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	Project Operation DREDGING INSPECTORS' INSTRUCTION GUIDE	
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HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D. C.

Pamphlet
No. 1130-2-310

28 June 1963

PROJECT OPERATION
Dredging Inspectors' Instruction Guide

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*Appendix - Specific Duties and Reporting

*This will be published at a later date.

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1. Purpose and Scope.

a. This publication contains information for assisting and instructing dredging inspectors in the performance of those technical and administrative duties which are required for the proper inspection of such operations. Its chief objective is to promote efficient and uniform procedures for inspecting dredging operations, handling computations, and preparing related reports.

b. For the most part this pamphlet is a guide only. It does not supersede the technical provisions of any contract or invalidate any Contracting Officers' directives and regulations. Although the procedures are specifically for contract operations, they are equally applicable to Government plant and hired labor dredging except for hopper dredge operations which are treated separately in the "Manual of Instructions for Hopper Dredge Operations and Standard Reporting Procedures."

2. References.

- a. ER 1130-2-310
- b. EM 385-1-1
- c. EM 1125-2-312

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3. Dredging Program. The Corps of Engineers annual dredging program involves the removal and disposal of approximately 250 million yards of material at a cost exceeding \$100 million. This includes new work dredging as well as maintenance. A continued and extensive dredging program is necessary for the improvement and subsequent maintenance of the interlacing systems of harbors and waterways. The 500 commercial harbors and 23,000 miles of waterways being maintained as Federally authorized projects handle more than one billion tons of commerce annually. The unrestricted movement of commerce over the navigable waters of the United States is a vital asset to its economic welfare and security.

4. Terminology. In dredging, as in other Corps of Engineers construction, there are certain administrative and documentary terms so closely related to the work that the inspector needs to be thoroughly familiar with their meaning. These terms, as used in this pamphlet, are defined as follows:

a. District Engineer. The District Engineer, nearly always a United States Army Officer, is the highest authority in the District. In those Corps of Engineers organizations having the operational unit at Division level (such as New England Division), the term District Engineer refers to the Division Engineer.

b. Contracting Officer. The Contracting Officer, usually the District Engineer is the official authorized to enter into and administer a Corps of Engineers contract.

c. Resident Engineer. On Corps of Engineers construction and maintenance work, the Contracting Officer generally has an authorized representative at the work site who is directly responsible for determining that the terms of the contract are being complied with. On work of major scope this official is generally a Resident Engineer with a staff of inspectors under his supervision. On work of less magnitude, and particularly in dredging operations, the representative is an Inspector Supervisor or the Inspector himself.

d. Supervisory Personnel. The Supervisory Personnel are those officials in the direct chain of command who are responsible for the operation and prosecution of the construction work. The Supervisor is responsible for direct supervision of the inspector's work and issues instructions and orders to the inspector. All communication between the inspector and the District Office will be made through his supervisor except in emergencies.

e. Higher Authorities. Higher Authorities are those officials whose concern with the work is indirect and supplementary. They include personnel and all officials from Divisions and the Office of the Chief of Engineers.

f. Contractor. The Contractor is that person or group of persons who agrees for a stated sum of money to do a specific item of work for the Corps of Engineers. The term Contractor, in this manual, embraces the prime contractor and all the subcontractors employed by him.

g. Contract. The Contract is a legal written agreement between the Contractor and the Contracting Officer which binds the Contractor to do certain specified work for an agreed sum of money.

h. Plans and Specifications. The Plan is a drawing which in general construction shows the principal proportions and relative positions of the various parts of the work. In dredging, the chief feature of the Plan locates the area to be dredged by means of horizontal boundaries and vertical distances from the water surface. These vertical distances, correlated to a desired datum, are called soundings and are shown on the Plan either as a series of numerical notations graduated, usually, to tenths of a foot, or by channel cross sections. The Plan also includes certain information peculiar to dredging operations such as tide and stream data, type and location of buoys, location of disposal areas, etc. The Specifications are a narrative supplement to the

Plan and state what is to be done, the controls required, and how the various items of work are measured and paid for. Together, the Plans and Specifications call for completed work representing the best considered judgment of the District Engineer and are legally a part of the Contract.

1. Modifications to the Contract. Modifications change the provisions of a contract after award to cover additions, revisions, and deletions to the work, extensions of time, changes in design, changed conditions, or other changes found to be necessary and in the best interest of the United States. The modification may be issued in the form of a Change Order or Supplemental Agreement. A Change Order is used if the modification proposed is within the scope of the contract and the work can be required of the Contractor without his consent although the payment therefor is subject to negotiation. A Supplemental Agreement augments contract work items which are not within the scope of the awarded contract; that is, work which the contractor cannot be required to perform without his consent.

5. Dredging Definition. Dredging is the removal of material usually from under water for the purpose of constructing new canals or waterways, maintaining existing channel depths and widths, obtaining fill for reclamation of lowland areas, replenishing beaches, constructing dikes and levees, and obtaining construction materials, such as sand, gravel, and shell, for commercial use.

6. Types of Dredges. Dredges are floating excavation machines used to remove materials from under water. The two major types employed in Corps of Engineers work are the bucket and hydraulic (suction). Each type may have several forms as described below:

a. Bucket Dredge. The bucket dredge consists basically of a digging bucket manipulated from a floating hull, the material excavated usually being deposited in scows or barges for subsequent disposal. The mechanics of operation and bucket structure account for the various nomenclature of bucket dredges, commonly known as clamshell, orange peel, dipper, and ladder.

(1) Clamshell and Orange Peel Dredges. These dredges are essentially stiff-leg derricks or crane on a floating platform and operate by lowering an open grab bucket onto the material to be excavated, closing the bucket, then raising it and dumping the material by opening the bucket. The clamshell and orange peel, as implied by their names, are so called because of the general shape of their bucket sections.

(2) Dipper Dredge. A dipper dredge is essentially a floating power shovel and operates a rooting bucket on a stiff arm.

(3) Ladder Dredge. The ladder dredge consists of a series of buckets attached to an endless chain running the length of a firmly braced ladder. In operation, the ladder is lowered until the moving buckets contact and dig into the material to be excavated. The filled buckets ascend the ladder by means of the endless chain and dump their contents into a chute at the top of the ladder. The buckets continue down on the opposite side of the ladder and the operation is repeated.

b. Hydraulic Dredge. The hydraulic dredge consists essentially of a centrifugal pump which draws in a mixture of water and excavated material through a suction pipe, and discharges it through a pipe to a place of disposal. The suction pipe, pump, power units, and auxiliary machinery are carried on a floating hull. The method of disposal characterizes the two major forms of the hydraulic dredge. These are the hydraulic pipeline and hopper dredges.

(1) Hydraulic Pipeline Dredge. The hydraulic pipeline dredge transports the excavated material to a place of disposal by means of a floating, submerged, or shore pipeline, or combinations thereof. This pipeline is connected to pipe within the dredge hull leading to the discharge end of the pump. Another pipe long enough to contact the material being dredged at various depths is flexibly connected to the suction side of the pump. The lower end of this suction pipe making contact with the material is fitted with various types of heads. The type of head distinguishes the three major classes of pipeline dredges, namely plain suction, dust pan, and cutterhead, which are described below.

(a) Plain Suction - The plain suction is the simplest form of pipeline dredge. Its suction head is a simple structural opening attached to the bottom of the suction pipe and is somewhat larger than the discharge pipe. The dredge is generally a non self-propelled floating hull supporting the dredging machinery and pipes.

(b) Dust Pan - The dust pan dredge is similar to the plain suction type except that it may be self-propelled and its head at the suction end resembles a huge vacuum cleaner.

(c) Cutterhead - The cutterhead dredge is the most widely used pipeline dredge. The head is a rotating assembly of spiral cutting blades surrounding a suction nozzle. It is driven by a shaft geared to the cutter drive assembly powered by a separate motor from that driving the pump. In operation, the cutterhead rotates against the material being dredged, cutting clay, breaking off chunks of soft rock such as coral and shale, and stirring up gravel, silt and sand to such an extent as to enable a suitable mixture of materials and water to pass into and through the pipeline.

(2) Hopper Dredge. The hopper dredge, usually a seagoing vessel equipped and manned for ocean navigation, pumps the dredged material directly into hoppers built into its own hull. When loaded the dredge proceeds to the disposal area and dumps the material through gates in the bottom of the hoppers. When empty, the gates are closed and the vessel proceeds back to the dredging area where the entire operation is repeated. The inspection procedure for hopper dredges is prescribed in the Corps of Engineers "Manual for Instructions for Hopper Dredge Operations and Standard Reporting Procedures."

c. Tabulation. The following briefly identifies the principal dredge types:

<u>Type</u>	<u>Mode of Operation</u>
Hydraulic Dredges	Material moved by water through pipe.
Pipe Line	No storage - continuous pipe delivery.
Plain Suction	Nozzle sucks loose sand or mud.
Cutterhead	Rotary cutter loosens material for nozzle.
Dustpan	Water jets loosen sand for wide flat nozzle.
Seagoing Hopper	Drag nozzle feeds hoppers in sea-going vessel.
Bucket	Digging bucket manipulated from floating hull.
Clamshell	Two part bucket swung from stiff-leg derrick.
Orange peel	Three or four part bucket used on rock or in limited space.
Dipper	Rooting bucket on stiff arm.
Ladder	Chain of buckets on pivoted arm.
Stationary	Mining or gravel producer.
Barge loading	Belt or chute conveyor to barges alongside.
Seagoing Hopper	Hoppers in seagoing vessel.

7. Submerged Rock Removal Equipment. There are two principal types of equipment for breaking up hard rock under water so it can be handled and removed by a dredge. In Corps of Engineers work it is usually broken up by drilling and blasting. A securely anchored barge called the Drill Boat is used for this purpose. A series of rock drills secured in vertical guide frames are mounted on the barge to permit operation over the side. The explosive charge is inserted into the drilled holes through a pipe or loading tube. The entire operation is systematically controlled to assure proper and safe procedure. Another system of breaking up rock, used mostly in Europe, is by means of a rock breaking machine. The equipment mounted on a barge operates like a pile driver raising and dropping a heavy structural steel shape with a hardened point or chisel edge upon the submerged rock. The rock breaks up under the impact of the blows being concentrated on a limited area.

8. Disposal Equipment. The bucket type dredge ordinarily requires dump scows for the disposal of the materials. The dump scow, which is generally utilized, is a barge divided into a series of bins or pockets into which the dredged material is deposited. There are two general types of dump scows, distinguished by their method of dumping - the side dump and the bottom dump. The bottom dump scow is used if the depth of water in the disposal area is sufficient to allow the bottom dump gates to hand freely. The side dump scow is used in shallower water. The hydraulic dredge, excluding the hopper type, disposes of its material by means of a pipeline extending

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from the dredge to the place of disposal. The discharge line, fitted with flexible connections at critical sections, is usually made up of three parts - the pipe on the dredge, the pipe afloat, and the pipe ashore. The floating pipeline is supported by a series of pontoons adequately spaced to keep the pipe afloat and in line. Under certain conditions, submerged pipe or pipe on trestle is also used in the discharge line.

9. Inspector's Responsibilities.

a. Preparation for Duties. An inspector has a responsible and important assignment as the contracting officer's representative at the work site. In preparing himself for the position he should take on-the-job training. Prior surveying experience is desirable. He should acquaint himself with the applicable Engineer Regulations and Manuals and retain a copy of this Engineer Pamphlet for ready reference.

b. Contract Plans and Specifications. The inspector's prime responsibility on both contract dredging and hired labor operations is to assure that the work is being accomplished in accordance with the plans and specifications. He should be thoroughly familiar with these documents. The inspector must bear in mind that standard or guide plans and specifications are constantly being revised to incorporate new policies and improved procedures and techniques. For this reason he should not rely on his familiarity with plans and specifications for similar work performed previously but should review such documents for each job assignment. He should pay particular attention to those portions of the contract and specifications pertaining to changed conditions, misplaced material, locations of obstructions such as underwater cables, pipelines, or sunken vessels and to the project limits defining width, depth, allowable over-depth, and side slopes.

c. Plant and Equipment. For each job assigned, the inspector shall become familiar with the various types of dredging equipment and attendant plant to be used, their capabilities, and their operating procedures. In addition, in order to understand the dredge operation and progress of the work, he should familiarize himself with each operator's handling of the equipment.

d. Reference Marks, Tide & Stream Gages, etc. The inspector shall acquaint himself with the locations of reference marks, range markers, tide and stream gages (temporary and permanent), bench marks, navigation buoys (lighted and unlighted), base lines, and the various permanent orientation points which are located on the plans. He will also know the reference datum plane being used. In contract operations, it is the inspector's responsibility to assure that the contractor maintains all dredging ranges, gages, stakes, etc. in good condition and that he maintains lights on all necessary dredging markers during hours of darkness.

e. Regulations for Lights and Signals in Navigable Waterways. All dredging operations under the supervision of the Corps of Engineers must comply with the General Regulations of the Department of the Army and

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the U. S. Coast Guard as stated respectively in the following Federal Regulations: "Title 33 CFR 201.1 to 201.16" and "Title 33 CFR, 80.18 to 80.31a." These regulations govern signal lights, day signals, channel markers and passing other vessels or floating plant working in navigable channels, etc. The inspector is required to become familiar with these regulations and to assure that they are observed by the operating units concerned. Violations in the case of contract dredging shall be brought to the attention of the contractor's representative or to the supervisor in charge where hired labor operations are involved. In either case, the inspector is to report the violation to his supervisor.

f. Other General Preparations.

(1) Before reporting to the site of the work for a new assignment, the inspector should confer with his supervisor concerning special instructions necessary for that particular operation. He should obtain a copy of the contract, plans, specifications, pertinent maps, dredging report forms, log book, and necessary tools, instruments, and office supplies.

(2) As soon as possible after reporting to the site of the work, the inspector shall confer with the contractor's representative in charge of the operations relative to the layout of the work, ranges, grades, tide or stream gages, safety requirements, and other matters pertinent to that particular job.

(3) An initial complete safety inspection of the contract plant is generally made by the District Safety Officer prior to commencement of work. Within a week after commencement of operations, the inspector, in the company of the contractor's or hired labor supervisory representative, shall make a follow-up safety inspection of the plant and equipment. Each week thereafter a safety check will be made and any violations will be called to the attention of the superintendent in charge of the operation with a request for their correction and at the same time a report should be made to the inspector's supervisor. If after a reasonable amount of time the correction is not made, his supervisor shall be so advised.

10. Tour of Duty.

a. The normal tour of duty is 8-hours per day for five days per week. However, this normal tour is subject to change at the discretion of the dredging inspector's supervisor to conform to the work requirements.

b. In the event that the incoming inspector does not report as scheduled on jobs covered by more than one shift per day the inspector on duty will notify his supervisor as soon as possible and remain on duty until relieved.

c. In the event of sickness or other emergency (personal or otherwise) where the inspector finds he cannot report for duty or he must

leave the job site, he shall notify his supervisor or arrange to have him notified in order that a replacement can be made prior to his departure, if possible.

11. Authority.

a. The inspector as the District Engineer's official representative at the site of the work has certain direct and indirect authority to assure that the work is being performed in accordance with the plans and specifications. The inspector shall ascertain from his supervisor the full extent of this authority when he is assigned to the work. The following authorities are generally applicable throughout the Corps of Engineers and may be utilized by the inspector unless specifically instructed otherwise by his supervisor. These authorities apply mainly to contract dredging but should also govern hired labor operations where applicable.

(1) The inspector can direct the contractor to comply with all requirements of the contract and other instructions from his supervisor falling within the purview of the contract. If the contractor refuses to comply, the inspector shall immediately notify his supervisor.

(2) The inspector can direct the suspension of operations at any unit of work where the contractor upon request does not correct a safety hazard which is so grave as to endanger life, limb, or property or cause serious damage to the work. Immediately after exercising this authority, the inspector is to inform the contractor's representative at the site in writing, citing the specific safety violation, the date and time of the request for its correction, and the person to whom the request was made and then notify his supervisor of the action taken.

(3) The inspector has the authority to interview the contractor's non-supervisory personnel (laborers and mechanics) to determine whether their classifications and wage rates are proper.

(4) The inspector can direct the suspension of work in pipeline dredge operations when the material passing over the spillway from the disposal area exceeds the tolerance permitted by the specifications unless corrective action is taken promptly. Operations will not be resumed until the condition has been corrected.

(5) The inspector can require the contractor to furnish on request the use of men and equipment forming a part of the normal crew and equipment as may be reasonably necessary for his transportation from designated points on shore to and from the various pieces of plant and the dumping grounds and for inspecting and supervising the operations.

b. The inspector is not authorized to:

(1) Change any provisions of the contract plans and specifications.

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(2) Interpret the results of surveys for acceptance of the work.

(3) Support the contractor verbally or in writing, directly or indirectly in any interpretation or application of any provisions of the contract in any controversy with the Government.

(4) Give orders or instructions to any of the contractor's personnel except to the one in charge of the operation at the site and to men assisting the Inspector in his duties, as stated in paragraph 11a(5) above.

(5) Direct the contractor in methods of operations and procedures to be followed in accomplishing the work except as may be provided in the specifications.

(6) Accept from the contractor any gifts or gratuities of any kind.

12. Relations with the Public. The inspector must always be aware that he is the representative of the Corps of Engineers and the United States Government. Therefore, his actions in relations with the public should reflect credit upon himself and the organization he represents. The inspector should answer questions regarding the public improvements being made and the resulting advantages to the general welfare, as permitted by applicable security regulations. He is to be courteous and respectful to all visitors with particular concern for their safety and he should offer his assistance whenever needed and without interference with his official duties. The inspector should cooperate with local public officials in matters related to the work to the fullest extent legally possible and within his authority.

13. Relations with Contractor.

a. The inspector's position as a representative of the Contracting Officer imposes an obligation to maintain a standard of conduct to command the attention and respect of the contractor and his employees. He shall not require the contractor to perform work in excess of that called for in the plans and specifications. It is essential in his relations with the contractor that the inspector be fair, impersonal, and firm without adopting a stiff or unduly formal manner.

b. The inspector should always be courteous and exert every reasonable effort to establish and maintain a friendly and cooperative atmosphere with the contractor consistent with the Government's interest. Instructions regarding the work are to be given only to the contractor's authorized representative, usually the superintendent or foreman, except when immediate orders are required to prevent imminent human injury or severe damage to the work. The inspector should not delay the contractor unnecessarily or interfere with his method of operation unless a continuation of the operation in progress would obviously lead to unsatisfactory

and unacceptable work.

c. Differences of opinion between the inspector and the contractor's representative shall be referred by the inspector to his supervisor. The inspector shall avoid arguments with the contractor's representative particularly in front of his personnel and he should never criticize the contractor's work in their presence. Differences of opinion between the inspector and other Government employees should never be discussed in the presence of the contractor or any of his employees.

d. There is no contractual relationship between a subcontractor and the Government. Therefore, the inspector shall deal with the subcontractor through the prime contractor. However, as a practical matter, there is no objection to direct dealings between the inspector and subcontractors provided that the matters in question are routine and non-controversial in nature and that the prime contractor is subsequently informed. As a matter of propriety, an understanding between the inspector and the prime contractor relating to direct action with subcontractors should be resolved prior to the start of work under the subcontracts.

14. Accommodations and Meals. A standard paragraph in dredging specifications requires the contractor to furnish on board the dredge or other craft upon which they are employed, a suitable separate room for office and sleeping purposes or provide equivalent accommodations ashore. The specifications also provide that the contractor shall, when required, furnish meals of a satisfactory quality to the inspectors employed on the work if he maintains an establishment on the work for the subsistence of his own employees. The contractor is reimbursed by the Government at a stated rate per person for each meal furnished. In order that the Government may have information upon which to base the reimbursement, the inspector may be required to submit a report as to the number of meals furnished.

15. Labor Relations. Every Government construction contract contains specific labor clauses with which the contractor must comply. Basically, these clauses prescribe certain minimum working conditions on all Government construction work. The applications of these provisions in detail can be obtained from the District's labor relations manuals or instructions supplemented by the advice of the district labor advisor. In general, these labor provisions are derived from three principal labor laws: "Davis-Bacon Act," "Eight-Hour Law" and "Copeland (Anti-Kickback) Act." It is the inspector's duty to ascertain whether the contractor is complying with the requirements of these acts. Continuous and careful inspection is essential to success of the enforcement program. Violations detected and corrected in the early stages of construction may prevent subsequent problems and expensive investigations. To assure compliance the inspector will periodically spot check the contractor's laborers and mechanics, recording the results on the "Contractor's Employee Interview Report," (see Appendix), to insure the following:

a. That the pay of the laborers and mechanics is not less than the minimum hourly wage rate as shown on the approved "Minimum Wage Scale" chart which must be posted by the contractor at the site of the work at prominent locations accessible to the workers at all times. In this connection, the inspector should examine carefully payroll records such as time books, payroll work sheets and where authorized by his supervisor, a copy of the official payroll. (Davis-Bacon Act).

b. That no mechanic or laborer works more than eight hours in any one calendar day without compensation for each excess hour at not less than one and one-half times the basic rate of pay. (Eight-Hour Laws).

c. That the contractor makes only certain lawful specific deductions from the pay of his laborers and mechanics. (Copeland Act).

d. That the contractor does not discriminate against any employee or applicant for employment because of race, religion, color, or national origin. (Nondiscrimination Clause).

16. Inspections by Supervisory Personnel. Inspections by supervisory personnel are generally made once a week or by spot checks as required. Other inspections from higher authorities can be expected from time to time. Whenever possible, the inspector will be informed by his supervisor of the impending visit in order that he can be present to meet the inspecting officials and to explain the phases of work with which they may be concerned. The inspector should discuss the proposed visit with the contractor, particularly if it is necessary to arrange for transportation utilizing the contractor's equipment. The inspector will record in his log and on the daily report all official visitors who inspect the work under his supervision.

17. Security Regulations.

a. Dredging work is generally of non-confidential nature. Security, therefore, in the sense of safeguarding defense information or operations, is not usually of concern to a dredging inspector. In those instances in which the work is of classified nature, the inspector will become familiar with the specific regulations involved and will require their enforcement. Applicable security procedures and instructions should be clarified and approved by the district security officer.

b. Insofar as the security of plant, equipment and materials owned by the contractor is concerned, the responsibility for their protection rests entirely with the contractor. However, where Government materials have been furnished to the contractor, the inspector is responsible to see that the contractor takes all necessary precautions to safeguard the items provided. The inspector is also responsible for the security of his personal equipment, papers, and records which he should

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keep in a locked desk or cabinet when he is away from his office. On hired labor operations, the security of the equipment is generally the concern of the master of the dredge or the supervisor in charge of the dredging operations. The inspector's responsibility is limited to safeguarding Government property issued to him.

18. Safety Procedures.

a. Every inspector is responsible for seeing that the work under his supervision is being performed in a safe manner. To assist in attaining this objective, the Corps of Engineers requires that certain standard safety practices be followed in all work under its jurisdiction whether by contract or hired labor. These standards are outlined in the manual "General Safety Requirements," EM 385-1-1, approved by the Chief of Engineers. The inspector will become thoroughly familiar with the contents of this manual with particular attention to those applicable provisions pertinent to the work to which he is assigned. The manual is printed in pocket size to enable the inspector to keep it in his possession for ready reference at the site of the work. The inspector will require all persons, whether contractor or Government personnel, to comply with applicable safety requirements whether stated in the manual or specifically directed by the District Engineer.

b. The inspector shall be safety conscious at all times. He shall notify the contractor's superintendent or the hired labor supervisor immediately of any safety violation and request its correction. If the safety violation is not corrected, the inspector shall immediately notify his supervisor who will take any further action that may be required.

c. If a safety violation endangers life or property, or threatens serious damage to the work, the inspector can without further warning stop the work at the site of violation and not permit its resumption until the condition has been remedied. (See para 11a(2) Authority.)

d. The inspector by his personal actions should set a good example for it is his responsibility not only to enforce the Corps of Engineers safety policy but also to sell it as a good investment to all concerned. The contractor should be informed that these requirements have been prescribed to protect the health and safety of his personnel, to minimize damage to his equipment, and to improve the efficiency of his operations by eliminating delays caused by accidents. Further, the inspector should always comply with the safety standards himself particularly when his actions obviously emphasize a required safety provision, such as, wearing a life vest when transferring between floating plant or walking a pontoon line.

e. In Corps of Engineers contract construction, the contractor is required to submit a safety program setting forth his proposals in writing for effectuating the provisions for Accident Prevention required by the contract. This program when approved by the Contracting Officer, together

with EM 385-1-1, will be the inspector's guide for determining that adequate and orderly safety procedures are being followed. It is, therefore, important that the inspector obtain a copy of this approved program and to see that the contractor's superintendent is also provided with a copy. Usually, such a program lists the frequency of the accident prevention conferences to be held and the persons who will conduct the meetings. The inspector should attend these conferences and assist when requested in solving any safety problems that may arise.

f. One of the requirements in connection with safety procedures is the preparation of a "Monthly Exposure Report." This report is generally prepared in the District Office with information submitted from the field. Where required, the inspector will submit the desired information in a manner and form specified by his supervisor.

* g. In the event of a disabling injury to any employee or accident to any plant or property of the Government or the contractor, involving damage estimated at \$100.00 or more, or any accident to which the contractor is a party involving injury or damage to a third party or his property, the inspector shall request the contractor's superintendent to submit a report thereof on ENG Form 3394 "Accident Report" (Feeder report to DA Form 285), or as otherwise instructed. Collisions, groundings, and/or other accidents in the vicinity of the work involving parties other than the Government and the contractor should be reported by the inspector to his supervisor, giving a complete description of the accident including a sketch and a statement of contributing causes, such as unfavorable weather and channel conditions prevailing at the time. The inspector should immediately inform his supervisor of any accident resulting in critical or fatal injuries or in property damage estimated at \$10,000 or more.

h. The designated inspector shall submit weekly to his supervisor a "Report of Safety Survey," (see appendix).

19. Photographs. Specific policies regarding taking photographs of construction activities, including the issuance of Government-owned cameras and film is regulated by the district. Photographs should be taken of those features of the work which may be involved in future controversies or claims with the contractor and of any situation which would substantiate an inspector's report or records where such supplemental data may be required. For example: repeated safety violations, accidents, collisions, faulty equipment, substantial change in character of dredged materials from that indicated in the plans and specifications and damages to navigation aids and range structures. Photographs should be identified sufficiently for future reference. The identification should include name of inspector taking the picture, date and time the picture was taken, project name, location of work, contract number, name of contractor and a brief description of what the picture shows. When possible, photographs of problem areas should be taken successively from a predetermined fixed location and fixed foresight.

20. Progress Charts.

a. A progress chart is required for each job showing the sequence and time required for performing the various features of work. As required by the specifications, the chart is prepared and submitted by the contractor and approved by the Contracting Officer. When approved, the progress chart is a guide in determining whether or not the work is proceeding satisfactorily. If so required, the inspector will post the chart in his office and record thereon at prescribed intervals the actual progress of the work. When so notated, the chart becomes a visible record of the actual progress of the work at any particular time compared against the scheduled progress at the end of the same period of time. A sample executed "Construction Progress Chart" is shown in the Appendix.

b. In addition, the inspector shall maintain a chart which will show the area covered each day. Contract drawings or before dredging maps are well suited for this purpose. Each day the work, such as area dredged, area drilled and blasted, length of dike placed, etc., shall be plotted on the chart and identified by date.

21. Soundings.

a. In dredging operations the depth of water before and after dredging is required for preparation of daily reports and spot check of the area being dredged. The after-dredging soundings may be used as a basis for partial payments. In some districts the inspector may be required to obtain these soundings.

b. The procedure in taking manual soundings is generally as follows. A suitable line marked at required intervals (in feet) weighted with lead is lowered into the water at the location desired, usually behind the dredge. When the lead rests on bottom, which can be readily determined by experience, the water level on the line is noted and recorded. This reading, corrected to the applicable reference plane, is the sounding desired. To "fix" the sounding for recording purposes its horizontal location must be determined. This is accomplished in a number of ways depending upon the nature of the work, type of sounding, and available equipment. For example, when soundings are taken from a dredge, the horizontal locations can be approximately determined from correlation with the dredge position. If a rowboat is used, the soundings can be fixed horizontally by taking them at prescribed intervals along a system of ranges previously established. The intervals should be decreased when sounding the side slopes of the cut. Transits, sextants, tag lines, etc. are other equipment used to obtain horizontal locations. The specific procedure in any particular district and detailed instructions for obtaining the soundings will be given to the inspector by his supervisor. In view of the specialized equipment involved, the inspector will usually not be required to use "echo" or electronic sounding devices.

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c. The use of a sounding lead of a particular size and design is governed by the character of the material being dredged. In a sand bottom, a lead weight of about eight pounds is adequate. In silt or mud, a disc at least six inches in diameter should be attached to the lead. The line itself should be checked periodically to assure its accuracy.

d. Sounding poles constructed of wood, approximately 2 inches square, or hollow aluminum, approximately 2 inches in diameter, marked off in feet, can be used in shallow channels or waterways.

22. Horizontal and Vertical Control.

a. No construction work can proceed with any degree of accuracy, without a system of horizontal and vertical controls enabling each part of the work to be related to its proper position. In dredging, taking soundings, locating the work, "fixing" the dredge, placing range markers, buoys, etc. are all dependent on such control.

b. Generally, the contractor is responsible for laying out his work from bench marks, base lines and water level or tide gages established by the Government. In order to follow the work and make independent checks, the inspector must familiarize himself with these basic as well as other parts of the horizontal and vertical control system. Periodically the inspector shall check insofar as possible range markers, range targets, tide and stream gages, dredging buoys, etc. to assure that they remain properly located and calibrated throughout the length of the job. He should also periodically check the Contractor's determination of the dredge location.

23. Character of Materials. Determinations of the character of materials being dredged and the percentage of each type are required for record purposes and may be used to ascertain that the material is similar to that described in the specifications or delineated on the plans as boring logs. This data must be obtained daily and recorded in the inspector's log and on the applicable daily report. Unless the inspector has been given special instructions by his supervisor and the proper equipment to make a detailed analysis, this determination is to be his best estimate obtained from a visual and physical inspection of samples of the material. A general classification of dredged materials and a guide to their identification follow:

a. Rock. Solid ledges of hard strata of substantial thickness which usually have to be drilled and blasted before removal. Thin "slabs" of rock may be broken by chisals or rock cutterheads.

b. Sand. Small, hard grained, individually visible particles of soil up to $\frac{1}{4}$ " in diameter having a distinctly gritty feeling.

c. Gravel. Smooth rock fragments usually mixed with sand, water worn, with particles ranging from $\frac{1}{4}$ " to 3" in diameter.

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d. Cobbles. Stone worn and rounded detached from its original bed ranging from 3" to about 10" in diameter.

e. Boulders. Large stone worn and rounded generally over 10" in diameter.

f. Clay. A cohesive soil, plastic when wet, smooth and greasy to the touch, sticking to the fingers when moist.

g. Hard Pan (Caliche). A cemented soil formation composed of clay, boulders, sand and gravel.

h. Mud. Finely powdered materials mixed with organic particles of animal and vegetable matter, dark color and usually having an odor of decaying vegetable matter.

i. Silt. Fine grained non-cohesive material ranging in particle and size between clay and sand.

24. Surveys. Except in those instances where the inspector is sufficiently trained and equipped and specifically directed to do so, surveys will be made by a Government survey party. When surveys of any type for any part of the work are required, the inspector will notify his supervisor of their need sufficiently in advance as not to unduly delay operations. He will cooperate with the survey party to the fullest extent possible supplying them with all pertinent information and any unusual circumstances related to the survey. If necessary, the inspector will notify the contractor's superintendent of the impending survey so that he or his representative may accompany the survey party if they so desire.

25. Computations.

a. The linear distance (length of cut), average width of cut, area and volume dredged are basic items of information required each day for recording of the progress of the work and for inclusion on the applicable daily report.

(1) The length of cut is the distance advanced by the dredge in a dredge cut. It is readily obtained from physical measurements or computations of distances between known ranges.

(2) The width of the cut is the width of that area covered by the dredge in a dredge cut.

(3) The area dredged is the product of the length of the cut and the width of the cut.

(4) The average depth dredged is the difference between the average depths in the dredge cut before and after dredging.

(5) The volume of material dredged is the product of the area dredged and the average depth dredged.

b. In general, the following equation can be used for computing the volume of cubic yards of materials dredged in any area desired, exclusive of side slope areas.

$$V = \frac{W \times D \times L}{27}$$

Where V = Volume in cubic yards.

W = Average width of cut in feet.

D = Average depth of cut in feet.

L = Length of cut in feet.

c. Computations for obtaining volumes of materials in the slopes of the channel vary with the district and type of dredging plant used. Accordingly, the inspector will receive his instructions for making slope calculations from his supervisor.

d. The average end area method (prismoidal formula) of computing the volume of excavation is readily adapted to long narrow channels or canals. In the calculation of the volume by this method, let $A_1, A_2, A_3, \dots, A_n$ represent the areas of successive cross sections, D the constant distance between sections, and V the desired volume, then

$$\begin{aligned} V &= \left(\frac{A_1 + A_2}{2} \right) D + \left(\frac{A_2 + A_3}{2} \right) D + \dots + \left(\frac{A_{n-1} + A_n}{2} \right) D \\ &= \frac{D}{2} (A_1 + 2A_2 + 2A_3 + \dots + 2A_{n-1} + A_n) \\ &= D \left(\frac{A_1}{2} + A_2 + A_3 + \dots + A_{n-1} + \frac{A_n}{2} \right) \end{aligned}$$

26. Records.

a. Logs

(1) The inspector shall keep an official log book in which he will record daily all significant actions, or incidents, such as collisions, groundings, etc. and any special instructions pertinent to the work. He will log entries which will be required to complete his reports and record any occurrence which could lead to a future claim by or against the United States Government. Only one official log book will be kept for any single job regardless of the inspection coverage or the number of shifts worked. On jobs of more than one shift, each inspector will make his own entries in the log during his shift and each shift's entries will be followed by the inspector's signature. The log book will be used for no other purpose. Upon completion of the work, the log book will be submitted to the supervisor for filing as a permanent record.

(2) It cannot be emphasized too strongly that it is of the utmost importance to maintain an accurate, legible and complete log as it is the most valid documentary record of the progress of the work. It should include but not be limited to the following entries:

- (a) Date
- (b) Weather
- (c) Delaying factors and the length of delays. Work stoppages including time stopped, time resumed, reason for stoppage, the number of personnel and equipment involved, and resolution of the problem causing the delay.
- (d) General description of work performed.
- (e) Discussions with the contractor or his representative (include name and title of person with whom discussed), including particularly those relative to interpretation of plans and specifications, deviations from contract requirements, and any statements which might indicate that a claim may be filed.
- (f) Conditions differing in any respect from those indicated in the plans and specifications, particularly factors which may be classified under the "Changed Conditions" Article of the contract.
- (g) Instructions from supervisor and resultant action.
- (h) Labor relations, including interviews, difficulties, and strikes.
- (i) Names and titles of visitors.
- (j) Accidents, and near accidents with names of persons and type of equipment involved.
- (k) Any other pertinent matters which may be of value at a later date.

(3) The log book should be kept in a formal manner. Entries shall be made in ink or indelible pencil. No erasures shall be made. Errors shall be lined out in such a way as to leave original entries legible and the changes thus made will be initialed and dated by the person making the change. The title on the log will be in ink. If desired, the first few sheets of each book may be left blank for an index. Entries will be made chronologically from front to back with no lines or pages skipped. Repetitive dates and headings at the beginning of each day's entry may be stamped or printed.

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b. Files. The inspector shall maintain a working file in his office including a copy of the contract, plans and specifications and supplements, modifications, and changes thereto; before and after dredging maps; copies of all pertinent correspondence relative to the work; memoranda from his supervisor; executed reports and blank report forms.

27. Reports. An important duty of the inspector is the preparation of the reports required in connection with dredging operations. Since the type and method of operations vary throughout the country, the required reports will also vary somewhat with each district concerned. However, there are a number of reports which are applicable throughout the Corps of Engineers, the most important of which are shown, together with instructions for their preparation, in the Appendices. The district will supplement these with any others it feels desirable and necessary.

FOR THE CHIEF OF ENGINEERS:



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