

RESOLUTION A.586(14)

*Adopted on 20 November 1985
Agenda item 12*

**REVISED GUIDELINES AND SPECIFICATIONS FOR OIL DISCHARGE
MONITORING AND CONTROL SYSTEMS FOR OIL TANKERS**

THE ASSEMBLY,

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations concerning the prevention and control of marine pollution from ships,

NOTING that regulation 15(3)(a) of Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) and further amended in 1984, specifies that oil tankers of 150 tons gross tonnage and above shall be fitted with an oil discharge monitoring and control system approved by the Administration and designed and installed in compliance with the Guidelines and Specifications for Oil Discharge Monitoring and Control Systems for Oil Tankers developed by the Organization,

NOTING ALSO resolution A.496(XII) entitled "Guidelines and Specifications for Oil Discharge Monitoring and Control Systems for Oil Tankers" developed in implementation of the said regulation,

NOTING FURTHER the proposed regulation 14 of Annex II of MARPOL 73/78 in respect of the carriage of category C and D oil-like substances in oil tankers,

RECALLING that by resolution MEPC.10(18) the Marine Environment Protection Committee recognized the need to improve the performance standards of oil discharge monitoring and control systems for oil tankers and resolved to develop new guidelines and specifications for such installations,

HAVING CONSIDERED in the light of the requirements of Annex I of MARPOL 73/78 the recommendation submitted by the Marine Environment Protection Committee,

1. ADOPTS the Revised Guidelines and Specifications for Oil Discharge Monitoring and Control Systems for Oil Tankers, the text of which is set out in the Annex to this resolution, for application to oil tankers the keels of which are laid or which are in a similar stage of construction (hereinafter referred to as "constructed") on or after 2 October 1986;
2. INVITES Governments to implement these Revised Guidelines and Specifications when approving oil discharge monitoring and control systems being installed under regulation 15(3)(a) of Annex I of MARPOL 73/78 on oil tankers constructed on or after 2 October 1986;
3. AUTHORIZES the Marine Environment Protection Committee to extend the specifications for type approval of oil content meters contained in the Annex to this resolution and in the Annex to resolution A.393(X) to cover the testing of oil content meters intended to be used by oil tankers carrying category C and D oil-like Annex II substances*.

* The amendments adopted by the MEPC (resolution MEPC 24(22)) have been incorporated in the Annex to the present resolution.

ANNEX

**REVISED GUIDELINES AND SPECIFICATIONS FOR OIL DISCHARGE
MONITORING AND CONTROL SYSTEMS FOR OIL TANKERS**

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1. INTRODUCTION

1.1 Purpose

1.1.1 These Guidelines and Specifications contain requirements regarding the design, installation, performance and testing of oil discharge monitoring and control systems on oil tankers as required by regulation 15(3)(a) of Annex I to MARPOL 73/78.

1.1.2 The purpose of these Guidelines and Specifications is:

- .1 to provide a uniform interpretation of the requirements of regulation 15(3)(a) of Annex I to MARPOL 73/78;
- .2 to assist Administrations in determining appropriate design, construction and operational parameters for oil discharge monitoring and control systems for oil tankers, hereinafter referred to as "monitoring systems", when such systems are fitted in ships flying the flag of their State;
- .3 to define test and performance requirements for oil content meters and control sections forming part of monitoring systems;
- .4 to define requirements for plan approval of installations and functional testing of installed equipment; and
- .5 to provide guidance for the survey of installations on board.

1.1.3 These Guidelines and Specifications also apply to oil content monitoring systems used for monitoring certain category C and D oil-like noxious liquid substances carried in accordance with regulation 14 of Annex II of MARPOL 73/78. Wherever in these Guidelines and Specifications reference is made to oil being monitored, this applies likewise to such oil-like noxious liquid substances.

1.2 Applicability

1.2.1 These Revised Guidelines and Specifications apply to installations being made in oil tankers, the keels of which are laid or which are at a similar stage of construction on or after 2 October 1986. The Guidelines and Specifications adopted under resolutions A.393(X), A.496(XII) and MEPC.13(19) are not applicable to oil tankers to which these new Guidelines and Specifications apply.

1.2.2 Installations made in "existing" tankers as defined in regulation 1(7) before 2 October 1986, and installations made in "new" tankers as defined in regulation 1(6) of Annex I of MARPOL 73/78, and the keels of which are laid or which are at a similar stage of construction before 2 October 1986, should comply either with the requirements contained in the Guidelines and Specifications adopted under resolutions A.393(X), A.496(XII) and MEPC.13(19) or with the requirements contained in these Guidelines and Specifications.

1.3 Summary of requirements

1.3.1 The approval requirements for various parts of a monitoring system as specified in these Guidelines and Specifications are summarized below:

- .1 the oil content meter should be tested for type approval in accordance with the procedures described in part 1 of the Annex;
- .2 the oil content meter and the control section of a monitoring system should be subjected to the environmental tests specified in part 2 of the Annex;
- .3 documentation for plan approval, as specified in section 8, should be submitted to the Administration prior to the installation of the monitoring system;
- .4 the component parts of the system should undergo the workshop functional tests specified in section 7; and
- .5 the complete monitoring system should be surveyed in accordance with the procedures laid down in section 10.

2 BACKGROUND

2.1 The requirements of Annex I of MARPOL 73/78 relating to oil content monitoring of oil tanker ballast and tank washing water are set out in regulation 15(3)(a), which stipulates that oil tankers of 150 tons gross tonnage and above should be equipped with an approved monitoring system and that such system should record continuously:

- .1 the discharge of oil in litres per nautical mile; and
- .2 the total quantity of oil discharged or, alternatively, the oil content of the effluent and the rate of discharge.

In both cases the record should be identifiable as to time and date and should be kept for at least 3 years.

2.2 Regulation 15 also stipulates that the system should come into operation when there is any discharge of effluent into the sea and should be such as will ensure that any discharge of oily mixture is automatically stopped when the instantaneous rate of discharge of oil exceeds that permitted by regulation 9(1)(a).

2.3 Resolution A.445(XI) recognizes the need for early installation of oil discharge monitoring and control systems in order that operational experience may be gained. That resolution further invites the Marine Environment Protection Committee to develop guidelines for the progressive installation of monitoring systems for new and existing oil tankers.

2.4 An incentive scheme was adopted under resolution A.496(XII), specifying the standard of systems to be installed in tankers depending on their size and age. The implementation requirements in these Guidelines and Specifications conform with the requirements in that scheme as regards installations in new tankers as defined in regulation 1(6) of Annex I of MARPOL 73/78.

3 DEFINITIONS

3.1 Oil discharge monitoring and control system

3.1.1 An oil discharge monitoring and control system, referred to in these Guidelines and Specifications as a "monitoring system", is a system which monitors the discharge into the

sea of oily ballast or other oil-contaminated water from the cargo tank areas and comprises the items specified in paragraph 5.1.4.

3.2 Control section

3.2.1 A control section of a monitoring system is a unit composed of the items specified in paragraph 5.1.4.7 and capable of operating either as a "control unit" or as a "computing unit" as specified in section 4.

3.3 Overboard discharge control

3.3.1 An overboard discharge control is a device which automatically initiates the sequence to stop the overboard discharge of the effluent in alarm conditions and prevents the discharge throughout the period the alarm condition prevails. The device may be arranged to close the overboard valves or to stop the relevant pumps, as appropriate.

3.4 Starting interlock

3.4.1 A starting interlock is a facility which prevents the initiation of the opening of the discharge valve or the operation of other equivalent arrangements before the monitoring system is fully operational when use of the monitoring system is required by the Convention.

3.5 Control unit

3.5.1 A control unit is a device which receives automatic signals of:

- .1 oil content of the effluent;
- .2 flow rate of discharge;
- .3 ship's speed in knots;
- .4 date and time (GMT); and
- .5 status of the overboard discharge control.

3.5.2 The unit shall make automatic recordings of data as specified in paragraph 5.8.2.

3.6 Computing unit

3.6.1 A computing unit is a device which receives automatic signals of:

- .1 oil content of the effluent; and
- .2 date and time (GMT);

In addition, the computing unit should be arranged to accept manual input of:

- .3 status of the overboard discharge arrangement;
- .4 flow rate of discharge; and
- .5 ship's speed in knots.

3.6.2 The unit shall make automatic recordings of data as specified in paragraph 5.8.2.

3.7 PPM

3.7.1 "Ppm" means parts of oil per million parts of water by volume.

4 IMPLEMENTATION REQUIREMENTS

4.1 Detailed monitoring system requirements for oil tankers to which these Guidelines and Specifications apply are differentiated as detailed below:

.1 *Category A monitoring system*

.1.1 This system should be fitted to oil tankers of 4,000 dwt and above. It should employ a control unit and be fitted with a starting interlock and an overboard discharge control.

.2 *Category B monitoring system*

.2.1 This system should be fitted to oil tankers of less than 4,000 dwt but more than 150 gross tons. It should employ a computing unit. No starting interlock is required and the overboard discharge arrangement may be activated manually.

5 TECHNICAL SPECIFICATIONS

5.1 Oil discharge monitoring and control system

5.1.1 The monitoring system should be capable of effectively monitoring and controlling the discharge of any effluent into the sea through those overboard discharge outlets permitted by regulation 18 which, in the opinion of the Administration, are necessary to fulfil the operational requirements of the oil tanker.

5.1.2 The discharge of dirty ballast water or other oil-contaminated water from the cargo tank areas into the sea through outlets which are not controlled by the monitoring system is an infringement of the Convention.

5.1.3 The monitoring system should function effectively under all environmental conditions which oil tankers are normally assumed to encounter, and should be designed and constructed to satisfy the specifications for environmental testing specified in part 2 of the Annex to these Guidelines and Specifications. Moreover,

- .1 the system should, except as permitted for a category B system, be so designed that no discharge of dirty ballast or other oil-contaminated water from the cargo tank areas can take place unless the monitoring system is in the normal operating mode and the relevant sampling point has been selected;
- .2 preferably the system should sample the effluent discharge from a minimum number of discharge outlets and be so arranged that discharge overboard can take place via only one outlet at a time;
- .3 where it is intended that more than one line be used for simultaneous discharging purposes, one oil content meter, together with a flow meter, should be installed in each discharge line. These instruments should be connected to a common processor; and
- .4 in order to avoid alarms due to short-term high oil concentration signals (spikes) causing indications of high instantaneous rates of discharge, the short-term high ppm signal may be suppressed for a maximum of 10 seconds. Alternatively, the instantaneous rate of discharge may be continuously averaged during the preceding 20 seconds or less as computed from instantaneous ppm values of the oil content meter readings received at intervals not exceeding 5 seconds.

5.1.4 The monitoring system should comprise:

- .1 an oil content meter to measure the oil content of the effluent in ppm. The meter should be approved in accordance with the provisions contained in the Annex to these Guidelines and Specifications and be certified to take into account the range of cargoes carried;
- .2 a flow rate indicating system to measure the rate of effluent being discharged into the sea. For a category B monitoring system, where the flow rate may be inserted into the computing unit manually, the arrangement described in paragraph 5.4.7 should be used;
- .3 a vessel speed indicating device to give the vessel's speed in knots. For a category B monitoring system, where the vessel's speed may be inserted into the computing unit manually, the arrangement described in paragraph 5.5.2 should be used;
- .4 a sampling system to convey a representative sample of the effluent to the oil content meter;
- .5 an overboard discharge control to stop the overboard discharge. For a category B system the arrangement for stopping the overboard discharge may be manual;
- .6 a starting interlock to prevent the discharge overboard of any effluent unless the monitoring system is fully operational. A category B system requires no starting interlock;
- .7 a control section comprising:
 - .7.1 a processor, which accepts signals of oil content in the effluent, the effluent flow rate and the vessel's speed and computes these values into litres of oil discharged per nautical mile and the total quantity of oil discharged;
 - .7.2 means to provide alarms and, for a category A monitoring system, command signals to the overboard discharge control;
 - .7.3 a recording device to provide a record of data in accordance with paragraph 5.8.2;
 - .7.4 a data display to exhibit the current operational data in accordance with paragraph 5.9;
 - .7.5 a manual override system to be used in the event of failure of the monitoring system; and
 - .7.6 for a category A monitoring system, means to provide signals to the starting interlock to prevent the discharge of any effluent before the monitoring system is fully operational.

5.1.5 Each main component of the oil content monitoring system should be fitted with a name-plate, properly identifying the component by assembly drawing number, type or model number and serial number, as appropriate.

5.1.6 If installed in a hazardous area, the electrical components of the monitoring system should meet the appropriate safety requirements* laid down for these areas.

* As specified in IEC publication 92 or its equivalent.

5.2 Oil content meter

5.2.1 An oil content meter should satisfy the test and performance specifications contained in part 1 of the Annex to these Guidelines and Specifications and should conform with the general requirements contained in subsection 5.2.

5.2.2 The accuracy of meters designed to monitor a wide range of oil content should be such that the reading will represent the actual oil content of the sample being tested within ± 10 ppm or $\pm 20\%$, whichever is the greater. The accuracy should remain within the above limit despite the presence of contaminants other than oil, such as entrained air, rust, mud and sand.

5.2.3 The meter should be designed so that it functions within the above limit when the power supply (in the form of electricity, compressed air, etc.) is varied by 10% from the value for which the meter is designed.

5.2.4 It is desirable that the reading should not be affected by the type of oil. If it is, it should not be necessary to calibrate the meter on board ship, but pre-set alterations in the calibration may be made in accordance with the manufacturer's instructions. In the latter case, means should be available to check that the correct calibration has been selected for the oil in question. The accuracy of the readings should at all times remain within the limit specified in 5.2.2.

5.2.5 The response time of the meter, as defined in paragraph 1.2.8 of part 1 of the Annex, should not exceed 20 seconds.

5.2.6 The meter may have several scales as appropriate for its intended use. The full range of the scale should not be less than 1,000 ppm.

5.2.7 The meter should have simple means to enable the ship's crew to check the functioning of the electrical and electronic circuitry of the meter by introduction of a simulated signal corresponding approximately to half the full scale reading of the meter. It should also be possible for qualified personnel to recalibrate the meter on board the oil tanker.

5.2.8 The meter should, if intended to be fitted in locations where flammable atmospheres may be present, comply with the relevant safety regulations for such spaces. Any electrical equipment which is part of the meter should be placed in a non-hazardous area, or should be certified by the Administration as safe for use in a hazardous atmosphere. Any moving parts which are fitted in hazardous areas should be so arranged as to avoid the formation of static electricity.

5.2.9 The meter should not contain or use any substance of a dangerous nature, unless adequate arrangements, acceptable to the Administration, are provided to eliminate any hazard introduced thereby.

5.2.10 The meter should resist corrosion in conditions of the marine environment.

5.2.11 The meter should be constructed from materials compatible with the liquids to be tested.

5.3 Sampling system

5.3.1 Sampling points should be so located that relevant samples can be obtained from those outlets that are used for operational discharges in accordance with paragraph 5.1.1. The sampling probes located in the overboard discharge lines and the piping system connecting the sampling probes to the oil content meter should meet the requirements of this section.

5.3.2 The piping and probes should be of a material resistant to fire, corrosion and oil and be of adequate strength, properly jointed and supported.

5.3.3 The system should have a stop-valve fitted adjacent to each probe, except that, where the probe is mounted in a cargo line, two stop-valves shall be fitted, in series, in the sample line; one of these may be the remote controlled sample selector valve.

5.3.4 Sampling probes should be arranged for easy withdrawal and should as far as practicable be mounted at an accessible location in a vertical section of the discharge line. Should it be necessary to fit sampling probes in a horizontal section of the discharge line it should be ascertained, during the installation survey, that the pipe runs full of liquid at all times during the discharge of the effluent. Sampling probes should normally penetrate inside the discharge pipe to a distance of one quarter the diameter of that pipe.

5.3.5 Means should be provided for cleaning the probes and piping system by the provision of permanent clean water flushing arrangements or an equivalent method. The design of the probes and piping should be such as to minimize their clogging by oil, oily residue and other matter.

5.3.6 The velocity of the fluid in the piping should be such that, taking into consideration the length of the piping, the overall response time should be as short as possible between an alteration in the mixture being pumped and the alteration in the meter reading and in any case not more than 40 seconds, including the response time of the meter.

5.3.7 The location of sampling probes in relation to any point of flow diversion to a slop tank should be selected with regard to the need for sampling the oily water in the recirculation mode.

5.3.8 The arrangements for driving the sampling pump or any other pumps used in the system should have regard to the safety requirements of the space in which the pump is located. Any bulkhead penetration between a hazardous and a non-hazardous area should be of a design approved by the Administration.

5.3.9 The flushing arrangement should be such that where necessary it can be utilized for test-running and stabilizing the oil content meter and correcting for zero setting.

5.3.10 Sample water returning to the slop tank should not be allowed to free-fall into the tank. In tankers equipped with an inert gas system a U-seal of adequate height should be arranged in the piping leading to a slop tank.

5.3.11 A valve should be provided for the manual collection of samples from the inlet piping to the meter at a point downstream of any sampling pump or at an equivalent location satisfactory to the Administration.

5.4 Flow rate indicating system

5.4.1 A flow meter for measuring the rate of discharge should be installed in a vertical section of a discharge line or in any other section of a discharge line as appropriate, so as to be always filled with the liquid being discharged.

5.4.2 A flow meter should employ an operating principle which is suitable for shipboard use and, where relevant, can be used in large diameter pipes.

5.4.3 A flow meter should be suitable for the full range of flow rates that may be encountered during normal operation. Alternatively, arrangements such as the use of two flow meters of different ranges or a restriction of the operational flow rate range may be necessary to meet this requirement.

5.4.4 The flow meter, as installed, should have an accuracy of $\pm 15\%$, or better, of the instantaneous rate of discharge throughout the operating range for discharging the effluent.

5.4.5 Any component part of the flow meter in contact with the effluent should be of corrosion-resistant and oil-resistant material of adequate strength.

5.4.6 The design of the flow metering arrangements should have regard to the safety requirements of the space in which such metering arrangements are located.

5.4.7 In oil tankers fitted with a category B monitoring system the flow rate may be determined from the pump characteristics and the data be inserted manually into the computing unit.

5.4.8 In oil tankers fitted with a category B monitoring system where it is intended to discharge dirty ballast to the sea by gravity, as permitted by regulation 18(6)(d), means such as calibration curves should be provided to estimate the flow rate of discharge and the data should be inserted manually into the computing unit.

5.5 Ship's speed indicating system

5.5.1 The automatic speed signal required for a category A monitoring system should be obtained from the ship's speed indicating device* by means of a repeater signal. The speed information used may be either speed over the ground or speed through the water, depending upon the speed measuring equipment installed on board.

5.5.2 In oil tankers fitted with a category B monitoring system, the ship's speed may be inserted manually into the computing unit. Such data should be obtained from the speed log or from an equivalent source.

5.6 Overboard discharge control arrangement

5.6.1 In oil tankers fitted with a category A monitoring system the overboard discharge control should be able to stop the discharge of the effluent into the sea automatically by either closing all relevant overboard discharge valves or stopping all relevant pumps. The discharge control arrangement should be fail-safe so that all effluent discharge is stopped when the monitoring system is not in operation, at alarm conditions, or when the monitoring system fails to function.

5.6.2 In oil tankers fitted with a category B monitoring system, the overboard discharge control arrangement may be activated manually.

5.7 Processor and transmitting device

5.7.1 The processor of a control section should receive signals from the oil content meter, the flow rate indicating system and the ship's speed indicating system at time intervals not exceeding 5 seconds and should automatically compute the following:

- .1 instantaneous rate of discharge of oil in litres per nautical mile; and
- .2 total quantity of oil discharged during the voyage in cubic metres or litres.

* See "Recommendation on Performance Standards for Devices to Indicate Speed and Distance" (Annex to resolution A.478(XII)).

5.7.2 In category B monitoring systems where the flow rate and ship's speed may be inserted manually, the current information should be retained in the processor for use in the continuous calculation of the oil discharge rate and the total quantity of oil discharged and should be recorded at intervals specified in paragraph 5.8.3. The information currently inserted into the processor should remain visibly displayed.

5.7.3 When the limits imposed by regulation 9(1)(a)(iv) and (v) are exceeded, the processor should provide alarms and, in a category A system, provide command signals to the overboard discharge control arrangement which will cause the discharge of effluent into the sea to stop.

5.7.4 The processor should normally include a device for the continuous generation of time and date information. Alternative arrangements for the automatic and continuous reception of time and date information from an external source may be accepted.

5.7.5 In the event of power failure the processor should retain its memory in respect to computation of the total quantity of oil discharged, time and date. A printout of data should be obtained when the monitoring system is operating with manual override, but this is not required if, when the power fails, the monitoring system activates the overboard discharge control to stop the discharge of effluent.

5.8 Recording devices

5.8.1 The recording device of a control section should include a digital printer. The recorded parameters should be explicitly identified on the printout. The printout should be legible and should remain so once removed from the recording device and should be retained for at least 3 years.

5.8.2 The data to be automatically recorded should include at least the following:

- .1 instantaneous rate of discharge of oil (litres per nautical mile);
- .2 instantaneous oil content (ppm);
- .3 the total quantity of oil discharged (cubic metres or litres);
- .4 time and date (GMT);
- .5 ship's speed in knots;
- .6 effluent flow rate;
- .7 status of the overboard discharge control or arrangement;
- .8 oil type selector setting, where applicable;
- .9 alarm condition;
- .10 failure (i.e. no flow, fault, etc.); and
- .11 override action (i.e. manual override, flushing, calibration, etc.).

Any information inserted manually should be identified on the printout as a manual input.

5.8.3 Data required in paragraph 5.8.2 of these Guidelines and Specifications should be printed out, as applicable, with the following minimum frequency:

- .1 when the discharge is started;
- .2 when the discharge is stopped;
- .3 at intervals of not more than 10 minutes (except when the system is in stand-by mode);
- .4 when an alarm condition develops;
- .5 when normal conditions are restored;
- .6 when input data are introduced;
- .7 whenever the computed rate of discharge varies by 10 litres per nautical mile;
- .8 when zero-setting or calibration modes are selected; and
- .9 on manual command.

5.8.4 The recording device should be located in a position easily accessible to the person in charge of the overboard discharge operation.

5.9 Data display

5.9.1 In addition to the recorded printout, the current data should be visibly displayed and should as a minimum contain the following:

- .1 instantaneous rate of discharge of oil (litres per nautical mile);
- .2 total quantity of oil discharged (cubic metres or litres);
- .3 instantaneous oil content (ppm);
- .4 flow rate;
- .5 ship's speed; and
- .6 status of the overboard discharge control or arrangement.

5.9.2 The data display should be located in a position easily observed by the person in charge of the overboard discharge operation.

5.10 Manually operated alternatives

5.10.1 The alternative means of obtaining information in the event of a failure in the monitoring system should be as follows:

- .1 oil content meter or sampling system: visual observation of the surface of the water adjacent to the effluent discharge;
- .2 flow meter: pump discharge characteristics, etc;
- .3 ship's speed indicating device: main engine r.p.m. etc;
- .4 processor: manual calculation and manual recording; and
- .5 overboard discharge control: manual operation of pumps and valves.

5.11 Alarm conditions resulting in the stopping of discharge

5.11.1 Audio-visual alarms should be activated for any of the following conditions and the monitoring system should be so arranged that the discharge of effluent into the sea is stopped:

- .1 whenever the instantaneous rate of discharge of oil exceeds 60 litres per nautical mile;
- .2 when the total quantity of oil discharged reaches 1/30,000 of the previous cargo;
- .3 in the event of failure of the system's operation, such as:
 - .3.1 power failure;
 - .3.2 loss of sample;
 - .3.3 significant failure of the measuring or recording system; or
 - .3.4 when the input of any sensor exceeds the effective capacity of the system.

5.12 Location of alarm indicator

5.12.1 The alarm indicator of the system should be installed in the cargo control room, where provided, and/or in other places where it will attract immediate attention and action.

6 SPECIFICATIONS FOR TYPE APPROVAL TESTING OF THE OIL CONTENT METER AND THE CONTROL SECTION OF AN OIL DISCHARGE MONITORING AND CONTROL SYSTEM

6.1 Testing requirements

6.1.1 An oil content meter should be tested for its ability to determine the oil content over a wide range of oil contents and types of oil and within the accuracy limits specified in paragraph 5.2.2. The meter, which is to be identical in all respects with the production model for which the approval will apply, should be type-tested in accordance with the test and performance specifications contained in part 1 of the Annex to these Guidelines and Specifications.

6.1.2 An oil content meter and a control section of the monitoring system, which is to be identical in all respects with the production model for which the approval will apply, should be type-tested in accordance with the specification for environmental testing contained in part 2 of the Annex to these Guidelines and Specifications.

6.2 Approval and certification procedures

6.2.1 Oil content meters which in every respect fulfil the requirements of these Guidelines and Specifications may be approved by the Administration for fitting on board tankers. The approval should take the form of a certificate of type approval specifying the main particulars of the apparatus and any limiting conditions on its usage necessary to ensure its proper performance. Such certificate should be issued in the format shown in part 3 of the Annex to these Guidelines and Specifications. A copy of the certificate of type approval for the oil content meter should be carried aboard an oil tanker fitted with such an equipment at all times.

6.2.2 A certificate of type approval should be issued for the specific application for which the oil content meter is approved, i.e. for crude oil, "black" products, "white" products, other products or applications as listed on the certificate.

6.2.3 Approved oil content meters may be accepted by other countries for use on their vessels on the basis of the first trials, or after new tests carried out under the supervision of their own representatives. Should an oil content meter pass a test in one country but fail a test of a similar nature in another country, then the two countries concerned should consult one another with a view to reaching a mutually acceptable agreement.

7 WORKSHOP FUNCTIONAL TEST REQUIREMENTS

7.1 Each oil content meter and each control section of a monitoring system should be subjected to a functional test on a suitable test bench prior to delivery. The detailed programme for a functional test of such equipment should be developed by the manufacturer, taking into account the features and functions of the specific design of equipment. A completed workshop certificate including the delivery test protocol should be supplied with each unit delivered.

7.2 A functional test conducted on an oil content meter should include at least all the following operations:

- .1 check flow rate, pressure drop or an equivalent parameter as appropriate;
- .2 check all alarm functions built into the meter;
- .3 check all switching functions interconnecting with other parts of the system; and
- .4 check correct reading at several ppm values on all measurement scales when operated on an oil appropriate for the application of the meter or by an equivalent method.

7.3 A functional check conducted on a control section of a monitoring system should include at least all the following operations:

- .1 check all alarm functions;
- .2 check correct function of the signal processor and the recording equipment when simulated input signals of ppm, flow rate and speed are varied;
- .3 check that the alarm is activated when the input signals are varied so that the discharge limits contained in regulation 9(1)(a)(iv) and (v) are exceeded;
- .4 check that a signal is given to the overboard discharge control when alarm conditions are reached; and
- .5 check that the alarm is activated when each one of the input signals is varied to exceed the capacity of the system.

8 PLAN APPROVAL REQUIREMENTS

8.1 Adequate documentation should be prepared well in advance of the intended installation of a monitoring system and should be submitted to the Administration for approval. The documentation to be submitted should include at least all the following:

- .1 a description of the monitoring system, including identification of the category of monitoring system applicable to the oil tanker according to section 4. The description should include a diagrammatic drawing of the pumping and piping arrangements,

identifying the operational outlets for dirty ballast and oil-contaminated water from the cargo tank area and compatible with the operational requirements set out in the oil tanker's cargo and ballast handling manuals. Special considerations may have to be given to installations in oil tankers which have unusual pumping and piping arrangements;

- .2 equipment manuals, supplied by manufacturers, which should contain details of the major components of the monitoring system;
- .3 an operations and technical manual for the complete monitoring system which is proposed to be installed in the oil tanker. This manual should cover the arrangements and operation of the system as a whole and should specifically describe parts of the system which are not covered by the manufacturer's equipment manuals;
- .4 the operations section of the manual should include normal operational procedures and procedures for the discharge of oily water in the event of malfunction of the equipment;
- .5 the technical section of the manual should include adequate information (description and diagrammatic drawings of the pumping and piping arrangements of the monitoring system and electrical/electronic wiring diagrams) to enable fault finding and should include instructions for keeping a maintenance record;
- .6 a technical installation specification defining, *inter alia*, the location and mounting of components, arrangements for maintaining the integrity of the boundary between safe and hazardous spaces and the arrangement of the sample piping, including calculation of the sample response time referred to in paragraph 5.3.6;
- .7 a copy of the certificate of type approval for the oil content meter and technical documentation relevant to other main components of the monitoring system; and
- .8 a recommended test and checkout procedure specific to the monitoring system installed. This procedure should specify all the checks to be carried out in a functional test by the installation contractor and should provide guidance for the surveyor when carrying out the on-board survey of the monitoring system.

9 GENERAL INSTALLATION REQUIREMENTS

9.1 The on-board installation arrangements must be such that satisfactory function of the entire system is obtained and all safety regulations issued by the relevant Administration are complied with.

9.2 The installation arrangements must conform in each case with those specified and approved under the procedure for plan approval outlined in section 8.

9.3 The installation arrangements must also satisfy all relevant parts of the technical specifications in section 5 and all relevant installation instructions provided by the manufacturer of the various items of equipment and components.

10 INSTALLATION SURVEY

10.1 Verify that the following documentation is on board in a suitable format for permanent use:

- .1 copy of the certificate of type approval for the oil content meter;

- .2 statement from the Administration, or from a laboratory authorized by the Administration, to confirm that the control section of the monitoring system has been type-tested in accordance with the specifications for environmental testing contained in part 2 of the Annex;
- .3 equipment manuals for major components of the system;
- .4 operations and technical manual approved by the Administration, containing a technical description of the system, operational procedures and backup procedures in case of equipment malfunction;
- .5 installation specification; and
- .6 installation checkout procedures.

10.2 Verify the completeness of the workshop certificate for the oil content meter and the control section of the monitoring system.

10.3 Verify that the system installation has been carried out in accordance with the approved technical installation specification referred to in paragraph 8.1.6.

10.4 Verify that:

- .1 the oil content meter is identical to the one for which the certificate of type approval has been issued;
- .2 the installation of the oil content meter and the control section of the monitoring system has been carried out in accordance with the manufacturer's equipment specification; and
- .3 the operational outlets are located in the positions indicated on the drawing of the pumping and piping arrangements.

10.5 Verify that the workmanship of the installation is satisfactory and, in particular, that the bulkhead penetrations are to the relevant approved standard.

10.6 Verify that the monitoring system operates correctly when tested in accordance with the approved procedures contained in section 11 of these Guidelines and Specifications.

11 ON-BOARD FUNCTIONAL TEST AND CHECKOUT PROCEDURE

11.1 The functional test referred to in paragraph 8.1.8 should include at least all the following tests when the monitoring system is operating on water:

- .1 verify correct running of pumps, absence of leakage in the sample pumping and piping system, correct functioning of remote controlled sampling valves, etc;
- .2 verify by checking flow rates or pressure drops, as appropriate, that the system operates under correct flow conditions. This test should be repeated separately for each sampling point;
- .3 verify that alarms function correctly when a malfunction occurs external to the monitoring system, such as no sample flow, no flow meter signal, power failure, etc;

- .4 vary the simulated input signals manually while the monitoring system is operating on water and check the recordings for correct values and timing. Vary the simulated manual input signals until alarm conditions are obtained, and verify proper recordings. For a category A monitoring system ascertain that the overboard discharge control is activating and verify that the action is being recorded;
- .5 verify that normal operating condition can be reset when the value of the instantaneous rate of discharge is reduced below 60 litres per nautical mile;
- .6 activate the manual override control and verify that a recording is made and that for a category A monitoring system the overboard discharge control can be operated;
- .7 turn off the system and verify for a category A monitoring system that the overboard discharge control cannot be operated;
- .8 start up the system and check the zero and gain setting for the oil content meter in accordance with the manufacturer's operations and technical manual; and
- .9 check the accuracy of any installed flow meter, for example by pumping water in a loop where the flow rate may be calculated from the level change in a tank. The check should be made at a flow rate of about 50% of the rated flow of the flow meter.

ANNEX

This Annex contains detailed test and performance specifications for components of an oil discharge monitoring and control system for oil tankers. The Annex is divided into three parts:

- Part 1 Test and performance specifications for type approval of oil content meters
- Part 2 Specification for environmental testing for type approval of the oil content meter and the control section of an oil discharge monitoring and control system
- Part 3 Documentation of approval

PART 1 — TEST AND PERFORMANCE SPECIFICATIONS FOR TYPE APPROVAL OF OIL CONTENT METERS

1.1 General

1.1.1 This test and performance specification for type approval relates to oil content meters. In addition, the electronic section of the oil content meter should be tested in accordance with the specification for environmental testing contained in part 2 of this Annex.

1.1.2 The meter being tested should satisfy all the relevant requirements contained in section 5 of these Guidelines and Specifications.

1.2 Test specifications

1.2.1 A meter designed to operate over a wide range of oil content should measure the true oil content of the sample entering the meter during each test within ± 10 ppm or $\pm 20\%$, whichever is the greater, and testing should be performed in accordance with the procedures detailed in paragraphs 1.2.5 to 1.2.18 of this specification.

1.2.2 A diagrammatic arrangement of a test rig for evaluating the performance of oil content meters is given in figure 1. The accuracy of the oil content meter should be determined by comparing its readings with a known flow of oil injected into a known flow of water. The grab samples taken should be analysed in a laboratory by the method described in paragraph 1.3 of this specification. The results of the laboratory analysis will be used for correlation and to indicate sampling and test equipment variability. The water flow rate should be adjusted so that the entire oil-water flow passes through the oil content meter, except the intermittent grab sample stream. Special care should be given to keep, continuously, a constant oil content in the water that flows into the meter. The oil and contaminant metering pumps should be adjusted to deliver a steady flow. If oil injection becomes intermittent at low concentrations, the oil may be premixed with water to provide continuous flow, if absolutely necessary. The oil injection point should be immediately upstream of the oil content meter inlet to minimize time-lags caused by the sample system. Wherever Arabian light crude oil is specified in particular tests, a similar crude oil may be substituted, provided that the oil selected is used throughout the tests.

1.2.3 The sampling arrangement should be such that a representative homogeneous sample is obtained under all conditions of operation and under all operational proportions of oil content. The sample should be obtained at the open discharge outlet from the meter, but when this is impracticable the sampling arrangements shown in figure 2 should be used. Special care should be taken in collecting and preserving the sample to ensure validity of the resultant findings.

1.2.4 Should the oil content meter incorporate a filter or other device for removing solid contaminants from the mixture to be tested, such a device should be regarded as part of the oil content meter and be connected during all the tests. After completion of the contaminant tests referred to in paragraph 1.2.10 the device used to remove solid contaminants from the mixture should be opened up and the residues inspected to ascertain that they do not contain significant amounts of oil.

1.2.5 The oil content meter should be calibrated and zeroed in accordance with the manufacturer's instructions. It should then be tested with Arabian light crude oil at the following concentrations in ppm: 0, 15, 50, 100, 200 and at intervals of 200 up to the maximum of the meter's highest range. A complete calibration curve should be constructed. Each concentration test should last for 15 minutes. After each concentration test the meter should be run on oil-free water for 15 minutes and the reading noted.

1.2.6 After calibration in the previous test, the oil content meter should be tested at concentrations of 15 ppm, 100 ppm and 90 per cent of the maximum full scale with the following oils:

<i>Type of oil</i>	<i>Categories represented</i>
Sahara blend	Density - low Viscosity - low Pour point - very low Producing country - Algeria General description - mixed base
Arabian light crude	Density - medium Viscosity - medium Pour point - low Producing country - Saudi Arabia General description - mixed base

Nigerian medium crude	Density - high Viscosity - medium Pour point - low • Producing country - Nigeria General description - naphthenic
Bachaquero 17 crude	Density - very high Viscosity - very high Pour point - low Producing country - Venezuela General description - asphaltic
Minas crude	Density - medium Viscosity - high Pour point - very high Producing country - Indonesia General description - paraffinic
Residual fuel	Bunker C or No.6 fuel oil

Note: Other oils covering the range of properties shown may be substituted if those shown are unobtainable.

Following each test, the meter should be run on oil-free water for 15 minutes and the meter reading recorded. If it is necessary to re-zero, recalibrate, dismantle or water-flush to clean the meter between tests, this fact and the time required to recalibrate or clean the meter should be noted and recorded on the certificate.

1.2.7 If the meter is considered suitable for "white" petroleum products, it should also be tested with the following products in a manner similar to the tests set out in paragraph 1.2.6:

- Automotive gasoline;
- Kerosene; and
- Light diesel or No.2 fuel oil.

If the meter is to be considered suitable for any of the category C and D oil-like noxious liquid substances referred to in the list contained in the unified interpretations to regulation 14 of Annex II of MARPOL 73/78, it should also be tested against each such substance for which approval is required, in a manner similar to the tests set out in paragraph 1.2.6. The high shear pump shown in figure 1 should be kept in operation at high speed during this test to assist in dissolving the appropriate fraction of the substance in the water stream.

1.2.8 The oil content meter should be run on oil-free water and zeroed. The oil injection pump, set to 100 ppm Arabian light crude oil, should be turned on.

The following response times should be recorded and included on the certificate:

- .1 time for first detectable reading;
- .2 time to read 63 ppm; and
- .3 time for reading to stabilize at maximum, the value (ppm) of which should be recorded.

Following this upscale test, the oil injection pump should be turned off and the following response times should be recorded and included on the certificate:

- .4 time for the maximum reading to drop detectably;
- .5 time to read 37 ppm; and
- .6 time for reading to stabilize at minimum, the value (ppm) of which should be recorded.

The response time of the meter, which should be taken as the average of the response time recorded to read 63 ppm and the response time recorded to read 37 ppm, should be less than 20 seconds.

1.2.9 Two tests using Arabian light crude oil should be performed to determine the effect of oil fouling on calibration shift. The first test should be done with a 10% oil concentration and the second with a 100% oil concentration.

For the 10% oil concentration test the meter should initially be running on oil-free water. The high capacity oil injection pump, set to give 10% oil in water, should be turned on for one minute and then turned off.

For the 100% oil concentration test the meter should be running on oil-free water. The water should be turned off and oil turned on for one minute. The oil should then be turned off and the oil-free water flow resumed.

Care must be taken in the design of the test equipment to ensure that the oil fouling test results are not degraded by fouling of the sample piping external to the meter.

The following response times should be noted for both tests and recorded on the certificate:

- .1 time for first detectable reading;
- .2 time to read 100 ppm;
- .3 time for reading to go off scale on the highest range;
- .4 time for reading to return back on scale on the highest range;
- .5 time for reading to return to 100 ppm; and
- .6 time for reading to return to zero or stabilize at minimum ppm reading.

If it is necessary to dismantle or water-flush to clean the meter after each oil fouling test for it to return to a zero reading, this fact and the time required to clean and recalibrate the meter shall be noted and recorded on the certificate.

After successful completion of both oil fouling tests, a 100 ppm mixture of Arabian light crude oil should be introduced and any calibration shift noted and recorded on the certificate.

1.2.10 The meter should be run on contaminated water as follows:

- .1 the meter should be run on water, and the contaminant described in .2 of this paragraph should be added to the water contained in the mixing tank in the concentration stated. Arabian light crude oil will be added to the mixture of water and contaminants in the following concentrations:
 - 15 ppm;
 - 100 ppm; and
 - 300 ppm.

Any shift in the meter reading should be noted and recorded on the certificate;

- .2 the contaminant should be a mixture containing not less than 270 ppm by weight of attapulgite (see note (a)) and 30 ppm by weight of iron oxides (see note (b)). Each material should be mixed sequentially in the mixing tank to the following criteria:
 - .2.1 attapulgite for a period of not less than 15 minutes so that a homogeneous suspension is formed; iron oxides for an additional period of not less than 10 minutes. The mixing process should maintain the contaminants in suspension throughout the test period;
 - .2.2 sufficient water should be available in the mixing tanks to ensure an effective test period of not less than 15 minutes.

Notes:

- (a) Attapulgite is a clay mineral with the chemical formula $(Mg, Al)_5Si_8O_{22}(OH)_4 \cdot 4H_2O$ and is stable in both fresh and salt water. The test contaminant should have a particle size distribution with about 30% of 10 microns or less and a maximum particle size of 100 microns.
- (b) The term "iron oxides" is used to describe black ferrosferic oxide (Fe_3O_4) with a particle size distribution of which 90% is less than 10 microns, the remainder having a maximum particle size of 100 microns.

1.2.11 The meter should be run on water with air entrainment as follows:

- .1 Air should be injected into the test circuit immediately before the sample pump or, in the absence of such pump, immediately before any conditioning unit used to prepare the mixture for measurement. Injection should be by needle having an orifice dimension not exceeding 0.5 mm in diameter arranged in line with the sample flow. The quantity of air injected should be 1% of the designated flow rate of the sample pump or conditioning unit at the point of injection. Air should be delivered to the system by direct injection or pump via a suitable measuring device designed to permit a constant controllable flow rate within $\pm 10\%$ of the required rate of injection for an uninterrupted effective test period of not less than 15 minutes.
- .2 Arabian light crude oil should be added to this mixture of water and air in the following concentrations:
 - 15 ppm;
 - 100 ppm; and
 - 300 ppm.

Any shift in the meter reading should be recorded on the certificate.

1.2.12 The meter should be run on a mixture of water and Arabian light crude oil of 100 ppm. The high shear pump, shown in figure 1, should be run at various speeds to provide a range of oil particle size to the meter and on completion of this test the pump should be stopped. Any effect of particle size on the meter reading should be noted and recorded on the certificate. The purpose of this test is to demonstrate that the meter's accuracy is not significantly affected by the oil droplet size or by the degree of oil and water mixing.

1.2.13 The meter should be run on a mixture of water and Arabian light crude oil of 100 ppm. The water temperature should initially be set at 10°C and then at 65°C. If the manufacturer's specification lists an operating maximum water temperature of less than 65°C, the meter should be run at that maximum temperature and this fact together with any effect of water temperature on the meter reading should be recorded on the certificate.

1.2.14 The meter should be run on a mixture of water and Arabian light crude oil of 100 ppm. The water pressure or flow rate of the mixture should be adjusted from one-half normal, to normal and to twice normal. Any effect of these changes on the meter reading should be recorded on the certificate. This test may require modification, depending on the flow characteristics of the meter.

1.2.15 The meter should be run on a mixture of water and Arabian light crude oil of 100 ppm. The water and oil injection pumps should be shut off and the meter left on with no other changes made. After 8 hours, the water and the oil injection pumps should be turned on and set to provide a mixture of 100 ppm. The meter readings before and after each test and any damage to the meter should be recorded on the certificate. This test also determines the proper functioning of the low flow shut-off and alarm.

1.2.16 The meter should be run on a mixture of water and Arabian light crude oil of 100 ppm. The supply voltage should be increased to 110% of the nominal value for one hour and then reduced to 90% of the nominal value for one hour. Any effect on meter performance should be recorded on the certificate.

If the operation of the meter requires any utilities besides electricity, it should be tested with these utilities at 110% and 90% of the design figures.

1.2.17 The meter should be calibrated and zeroed in accordance with the procedures in the manufacturer's instructions manual. A mixture of water and Arabian light crude oil of 100 ppm should be run through the meter for 8 hours and any calibration drift recorded on the certificate. Following this, the meter should be run on oil-free water and any zero drift recorded on the certificate.

1.2.18 The meter should be shut down and de-energized for one week. It should be turned on and started in accordance with the manufacturer's instructions. After the suggested warm-up and calibration procedures, the meter should be run for a period of 8 hours, operating alternately for one hour on a mixture of water and Arabian light crude oil of 100 ppm and for one hour on oil-free water. After each step in the operation, any zero or span drift should be recorded on the certificate. The total time required to perform the manufacturer's suggested warm-up and calibration procedures should also be recorded on the certificate.

1.2.19 A specification of the instrument concerned and a diagrammatic presentation of the test arrangements should be provided to the Administration by the manufacturer when applying for type approval and the following data should be reported in the international metric system of units:

- .1 types and properties of oils used in the tests;
- .2 details of contaminants used, in the form, for example, of a supplier's certificate or laboratory test protocol; and
- .3 results of tests and analysis of grab samples.

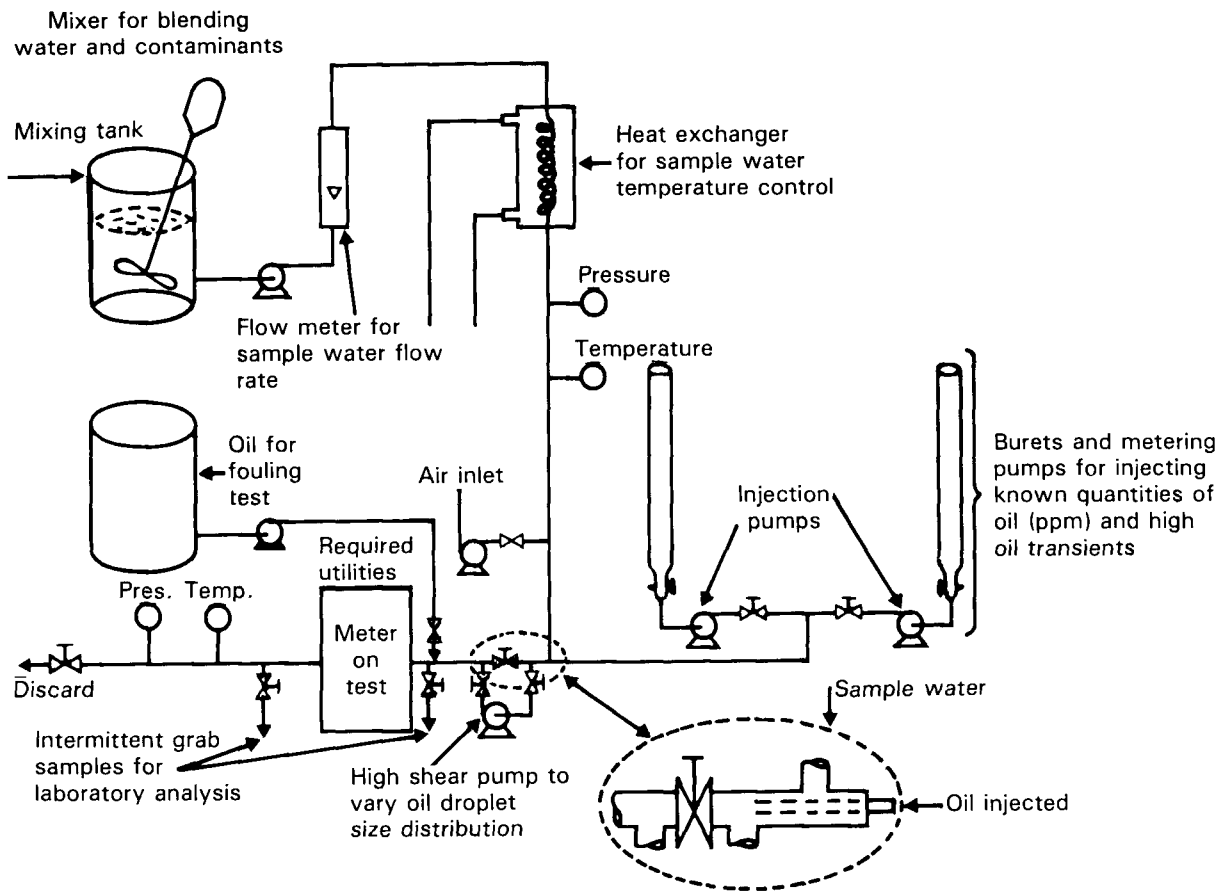
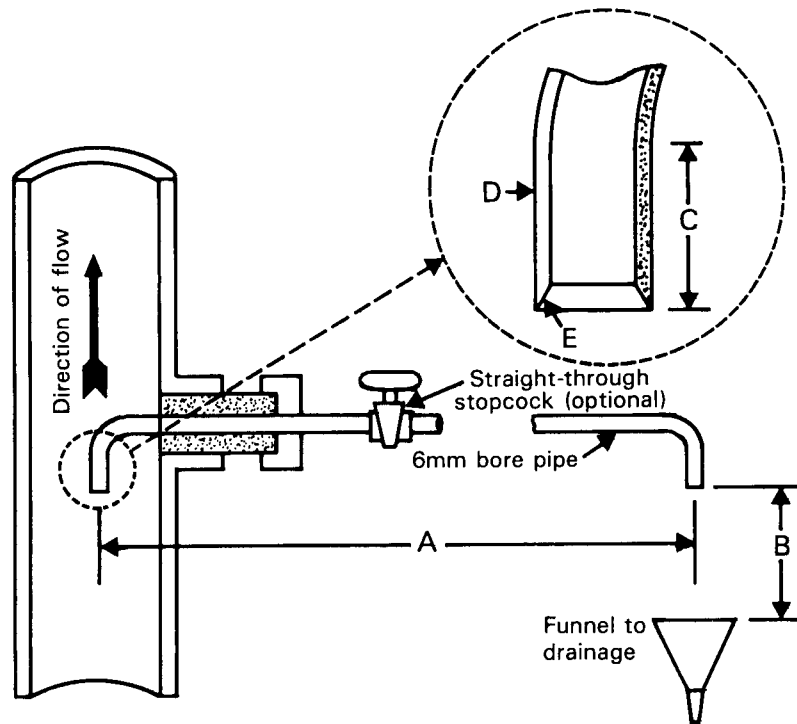


Figure 1 — Test rig

The size of the mixing tank should be specified so as to allow a minimum "once through" effective test period of 15 minutes. Adequate arrangements should be made for in-tank mixing or recycling to ensure a homogeneous mixture.



- A Distance A, not greater than 400mm.
- B Distance B, sufficient to insert sampling bottle.
- C Dimension C, straight length should not be less than 60mm.
- D Dimension D, pipe thickness should not be greater than 2mm.
- E Detail E, chisel-edged chamfer (30°).

Figure 2 — *Alternative sampling arrangement in test rig*

1.3 Method for the determination of oil content

1.3.1 *Scope and application*

- .1 The method includes the measurement of most light oil fractions, although some loss of volatile components will occur during extraction.
- .2 The method has a nominal working range from 2 to 80 mg/l. The lower level of detection can be improved to 0.1 mg/l by using longer path-length cells. The upper limit of the method can be extended at least to 1,000 mg/l by preparing dilutions of the sample extract.

1.3.2 *Summary of method*

- .1 The sample is acidified to a low pH value and extracted with two volumes of carbon tetrachloride. The oil content is determined by comparison of the infrared absorbances of the sample extract against known concentrations of the appropriate reference oil. Other suitable non-infrared active solvents may be used if preferred.

1.3.3 *Sampling and storage*

- .1 A representative sample of 1 litre volume is collected in a narrow-necked glass bottle with a pressure-sealing cap. Unless the sample will be extracted on the day of collection, it is preserved by adding 5 ml hydrochloric acid (HCl) (see 1.3.5.1).
- .2 The collection of a composite sample is impractical, as losses of oily matter will occur on sampling equipment. Individual portions collected at prescribed time intervals must therefore be analysed separately to obtain the average concentration over an extended period.

1.3.4 *Apparatus*

- .1 Separatory funnel, 1,000 ml volume, with Teflon stopcock;
- .2 Infrared spectrophotometer;
- .3 Cells, 5 mm path-length, sodium chloride or infrared grade quartz with a minimum of 80% transmittance at $2,930\text{ cm}^{-1}$. The 5 mm path-length is recommended as being convenient for monitoring levels normally encountered. Longer path-lengths may be used;
- .4 Filter paper, medium grade, 12.5 cm.

1.3.5 *Reagents*

- .1 Hydrochloric acid, HCl 1:1. Mix equal amounts of concentrated HCl and distilled water;
- .2 Sodium chloride, NaCl reagent grade;
- .3 Carbon tetrachloride, CCl_4 reagent grade;
- .4 Oil reference: oil collected from the source at the same time as the sample was collected;
- .5 Stock reference standard (3 mg/ml): accurately weigh about 0.30 g of reference oil (1.3.5.4) into a tared 100 ml volumetric flask and dilute to volume with carbon tetrachloride;
- .6 Calibration standards: prepare a series of dilutions by pipetting volumes of stock reference standard into 100 ml volumetric flasks and diluting to volume with carbon tetrachloride. A convenient series of volumes is 5, 10, 15, 20 and 25 ml of stock solution. Calculate the exact concentrations of the dilutions in milligrams per 100 ml solution from the weighing above (1.3.5.5).

1.3.6 *Extraction*

- .1 If the sample was not acidified at the time of collection, add 5ml hydrochloric acid (1.3.5.1) to the sample bottle. After mixing the sample, check the pH value by touching pH-sensitive paper to the cap to ensure that the pH is 2 or lower. Add more acid if necessary.
- .2 Pour the sample into a separatory funnel and add 5 g of sodium chloride.

- .3 Add 50 ml carbon tetrachloride to the sample bottle. Cap tightly and thoroughly shake the bottle to rinse the inside and cap. Transfer the solvent into the separatory funnel and extract by shaking vigorously for 2 minutes. Allow the layers to separate.
- .4 Drain the solvent layer through a funnel containing solvent-moistened filter paper into a 100 ml volumetric flask.
- .5 Repeat steps .3 and .4 above with an additional 50 ml portion of fresh solvent; combine all solvent in the volumetric flask.
- .6 Rinse the tip of the separatory funnel, filter paper and funnel with small portions of carbon tetrachloride and collect the rinsings in the volumetric flask. Adjust the extract volume up to 100 ml and stopper the flask. Mix well.
- .7 Drain the water layer into a 1,000 ml graduated cylinder and estimate the sample volume to the nearest 5 ml.

1.3.7 *Infrared spectroscopy*

- .1 Prepare the infrared spectrophotometer according to the manufacturer's instructions.
- .2 Rinse a cell with two volumes of the solution to be measured, then completely fill the cell with solution. Place a matched cell containing carbon tetrachloride in the reference beam.
- .3 Scan samples and standards from 3,200 cm^{-1} to 2,700 cm^{-1} .

Note 1: Single beam and non-scanning spectrophotometers can be used for this test. Follow the manufacturer's instructions and measure the absorbance directly at or near 2,930 cm^{-1} .

- .4 Construct a straight baseline under the hydrocarbon band as illustrated in figure 3. If the scan is recorded on absorbance paper, read the absorbance of the peak maximum at 2,930 cm^{-1} and subtract the absorbance of the baseline at that point. If the scan is recorded on transmittance paper, the net absorbance is:

$$\log_{10} \frac{\%T \text{ (baseline)}}{\%T \text{ (peak maximum)}}$$

- .5 Prepare a calibration plot of net absorbance in relation to milligrams per 100 ml oil using the response of the standards.

Note 2: The oil concentration may be plotted as a percentage of stock standard. When this procedure is used, the concentration of the stock standard must be used in the calculations (see 1.3.8.2).

- .6 If the net absorbance of a sample exceeds 0.8 or the linear range of the instrument as determined by the calibration plot, prepare a dilution of the sample by pipetting an appropriate volume of the extract into a volumetric flask and diluting to volume. If the absorbance is less than 0.1, more accurate results can be obtained by using a longer path-length cell.

1.3.8 *Calculations*

.1 Use the calibration plot to calculate the milligrams of oil in each 100 ml of sample extract or dilution.

.2 Calculate the oil content in the sample using the formula:

$$\text{milligrams per litre of oil} = \frac{R \times D \times 1000}{V}$$

where:

R = milligrams of oil in 100 ml solution (determined from calibration plot)

D = extract dilution factor, if used (1.3.7.6)

V = volume of sample, in millilitres (1.3.6.7).

.3 Report results to two significant figures for levels below 100 mg/l.

Note 3: For quality control, a reagent blank should be carried through each step of the procedure.

.4 For purposes of comparison with meter records, the results should also be presented in parts per million (volume/volume) with due allowance for the relative density of the oil.

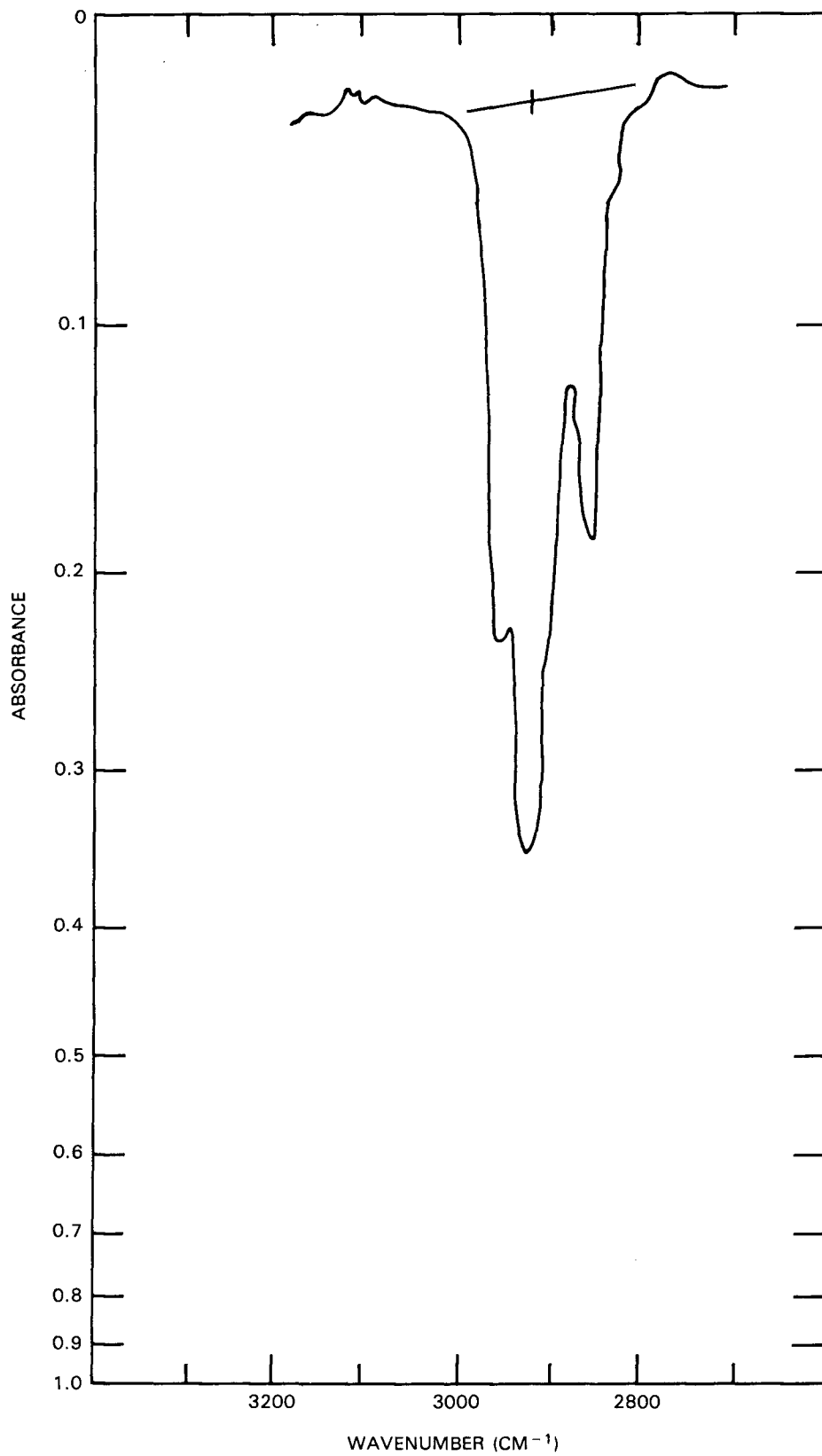


Figure 3 – *Spectrum illustrating baseline construction*

PART 2 — SPECIFICATION FOR ENVIRONMENTAL TESTING FOR TYPE APPROVAL OF THE OIL CONTENT METER AND THE CONTROL SECTION OF AN OIL DISCHARGE MONITORING AND CONTROL SYSTEM

2.1 General

The specification for environmental testing for type approval relates to the electronic section of the oil content meter and the control section of a monitoring and control system. A control section may be an independent unit or be combined with the electronic part of the oil content meter.

The equipment tested should comply with all the relevant requirements contained in section 5 of the Guidelines and Specifications.

2.2 Test specifications

2.2.1 Testing requirements

The electronic section of the oil content meter and the control section of the monitoring system in the standard production configuration should be subjected to the programme of environmental tests set out in this specification at a laboratory approved for the purpose by the Administration or by the competent authority of the manufacturer's home country. A copy of the environmental test document, in a format similar to that specified in paragraph 3.2 of this specification, should be submitted to the Administration by the manufacturer together with the application for type approval.

2.2.2 Test specification details

Equipment should operate satisfactorily on completion of each of the following environmental tests:

.1 *Vibration tests*

.1.1 a search should be made for resonance over the following range of frequency and amplitude or acceleration:

.1.1.1 2 to 13.2 Hz with an amplitude of ± 1 mm; and

.1.1.2 13.2 to 80 Hz with an acceleration of ± 0.7 g.

This search should be made in each of the three planes at a rate sufficiently low to permit detection of resonance;

.1.2 the equipment should be vibrated in the planes at each major resonant frequency for a period of 2 hours;

.1.3 if there is no resonant frequency, the equipment should be vibrated in each of the planes at 30 Hz with an acceleration of ± 0.7 g for a period of 2 hours;

.1.4 after completion of the tests specified in .1.2 or .1.3 of this paragraph a search should again be made for resonance and there should be no significant change in the vibration pattern.

.2 *Temperature tests*

.2.1 Equipment that may be installed in exposed areas on the open deck or in an enclosed space not environmentally controlled should be subjected, for a period of not less than 2 hours, to:

- .2.1.1 a low temperature test at -25°C ;
- .2.1.2 a high temperature test at 55°C .
- .2.2 Equipment that may be installed in an enclosed space that is environmentally controlled, including an engine-room, should be subjected, for a period of not less than 2 hours, to:
 - .2.2.1 a low temperature test at 0°C ;
 - .2.2.2 a high temperature test at 55°C .

At the end of each of the tests referred to in this subparagraph above, the equipment should be switched on and it should function normally under the test conditions.

.3 Humidity tests

- .3.1 Equipment should be left switched off for a period of 2 hours at a temperature of 55°C in an atmosphere with a relative humidity of 90%. At the end of this period the equipment should be switched on and should operate satisfactorily for one hour.

.4 Tests for protection against heavy seas

- .4.1 Equipment that may be installed in exposed areas on the open deck shall be subjected to tests for protection against heavy seas in accordance with IP 56 of IEC publication 529 or its equivalent.

.5 Fluctuation in power supply

- .5.1 Equipment should operate satisfactorily with:
 - .5.1.1 a voltage variation of $\pm 10\%$ together with a simultaneous frequency variation of $\pm 5\%$;
 - .5.1.2 a transient voltage of $\pm 20\%$ together with a simultaneous frequency transient of $\pm 10\%$, with a transient recovery time of 3 seconds.

.6 Inclination test

- .6.1. Equipment should operate satisfactorily at angles of inclination up to 22.5° in any plane from the normal operating position.

.7 Reliability of electrical and electronic equipment

- .7.1 The electrical and electronic components of the equipment should be of a quality guaranteed by the manufacturer and suitable for their intended purpose.

PART 3 — DOCUMENTATION OF APPROVAL

3.1 Certificate of type approval for oil content meters

3.1.1 Satisfactory compliance with all the test requirements enumerated in part 1 of this Annex should be shown in the certificate of type approval issued by the Administration in the format specified in paragraph 3.1.2 below. An Administration may issue a certificate of type approval based on separate testing or on testing already carried out under supervision by another Administration.

3.1.2 A certificate of type approval should be in the format shown in the appendix to this Annex. The certificate should identify the type and model of the oil content meter to which it applies and identify equipment assembly drawings, duly dated. Each drawing should bear the model specification numbers or equivalent identification details. The certificate should include the full performance test protocol on which it is based. If a certificate of type approval is issued by an Administration based on a certificate previously issued by another Administration, the certificate should identify the Administration which conducted the tests on the oil content meter and a copy of the original test results should be attached to it.

3.2 Format of environmental test protocol

3.2.1 Satisfactory compliance with the environmental tests laid down in these Guidelines and Specifications, where applicable, should be shown on the environmental test protocol issued by the testing laboratory. The protocol should include at least the following details:

- .1 identification of the equipment by type and drawing number, duly dated;
- .2 a statement of the tests conducted on the equipment, including the results thereof.

3.2.2 The environmental test protocol should be endorsed by either the Administration or a competent authority of the manufacturer's home country to confirm that the laboratory is approved to conduct such tests. The protocol should also be signed and dated by the person in charge of the laboratory.

APPENDIX



NAME OF ADMINISTRATION

CERTIFICATE OF TYPE APPROVAL FOR OIL CONTENT METERS INTENDED FOR MONITORING THE DISCHARGE OF OIL-CONTAMINATED WATER FROM THE CARGO TANK AREAS OF OIL TANKERS

This is to certify that the oil content meter, comprising the equipment listed below, has been examined and tested in accordance with the requirements of the specification contained in part 1 of the Annex to the Guidelines and Specifications contained in IMO resolution A.586(14). This certificate is valid only for an oil content meter referred to below.

Oil content meter supplied by under type and model designation and incorporating:

Oil content meter analysing unit manufactured by to specification/assembly drawing No. date

Electronic section of oil content meter manufactured by to specification/assembly drawing No. date

* Sample feed pump manufactured by to specification/assembly drawing No. date

* Sample conditioning unit manufactured by to specification/assembly drawing No. date

The oil content meter is acceptable for the following applications:

- * Crude oils
* "Black" products
* "White" products
* Oil-like noxious liquid substances, other products, or applications, listed below

A copy of this certificate should be carried aboard a vessel fitted with this equipment at all times.

Test data and results attached as appendix.

Signed

Official stamp

Administration of

Dated this day of 19

* Delete as appropriate

APPENDIX

TEST DATA AND RESULTS OF TESTS
CONDUCTED ON AN OIL CONTENT METER IN ACCORDANCE WITH PART 1
OF THE ANNEX TO THE GUIDELINES AND SPECIFICATIONS
CONTAINED IN IMO RESOLUTION A.586(14)

Oil content meter submitted by

Test location

Method of sample analysis

Samples analysed by

Environmental testing of the electronic section of the oil content meter has been carried out in accordance with part 2 of the Annex to the Guidelines and Specifications contained in IMO resolution A.586(14). The equipment functioned satisfactorily on completion of each test specified on the environmental test protocol.

		READINGS (ppm)			REMARKS
		Indicated	Measured	Grab sample	
CALIBRATION	0	.....	.....	.....
	15	.....	.....	.....
	50	.....	.....	.....
	100	.....	.....	.....
	200	.....	.....	.....
	400	.....	.....	.....
	600	.....	.....	.....
	800	.....	.....	.....	TEST WATER TEMPERATURE °C
	1000	.....	.....	.....	RE-ZERO YES/NO*
					RECALIBRATE YES/NO*
OIL TYPE					
RESPONSE TESTS					
Sahara blend					
	15	.....	.....	.....
	100	.....	.....	.....
90% M.F.S.V. = RECORDED ZERO		.....	.....	.....
					RE-ZERO YES/NO*
					TIME mins
					RECALIBRATE YES/NO*
					TIME mins
					CLEAN YES/NO*
					TIME mins
Arabian light crude					
	15	.....	.....	.....
	100	.....	.....	.....
90% M.F.S.V. = RECORDED ZERO		.....	.....	.....
					RE-ZERO YES/NO*
					TIME mins
					RECALIBRATE YES/NO*
					TIME mins
					CLEAN YES/NO*
					TIME mins
M.F.S.V. = MAXIMUM FULL SCALE VALUE					

* Delete as appropriate

			READINGS (ppm)		REMARKS
	Indicated	Measured	Grab sample		
Nigerian medium crude					
	15	.....	.....	.....
	100	.....	.....	.....
	90% M.F.S.V. =	.....	.....	.....
	RECORDED ZERO	.....			RE-ZERO YES/NO* TIME mins RECALIBRATE YES/NO* TIME mins CLEAN YES/NO* TIME mins
Bachaquero 17 crude					
	15	.....	.....	.....
	100	.....	.....	.....
	90% M.F.S.V. =	.....	.....	.....
	RECORDED ZERO	.....			RE-ZERO YES/NO* TIME mins RECALIBRATE YES/NO* TIME mins CLEAN YES/NO* TIME mins
Minas crude					
	15	.....	.....	.....
	100	.....	.....	.....
	90% M.F.S.V. =	.....	.....	.....
	RECORDED ZERO	.....			RE-ZERO YES/NO* TIME mins RECALIBRATE YES/NO* TIME mins CLEAN YES/NO* TIME mins

* Delete as appropriate

		READINGS (ppm)				
		Indicated	Measured	Grab sample	REMARKS	
Residual fuel	15	.....	.....	.....
	100	.....	.....	.....
	90% M.F.S.V. =	.....	.....	.....
	RECORDED ZERO	.....	.....	.....	RE-ZERO	YES/NO*
					TIME	mins
				RECALIBRATE	YES/NO*	
				TIME	mins	
				CLEAN	YES/NO*	
				TIME	mins	
Automotive gasoline	15	.....	.....	.....
	100	.....	.....	.....
	90% M.F.S.V. =	.....	.....	.....
	RECORDED ZERO	.....	.....	.....	RE-ZERO	YES/NO*
					TIME	mins
				RECALIBRATE	YES/NO*	
				TIME	mins	
				CLEAN	YES/NO*	
				TIME	mins	

* Delete as appropriate

		READINGS (ppm)				
		Indicated	Measured	Grab sample	REMARKS	
Kerosene	15	.....	.....	.....
	100	.....	.....	.....
	90% M.F.S.V. =	.....	.....	.....
	RECORDED ZERO	.....	.....	.....	RE-ZERO	YES/NO*
					TIME	mins
				RECALIBRATE	YES/NO*	
				TIME	mins	
				CLEAN	YES/NO*	
				TIME	mins	
Light diesel fuel	15	.....	.....	.....
	100	.....	.....	.....
	90% M.F.S.V. =	.....	.....	.....
	RECORDED ZERO	.....	.....	.....	RE-ZERO	YES/NO*
					TIME	mins
				RECALIBRATE	YES/NO*	
				TIME	mins	
				CLEAN	YES/NO*	
				TIME	mins	

Note: If alternative oils covering the same range of properties as the crude oils listed are used, these should be substituted where applicable.

* Delete as appropriate

OIL-LIKE NOXIOUS LIQUID SUBSTANCES, OTHER PRODUCTS OR APPLICATIONS*

		READINGS (ppm)			REMARKS
		Indicated	Measured	Grab sample	
Name of product 15 100 90% M.F.S.V. = RECORDED ZERO					
					RE-ZERO YES/NO** TIME mins RECALIBRATE YES/NO** TIME mins CLEAN YES/NO** TIME mins
Name of product 15 100 90% M.F.S.V. = RECORDED ZERO					
					RE-ZERO YES/NO** TIME mins RECALIBRATE YES/NO** TIME mins CLEAN YES/NO** TIME mins

* This page should be included in the certificate only if the oil content meter has been tested against category C or D oil-like noxious liquid substances.

** Delete as appropriate.

RESPONSE TIMES

seconds

First detectable reading		.....
	63 ppm	..... ①
Stabilized maximum reading	..... ppm	.....
First detectable drop		.....
	37 ppm	..... ②
Stabilized minimum reading	..... ppm	.....
RESPONSE TIME =	$\frac{\textcircled{1} + \textcircled{2}}{2}$	=

OIL FOULING AND CALIBRATION SHIFT

10% oil concentration test

First detectable response		.....
	100 ppm	.....
Off scale on highest range		.....
On scale on highest range		.....
	100 ppm	.....
Minimum reading	..... ppm	.....
Further cleaning required YES/NO* (State extent)		
Time	mins	

100% oil concentration test

seconds

First detectable response		.....
	100 ppm	.....
Off scale on highest range		.....
On scale on highest range		.....
	100 ppm	.....
Minimum reading	..... ppm	.....
Further cleaning required YES/NO* (State extent)		
Time	mins	
Calibration shift	..... ppm	

* Delete as appropriate.

CONTAMINANTS TEST

Meter reading shift with 300 ppm non-oil contaminants mixed with water and Arabian light crude oil added in oil concentrations of:

- 15 ppm ppm
- 100 ppm ppm
- 300 ppm ppm

Meter reading shift with 1% air entrained in water and Arabian light crude oil added in concentrations of:

- 15 ppm ppm
- 100 ppm ppm
- 300 ppm ppm

OIL PARTICLE SIZE TEST

Meter reading shift ppm

TEMPERATURE TEST

Calibration test water temperature °C

Meter reading shift at 10°C ppm

Meter reading shift at 65°C ppm

SAMPLE PRESSURE OR FLOW TEST

Meter reading shift at 50% of normal ppm

Meter reading shift at 200% of normal ppm

Deviations from this test should be stated if necessary

Meter reading before shutoff ppm

Meter reading after start-up
(minimum dry period 8 hours) ppm

Damage to meter as follows:

* Delete as appropriate.

UTILITIES SUPPLY VARIATION TEST

- 110% voltage effects
- 90% volatage effects
- 110% air pressure effects
- 90% air pressure effects
- 110% hydraulic pressure effects
- 90% hydraulic pressure effects

OTHER COMMENTS

CALIBRATION AND ZERO TEST

- Calibration drift ppm
- Zero drift ppm

SHUTDOWN AND RE-ENERGIZATION TEST

- Span drift ppm
- Zero drift ppm
- Time for warm-up and calibration mins

Signed

Date

Official stamp

(Official stamp or equivalent identification and the date of approval to be placed on all pages of the test protocol)