZ. or

2. LAZ 72/LVG59 with transducers LSE 133/140 for dual frequency of 50 KHZ and 200 KHZ.

Specifications are:

1. Min sounding distance below transducer 10 CM (4")

2. Smallest range on recorder 20 meters (65.6')

3. Width of paper 228.6 NM (9")

4. Pulse frequency 30 and 200 KHZ or 50 and 200 KHZ.

5. Output power for 30 or 50 KHZ 450 Watts

6. Output power for 200 KHZ 40 Watts

7. Pulse length for 30 and 50 KHZ .3, 1 or 3 millisec. switchable.

8. Pulse length for 200 KHZ 50 Micro seconds.

9. Bandwidth for 30 and 50 KHZ is 1 and 3 KHZ switchable.

10. Bandwidth for 200 KHZ is 30 to 40 KHZ.

Continued...

Amalgamated Dredge Design, Inc.
November 6, 1979
Quote No. 75

PRICES

1. 1 ea. LAZ 72 AT Echograph with PGN 25-450 Watt Output 30 KHZ or 50 KHZ

PRICE $ 7,305.00

2. 1 ea. LVG 59 Transceiver 200 KHZ - 40 watt output PRICE $ 4,770.00

3. 1 ea. LSE 132 30 KHZ transducer for Steel Hull ship or

   1 ea. LSE 133 50 KHZ transducer for Steel Hull ship PRICE $ 1,525.00

4. 1 ea. LSE 140 200 KHZ transducer for Steel Hull ship PRICE $ 1,475.00

If distance between transducer and echograph is more than 10 meters you will have to add connection Box VK10. The same applies for distance between LVG 59 and transducer LSE 140.

VK 10	PRICE	$ 55.00

Brochures on the LAZ 72 and optional accessories will follow by mail and will include:

DAZ 6 Digital depth indicator	PRICE	$ 7,095.00
DAZ 8 Digital control unit	PRICE	$ 3,600.00
DSG 8 Display Selector	PRICE	$ 6,890.00

TERMS & CONDITIONS

1. Prices are U.S. List, F.O.B. Palm Coast, Florida.

2. Delivery 60 days after receipt of order.

3. Prices are firm for deliveries prior to December 31, 1979. For later delivery, price at time of delivery prevails.

4. This quotation is valid until December 6, 1979.

We appreciate your interest in our products and would like to take this opportunity to thank you.

Sincerely,

ITT DECCA MARINE, INC.

Paul H. Bligh
Manager
Sales Administration

PHB:df

ARNESSEN MARINE SYSTEMS, INC.
One Battery Park Plaza, New York, N.Y. 10004 • Tel:(212)425-7900 • Telex: 22-2028 • Cable: Elecraft, N.Y.

November 20, 1979
Our Reference 462/79

RECEIVED
NOV 2 . 1979
AMALGAMATED DREDGE DESIGN

Amalgamated Dredge Design, Inc.
856 Public Ledger Building
Philadelphia, PA. 19106

ATT: Mr. A. D. Manwell

Gentlemen:

We have contacted various manufacturers in regard to your echo sounder requirements mentioned in your letter of October 26.

We believe that the Dual Frequency Echo Sounder System, Model FE-824 will fulfill your requirements. Furuno Electric Co. Ltd. is a leader in the echo sounder/sonar field, with equipment in service world wide.

Quotation Number 1808

Item 1. Furuno Dual Frequency Echo Sounder Model FE-824

- available as wet or dry paper recorder
- 2 Kw transmitter power, with power reduction control
- three pulse lengths - switchable
- Variable paper speed
- seven different depth models available
- five frequency combinations available
  - 15 and 200 KHz
  - 15 and 50 KHz
  - 28 and 200 KHz
  - 50 and 200 KHz
  - 28 and 50 KHz
- optional EM-1 scale expander, ES-5 memo-scope and ED-202 digital unit can be added with ease
- whiteline and TVG controls
- display modes include:
  - (a) normal recording at high frequency over full 8 inches
  - (b) normal recording at low frequency over full 8 inches
  - (c) normal recordings at both frequencies simultaneously (top half and bottom half of paper)
  - (d) combined recording over full 8 inches using high frequency until white line signal is detected then automatically switching to low frequency, giving

(d) con't.
high frequency fish recordings for best definition and low frequency bottom recordings for best ground discrimination.

FE-D824 (Dry Paper) or FE-W824 (Wet Paper) - all depth variations

Prices:

15 and 200 KHz with 15F-4 and 200 B-8 transducers------------------$ 6,500.00
15 and 50 KHz with 15F-4 and 50B-12 transducers--------------------$ 6,675.00
28 and 200 KHz with 28F-18 and 200 B-8 transducers-----------------$ 6,550.00
50 and 200 KHz with 50B-12 and 200 B-8 transducers-----------------$ 6,195.00
28 and 50 KHz with 28F-18 and 50B-12 transducers-------------------$ 6,695.00

Recorder only (all frequency combinations)-------------------------$ 5,725.00

Item 2. Memo-Scope ES-5, CRT echo magnifier with memory, including:

(a) Five expanded depth ranges 2.5 to 60 fathoms
(b) Swing or differential display
(c) Bottom lock
(d) Range Spread
(e) Surface lock
(f) Recorder Interface Kit
(g) Operation from 12/24/32 V DC 110/220 V AC

Price Each---$ 3,495.00

Item 3. EMI Scale Expander (memo-graph) with:

(a) Bottom lock
(b) Range Spread
(c) Surface lock
(d) Five expansion ranges
(e) Marker lines
(f) Interface Kit

Price Each---$ 3,325.00

Item 4. Digital Depth Indicator ED-202, with:
(a) Three digit readout (feet, fathoms or meters)
(b) Depth alarm
(c) Recorder interface kit
(d) Operation from 110/220 V AC

Price Each---$ 3,050.00

Alternatively,

Item 5. Paragon "3-D" Digital Depth Display.

This indicator unit can interface with any standard recorder, and provides a Solid-State digital readout. The unit has its own receiver and acts independently upon the returned signal from the main unit's transmitter. Range capability to 999 fathoms, variable depth alarm to 90 fathoms.

Price Each--$ 474.00

Validity: 60 days from date

Prices: F.O.B. San Francisco, California

Delivery: 30 days from contract

Terms: 30 days net.

Sincerely,

ARNESSEN MARINE SYSTEMS, INC.

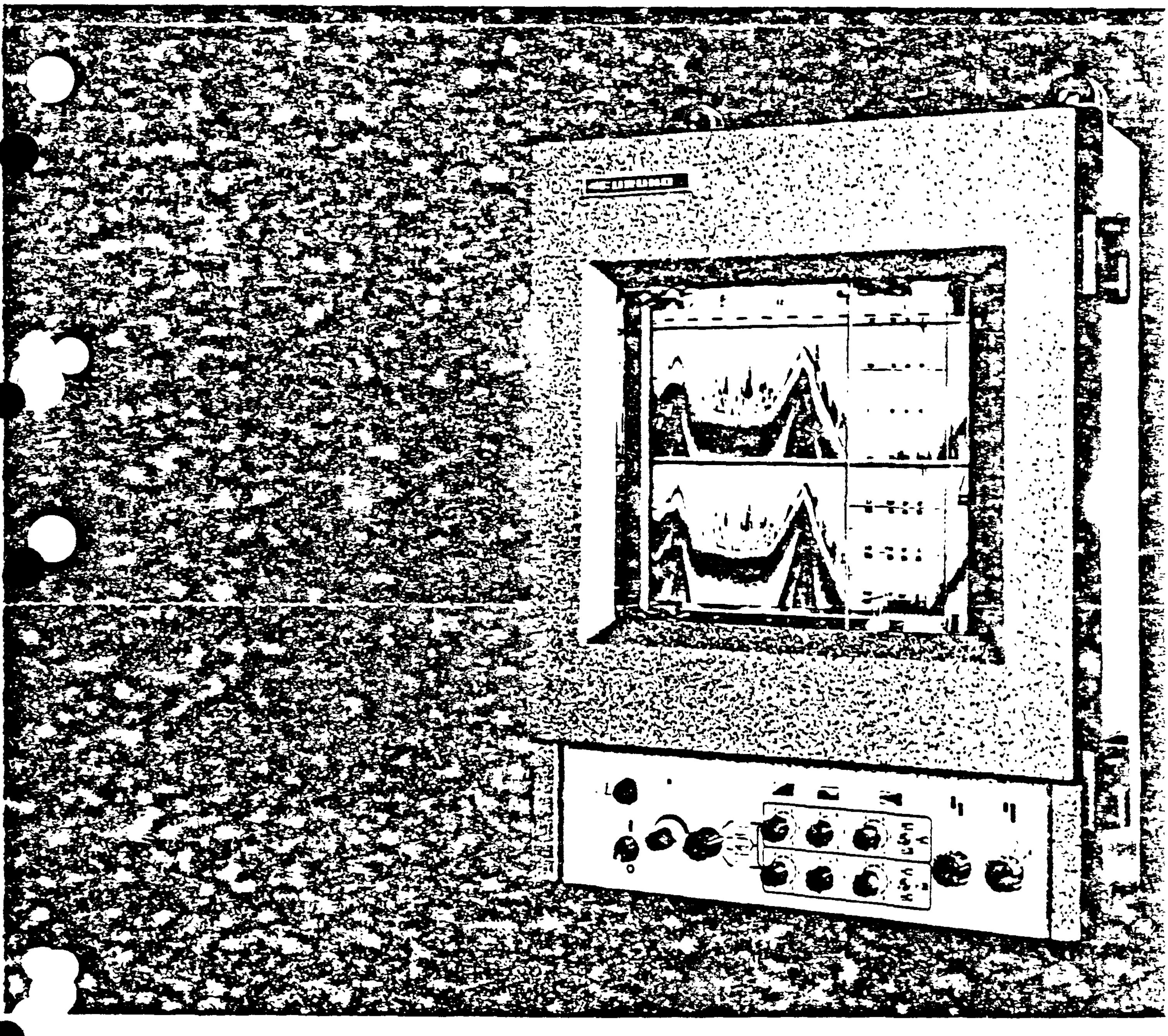
Stephen P. Keller
Manager
Communications and
Navigation Systems

SPK/dh

Super Quality Series-8

DUAL FREQUENCY ECHO SOUNDER

MODEL FE-824



® The future today with FURUNO's electronics technology.

FURUNO ELECTRIC CO., LTD.

9-52, Ashihara-cho, Nishinomiya City, Japan
Cable: FURUNO NISHINOMIYA, Telex: 5644-325

Catalogue No. E-26

SPECIFICATIONS OF FE-824

TYPE	DEPTH RANGES		TX RATES (ppm) *	PAPER SPEED (mm/min) **
	SINGLE FREQUENCY	DUAL FREQUENCIES		
A	(1) 0– 60, 30– 90, 60– 120, 90– 150m	(1) 0– 30, 30– 60, 60– 90, 90– 120m	196	4.7 – 28
	(2) 0– 120, 60– 180, 120– 240, 180– 300m	(2) 0– 60, 60– 120, 120– 180, 180– 240m	98	2.4 – 14
	(3) 0– 240, 120– 360, 240– 480, 360– 600m	(3) 0–120, 120– 240, 240– 360, 360– 480m	49	1.2 – 7
	(4) 0– 480, 240– 720, 480– 960, 720–1200m	(4) 0–240, 240– 480, 480– 720, 720– 960m	25	0.6 – 3.5
B	(1) 0– 80, 40– 120, 80– 160, 120– 200m	(1) 0– 40, 40– 80, 80– 120, 120– 160m	148	3.5 – 21
	(2) 0– 160, 80– 240, 160– 320, 240– 400m	(2) 0– 80, 80– 160, 160– 240, 240– 320m	74	1.8 – 10.5
	(3) 0– 320, 160– 480, 320– 640, 480– 800m	(3) 0–160, 160– 320, 320– 480, 480– 640m	37	0.9 – 5.3
	(4) 0– 640, 320– 960, 640–1280, 960–1600m	(4) 0–320, 320– 640, 640– 960, 960–1280m	19	0.5 – 2.7
C	(1) 0– 100, 50– 150, 100– 200, 150– 250m	(1) 0– 50, 50– 100, 100– 150, 150– 200m	118	2.8 – 16.8
	(2) 0– 200, 100– 300, 200– 400, 300– 500m	(2) 0–100, 100– 200, 200– 300, 300– 400m	59	1.4 – 8.4
	(3) 0– 400, 200– 600, 400– 800, 600–1000m	(3) 0–200, 200– 400, 400– 600, 600– 800m	30	0.7 – 4.2
	(4) 0– 800, 400–1200, 800–1600, 1200–2000m	(4) 0–400, 400– 800, 800–1200, 1200–1600m	15	0.4 – 2.1
D	(1) 0– 120, 60– 180, 120– 240, 180– 300m	(1) 0– 60, 60– 120, 120– 180, 180– 240m	98	2.4 – 14
	(2) 0– 240, 120– 360, 240– 480, 360– 600m	(2) 0–120, 120– 240, 240– 360, 360– 480m	49	1.2 – 7
	(3) 0– 480, 240– 720, 480– 960, 720–1200m	(3) 0–240, 240– 480, 480– 720, 720– 960m	25	0.6 – 3.5
	(4) 0– 960, 480–1440, 960–1920, 1440–2400m	(4) 0–480, 480– 960, 960–1440, 1440–1920m	13	0.3 – 1.8
E	(1) 0– 160, 80– 240, 160– 320, 240– 400m	(1) 0– 80, 80– 160, 160– 240, 240– 320m	74	1.8 – 10.5
	(2) 0– 320, 160– 480, 320– 640, 480– 800m	(2) 0–160, 160– 320, 320– 480, 480– 640m	37	0.9 – 5.3
	(3) 0– 640, 320– 960, 640–1280, 960–1600m	(3) 0–320, 320– 640, 640– 960, 960–1280m	19	0.5 – 2.7
	(4) 0–1280, 640–1920, 1280–2560, 1920–3200m	(4) 0–640, 640–1280, 1280–1920, 1920–2560m	10	0.3 – 1.3
F	(1) 0– 200, 100– 300, 200– 400, 300– 500m	(1) 0–100, 100– 200, 200– 300, 300– 400m	59	1.4 – 8.4
	(2) 0– 400, 200– 600, 400– 800, 600–1000m	(2) 0–200, 200– 400, 400– 600, 600– 800m	30	0.7 – 4.2
	(3) 0– 800, 400–1200, 800–1600, 1200–2000m	(3) 0–400, 400– 800, 800–1200, 1200–1600m	15	0.4 – 2.1
	(4) 0–1600, 800–2400, 1600–3200, 2400–4000m	(4) 0–800, 800–1600, 1600–2400, 2400–3200m	8	0.2 – 1.1
G	(1) 0– 240, 120– 360, 240– 480, 360– 600m	(1) 0–120, 120– 240, 240– 360, 360– 480m	49	1.2 – 7
	(2) 0– 480, 240– 720, 480– 960, 720–1200m	(2) 0–240, 240– 480, 480– 720, 720– 960m	25	0.6 – 3.5
	(3) 0– 960, 480–1440, 960–1920, 1440–2400m	(3) 0–480, 480– 960, 960–1440, 1440–1920m	13	0.3 – 1.8
	(4) 0–1920, 960–2880, 1920–3840, 2880–4800m	(4) 0–960, 960–1920, 1920–2880, 2880–3840m	7	0.2 – 0.9

Fathom Scales available (Example AF, BF, ---)

* Sounding rates are shown for metric scales. For fathomic scales, multiply by 2/1.83.

** Shown are for dry paper recorder. In wet paper recorder, minimum speeds are twice higher.

RECORDING PAPER
FE-D824: Dry Paper PD-2020(204mm x 20m)
FE-W824. Wet Paper PW-2015(200mm x 15m)

OUTPUT POWER
2KW with continuous reduction

PULSE LENGTH
0.6, 1.2 and 1.8ms switchable (each for frequency)

FREQUENCY and MAXIMUM DETECTION *(GUIDANCE ONLY)*

FREQ	XDR TYPE	BEAMWIDTH (3dB)	Single Fish Detection(m)		Seabed (Sandy)
			30cm (TS:–30dB)	70cm (TS:–15dB)	
15KHz	15F-4	31 x 78°	160m	310m	3550m
28KHz	28F-18	22 circular	280	560	2900
50KHz	50B-12	12 circular	380	600	2100
60KHz	60B-55	10 circular	380	580	2000
88KHz	88B-10	10 circular	280	420	1400
200KHz	200B-8	5.4 circular	200	280	630

(Power 2 kW)

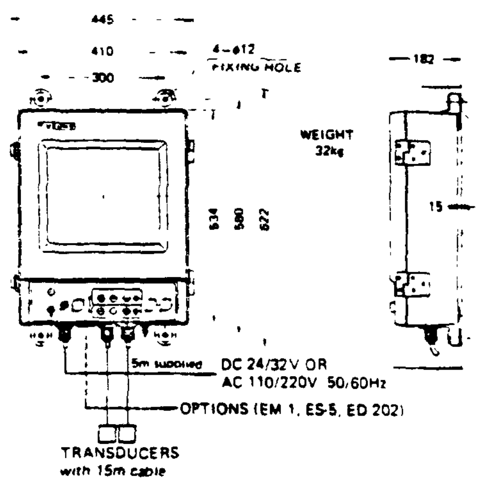
POWER SUPPLY
DC24/32V, 150W or
AC110/220V, 50-60Hz, 100VA

OPTIONS
TRANSDUCER TANK
HIGH POWER TRANSMITTER (5, 10 or 30KW)
5 or 10KW: 15, 28 or 50KHz
30KW: 15 or 28KHz

EM-1 MEMO-GRAPH
Expands water segment of 7.5, 15, 30, 60 or 120m in surface-lock, pelagic or bottom-lock mode.

ES-5 MEMO-SCOPE
Non-flickering visual display of expanded water segment anywhere within the fish finder detection range.

ED-202 DIGITAL INDICATOR
Direct read out of water depths. Reliable by digital signal processing. Alarms for preset depth.

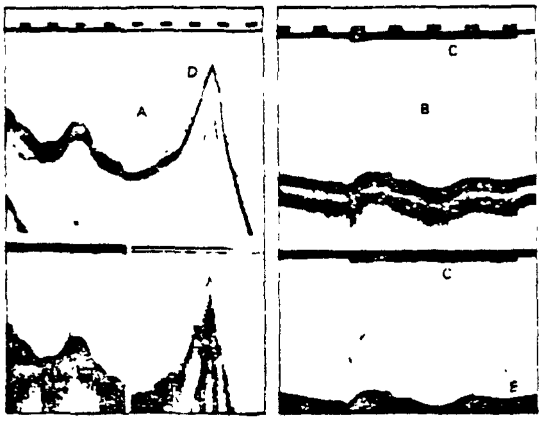


SPECIFICATIONS SUBJECT TO CHANGE FOR IMPROVEMENT

FOR FURTHER INFORMATION, PLEASE CONTACT ➔

FOR DETAILED INFORMATION PLEASE CALL:

ALITY, POWERFUL SOUNDER.



Upper. 200KHz Lower: 15KHz

CHOICE OF SINGLE OR DUAL FREQUENCY OPERATION

High Frequency

1. Good for small fish detection (A)
2. Fish spotted in high intensity (B) (darker marking)
3. Immune to surface contamination (cf. C & C')
4. Clear recording of pinnacles by a sharp beam (D)

Low Frequency

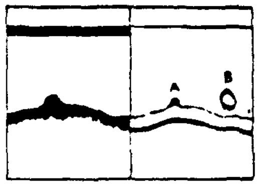
1. Wide beam facilitates to distinguish single fish (E).
2. Greater coverage by a wide beam width
3. Less attenuation to deeper ranges.
4. Reliable white line function in deep ranges.
5. Less effect by pitch and roll.

POWERFUL, 16 RANGES

Choice of 16 depth settings (4 basic and 4 phased on each basic range) permits greater precision in locating fish at any depth.

Built-in 2KW transmitter with continuous reduction ensures detection and resolution.

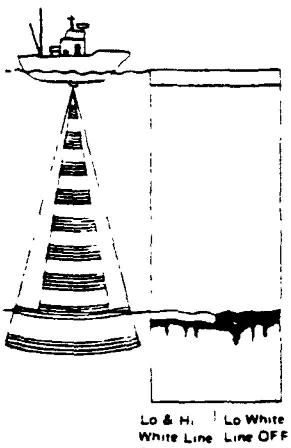
WHITE LINE



Without White Line, no fish apparent at bottom | With White Line bottom fish clear (A) High density school has white line effect (B)

White line facilitates detecting fish schools near or in contact with the seabed. Setting the control at high level will give the white line effect on fish schools, too, enabling an estimation of their density - more effect on higher density.

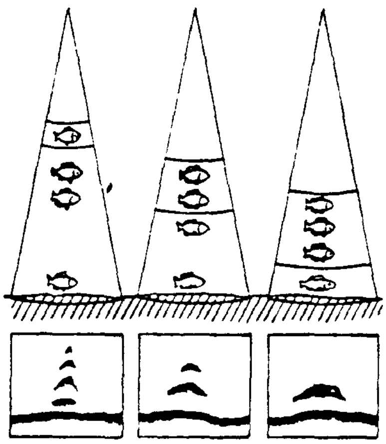
GROUND DISCRIMINATION



Lo & Hi White Line ON | Lo White Line OFF

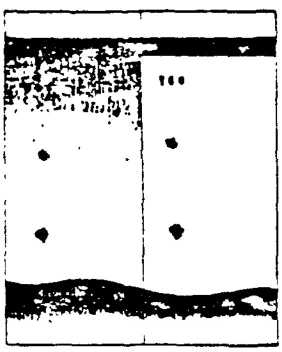
The high frequency provides high definition of bottom contour while the low frequency presents better ground discrimination by making bottom trailing longer at hard parts. This recorder has a special feature to give excellent ground discrimination by emitting two frequencies simultaneously. The high frequency amplifier serves to record fish and bottom contour, and switches to the low frequency amplifier upon detection of the white line signal.

PULSE LENGTH SELECTION



Pulse length can be selected in 3 ways. Vertical resolution is theoretically explained by (Sound velocity) x (Pulse length)/2. For the shortest pulse of 0.6 msec, the resolution is 45 cm (disregarding the transducer damping property and pulse elongation during propagation). The short pulse gives detailed information and the long pulse ensures ample detection in deeper ranges.

TVG(Time Varied Gain)

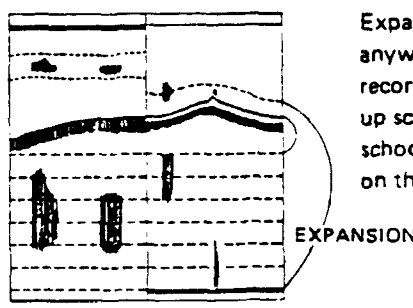


TVG compensates for propagation attenuation of ultrasonic waves by reducing the receiver gain near surface and gradually increasing the gain toward deeper range.

Recording intensity is equalized for the same size fish schools at shallow and deep ranges. It also shows up fish in surface, noise and plankton. Better to

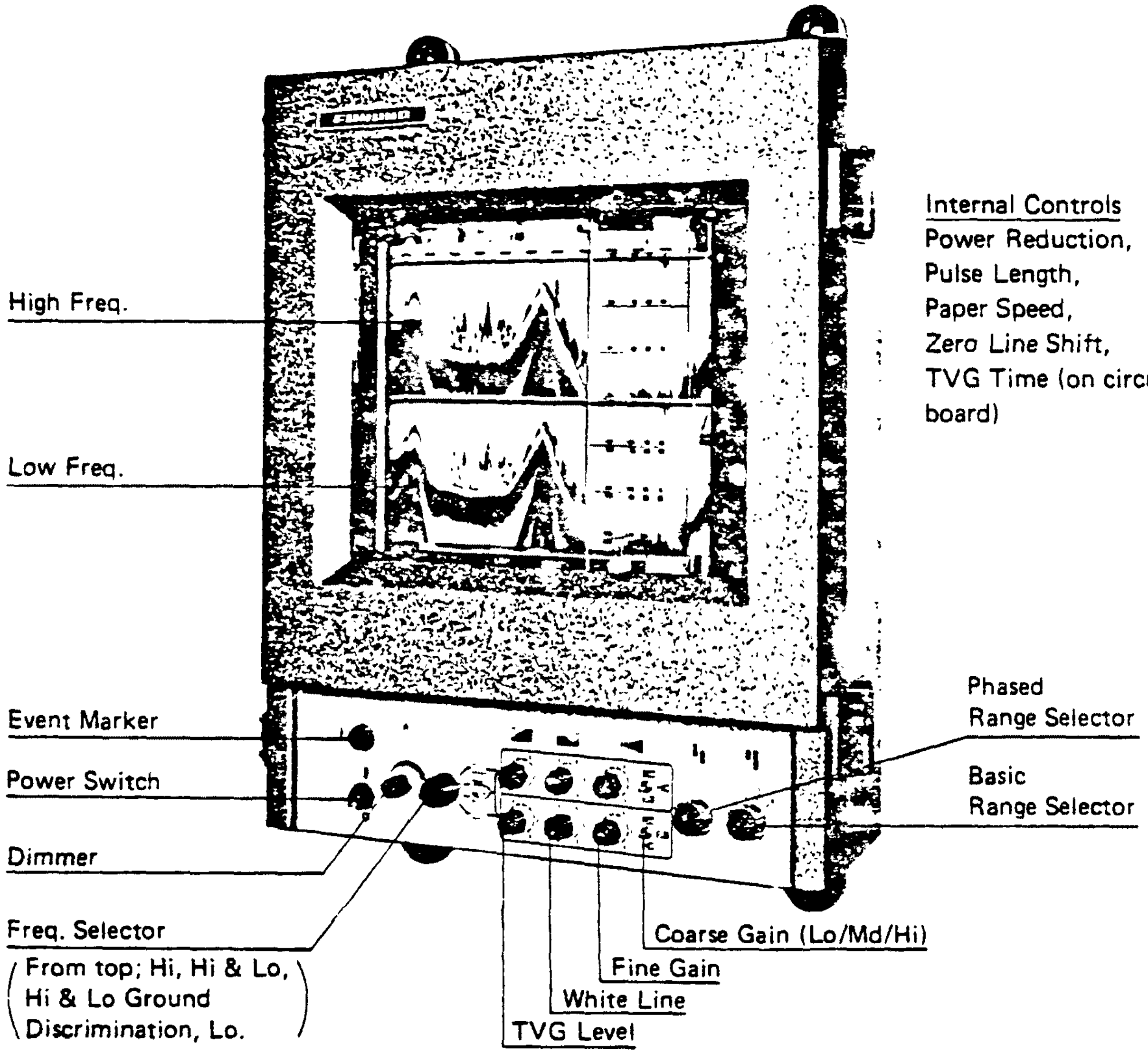
ECHOGRAM MAGNIFIER MEMO-GRAPH EM-1 (OPTION)

Expands a water segment anywhere within the normal recording range. Clearly shows up scattered or small fish schools which are not visible on the normal record.



MODEL FE-824 ... DUAL FREQUENCIES, SUPER Q

■ High sensitivity . . . low noise, wide dynamic range amplifier ■ Powerful . . . built-in 2KW solid-state transmitters for two frequencies ■ Time varied gain . . . adjustable in time (depth) and level ■ 3 pulse lengths ■ Choice of single or dual frequencies ■ Dry or wet paper (FE-D824 or FE-W824) ■ Compact and splashproof ■ Standardized printed circuit boards and modular assemblies, common to the various new-series models ■ Special ground discrimination technique.



The FE-824 is one of the Series-8 fish finders newly developed through FURUNO's advanced electronic technology. All Series-8 fish finders are engineered to the highest standards for severe marine environments, using standardized modules and sub-assemblies.

The equipment consists of a recorder unit and two transducers. The recorder incorporates the receivers, 2KW transmitters and control facilities for two frequencies, all in a rugged cast aluminum cabinet.

The recorder is available with either dry paper or wet paper. The 200mm (8-inch) wide paper gives detailed information of fish schools and seabed.

Dual frequency system increases flexibility of operation. The high frequency is suitable for detecting spanish mackerel, squids and other small fishes. It is also suited for trap fishing. The low frequency provides reliable sounding in deep waters. Because of different beamwidths and reflecting properties of two frequencies, it is even easier to appreciate fish amount and species.

The circuitry is fully solid-state for high reliability, segmented into pulg-in units for easy maintenance.

For avid fishermen, echogram magnifier EM-1, memoscope ES-5 and digital depth indicator ED-202 are optionally available to greatly increase the function of the basic fish finder.

X. TEST NO. 1

Test No. 1

Water Test

Condition: Dredge ready for work

Dustpan head fitted in agreed configuration

Orifice fitted in pipeline

Mercury manometer across orifice

Temporary valve fitted at stern swivel

Readings to be taken:

Pump vacuum gauge (Calibrated)

Pump pressure gauge (Calibrated)

Pipeline guages (2 off) (Calibrated)

Orifice manometer

Diesel engine fuel rack - Exhaust Pyrometers

or Electric motor voltage and amperage

Velocity meter (If fitted)

Water density

Procedure:

(1) Run up pump engine to full speed against 1/4 open valve. Continue running for 30 minutes.

(2) Gradually open valve until engine reaches full load. Set of reading taken after 20 minutes on full load.

(3) Close valve to give pipeline speed of approximately 18 feet per second. Set of readings after 20 minutes.

(4) Close valve to give pipeline speed of approximately 14 feet per second. Set of readings after 20 minutes.

(5) Close valve to give pipeline speed of approximately 10 feet per second. Set of readings after 20 minutes.

(6) Close valve to give pipeline speed of approximately 6 feet per second. Set of readings after 20 minutes.

(7) Close valve completely. Set of readings after 3 minutes.

Repeat procedures (2) to (6) in reverse order.

Run at procedure (2) for 4 hours.

Set of readings every 15 minutes.

Close examination of bearings glands, etc., for overheating, leakage, etc., during this period.

Carry out any adjustments found to be necessary.

After adjustments, if any, run at full load for one hour.

Pumping installation is now ready for dredging tests.

XI. DREDGING TESTS

Dredging Tests

As the cutter suction dredge will be in the dustpan mode, the following will be the variables tested: -

(a) Suction pipe velocity

(b) Immersion of head in material

(c) Speed of advance through the material

The instrumentation fitted will record output but the main parameter to be considered in the initial dredging test is pipeline density.

Until tests and modifications show that no further progress is possible, the ultimate aim of Phase One of dredging must be maximum density with the minimum turbidity.

Thereafter in Phase Two of dredging, the object must be to maximise output without reducing the standards of output and density attained in Phase One.

XII. ADAPTION OF DUSTPAN HEAD

Adaption of Dustpan Head

As an existing dustpan head is specified for the initial test, the main constructional problem is adapting an existing cutter suction dredge to take the dustpan head with the minimum of structural alterations. The simplest method of attaching the dustpan head to the ladder of the cutter suction dredge is to remove the cutter, lay the dustpan head on top of the ladder, introduce some supporting steelwork and weld and bracket to give an attachment strong enough to adequately support the dustpan head and also resist the digging and anchoring loads.

This exercise is shown in Figs. 1a - 1b - 1c. This arrangement is satisfactory in the sense that the attitude of the head to the ground is satisfactory for silt dredging and there is adequate ground clearance between the suction ladder and the material being dredged.

However, examination of the loadings involved demonstrated that: -

(a) The normal cutter suction dredge mode has the following loading:

(1) Ladder up - Pipe Empty - Load on Wires 20.41 tons

(2) Ladder up - Pipe Choked - Load on Wires 23.58 tons

(b) Dustpan head fitted as shown in Figs. 1a - 1b - 1c

(1) Ladder up - Pipe Empty - Load on Wires 43.4 tons

(2) Ladder up - Pipe Choked - Load on Wires 50.92 tons

The obvious alteration from Fig. 1 to Fig. 2 was to move the dustpan head rearwards as far as possible to reduce the load on the hoist gear. Unfortunately, although this is the best arrangement from a structural point of view, the suction ladder fouls the ground at the minimum and maximum depths envisioned in the study.

For this reason the arrangement shown in Figs. 2a - 2b - 2c is no longer being considered.

The final arrangement of the dustpan head is as shown in Figs. 3a and 3b. This arrangement requires a more complicated supporting structure and requires two more bends in the suction system.

(c) Examination of the hoist wire loadings in this position give the following:

(1) Ladder up - Pipe Empty - Load on Wires	37.67 tons
(2) Ladder up - Pipe Choked - Load on Wires	44.43 tons

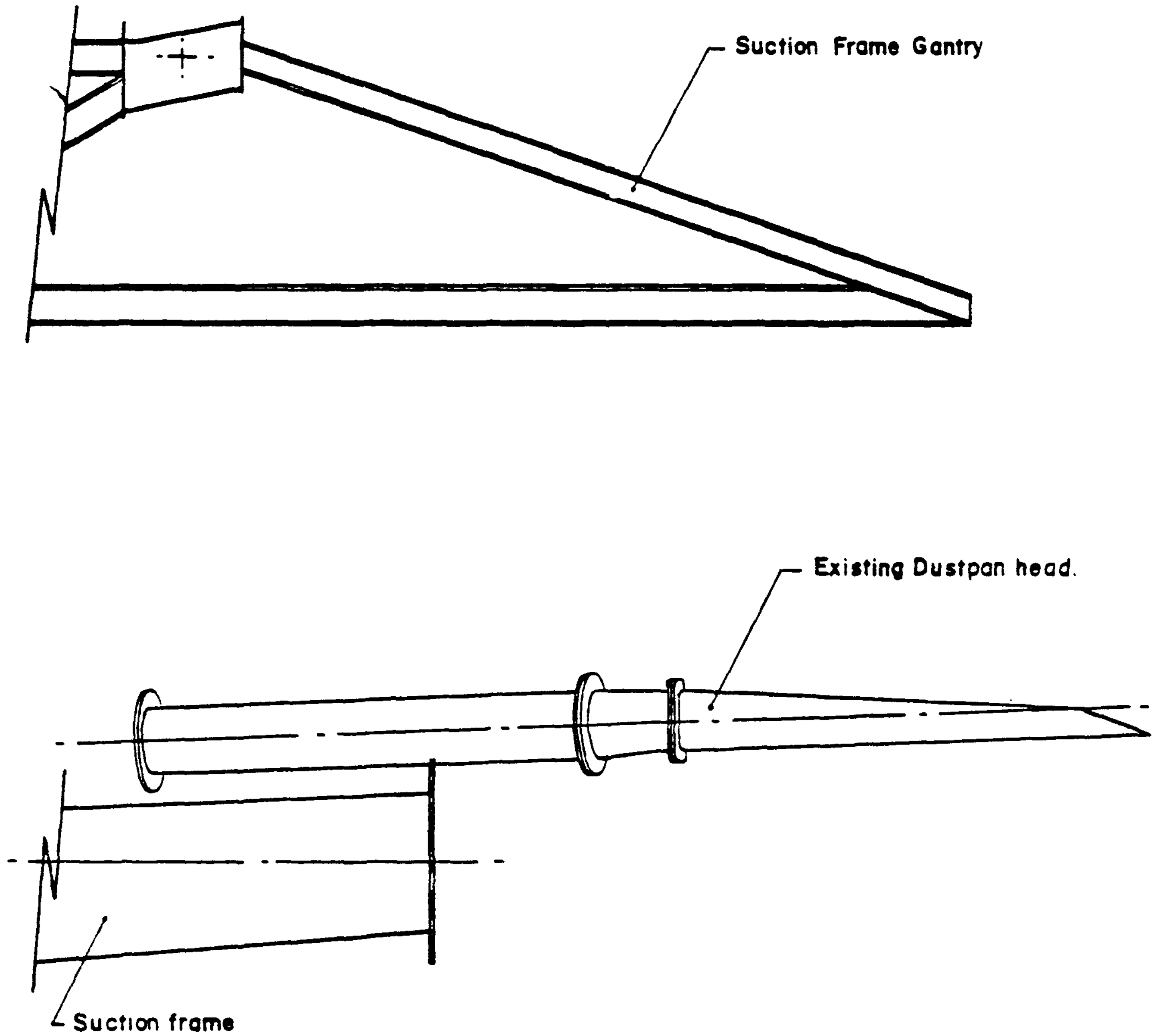
(d) From the above it is obvious that in the best position, i.e., the 45^{0} position shown in Figure 3a - 3b, the overload from the normal cutter suction dredge is as follows:

(1) Ladder up - Pipe Empty - Overload	184.5%
(2) Ladder Up - Pipe Choked - Overload	188.4%

These figures apply to the "known" dredge but will be indicative of any cutter suction dredge. As the indication is that the safety factor of the hoist gantry, hoist gear and hoist winch will be almost halved, then a very detailed analysis of all the involved components in the selected dredge will be required before finalising the choice of dredge.

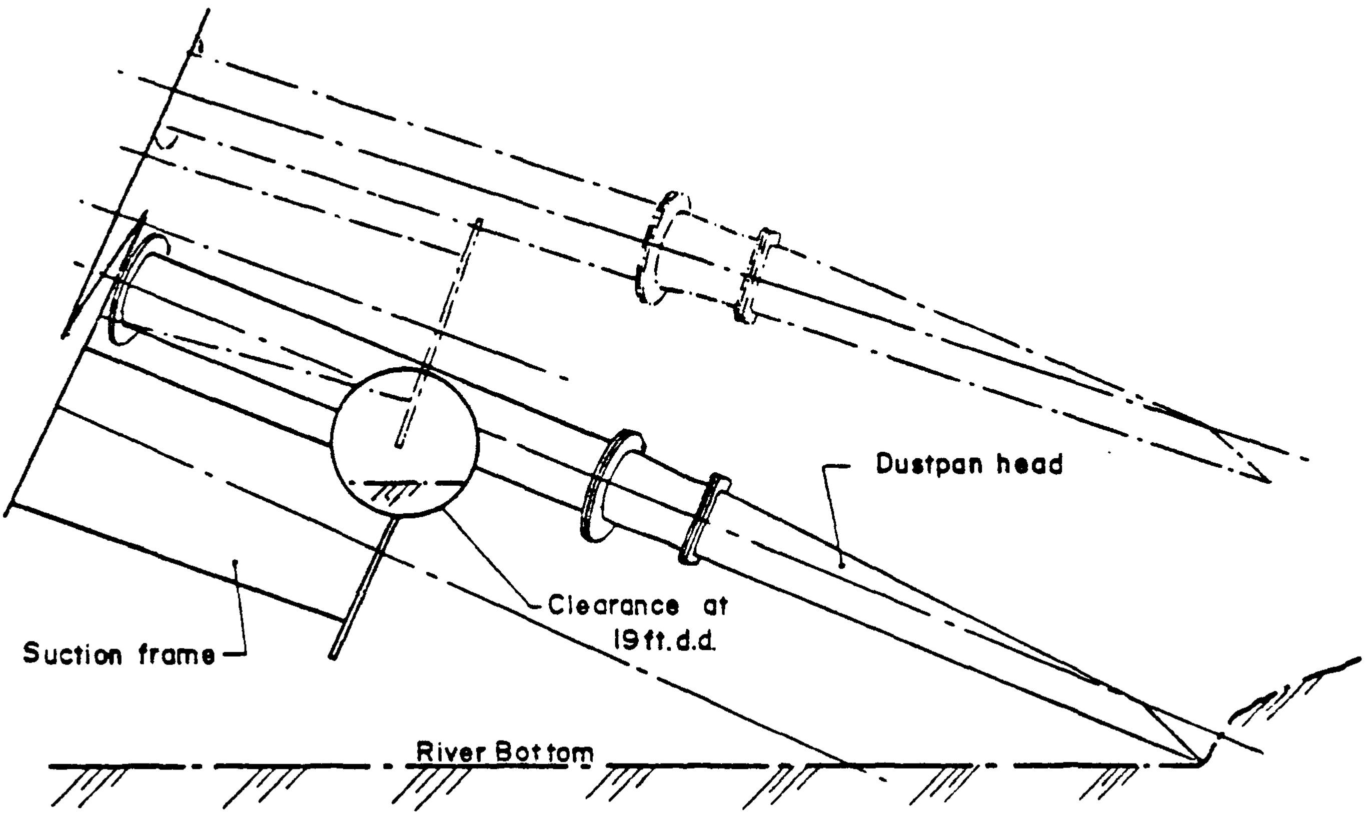
Taking into account the very high extra loadings involved, it is obvious that the test dredge must be selected with reference to the hoist components, in order to avoid the very expensive procedure of upgrading the hoist components to take care of the extra loading.

Fig. 1a.



Profile
(frame in stowed posn.)

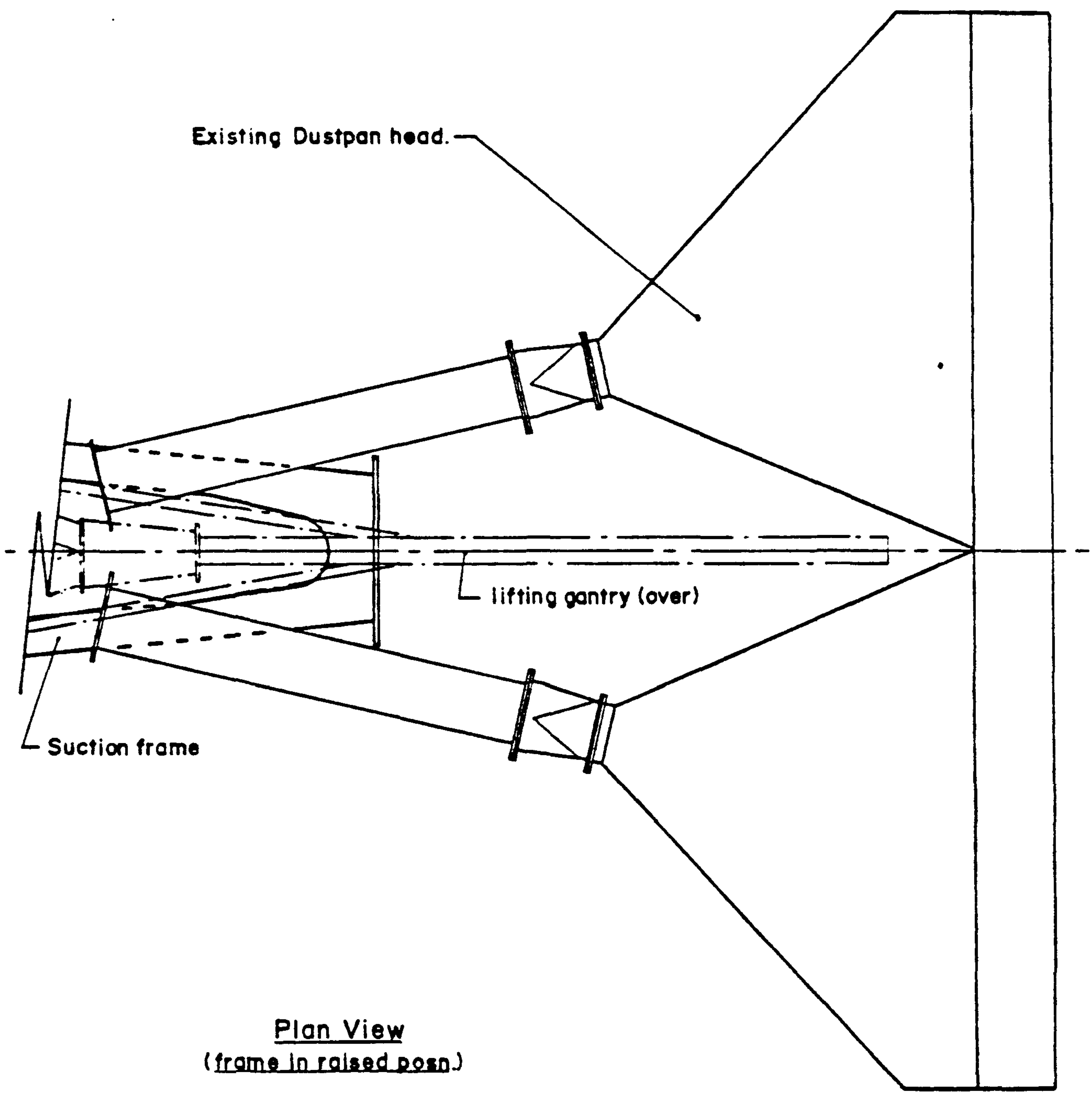
Fig. Ib.



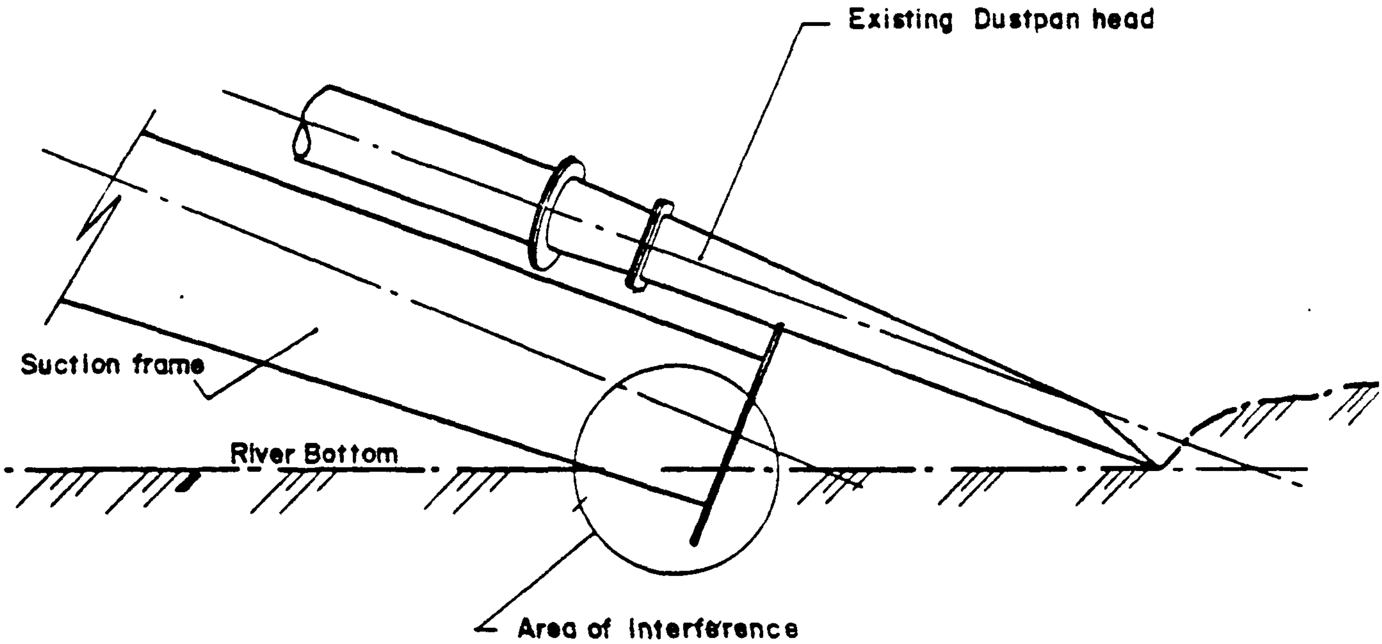
Profile
(at 25 ft. dredging depth.)

Amalgamated Dredge Design Inc.

Fig. Ic.

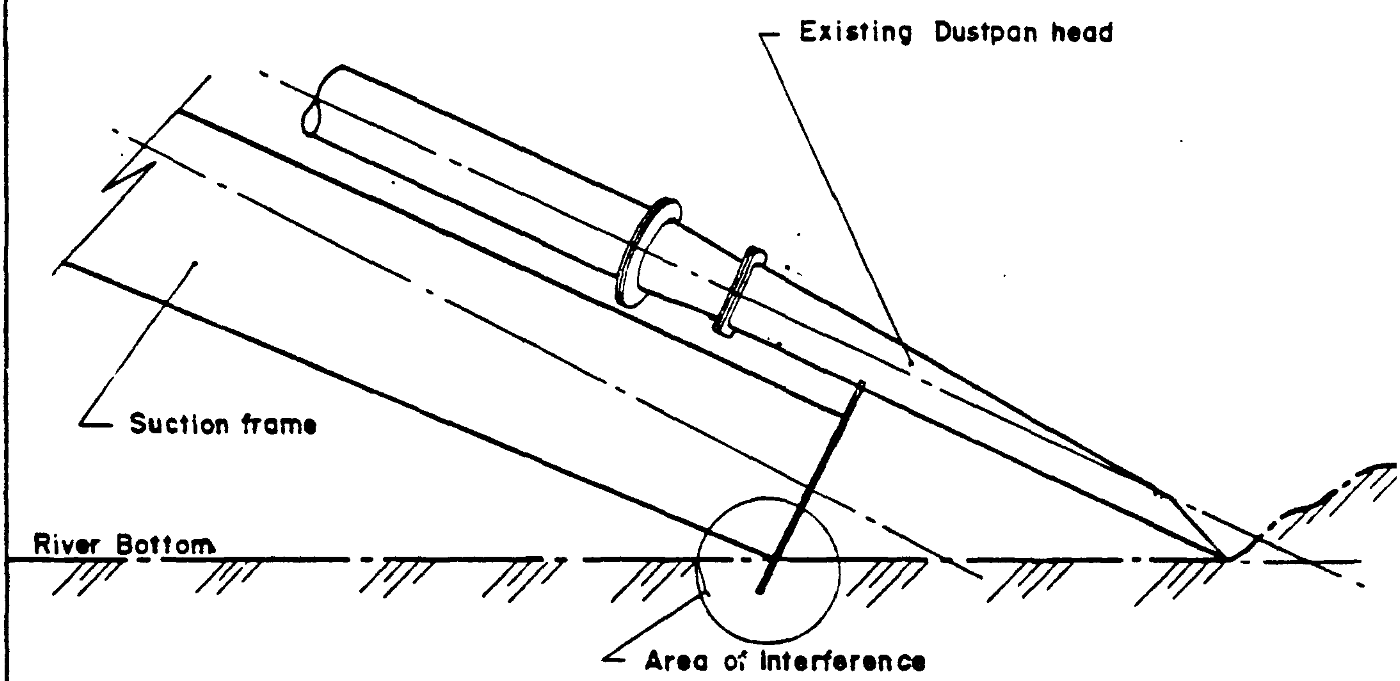


Plan View
(frame in raised posn.)



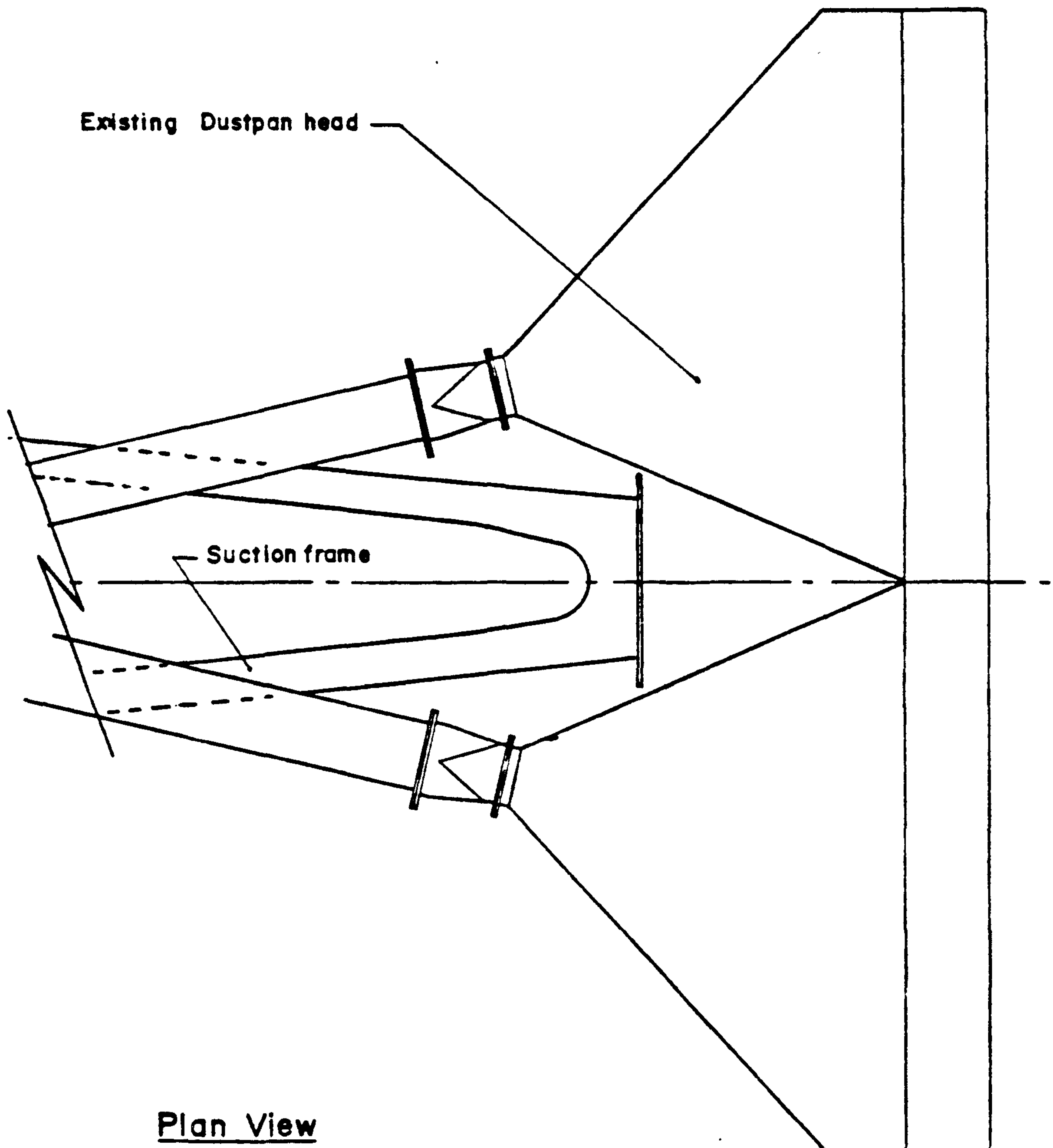
Profile
(at 19 ft. d.d.)

Fig. 2b.



Profile
(at 25 ft. d.d.)

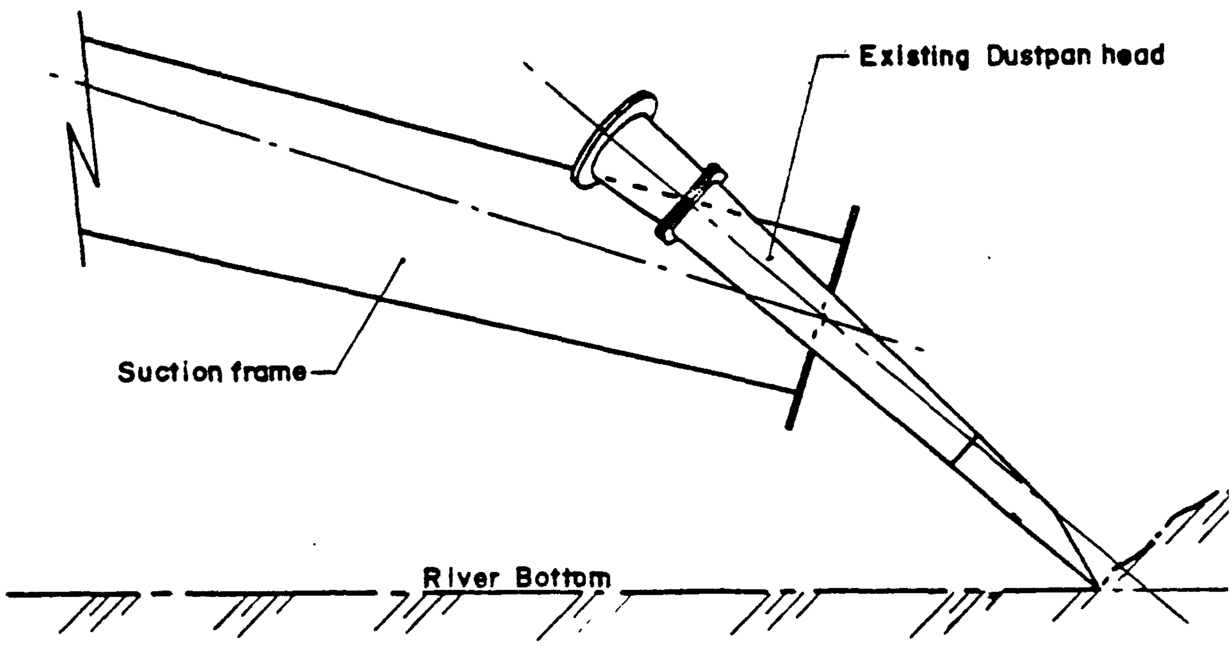
Fig.2c.



Plan View
(frame in raised posn.)

Amalgamated Dredge Design Inc.

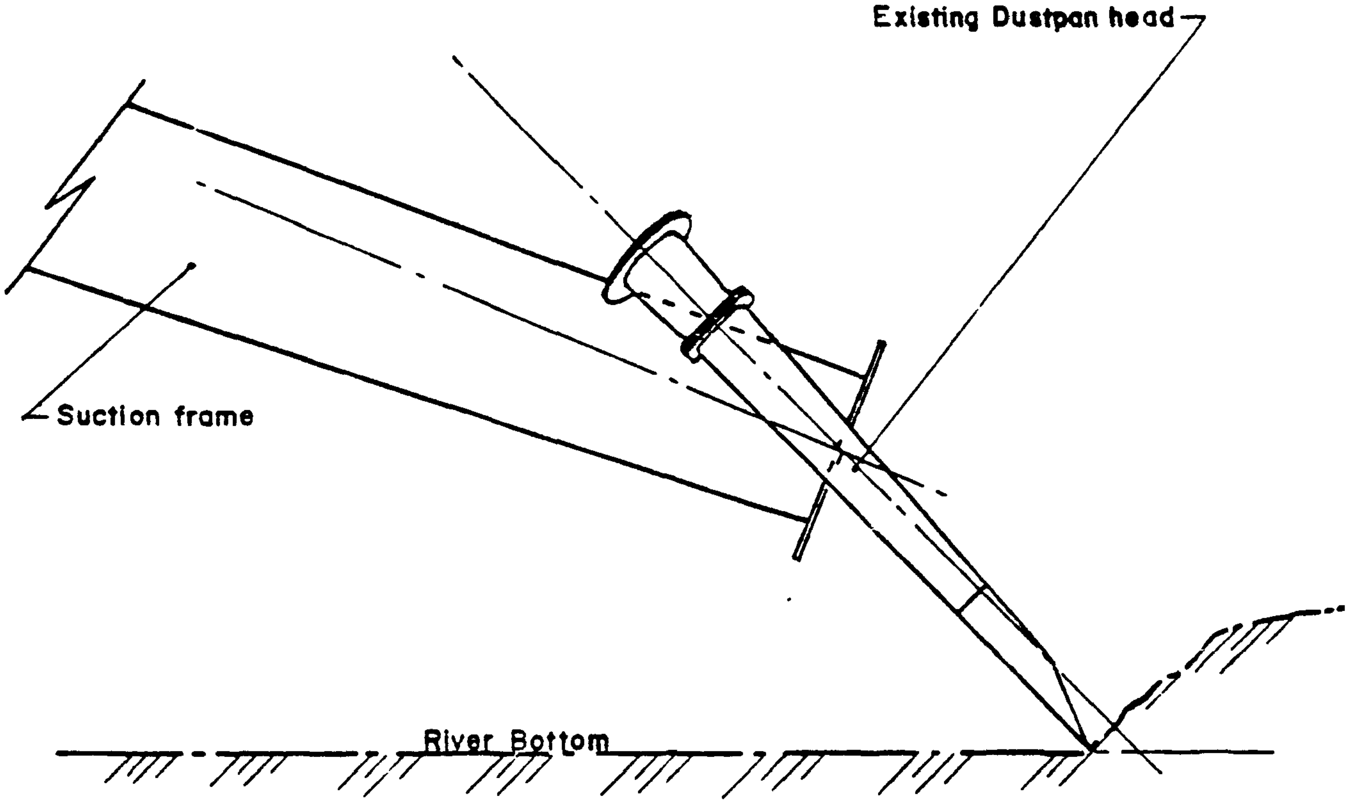
Fig. 3a.



Profile
(at 19 ft. d.d.)

Amalgamated Dredge Design Inc.

Fig.3b.



Profile
(at 25 ft.d.d.)

ADD

AMALGAMATED DREDGE DESIGN, INCORPORATED

856 PUBLIC LEDGER BUILDING • PHILADELPHIA, PENNSYLVANIA
(215) 925-8794 • Telex: 845182 DREDGE DES PHA, 19106

February 6, 1980

Mr. Frank T. Wootton
Chief, Water Resources Planning Branch
United States Army Engineering District Norfolk
Corps of Engineers
803 Front Street
Norfolk, VA 23510

Dear Sir,

Demonstration Project in James River, Virginia

Further to our preliminary Phase I Report of December 7, 1979, we now enclose for your perusal Addendum No. 1, based upon the proposed dredge "ESSEX." Additional copies of this addendum will be made available for circulation at our meeting in Norfolk, now scheduled for Feb. 20.

Also enclosed for your attention is our "Initial Cost Estimate" for the demonstration test; and based upon modification to the dustpan head of the A.C.O.E. dredge "KENNEDY" as well as to the cutter dredge "ESSEX" to accomodate this head. Additional copies of this cost estimate will again be made available for distribution at your discretion.

Finally, and for further discussion between ourselves, we have included a Proposed Scope of Work for A.D.D. in Phase 2 - the designing and planning phase leading up to the commencement of the test itself at the commencement of fiscal year 1981.

Trusting you find this to be in order, I remain,

Yours sincerely,

Alexander E. Izett
Executive Vice-President

:kmc
Enclosure(s)

Sio

<u>CONTENTS</u>

PHASE 1 ADDENDUM NO. 1

PHASE 1 - JAMES RIVER PROJECT: ADDENDUM NO. 1

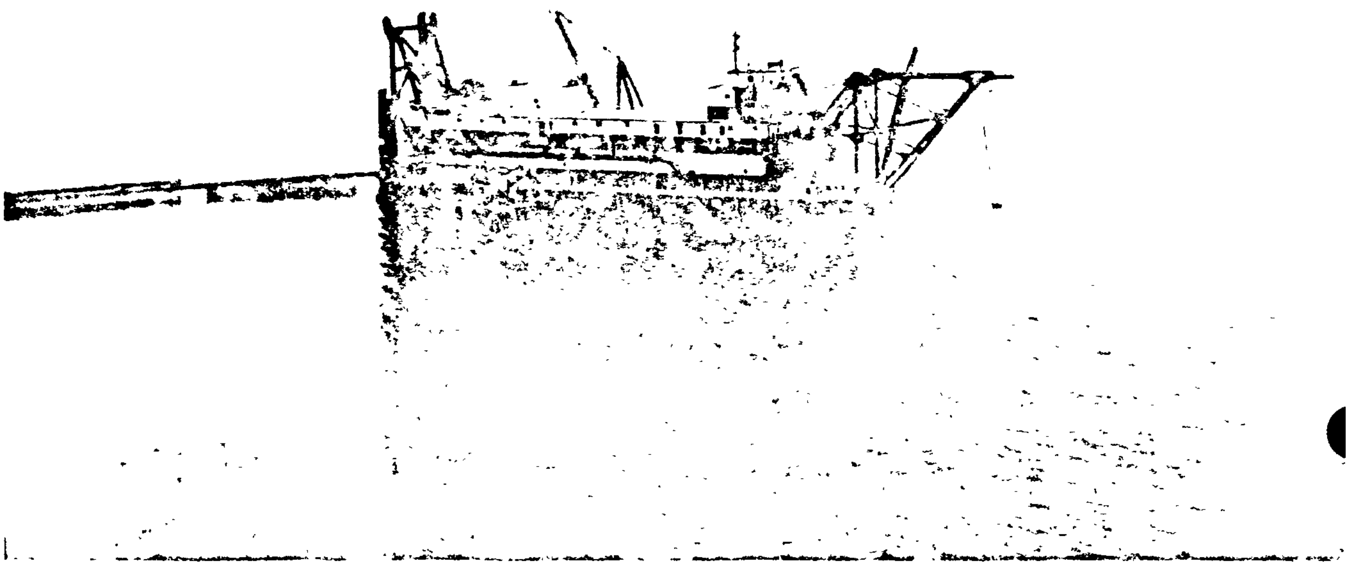
The Dredge

Following the submission, on December 7, 1979, of the preliminary Phase 1 Report, wherein reference was made to a "known" dredge for illustration purposes a further visit was made to Norfolk District to meet with local dredging contractors; namely, Atkinson Dredging Company and Norfolk Dredging Company, with a view to locating a suitable cutterhead dredge within the area; capable of being modified to carry the dustpan head as anticipated in the final test programme.

Just such a dredge would appear to exist in the "ESSEX", an 18" pipeline dredge, built in 1978, and owned and operated by Norfolk Dredging Company. Initial investigation would appear to suggest that this dredge would be eminently suitable for the task envisaged; however, prudence dictates that the "ESSEX" should be inspected on location in order to confirm this.

Furthermore, and after study of the proposed dustpan head on location at the A.C.O.E. jetty in St. Louis, it would appear that such a conversion could well be effected with the minimum of modification to both the dustpan head and its ladder (of the A.C.O.E. dredge "KENNEDY") as well as to the dredge "ESSEX" itself.

Details of the "ESSEX" appear on the following page. All references to the "known" dredge within the Phase I Report should therefore be corrected on the basis of this information.



Cutterhead Dredge "ESSEX" (photo: courtesy of Norfolk Dredging Co.

CUTTERHEAD DREDGE "ESSEX"

Principal Characteristics: --

Hull - Length	140"-0"
Breadth	36'-0"
Depth	10'-0'
Cutter Power	300 hp.
Dredging Depth	40'-0" (designed 55'-0")
[illegible] Size	21" x 19"
Power	2250 h.p.
[illegible] & Swing Winch	75 h.p. @ 400 r.p.m. 25,000 lb. S.L.P. @ 60 f.p.m. (based on 2nd wrap of 1" dia cable and 400 rpm of motor) 20" barrel dias.

Manoevring/Anchor Wires

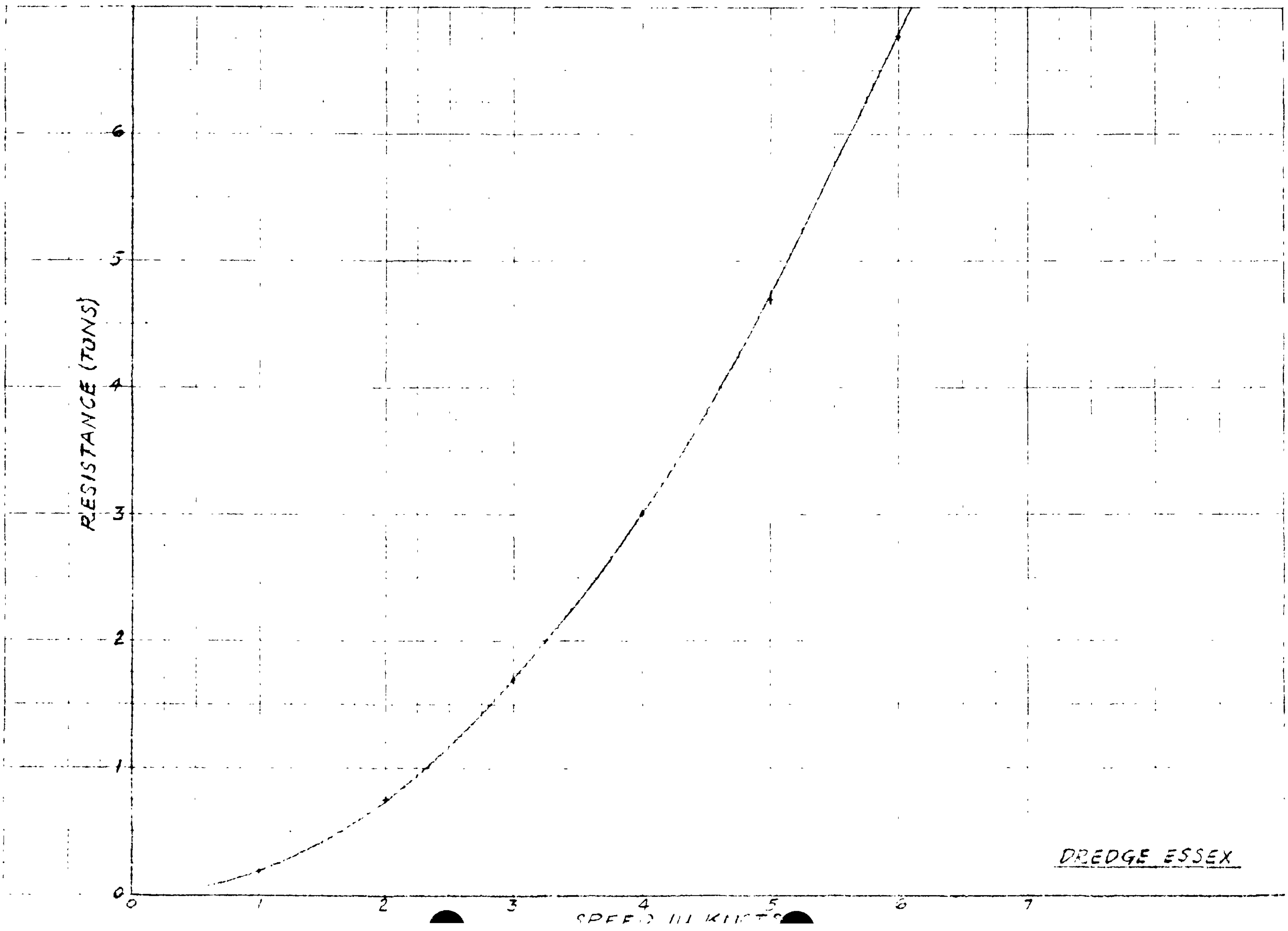
No problem is foreseen at this stage in adapting the swing winch barrels of the dredge "ESSEX" to accomodate the headwires of the "modified dustpan" dredge: at present the "ESSEX" operates with 600 ft. of 1 1/8" dia. wire rope, with a barrel capacity of even greater.

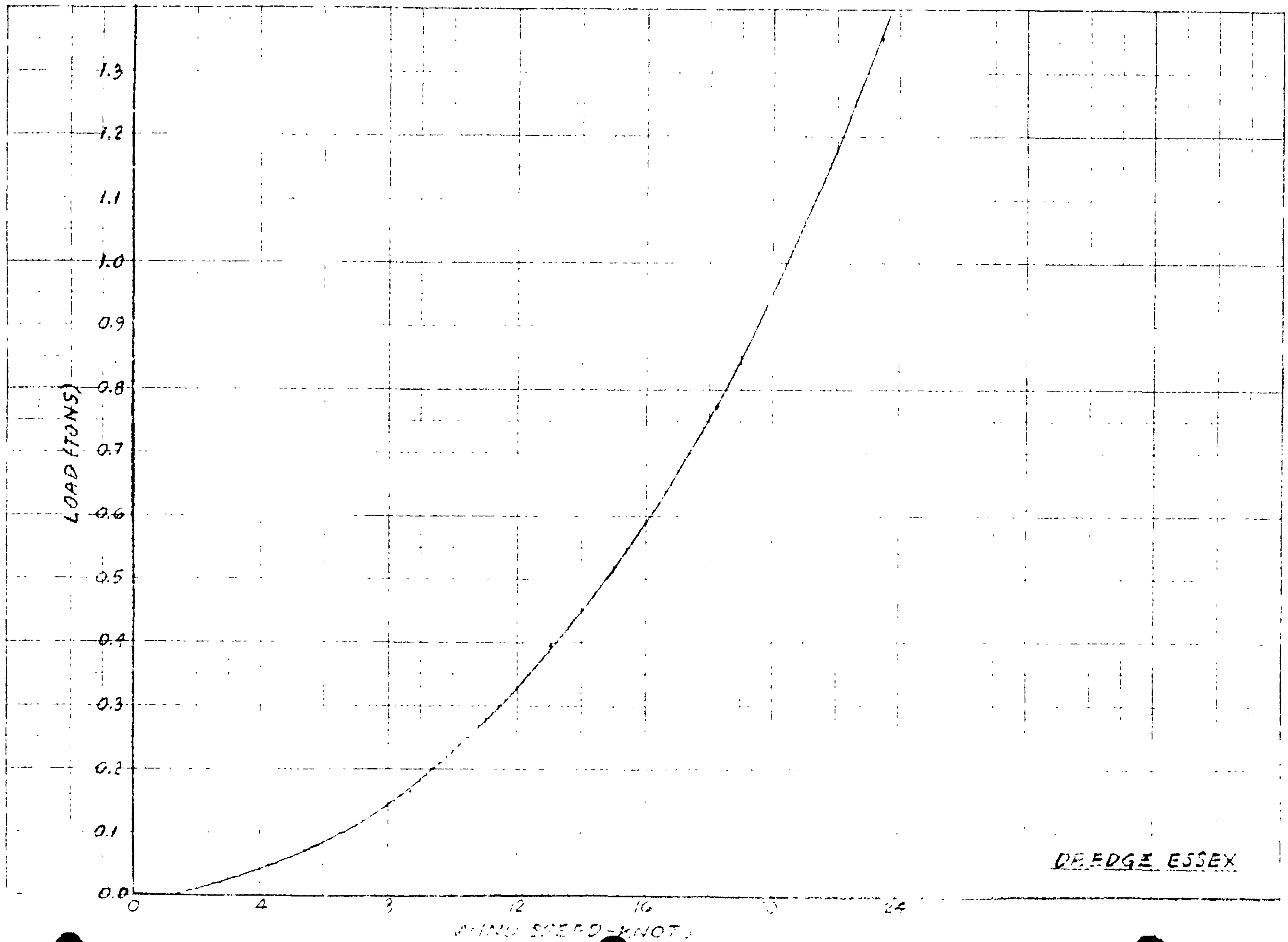
As was previously stated, the headwires of a dustpan dredge are designed to resist the combined pressures of wind and current resistance on the dredge hull as well as the pull required to force the dustpan head into the material. Modified graphs for both wind and current resistance, based on the dredge "ESSEX", are therefore appended hereto.

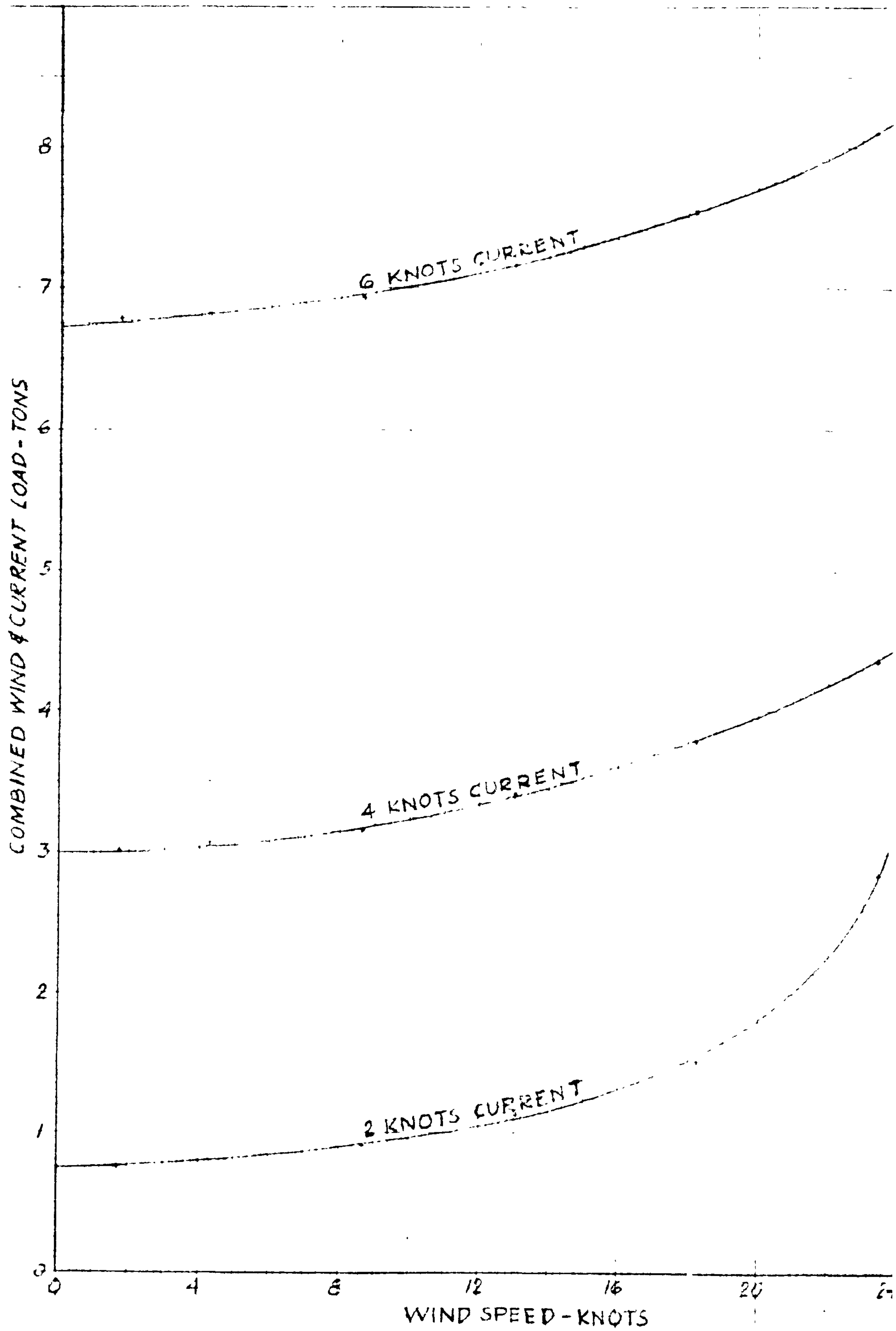
If we are to assume the same "head" force as previously, i.e., 0.5 ton, and the dredge operating against the same river current of 3 knots and a wind speed of 19 knots, then the total combined load would be 3.05 tons for the dredge "ESSEX."

This would then provide, on the basis of ½" 6/37 construction headwires, a safety factor of 5.14 assuming two such wires; and 2.57 with only one wire.

Reference in the earlier Report was made to the necessity of the dustpan dredge, when operating during flood tide, to be equipped with a stern anchor. On a modified "ESSEX" this would be achieved by utilising the anchor boom barrels of the forward winch and running the wire aft to a convenient point.


DREDGE ESSEX
RESISTANCE (TONS)
0
1
2
3
4
5
6
7


LOAD (TONS)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
0
4
12
16
24



DREDGE ESSEX

January 1980

EVALUATION OF MAINTENANCE PROJECT

JAMES RIVER NORFOLK

DREDGING TEST

INITIAL COST ESTIMATE

Copy No. 4 of 18 Copies

Estimate

Items 1-10 Inclusive	$2,052,600
Items 11-19 Inclusive	315,000
Items 20-24 Inclusive	Not Quantified
TOTAL	$2,367,600

ESTIMATE SUMMARY

Item	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Total
1	50,900	173,400	173,400	173,400	173,400	50,900	795,400
2		17,300	17,300	17,300	17,300		69,200
3		61,600	61,600	61,600	61,600		246,400
4		12,200	12,200	12,200	12,200		48,800
5		15,000	15,000	15,000	15,000		60,000
6		38,400	38,400	38,400	38,400		153,600
7	80,000	80,000	80,000	80,000	80,000	80,000	480,000
8		14,400	14,400	14,400	14,400		57,600
9	14,000	14,000	14,000	14,000	14,000	14,000	84,000
10		14,400	14,400	14,000	14,000		57,600
			1-10 Sub-Total				$ 2,052,600

Item	Description	Total
11	Transport from St. Louis Ladder & Suction Head & Fairleads	35,000
12	Removal of Ladder from Dredge "Essex"	20,000
13	Mobilization of Dredge "Essex"	100,000
14	Adaption of " KENNEDY " Ladder & Fairleads	35,000
15	Installation of " KENNEDY " Ladder & Fairleads	20,000
16	Testing Equipment	70,000
17	Installation of Test Equipment	10,000
18	Installation of Wire Ropes, Anchors, etc.	5,000
19	Cost of Wire Ropes, Anchors, etc.	20,000
	11 - 19 Sub-Total	$ 315,000

(Continued)

The following not quantified

20	Contingency allowance
21	Insurance not included in rental costs
22	ACOE personnel and services other than 4 recorders
23	"Other" personnel and services other than 4 recorders
24	"Committee" personnel and expenses
25	Travel and Hotel expenses

TOTAL $2,367,600

ACTIVITY COSTS

Item	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
1	50,900	173,400	173,400	173,400	173,400	50,900
2		17,300	17,300	17,300	17,300	
3		61,600	61,600	61,600	61,600	
4		12,200	12,200	12,200	12,200	
5		15,000	15,000	15,000	15,000	
6		38,400	38,400	38,400	38,400	
7	80,000	80,000	80,000	80,000	80,000	80,000
8		14,400	14,400	14,400	14,400	
9	14,000	14,000	14,000	14,000	14,000	14,000
10		14,400	14,400	14,400	14,400	

TEST EQUIPMENT COSTS

Item		
a	Velocity Meter	
b	Density Meter	55,000
c	Echo-Sounder	Survey vessel
d	Position Finders	Survey vessel
e	Turbidity meter	7,000
f	"Tank & Piping"	3,000
g	"Sample Pump"	1,000
h	Guages	1,000

PLANT MONTHLY COSTS

Item	Plant	Rental/mo	Op/month	Total
1	Dredge	50,900	122,500	173,400
2	Pipeline	17,300		17,300
3	Tug	12,200	49,400	61,600
4	Derrick	9,700	2,500	12,200
5	Supply Barge	14,000	1,000	15,000
6	Crew Boat	4,000	34,400	38,400
7	Survey Boat	30,000	50,000	80,000
8	ACOE	4 men	14,400	14,400
9	ADD		14,000	14,000
10	Others	4 men	14,400	14,400

POINTS FOR DISCUSSION

DUSTPAN HEAD

Dustpan Head - Ex Dredge Kennedy

On visual inspection of the "Kennedy" Dustpan head at St. Louis no problems emerged which would have prevented the use of this head on the dredge "Essex." However, it was felt that some of the unnecessary hardware should be removed from this unit before transporting it to Norfolk. Accordingly, arrangements were made to remove the following: --

(a) The main water supply pipe to the jet header manifold;

(b) The jet header manifold;

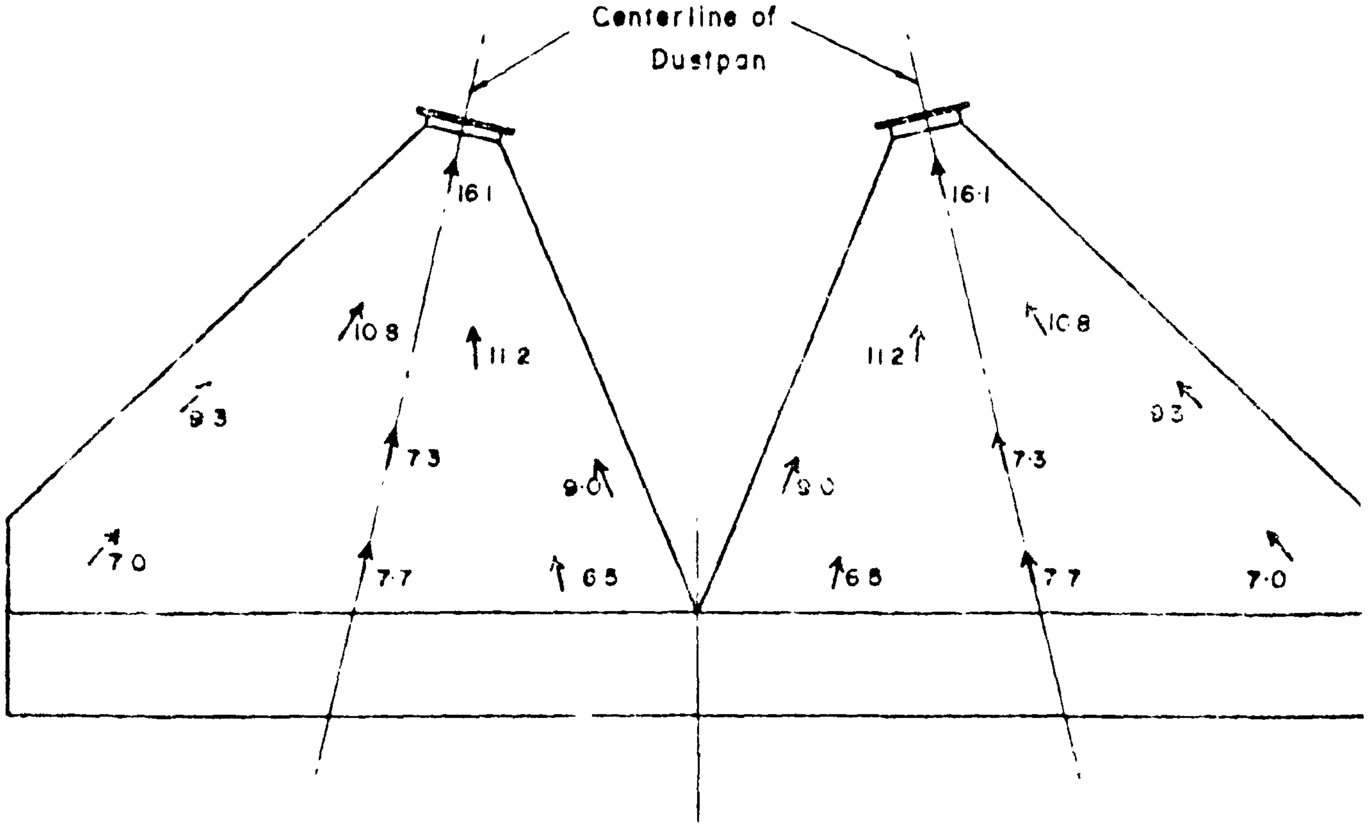
(c) The jet supply pipes;

(d) The cutting teeth fitted to the lower edge of the mouthpiece.

Removal of these appendages and obstructions to flow will then leave the mouthpiece area "clean" hydraulically. The flow pattern will then approximate to that shown on the attached sketch reproduced from the tests on the model head used in the "Jadwin" tests. The hydraulic effect of alterations or additions at the mouthpiece will then be amenable to calculation. It is suggested that, in Phase 2, the hydraulic effect of sub-dividing the mouthpiece area be investigated in an endeavour to ensure the best entry conditions with the head in its present configuration. The purpose of this sub-division should be to even out the present uneven flow within the head and at the same time give the head a better degree of lateral stability as it passes through the soft material. The dividers or "splitters" should also extend ahead of and below the entry to break the cohesion of the higher density silts.

Fig.1

Inlet Conditions



↑ = Direction of Flow

Note: All Velocities shown in Ft per sec.

KENNEDY LADDER

Kennedy Ladder

The modifications to the "Kennedy" ladder to suit the "Essex" trunnion bearings should be relatively simple and straightforward. However, consideration should be given to future use of the "Kennedy" ladder in other dredges in other areas. Should we then design trunnion bearings that can be easily modified or adapted, e.g., should the bearings be made oversize to enable various bushings to be used to adapt to other diameter of pins? Should the width also be adjustable by packing pieces or washers?

ESSEX WINCH

SPEED-MOTOR RATING-MANOEVRING

Essex Winch

The normal mode of dustpan dredge operation utilises two independently driven winch barrels. This independent operation is used by the dredge operator to maintain the dredge on the line of cut.

The "Essex" winch is a five barrelled winch driven by a single motor. It is intended to use the swing barrels of this winch for the head wires in the dustpan mode. The clutches driving the barrels are air set, spring release and the barrel brakes are spring set, air release. The characteristics of the pneumatic controls will require to be investigated to ensure that the head wires can be operated as if the barrels were independently driven, i.e., by slipping one clutch or by operating intermittently without losing tension on the head wires.

The main winch motor is 75 H.P. 400/1600 R.P.M. The barrel pull at 400 R.P.M. is 20,000 pounds and the line speed based on the second wrap is 60 feet per minute.

The proposed speed of advance based on 1000 cubic yards per hour output is 5 feet per minute.

The winch is also fitted with an auxiliary motor of 5 H.P. driving through a right angle reduction gear. Assuming the reduction gear is 75:5, i.e., 15:1 then the hauling speed using the auxiliary motor would be 4 feet per minute. Assuming again the same speed range as the main motor, this line

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speed would be variable between 4 feet per minute and 16 feet per minute.

These are assumptions as the auxiliary gearbox reduction and the auxiliary motor speed range cannot be made available to us at this time.

In view of the uncertainty of this major item effecting production and testing we feel an early visit to the Dredge Essex should be given highest priority.

ESSEX FAIRLEADS

Fairleads - Ex. Kennedy

As a dustpan dredge operates on two head wires it is essential that two robust balanced fairleads are fitted to the forward part of the Dredge Essex hull.

Accordingly arrangements were made with the ACOE staff at St. Louis to remove the forward fairleads from the Dredge Kennedy and forward these to Norfolk on the same transport as the Kennedy ladder and dustpan head.

ESSEX STERN ANCHORS

Stern Anchoring Arrangement

In the normal operating mode a dustpan dredge faces into the river current and requires only head anchors to remain on station.

When a cut has been completed over the shoal it is only necessary to pay out on the head wires and the river current will move the dustpan dredge back to the starting point of the cut.

However, in a tidal estuary where there may be periods of zero flow or reversal of flow it will be necessary to have four anchors, i.e., 2 head anchors and 2 stern anchors.

The 2 head anchors will be used in the normal mode when dredging and the two stern anchors will be used to create a drag to hold the dredge on station and resist the reversal of tidal flow if this takes place.

It is suggested that the stern anchoring arrangement use the anchor boom barrels of the main winch.

These wires would require to be led aft by means of snatch block and these could possibly be fastened to the normal mooring ballards.

Consideration would need to be given to the presence of the pipeline aft of the dredge.

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Ideally the stern anchor wires should be led underwater to a depth where they could safely pass under the floating pipeline.

If this is not practical then they could be led upwards to pass over the floating pipeline.

It is believed that either of these arrangements could be designed using the existing spuds as attachment points.

This problem would require to be investigated in Phase Two.

ESSEX PIPELINE

Essex Pipeline

The discharge floating pipeline of a dustpan dredge is normally rigid, (no ball joints) fitted with rotating floats which can be trimmed to the water flow to roughly position the pipeline in relation to the dredge. The final position of the discharge end of the pipeline is accomplished by means of a vane in the discharge outlet. This vane is under the control of an operator located on the last float and adjustment of this vane by the operator finally positions the discharge end of the pipeline.

This type of discharge arrangement is suitable when the intention is to spread the material over a long area local to the dredge.

However, it is our belief that the discharge area on the James River will not be local to the dredge and will not have the same length as the dredge cut.

On this assumption, i.e., a fixed discharge, a sufficient length of floating line to allow 1000 feet forward movement of the dredge and sufficient lateral movement to cover the shoal being dredged must be rented. The configuration and anchoring arrangements of the pipeline must be investigated when details of the dredging site and deposit ground are made available.

PHASE 2 - PROPOSED SCOPE OF WORK

Phase 2 - James River Project: Proposed Scope of Work

1) Provide final report giving detailed recommendations for the dredging tests to be carried out in fiscal year 1981.

2) Visit to Dredge "Essex" on location to inspect and confirm preliminary information.

3) Provide general arrangement drawing of Dredge "Essex" showing "Kennedy" ladder and dustpan head fitted.

4) Provide calculations sufficiently detailed to assure the owners of Dredge "Essex" that the test equipment will neither overload nor damage the hull or superstructure of the dredge.

5) Provide detailed drawings of the following: --

(a) Modifications to Dustpan Head and suspension;

(b) Modifications to "Kennedy" ladder and pivot bearings to suit "Essex" pivots;

(c) Modifications to "Essex" fore deck arrangement to enable "Kennedy" deck fairleads to be used;

(d) Arrangement of "Essex" anchor boom wires used as stern anchor wires;

(e) Arrangement of sampling points at dustpan head including detailed drawing of supporting structure;

(f) Sampling tank and fitting of turbidity meter;

(g) Test equipment and fitting instructions;

(h) Any other sketches required to assist the conversion sub-contractor.

6) Provide ADD personnel to discuss all aspects of the conversion with the nominated sub-contractor.

7) Provide ADD personnel on standby at the sub-contractor's work to ensure the required quality of workmanship.

8) Provide ADD personnel to assist in before charter surveys.

9) Visit to Dredge "Essex" to examine the dredge in the "as is" condition and to investigate the adjustments or modifications necessary to the main winch to enable it to be operated in the dustpan mode.