HYDROCARBON MANAGEMENT

HM 40 GUIDELINES FOR THE CRUDE OIL WASHING OF SHIPS' TANKS AND THE HEATING OF CRUDE OIL BEING TRANSPORTED BY SEA

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FOREWORD

The EI Hydrocarbon Management Advisory Group is responsible for the production and maintenance of standards and guides covering various aspects of static and dynamic measurement of petroleum. The Hydrocarbon Management Committee 4B (HMC 4B), deals with the measurement and loss of crude oil and oil products being transported within the marine environment, taking into consideration contractual constraints imposed by charterers, cargo owners, ship owners, and inherent vice of cargo.

HMC 4B is made up of experts from the oil industry, cargo surveyors, ship owners and representatives from marine terminals. It is a truly international committee with representatives from most Western European countries, the Middle East, and North and South America and China. Equipment manufacturers and experts having specific knowledge of measurement techniques are often invited to present papers to the sub-committee.

The EI maintains liaison with parallel working groups of the American Petroleum Institute's Committee on Petroleum Measurement, and other organizations concerned with quantitative measurement in other countries and in other industries.

The IP Hydrocarbon Management Guides are widely used by the petroleum industry and have received recognition in many countries by consumers and the authorities. In order to promote their wide adoption internationally, it is the policy to submit selected standards via the British Standards Institute to the International Standards Organisation's technical committee TC- 28 Petroleum Products and Lubricants, as potential International Standards.

A full list of the IP Hydrocarbon Management Guides is available on request from the Energy Institute.

The IP Hydrocarbon Management Guides are recommended for general adoption but should be read and interpreted in conjunction with weights and measures, safety, customs and excise and other regulations in force in a particular country in which they are to be applied. Such regulatory requirements have precedence over corresponding clauses in the IP document except where the requirements of the latter are more rigorous, when its use is recommended.

Although it is believed that adoption of the recommendations of this code will assist the user, the Energy Institute cannot accept any responsibility, of whatsoever kind, for damage or alleged damage arising or otherwise occurring on vessels or in or about premises where this document has been applied.

The crude oil properties given in this document have been reproduced from data submitted to HMC 4B. At the time of submission the organizations supplying the information considered it to be correct; however the Energy Institute is not responsible for any inaccuracies or variations in the data which may subsequently become apparent.

Users of these guidelines are invited to send comments, suggestions, or details of experience with this issue to:

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INTRODUCTION AND SCOPE

MARPOL regulations regarding Crude Oil Washing (COW) were introduced into the shipping industry in the late 1970s. The purpose of these regulations was to reduce the chances of marine pollution by reducing the need for water washing ships' tanks after discharge of cargo. Notwithstanding anything written hereunder, the current MARPOL regulations should be adhered to.

One of the older IMO resolutions regarding the specifications for design, operation and control of crude oil washing systems '*recognizes that further improvement may be required in the specifications, taking into account the development of technology in this field and in the light of experience gained*'.

This publication has been compiled with the aim of sharing the experiences of the oil companies represented on committee HMC 4B with other branches of the oil industry; and to provide guidance with regard to the carriage, heating and crude oil washing of the different crude oils. Some of the companies on the committee also operate tanker fleets thus enabling the data to be reviewed by the marine industry at large.

For this second edition to remain current there is provision for users to send data and recommendations to the EI on the form provided in Annex A. A table of crude oil properties can be found in Annex D. This annex is replicated on the HMC 4B website which can be found on www.energyinst.org.uk. Neither set of data should be used without consulting the remaining chapters in this publication.

The crude oils have been listed in alphabetical order. Against each crude is a set of characteristics obtained from a number of different assays. Many of the characteristics are given as a range which reflects the differences found in the base data. No single value in this guide should be considered as absolute. The carriage and discharge temperatures were generally obtained from current oil company guidelines. However, where there has been no information there may be a temperature, the choice of which has been based on experiences of crude oils with similar properties. Further explanation is given in Section 5.

Safe handling of crude oil is paramount in the industry. The committee has obtained some information on both hydrogen sulfide (H_2S) and benzene content. Again further explanation can be found in Section 5, with safety precautions highlighted in Section 6.

This document provides guidelines for the heating and Crude Oil Washing (COW) of many crude oils in the world that may be transported by sea.

As well as enhancing the current regulations regarding reducing marine pollution, the document is also designed to advise the reader on the grades of crude oil that may give rise to an increase in Volatile Organic Compounds (VOC) emissions if excessively used for COW.

The document also highlights a number of crude oils that are known to be potentially harmful due to concentration of hydrogen sulfide (H_2S) and/or benzene.

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REFERENCES

The following Standards and papers have been used in the preparation of this document:

Cloud point and crude oil washing, T.J. Gunner, October 1995, published by INTERTANKO.

Petroleum Measurement Tables, Volume XI/XII (ASTM D 1250-80).

Meteorology For Mariners, ISBN 0-11-400311-4, published by HMSO.

Note: Figures from this publication are reproduced in Annex B. Crown copyright is reproduced with the permission of the Controller of Her Majesty's Stationery Office.

International Safety Guide for Oil Tankers and Terminals, 4th edition, ISBN 1-85609-081-7, published by Witherby.

The IP Standard methods for analysis and testing of petroleum and related products, and British Standard 2000 Parts, latest edition, published by the Energy Institute.

ASTM Annual book of standards, Section 5, Petroleum Products, Lubricants, and Fossil Fuels, latest edition, published by ASTM.

Regulations for the Prevention of Pollution by Oil, Annex 1 of MARPOL 73/78 including amendments, ISBN 92-801-1280-5, published by IMO.

Crude Oil Washing Systems, 4th (2000) edition, ISBN 92-801-5094-4, published by IMO.

Revised Specifications for the Design, Operation and Control of Crude Oil Washing Systems, IMO resolution A.446 (XI) as amended A.496 (XII), published by IMO.

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GLOSSARY OF TERMS

For the purposes of these IP Guidelines, the terms used should be understood to have the following meanings:

asphaltenes: wax free material, insoluble in heptane but soluble in hot benzene.

ballast: water taken on board when a vessel is empty or partially loaded/discharged to increase draught so that the propeller is fully immersed, stability and trim are maintained, and stresses minimised. Specific ballast terms are as follows:

departure ballast: ballast taken on board prior to departure. If loaded into tanks that have previously contained cargo it may contain traces of oil and be termed *dirty ballast*.

clean ballast: ballast contained in cargo tanks that have been COW'd and thoroughly water washed. It may be discharged to sea and meets MARPOL requirements.

segregated ballast: ballast that is contained in dedicated ballast tanks serviced by dedicated ballast pumps and lines with no permanent connection to the cargo system.

heavy weather ballast: additional ballast loaded into cargo tanks to enable the vessel to maintain a safe sea-going condition under extreme weather conditions.

bottom wash: crude oil washing operations restricted to the lower parts of the tank bulkheads, internal structures and bottom of tanks. This can only be carried out by vessels equipped with programmable tank washing machines.

clingage: material which adheres to the surfaces of tank walls and structures, both horizontal and vertical, within empty and part empty tanks, other than bottom surfaces.

cloud point: for the purposes of this document, a calculated temperature (°C) as defined in Section 5.8.

crude oil: for the purposes of these guidelines crude oil types have been sub-divided into:

aromatic crude oil: see *high viscosity crude oil*.

high viscosity crude oil: a crude oil which due to its viscosity alone requires heating during transportation, COW or discharge. These types of crude oil generally have a high aromatic content and may have the designation *aromatic crude oil*.

volatile crude oil: crude oil, having a high concentration of components boiling below ambient temperature (Gas to C_4), which results in excessive gas evolution if used as a COW medium.

waxy paraffinic crude oil: a crude oil which, by function of its total wax content , requires heating to prevent sludge deposition during transportation and discharge.

crude oil washing (COW): the use of a high-pressure stream of crude oil cargo to dislodge or dissolve

clingage and sediments from the bulkheads, bottom and internal tank structures of a vessel during the discharge operation.

cutter stock: diluent material used for tank washing, acting as a solvent or viscosity reducer to enable better recovery of ROB. It may be heated.

full cycle washing: crude oil washing operation in which the complete cargo tank is washed.

gas to C_4: an abbreviation for the percent mass of hydrocarbon gases at normal temperature and pressure from C_1 to C_4 inclusive, present in crude oil.

inert gas (IG): a gas or gas mixture used to render the vapour space above the cargo non-flammable.

ISGOTT: International Safety Guide for Oil Tankers and Terminals.

IMO: International Maritime Organization.

ISO: International Organization for Standardization.

MARPOL: the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973, amended 1992.

on board quantity (OBQ): sum of measured liquid volume, including free water and measured non-liquid volume but excluding any vapours, in cargo tanks prior to loading.

pour point: the lowest temperature (°C) at which an oil will continue to flow when it is cooled under specified standard conditions.

remaining on board (ROB): sum of measured liquid volume, including free water, and measured non-liquid volume but excluding vapours, in cargo tanks on completion of discharge.

reid vapour pressure (RVP): absolute pressure exerted by the gas produced by evaporation from the liquid, as measured by Reid apparatus under the specific conditions of test temperature, vapour/liquid ratio and air saturation.

segregated ballast tankers (SBTs): vessels having sufficient dedicated ballast tanks to enable safe sea-going operations under normal weather conditions. See also *heavy weather ballast*.

slop tank(s): for the purposes of these guidelines tank(s) utilized as a reservoir for COW medium and receipt of tank washings.

stripping: the removal of the final contents of a cargo tank using equipment additional to the main cargo pumps.

threshold limit value (TLV): the time-weighted average concentration of a substance to which workers may be repeatedly exposed, for a normal 8-hour workday or 40-hour workweek, day after day without adverse effect.

trim: The difference between the fore and aft draught of the vessel. When the aft draught is greater than the forward draught, the vessel is said to be trimmed 'by the stern'. When the aft draught is less than the forward draught, the vessel is said to be trimmed 'by the head'.

true vapour pressure (TVP): the absolute pressure exerted by the gas produced by evaporation from a liquid, when the gas and liquid are in equilibrium at the prevailing temperature.

viscosity: a measurement of a fluid's resistance to flow at a prescribed temperature. In this document the unit of centistoke (cSt) has been used which is equivalent to mm^2/s.

volatile organic compounds (VOCs): a large family of carbon-containing compounds which are emitted or evaporate into the atmosphere and can take part in photochemical reactions in the air.

wax: a mixture of long chain hydrocarbons that crystallize at different temperatures as the overall fluid temperature falls.

wax/sediment = sludge: that element of the material in a ship's cargo tank which is essentially not free flowing. It consists of hydrocarbon waxes and may contain water/oil emulsions and sediments.

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CRUDE OIL WASHING AND HEATING GUIDELINE

4.1 GENERAL INFORMATION

In the past there has been no guideline for COW or Cargo Heating except for the general specifications given in the MARPOL regulations and the COW manuals supplied to each vessel. Over the past few years the number of different crude oils becoming available for carriage by sea has substantially increased. The quality of these crude oils can differ immensely. This has led to the industry questioning the present regulations especially as other environmental considerations such as air pollution must now be considered alongside marine pollution. The consequences of reducing oil losses to the environment are firstly to maximise the quantity of cargo discharged, for which there is a financial reward, and secondly, a better public perception of the oil industry. Present thinking is that performing a full COW on all occasions is not necessarily environmentally sound. For a large number of crude oils, minimising the amount of COW reduces cargo losses. However, COW methodology should be dependent on the appropriate crude oil characteristics, type of vessel, available equipment and previous experience.

There are two distinct areas where a full COW may be counter-productive: that of crude oils unsuitable for COW due to their viscous or waxy nature leading to high ROB, and that where the crude oils are particularly volatile, the use of which would result in excessive gas evolution.

4.2 HIGH VISCOSITY CRUDE OILS

For these crude oils the problem is high viscosity not necessarily sludge deposition, therefore these types of crude oil may have a lower carriage temperature than discharge temperature. They usually have a high aromatic content and may be known as 'aromatic crude oils'. A further complication arises with aromatic crude oils in that when used to wash paraffinic crude oil or vice versa, chemical incompatibility can cause the precipitation of asphaltenes from solution thereby increasing sludge deposition.

4.3 WAXY PARAFFINIC CRUDE OILS

It is important for these crude oils to maintain, or increase where appropriate, the oil temperature to the recommended level from the commencement of loading to prevent sludge deposition. Generally, there will be no difference between carriage and discharge temperature. Guidance on wax content is given in Section 5.6.

4.4 VOLATILE CRUDE OILS

These crude oils are not officially classed or listed in the MARPOL regulations, but have a potentially serious impact on vessel safety and the environment if used as a COW medium. Guidance on volatility is given in Section 5.5.

With volatile crude oils transported on COW tankers the COW operation can justifiably be reduced to a 'bottom wash only' or even 'zero' in appropriate cargo tanks, certainly in cargo tanks which will be used only for departure ballast.

Cargo tanks which will be used for clean ballast, required on arrival at the next port of loading, need to be carefully considered since these must meet the current MARPOL requirements. These requirements only give details for washing full cycles, the implication being that 'bottom washing only' is not currently acceptable.

For SBTs, the only tanks requiring COW would be those that may be required for heavy weather ballast.

Where the port for the next loading is known and the procedure is to pump all ballast ashore, a 'bottom wash only' should be acceptable. Where clean arrival ballast for the next load port must be discharged overboard, a more cautious approach must be adopted to reduce the risk of a marine pollution incident.

In all events the priority criteria are to ensure that the ship's cargo tanks are washed to the standard required to minimise all pollution risks.

4.5 SHIP TYPE

4.5.1 COW tankers

A number of crude oil carriers trading at present are still classed as COW tankers. Some of the cargo tanks on this type of vessel are also utilised for clean or departure ballast. MARPOL73/78, Annex 1, Reg. 13B states that, '*ballast water is only put into cargo tanks which have been crude oil washed*' and also requires that every tanker operating with COW systems shall be provided with an COW Operations and Equipment Manual detailing the system, equipment and specifying operational procedures. With COW tankers the extent that COW can be reduced is limited.

4.5.2 Segregated ballast tankers (SBTs)

COW tankers are gradually being replaced by Segregated Ballast Tankers (SBTs). Every tanker for which the building contract was placed after 1 June 1979 or delivered after 1 June 1982 is required to be fitted with protectively located ballast tanks and to be fitted for COW. With the exception of the heavy weather ballast tank(s) these tankers do not have to perform COW except for the control of sludge. The degree of control that can be exercised over COW is therefore much greater but will still be dependent upon whether the ship is fitted with programmable COW machines.

4.5.3 Double-hull tankers

These vessels are a particular type of SBT. The cargo carrying spaces are surrounded by tanks that can contain ballast water when on ballast passage. This means that there are wing ballast tanks outboard of the cargo spaces for the full length of the cargo space and double-bottom water ballast tanks below the cargo spaces.

When loaded with cargo, the oil is insulated from a hull that may be relatively cold due to ambient weather/sea conditions. It is possible that the oil will not require as much energy to retain loaded temperature or will not cool as fast as a conventional single-hull vessel.

Although on arrival the cargo may have a temperature above the cloud point, as ballast is taken on board, the inner hull could be substantially cooled. This cooling may encourage wax laydown within the cargo tank. It is important to assess the ballast water temperature and consider its cooling effect on the inner hull, bearing in mind the cargo quality.

4.6 CARGO HEATING

4.6.1 General

The optimum temperature to which the cargo should be heated is largely dependent upon the pour point, cloud point, total wax content and the viscosity of the cargo. The ambient weather and sea conditions also influence the heating requirements. Furthermore, it may be necessary to heat the cargo required for COW to a higher temperature than bulk cargo.

The data supplied in Annex D give, besides the characteristics of each crude, guidelines on the COW requirements, minimum carriage and transfer temperatures. The suggested COW procedures are coded for the two types of tankers, COW tankers or SBTs, for both winter and summer conditions. It should be emphasised that the temperatures and procedures given in Annex D guidelines: actual conditions experienced either during the voyage or during discharge may require a revision in implementation or procedure.

4.6.2 Heat exchangers/deep well pump combinations

Where cargo temperature is maintained using heating coils, the heat energy is imparted on a continuous basis for the majority of the discharge. Where deep-well pumps are used to circulate cargo via 'on-deck' heat exchangers, it is probable that during discharge heating cannot be continued. Vessels with this type of system installed may be unsuitable for carrying some heated crude oils.

4.7 PRE-CHARTERING STAGE

Before a ship is chartered the following information may be relevant :

a) That the COW and Inert Gas (IG) systems are fully operational according to the international/national regulations. These regulations also apply to the continuous monitoring and recording of IG pressure and oxygen content for the duration of the transfer operation. Failure of the monitors and recording instrumentation will preclude the carrying out of COW operations.

b) The ship type, which will dictate the level of COW required.

c) The COW machines, whether programmable or non-programmable.

d) Type of heating system, either continuous (heating coils), or not (heat exchangers with deep-well pumps).

Note: With respect to volatile cargoes i.e. those with high Gas to C_4 content, refer to Section 5.5; performing a full COW with non-programmable machines may generate unacceptable levels of hydrocarbon gas evolution which may cause a higher than normal loss on outturn and may give rise to air pollution.

These COW and heating guidelines are not intended to preclude charterers from specifying their own COW and heating requirements in a charter party.

4.8 CRUDE OIL WASHING

4.8.1 General

The ships' officers or charterers'/cargo receivers' representative (if appointed), should decide if COW needs to be performed and if so assess its effectiveness, even if the data suggest that COW is not required. For example, North Sea crude oils (e.g. Brent) generally have a moderate wax content and on short voyages in summer, where the cargo retains its loaded temperature, COW need not be performed. However, if the voyage is long then wax may settle out of the cargo and a bottom wash will be required. In most cases tank dips will need to be obtained at a number of points in each cargo tank to assess the amount and location of wax/sediments remaining after initial draining and to determine if COW is necessary. The IMO publication on crude oil washing systems advises in Section 4.4.4 that 'Suitable arrangements for hand dipping must be provided at the aftermost portion of a cargo tank and in three other suitable locations unless other approved means are fitted for efficiently ascertaining that the bottom of every cargo tank is dry'. The main disadvantage of COW is the generation of hydrocarbon gas. This gas constitutes a loss and should be considered in the formulation of any COW policy.

4.8.2 Non-hydrocarbon components of crude oil

It has to be recognised that COW is a vigorous washing method which ensures that the ship will discharge more of the non-hydrocarbon components such as sand and shale etc. than would be the case if COW is not carried out. These contaminants form part of the cargo and it is the responsibility of the terminal to receive these and treat/dispose accordingly. However, they are abrasive and have a detrimental effect on the internals of pipes, valves and fittings that accelerates wear, leading to increased maintenance costs around refineries and terminals; the performance of in-line samplers may also be affected. Furthermore, sludge problems in shore tanks are aggravated which in turn increases cleaning and disposal costs. The accumulation of sludge affects both shore tank measurement and water draining. Inadequate water draining of crude feed tanks can adversely affect refinery operations.

4.8.3 Charterer's representative

A charterer's or cargo receiver's representative may be appointed to monitor the cargo discharge. If appointed, his/her duties are to liaise with both the ship and shore personnel with regards to the general discharge operation and COW. Charterers' representatives are fully conversant with the crude oil properties and will be able to advise the ship's staff on the effectiveness of their discharge and COW plan. They should be sufficiently knowledgeable about discharging operations to be able to suggest changes to the plan that may be required during discharge, to maximise the outturn whilst minimising environmental pollution.

4.8.4 COW medium

Many COW operations manuals seem to imply that when performing COW, cargo tanks should be washed with 'fresh' crude oil and not with 're-cycled' crude oil from the slop tanks. The term 'fresh' means crude oil that is essentially dry and has not previously been used for COW, 're-cycled' being crude oil that has been previously used to wash the ship's tanks. This is particularly important when performing COW with waxy crude oils as continued washing with the same crude oil can lead to wax saturation and complete loss of solvency. COW using the 'closed-cycle' re-circulation method is not suited to routine crude oil washing as it causes delay, and increases the risk of passing sediment through the machines and of using oil which has lost much of its solvency. In order to maintain a consistent quality of oil discharged, tank washings should be commingled and discharged with the main cargo. The exceptions are waxy paraffinic cargoes where the slop tank contents are heated to a higher temperature than the rest of the cargo to assist in the removal of waxes. The crude oils that require this special treatment are noted in the data 'Remarks' column of Annex D.

4.8.5 Backloading 'cutter stock'

On occasions where large amounts of ROB are detected, it may be financially advantageous to backload a suitable 'cutter stock', if available, to be used for COW. If the cutter stock, which is usually a middle distillate oil, is heated, further improvements in the reduction of ROB may be obtained. Alternatively, a suitable crude oil having similar properties to cutter stock could also be used.

Only a few crude oils, as noted in Annex D, require washing with cutter stock. For example, the residues from Widuri, which is a high pour point crude oil with a high wax content, have successfully been removed with heated cutter stock.

The procedure was to discharge all cargo tanks to a depth of one metre and leave with the heating on. Each tank was then successively stripped, washed with cutter stock, and finally stripped, with good results. To clear the draining holes of wax the COW machines were programmed to bottom wash first and then be followed by a full-cycle wash.

Before backloading cutter stock careful consideration must be given to the following points:

— If the cutter stock is an on-specification product the cost of re-processing may be high in relation to the quantity and quality of the cargo residues recovered from the ship's tanks.

— The quality of ROB. There would be no point in performing this operation just to clean the cargo tanks of non-hydrocarbons.

— Discharge time available. This may be considerably increased if backloading of the cutter stock cannot take place until all of the cargo has been discharged.

— Suitable cutter stock is available.

It is recommended that this operation is not performed unless the economics of the situation have been carefully assessed.

Cargoes of waxy paraffinic or high viscosity crude oil which cannot be suitably conditioned to enable COW, or where cutter stock or a suitable crude oil is not available for washing, should be treated in the same way as fuel oil.

4.9 VENTING VAPOURS

4.9.1 In transit

During the voyage the vapour/IG pressure above the cargo may rise to a level considered as unsafe by ship's staff. Normal operations would involve releasing this pressure to the atmosphere by manual opening of the mast riser valves. The vapour/IG is released until the pressure falls to some arbitrary low level. However, if this low pressure is below the TVP of the cargo at the observed temperature the vapour/liquid equilibrium will be upset and more vapour will be created from the cargo. The eventual release of this vapour will increase

environmental pollution and cargo loss.

The committee believes that controlled venting at sea can reduce overall emissions and potential cargo loss. Traditionally, regular venting to a low pressure 200 – 300 mmH_2O, was thought to be the most effective method of tank pressure control. Recent studies have indicated that reducing to such low pressures can simply result in rapid evolution of more vapour and an accelerated pressure increase. Controlled venting to a higher pressure in the region of 800 to 1000 mm H_2O could significantly reduce total emissions.

4.9.2 During crude oil washing

Any gas generated by COW should remain within the ullage spaces and mixed with the inert gas. Gas vented off, especially during COW, means a substantial loss of light ends to the atmosphere thereby increasing environmental pollution. It is recommended that charterers instruct, and masters of ships ensure, that the IG system is operated such that excessive pressures are not generated and no vapour is vented to atmosphere during discharge. Except in an emergency, the mast riser and/or other vents should be kept closed. For dipping of tanks during COW operations, only gauging positions fitted with vapour lock valves should be used.

4.10 INSTRUCTIONS TO SHIPS' MASTERS

To help maximise outturns, it is recommended that the charterer or cargo owner's representative should liaise with the ship's master/chief officer to achieve the following:

a) Previous cargo:

The cargo representative must ascertain the type of cargo carried and the washing performed for the previous voyage. This information will help determine the COW to be carried out on the present voyage. If the previous cargo gave rise to substantial quantities of ROB/OBQ then even with a current cargo of a quality requiring no COW, as specified in Annex D, a bottom, or possibly a full COW, may be required to clean the ship to an acceptable standard. However, closed conditions should be maintained.

b) Trim:

To achieve effective stripping of the cargo tanks it is recommended that a good stern trim is maintained during COW and stripping of the tanks. Current COW operation manual requirements advise that '*...the trim conditions for crude oil washing given in the Operations and Equipment Manual shall be adhered to. In general, trim by the stern is only important during the final stages of tank discharge and shall be the maximum possible compatible with operational constraints...*'. If the tank suctions are offset from the centre line of the tank then the ship may also be listed so that the oil flows towards the tank suctions. Reference should be made to the vessel's COW operations manual and/or the vessel's standard conditions book.

Note: The requirement for trim during COW should not be mistaken for the MARPOL requirements of a vessel in ballast condition which limits the vessel's trim to 0,015 of the vessel's length. However, certain ports require this as the maximum trim to be attained to enable the vessel to be safely manoeuvred in an emergency.

c) Draining:

During COW a slight build up of washing oil on the tank bottom is normal. To some extent this is desirable since it carries the wax and sediments to the tank suctions. It is the degree of build up that has to be controlled. If the depth of oil at the after end of the tank exceeds 0,30 metres then COW should be suspended and the tank drained.

d) Stripping:

— Low viscosity crude oils:
Tanks should be left for as long as possible for 'run-down' to occur after COW and/or stripping for the first time. On completion of run-down the tanks should be restripped. Even if time is short it is suggested that the tanks should be stripped at least twice.

— High viscosity/high wax crude oils:
Tanks should be stripped immediately after COW and/or when first emptied. Restripping should take place shortly after, whilst the tank is still warm. High viscosity low pour point oils flow slowly and take time to reach the tank suction. In these cases it is better to wait for as long as possible before stripping the tanks for the final time. Due attention should be paid to the ambient conditions including sea and ballast temperatures which if cool may increase clingage during COW. To limit this effect it may be necessary to reduce the planned COW programme.

e) Slop tanks:

Because of electrostatic hazards, COW must not be performed with oil in slop tanks which have been used for Load-on-Top purposes or wet crude oil. Ship's officers should be instructed to discharge the slop tanks first and refill with dry oil from other cargo tanks.

f) COW feed tank:

Experience has shown that for the COW of high pour/waxy cargoes the COW feed tank (normally the slop tank) should be heated to at least 10°C above the average cargo temperature. Crude oils requiring this extra heating are listed in Annex D.

5

KEY TO CRUDE OIL DATA SHEETS

(Annex D)

5.1 CRUDE OIL TYPE

The crude oils have been arranged in alphabetical order.

Note: The absence of a value for a particular parameter indicates that data are not available; it does not indicate a nil result.

5.2 ASSAY DATE

The assay date is the date of the most recent assay received by HM-L-4B. However, an assay may not contain all of the data, for the crude oil under consideration, required by Annex D. Therefore some data may not be as recent as the assay date implies.

The data are generally displayed as a range except in the case of viscosity. One of the shortcomings of this collection method is that possible trends in crude quality cannot be tracked.

5.3 API GRAVITY

Since crude oils are traded in barrels and API Gravities the data in Annex D follow this system.

To interconvert from API Gravity at 60°F and density at 15°C use the *Petroleum Measurement Tables* (IP200/80 ASTM D 1250-80) Volume XI/XII, Table 3.

5.4 REID VAPOUR PRESSURE (RVP)

RVP is the most common vapour data available. The main problem with this information is that the sampling conditions are not known thus the values quoted have a large uncertainty. Also it is likely that RVP is not a realistic value when comparisons are made against vapour release from crude oil being carried in a ship's tank. However, in the short term, if a high RVP value is observed there may be a potential vapour loss during COW.

5.5 GAS TO C_4

Once again the results given in this column are highly dependent upon the conditions under which the samples were drawn. They are taken from the assay of each crude oil, considering the boiling fractions from methane to butane.

If the Gas to C_4 is a high value, generally in excess of about 2,5% m/m, high gas losses may be experienced during transportation but more particularly during COW operations.

5.6 TOTAL WAX

The total wax, expressed as a percentage weight, is the sum of the wax found in various boiling fractions of the crude oil assay.

Indications are:

Wax Content (% m/m)	**Sludge deposition**
< 3	Minimal
3 - 6	Some deposition under cooler climatic conditions
> 6	Some cargo conditioning may be required i.e. heating

5.7 POUR POINT

In the past, pour point has been considered as the primary indicator as to whether or not a crude oil should be heated. It was considered adequate to heat cargoes to a temperature of 10°C above the pour point. However, more recent research has indicated that this may not be such a useful criterion as once thought. Even at a suitable temperature above the pour point significant sludging can still occur. It is now felt that cloud point is a more suitable temperature indicator. However, pour point is included in Annex D since a correlation between pour point and cloud point is given in Section 7.

5.8 CLOUD POINT (CALC)

Cloud point is the temperature at which phase separation occurs. One of the considerations in this section has been terminology. Other publications use the terms wax appearance point, wax appearance temperature, or cloud point. All of these involve some form of experimental determination.

The temperatures quoted in Annex D are based on the two calculation methods shown in Section 7. The first correlation is based on a weighted wax content of individual boiling fractions. The second correlation is based on a blending indices method. In order to differentiate between the experimental and calculation methods the term 'cloud point (calc)' will indicate that it has been calculated.

As the determination of the temperature at which the first wax crystal precipitates out of solution is not so important in the marine industry, the equations used in this publication are of sufficient accuracy. However, cloud points calculated in this publication may not be sufficiently accurate for pipeline operations. Experimental techniques such as microscopy should be used.

5.9 KINEMATIC VISCOSITY

Where possible, two kinematic viscosities, at two temperatures, are given. In all cases both viscosities have been obtained from the same assay data. Using the formulae in Section 7 it is possible to calculate the kinematic viscosity at any temperature.

The viscosity at ambient temperature is important because it affects the efficiency of both the cargo and stripping pumps. To maintain optimum efficiency for centrifugal cargo pumps the cargo viscosity should not exceed 250 mm^2/s. During stripping operations the viscosity of the cargo should not exceed 600 mm^2/s.

Note: the unit mm^2/s was formerly entitled cSt (centistokes).

5.10 LOAD, CARRIAGE AND DISCHARGE TEMPERATURES

This information was collated from data supplied by the oil companies represented on committee HM-L-4B. Where data are unavailable, carriage and discharge temperatures have been included, where possible, which are based on the carriage and discharge conditions of other crude oils having similar properties. Generally, for paraffinic crude oils there will be no differentiation between carriage and discharge temperature. However, for aromatic crude oils the discharge temperature may need to be increased above the carriage temperature to reduce the viscosity during pumping operations. In the future sufficient information may become available to enable more specific instructions for heating the crude oil used for COW.

An additional temperature has been included in the data and labelled 'load' since some companies have indicated temperatures under which they would not commence loading a particular crude oil.

The data indicate the minimum temperature in all cases and have been arrived at by experience. However, ambient conditions throughout the voyage should also be given due consideration as minimum temperatures may need to be increased.

5.11 COW INSTRUCTIONS

COW codes developed for these guidelines can be

found in Annex D. References under 'Remarks', where necessary, are made to heating the contents of the slop tanks to a temperature of at least 10°C above the average cargo temperature. The value of 10°C is purely arbitrary but is based upon experience. A difference of less than 10°C does not give rise to an appreciable change in crude oil quality (usually viscosity). Temperature differences greater than 10°C may be required with some crude oils.

5.11.1 COW tanker (COWT) (Code A)

Where the COW codes in Annex D have the format AW/AS, AW is the code to be used for crude oil being carried or discharged in winter conditions whilst AS is the code for crude oil being carried or discharged in summer conditions. For example, for a code of A1/A2, A1 is the code to use for winter conditions and code A2 for summer conditions. Where the COW code in Annex D is a single code e.g. A3, this code can be used with equal validity in both winter and summer conditions.

As a general guide, the following summer/winter designations apply:

— Northern Hemisphere (North of the Tropic of Cancer). Summer: 1 April to 30 September. Winter: 1 October to 31 March.
— Southern Hemisphere (South of the Tropic of Capricorn). Summer: 1 October to 31 March. Winter: 1 April to 30 September.
— The code for the Tropics is usually obtained from the summer section (AS) of the above data. If in doubt the worst-case scenario should be chosen and the codes obtained from the winter section (AW) of the data.

Ambient conditions, for example cold sea water, can greatly affect the crude oil temperature, especially layers close to the hull or adjacent to the ballast tanks. Localised cooling to temperatures below the cloud point leads to precipitation of wax, which in turn aggravates clingage and ROB on discharge. On the other hand, high oil temperatures caused by high air and sea temperatures may lead to the evolution of hydrocarbon gas.

As a further guide the mean sea water and air temperatures for February and August are included in these guidelines (see Annex B).

5.11.2 Segregated ballast tankers (SBT) (Code B)

COW codes for SBTs are differentiated from COW Tankers (COWTs) by substituting a B for an A e.g. B4/B7.

5.12 HYDROGEN SULFIDE (H_2S)

Concentrations of H_2S (ppm mass) in the oil phase of various crude oils are also supplied. There is no correlation between the concentration of H_2S in the oil phase (ppm mass) with the concentration of H_2S in the vapour phase (ppm volume), (ISGOTT Section 16.5). However, for guidance purposes, crudes where high levels have been found in the vapour phase are noted. The blank spaces in the table do not indicate a value of zero but indicate that no information is available. At all times crude oil should be treated with caution as advised in ISGOTT, as referenced in Section 6.2 of this document.

5.13 BENZENE

Benzene contents of various crude oils are given on a percent mass/mass basis. Again, the precautionary advice in ISGOTT, as referenced in Section 6.4 of this document, should be consulted.

5.14 REMARKS

In the tables of Annex D the committee has tried to pull together as much added information as possible.

One of the main items covered is the possible presence of H_2S gas, especially in the vapour phase. A note regarding safety precautions when handling petroleum cargoes can be found in Section 6. The list of cargoes containing H_2S should not be considered as exhaustive as H_2S levels change with both field age and blend.

Some crude oils listed as 'subject to wax laydown in cold conditions' are those having a relatively high wax content that could result in larger than usual sludge deposition under certain conditions. A good example of this is Brent Blend which is transported unheated all the year round on short voyages across the North Sea, but requires some heating when being transported across the Labrador Current to the East Coast of the USA in winter.

Another note that has been used is 'COW with this crude may result in high tank pressures'. This is a reflection of the relatively high Gas to C_4 content of the crude oil. Due to their solvent properties these crude oils are generally considered good as a COW medium for removing the residues from past cargo. However, they generate high vapour volumes which increase cargo loss, cause tank pressures to rise, and may lead to air pollution as pressure is relieved to the atmosphere.

With some of these types of crude oil the need to COW is questionable. An example of this is Saharan Blend which has a high Gas to C_4 content, low wax content and low cloud point temperature.

Past versions of COW manuals listed a number of crude oils which were considered to be unsuitable for crude oil washing due to their high pour point or viscosity. However, nearly all of these crude oils have been successfully used for COW by suitable conditioning beforehand. Conditioning generally means to heat the oil but the addition of a detergent may be a possibility. It is for these reasons that most of the unsuitable crude oils listed in the COW manual have been given COW codes in Annex D.

Finally, the committee would like the users of this document to submit information on the Data Submission Form, given in Annex A, for inclusion in further revisions of Annex D.

6

SAFETY PRECAUTIONS WHEN HANDLING PETROLEUM CARGOES

6.1 INTRODUCTION

All persons involved in the handling of petroleum cargoes should be aware of the information on toxicity hazards contained in the International Safety Guide for Tankers and Terminals (ISGOTT), Chapter 16, *Toxicity of petroleum and associated substances*.

The risk of exposure to toxic vapours on deck is not to be disregarded, for here the testing of gas concentrations is generally unsatisfactory and the dilution of high concentrations of cargo vapour into the atmosphere depends on turbulence and diffusion. For this reason care is needed during loading, ballasting and gas freeing, and when measuring or sampling the cargo. Precautions on measuring and sampling are given in ISGOTT 7.2, and should be complied with.

In addition any person involved in the measurement and sampling of petroleum cargoes should make a practice of enquiring from the terminals and masters if cargoes have any abnormal concentrations of toxic components and/or whether special precautions should be applied.

6.2 HYDROGEN SULFIDE (H_2S)

H_2S is present in many crude oils and natural gasolines. Where high concentrations may be present, particularly in sour crude oils, the H_2S is generally removed by sweetening before shipment. All personnel handling cargoes containing H_2S should be fully aware of the hazards outlined in ISGOTT 16.5 and of the relevant precautions in ISGOTT 7.2.

It is recommended that ships' staff (deck), cargo inspectors and jetty/offsite operators wear H_2S monitors during all gauging and sampling operations concerning crude oil.

6.3 MERCAPTANS

Mercaptans are organic sulfur compounds which are present in some crude oils, natural gasolines and feedstocks. Concentrations of over 500 ppm mass can occur in some pentanes and up to 150 ppm in some naphthas.

It should be noted that the TLV is 0,5 ppm so the toxicity hazards, and the precautions necessary, are very similar to H_2S.

6.4 BENZENE

Pure benzene is no longer carried in conventional tankers but it is a component of many crude oils and products. The short term effects of exposure to the vapours of cargoes containing aromatics such as benzene, toluene, xylene and cumene, are similar to those of other hydrocarbon vapours although somewhat more severe. However, in addition, exposure to benzene vapours can present a chronic long-term health hazard. Again, full guidance on the toxicity and the precautions necessary when handling cargoes containing benzene and other aromatic hydrocarbons is outlined in ISGOTT 16.4.

7

CALCULATION PROCEDURES

7.1 VISCOSITY

The viscosities given in Annex D are taken directly from assay data. Where it is considered necessary to calculate a viscosity at a particular temperature, other than those quoted, a Refutas type equation can be used:

$$\log_{10}\log_{10}(V_x + 0{,}8) = \log_{10}\log_{10}\log_{10}(V_2 + 0{,}8) + B\left[\log_{10}\left(\frac{T_2}{T_x}\right)\right] \quad (7.1)$$

where:

V_x is the unknown viscosity at temperature T_x

V_2 is the known viscosity at temperature T_2

B is the temperature/viscosity slope and is a constant for each crude type

Note: The unit of kinematic viscosity is mm^2/s, formerly called the centistokes (cSt). The unit of temperature is the Kelvin (K).

where: $K = °C + 273$ (7.2)

Although the equation (7.1) is using $Log_{10}Log_{10}$ (logs to the base 10) throughout, natural logs (lnln) could also be used. It is essential to use a constant log base.

The B factor for a particular crude oil may be determined by substituting the two viscosity/ temperature pairs into equation (7.1). This factor can then be used with one of the two known viscosity/ temperature pairs to determine the viscosity at a third temperature, T_x. Where available the tabulated data include viscosities at two temperatures.

If only one viscosity/temperature pair is known from assay data an average B factor of 3,50 can be used.

7.1.1 Example 1 - Calculation of a viscosity *B* factor

Using the data for Maya crude oil given in Annex D, the following viscosity/temperature pairs are obtained:

$T_1 = 40{,}0\,°C$; $V_1 = 84{,}30\ mm^2/s$
$T_2 = 60{,}0\,°C$; $V_2 = 40{,}35\ mm^2/s$

The two temperatures must first be converted from Celsius to Kelvin:

$T_1 = 40 + 273 = 313\ K$
$T_2 = 60 + 273 = 333\ K$

Using equation (7.1) let $T_x = T_1 = 313$ K, let $V_x = V_1 = 84{,}30\ mm^2/s$, let $T_2 = 333$ K, and let $V_2 = 40{,}35$ mm2/s.

$$\log_{10}\log_{10}(84{,}3 + 0{,}8) = \log_{10}\log_{10}(40{,}35 + 0{,}8) + B\left[\log_{10}\left(\frac{333}{313}\right)\right]$$

$0{,}2855 = 0{,}2080 + (B \times 0{,}0269)$
$B = (0{,}2855 - 0{,}2080)/0{,}0269$
$B = 2{,}88$

7.1.2 Example 2 - Calculation of viscosity of a typical crude oil at an arrival temperature of 35°C

In this example the *B* factor is 2,88 as calculated in example 1.

$$T_x = 35 + 273 = 308 \text{ K}$$

From the two viscosity/temperature pairs given in Annex D choose the pair whose temperature is closest to T_x. That is 84,3 mm^2/s at 40°C.

Using equation (7.1) the viscosity V_x is calculated as follows:

$$\log_{10}\log_{10}(V_x + 0{,}8) = \log_{10}\log_{10}(84{,}3 + 0{,}8) + 2{,}88\left[\log_{10}\left(\frac{313}{308}\right)\right]$$

$$\log_{10}\log_{10}(V_x + 0{,}8) = 0{,}2855 + 0{,}0201$$

$$V_x = \left((\log_{10}^{-1}\log_{10}^{-1}(0{,}2855 + 0{,}0201)\right) - 0{,}8$$

$$V_x = 104{,}19 \text{ mm}^2/\text{s}$$

Viscosity at 35°C is 104,19 mm^2/s.

7.2 CLOUD POINT (CALC)

Two methods were used to calculate the cloud points in Annex D. These methods assume different wax concentration curves and neither method has been proven to be more reliable than the other. The cloud points for both methods are given as a temperature range.

7.2.1 Method 1

This method is based on an early equation developed by Dr T.J. Gunner:

$$\text{Cloud Point (°C)} = 104{,}26(\text{loglog}F - 1{,}55) \qquad (7.3)$$

where: $F = \dfrac{\alpha + \beta = \gamma}{2T}$

and
$\alpha = 4(W_{550} \text{ x } M_{550} \text{ x } C_{550})$
$\beta = 2(W_{509} \text{ x } M_{509} \text{ x } C_{509})$
$\gamma = (W_{369} \text{ x } M_{369} \text{ x } C_{369})$
$T = \Sigma C_{149}, C_{232}, C_{342}, C_{509}, C_{550}$

and
W_x is the wax content (% weight) of the relevant C_x 'cut'.
M_x is the melting point (°C) of the wax content W_x.
C is the % weight of the given distillation 'cut'.

Note: The subscript numbers have been used to indicate the distillation fraction (boiling range) on a crude oil assay such that:

149 means the cut between C_5 and 149°C
232 means the cut between 149°C and 232°C
342 means the cut between 232°C and 342°C
369 means the cut between 342°C and 369°C
509 means the cut between 369°C and 509°C
550 means the cut between 509°C and 550°C

Generally the assay cut points are company dependent and will not conform to those given above. However, there are software distillation packages available that will transform any series of 'cut' points to conform to those shown above.

Many crude oil assays do not report the melting points of the wax contents of the various fractions. A survey of the data available from 150 crude oils revealed the mean values and standard deviation from the mean of the three relevant fractions to be:

Crude 'Cut' (°C)	Mean Melting Point (°C)	Standard deviation (°C)
550	65	4
509	53	3
369	39	1

It is recommended that if wax melting points are not available then the above values are used.

7.2.2 Method 2

This utilises the blending indices of the various distillation 'cuts'. The blending index is calculated using the following equation:

$$\text{Log}_{10}I = 0{,}02916(\text{Cloud Point(°C)} + 73{,}33) \qquad (7.4)$$

where I is the blending index of the fraction under consideration. However, it is usual to add a subscript to indicate the particular fraction.

For fractions distilling below 149°C the index is assumed to be zero. For the fraction boiling between

149 °C and 232 °C, denoted by I_{149}, the index is 4,8. For the middle distillate fractions in the higher boiling ranges the blending index has to be calculated from cloud points given in the crude oil assay. To do this, the cloud point for each fraction is substituted into equation (7.4). For residues where only the pour point is reported, the cloud point is assumed to be 2 °C above the pour point and the index calculated.

The blending indices for each cut are now combined on a weight basis, according to the percentage weight of each fraction in the crude oil, to derive what may be termed the cloud point index of the blend, CPI_B. That is, the cloud point index for the crude oil in question:

$$CPI_B = \left(\frac{(W_{149} \times 4{,}8) + (W_{232} \times I_{232}) + (W_{342} \times I_{342}) + (W_{369} \times I_{369})}{100} \right) \quad (7.5)$$

where:

W_{149} is the percent weight of the fraction boiling between 149 °C and 232 °C.

W_{232} is the percent weight of the fraction boiling between 232 °C and 342 °C.

W_{342} is the percent weight of the fraction boiling between 342 °C and 369 °C.

W_{369} is the percent weight of the fraction boiling greater than 369 °C

I_{232},I_{342} and I_{369} are the cloud point indices calculated for the above fractions.

Once the CPI_B has been derived it can be entered into equation (7.6) to calculate the required cloud point of the crude oil:

$$\text{Log}_{10}CPI_B = 0{,}02916(\text{Cloud Point}(^\circ\text{C}) + 73{,}33) \quad (7.6)$$

Where the assay data do not include boiling data at the temperatures prescribed above, other boiling points can be used along with their corresponding cloud points.

7.2.3 Simplified procedure

Another equation is available to readers having no assay data. This is especially true for marine staff who may only have a load port Certificate of Quality. It is based upon the crude oil pour point and may be subject to very high uncertainty.

$$\text{Cloud Point}(^\circ\text{C}) = (20{,}2 \times 10^{(0{,}00708y - 0{,}1157714)}) + 8 \quad (7.7)$$

where: y is the crude oil pour point (°C).

7.2.4 Example 3 - Calculation of Cloud Point using equation (7.7)

Consider a cargo of Brent Blend crude oil where the Certificate of Quality advises that the pour point is −3 °C.

First calculate the exponential term in equation (7.7):

Exponential term = (0,00708 x pour point) – 0,1157714

Exponential term = (0,00708 x −3) – 0,1157714

Exponential term = -0,1370114

Cloud Point = $(20{,}2 \times 10^{-0{,}1370114}) + 8$

Cloud Point = 23 °C

The cloud points calculated from methods 1 and 2, and given in Annex D, give the range 20 °C to 26 °C. For this crude oil the simplified method appears reasonable. Further information can be found in the IMO Crude Oil Washing Systems, Section 9 of the Standard Formats (page 26- page 29).

ANNEX A

IP CRUDE OIL DATA SUBMISSION FORM

Users having data or experience in handling a crude oil not fully described in these guidelines, or more recent data than that shown, please complete a copy of the following form and return to:

Technical Department
Hydrocarbon Management Section
Energy Institute
61 New Cavendish Street
London W1G 7AR
United Kingdom

Test methods

The data for API Gravity, RVP, Pour Point and Kinematic Viscosity should be based upon the results obtained from current standard test methods. The procedures to be employed can be found in the IP's *Standard methods for analysis and testing of petroleum and related products and British Standard 2000 Parts* (latest available edition - published annually) or the annual book of ASTM Standards, Section 5, *Petroleum Products, Lubricants, and Fossil Fuels*, volumes 1 to 6 (latest available edition – published annually). Alternatively there may be equivalent ISO or National Standards.

Gas to C_4 will only be available from assay data. Total wax and cloud point may only be available after calculation based upon assay data.

Suggested temperatures

The carriage and discharge temperatures should be based on a balance between operational requirements, as well as financial and environmental concerns.

Comments on experiences of handling crude

Even if quality data are not available, should users be involved in the handling of a crude oil where an unusual characteristic was observed please spend a few moments in completing the comments section on the form. Other useful information to be included would be COW programme, voyage route and dates, air and sea temperatures (averages on route and those experienced during discharge).

The above information will be used in future editions of this publication.

IP CRUDE OIL DATA SUBMISSION FORM

Name:	Indicate Test Standards Used (√)		
Organisation:	Standard		Edition
Address:	IP		
	ASTM		
	Other (Specify)		

Date:

Crude Oil:

Test	Data				Test Method Used
API Gravity					
RVP (psi)					
Gas to C_4 (% m/m)					
Total Wax (% m/m)					
Pour Point (°C)					
H_2S (ppm) Liquid Phase					
H_2S (ppm) * Vapour Phase					
Benzene (% m/m) Liquid Phase					
Kinematic Viscosity mm^2/s	T_1 (°C)		V_1(cSt)		
	T_2 (°C)		V_2(cSt)		
Loaded Temp. (°C)					
Carriage Temp. (°C)					
Discharge Temp. (°C)					

Recommended COW codes: AW/AS BW/BS

Comments on Experiences of Handling this Crude Oil

* - If H_2S reading in vapour space, please list previous cargo.

ANNEX B

CLIMATIC CHARTS OF THE WORLD

Permission to reproduce the following four figures was kindly given by the Controller of Her Majesty's Stationery Office. The attached charts have been included to show mean air and sea temperatures for February and August.

It is hoped they will enable the user to gain better insight into the expected ambient conditions which may be experienced during a proposed voyage. Other factors not included in this publication, but which may have a large effect on the vapour emission from the cargo, are wind speed, wind direction and sea state.

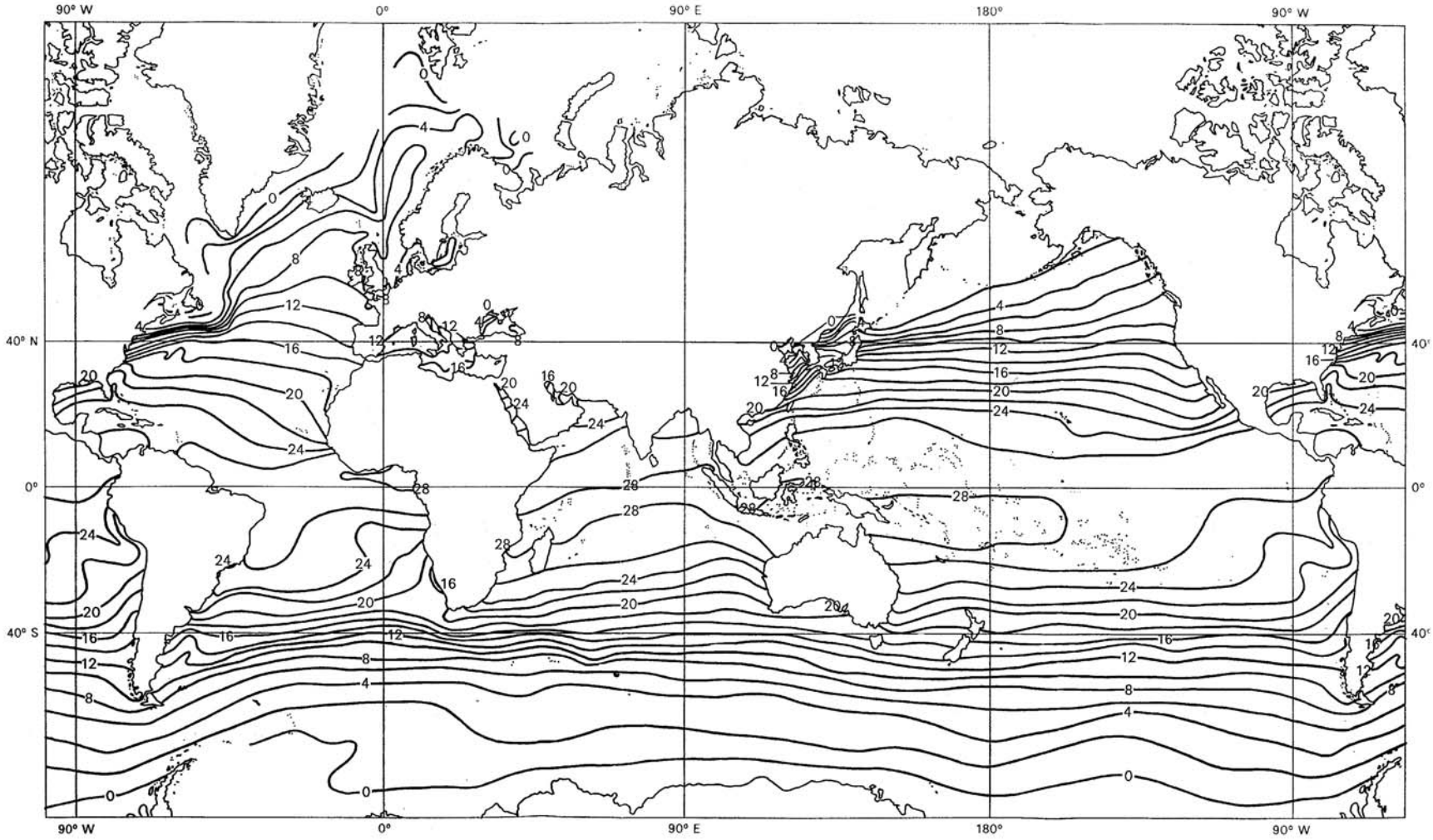

Figure B.1 Mean sea surface temperature (°C), February

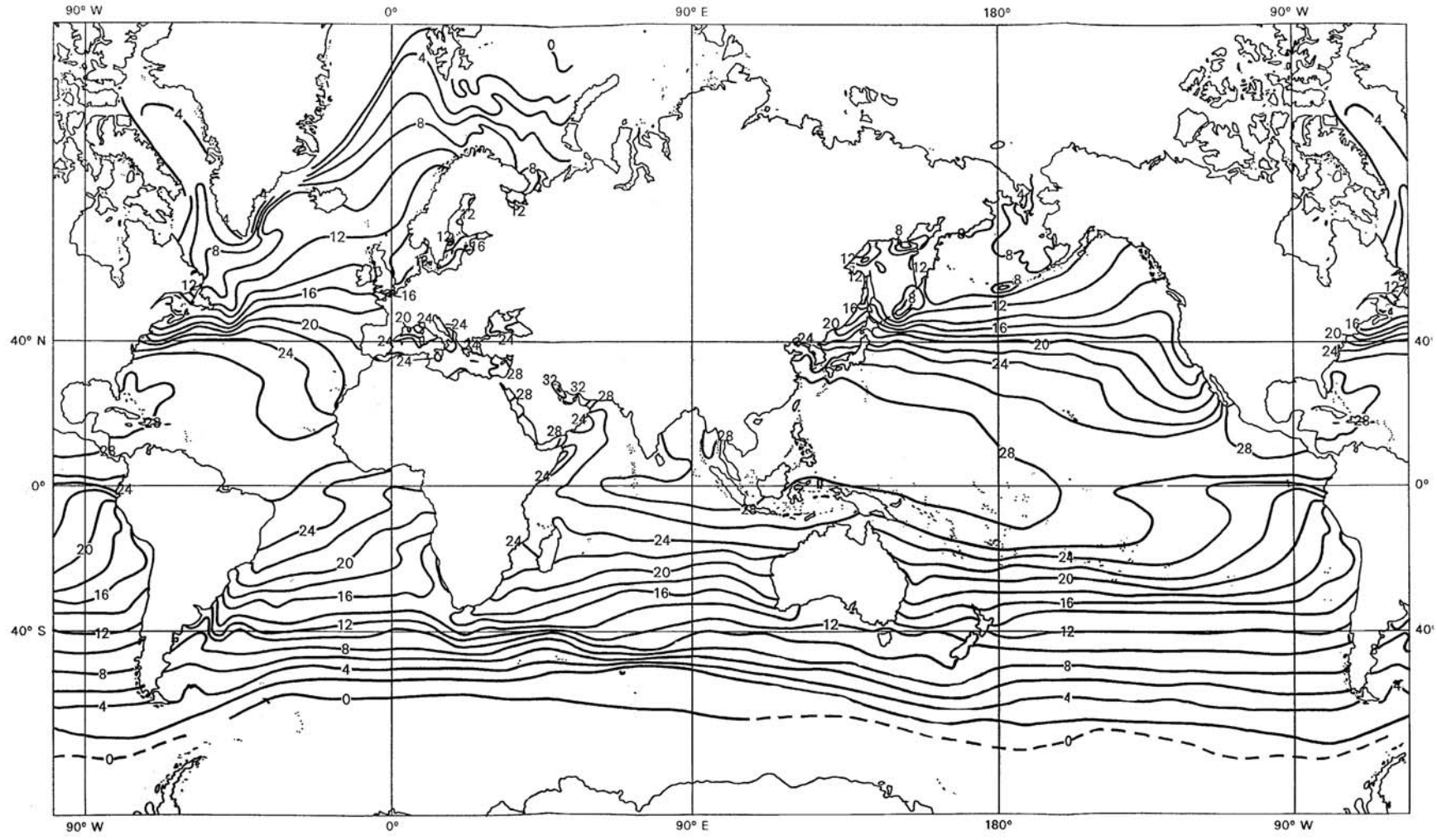

Figure B.2 Mean sea surface temperature (°C), August

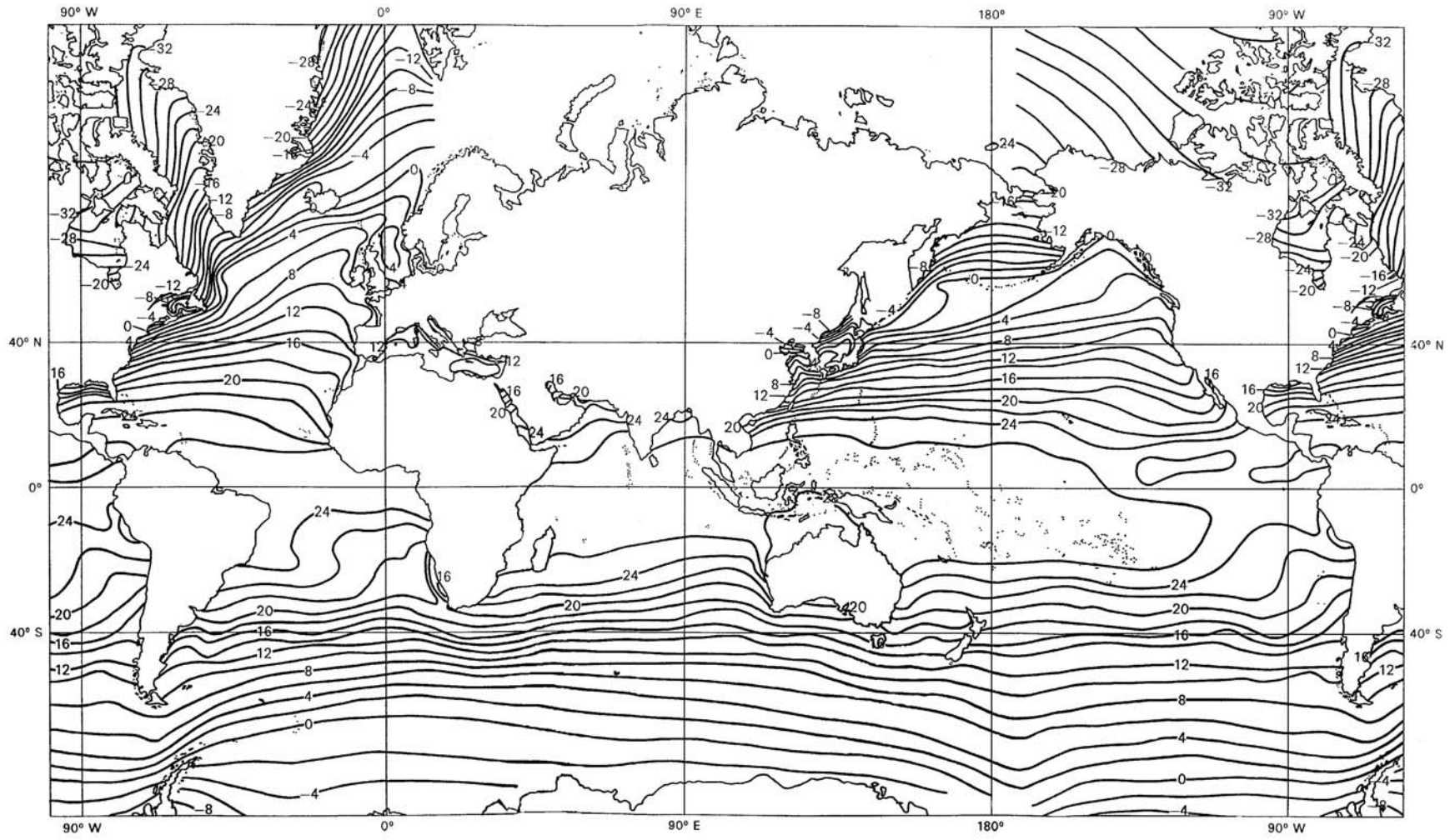

Figure B.3 Mean air temperature over the oceans (°C), February

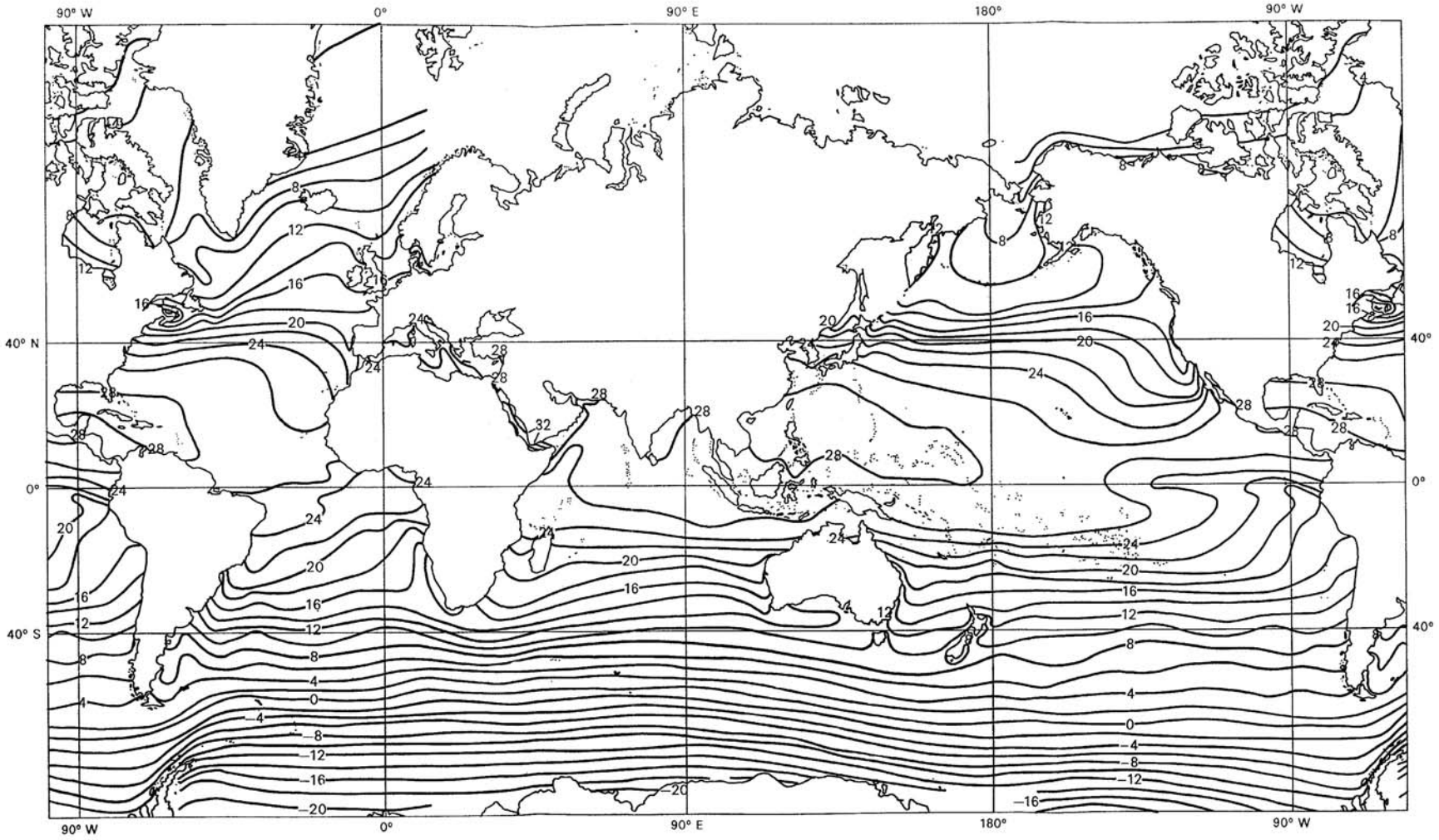

Figure B.4 Mean air temperature over the oceans (°C), August

ANNEX C

COMMENTS ON THE HANDLING OF SOME CRUDE OILS

Each comment is preceded by the date of the observations in the format (month/year).

Brent Blend

(11/01)
A number of cargoes have been reported as having been found to have vapour space H_2S readings in excess of 60 ppm at the receiving port. Further reports were received at the 05/02 meeting. A general warning was posted on the website.

Ezzaouia crude oil

(4/94)
This is a crude oil that must be heated to at least 57°C. It is often carried as a small single grade and can be treated as a heavy fuel oil. If the vessel is fitted with COW machines a wash with the hot crude has been found to be beneficial.

Flotta

(9/94)
Experiences of some parts of the industry indicate that there may be problems with varying cloud point from cargo to cargo. Sedimentation may be a problem but when heating is applied losses of light ends are evident. Some companies do not COW with this grade especially on short haul voyages where the cargo retains its heat.

Iranian Light

(4/95)
It was reported that a cargo of Iranian Light loaded at 20°C, but unheated, lost 0,2 % of vapour during loaded passage. Cargo cooling during the voyage led to significant sludge deposition which took 14,5 hours to COW and seven hours to educt.

Maya

(4/95)
This crude has been reported as being carried unheated with a parcel of Isthmus. The Isthmus was used to wash all tanks.

Miskar Condensate

(10/02)
This warning was posted onto the website. Miskar has been found to contain 4,7% vol benzene in the liquid phase. Vapour levels are usually below permissible exposure levels. However, personnel involved in transportation and inspection should wear appropriate protective equipment. Benzene content of vapour spaces should be checked prior to inspection and appropriate precautions taken.

Nile Blend

(10/00)
Members were referred to an article in Lloyds List dated 20/10/00 where it was reported that difficulties had been found when discharging this grade. High ROBs were being experienced.

(11/01)
It was reported that large quantities of wax were being deposited from Nile Blend cargoes. 100 m^3 was not unknown on a number of cargoes. These deposits were being carried over onto subsequent voyages.

Palanca crude oil

(9/94)
This crude oil has a relatively high total wax content which makes the outturn very uncertain. This crude oil will COW but the wash fluid may become saturated during the washing and lose its solvency. Once this occurs stripping becomes very difficult. For this crude oil re-cycled oil must not be used for COW. However, good discharge results have been obtained by using gas oil for washing.

(4/95)
It has been reported as having been carried without heating, loading at 28°C and discharging at 18°C. Another crude oil grade was backloaded and used for COW. The backloaded crude oils successfully tried were Saharan Blend and Qua Iboe. There was less loss using Qua Iboe which may have been due to the lower gas content of this crude oil when compared to Saharan Blend.

Urals (previously Russian export blend)

(05/02)
High vapour space H_2S levels have been reported above this grade.

Syrian Light crude oil

(4/94)
This crude oil can be very difficult to handle as the wax content is relatively high. Ambient weather conditions are very important and will affect the discharge. If transported within the Mediterranean Sea heating will not be required in summer, however it is likely that heating will be required in winter. If the vessel discharges in Northern Europe then it is probable that heating will be required even in the summer.

Although the cargo may need to be heated good outturn results can be obtained by heating the contents of the slop tanks by a further 10°C, just prior to discharge, and using for COW.

(5/97)
There was a recommendation to L-4B that Syrian Light crude oil should be heated to 35°C from the time of sailing, and maintained at that temperature, to completion of discharge. A warning was given that if no heating is applied then the final ROB in the winter may constitute 0,5% of the loss (3 000 US Barrels on a standard parcel size), whereas in the summer this may reduce to 0,25%, 1 500 Barrels. However, washing with Syrian Light has been known to cause accumulation of paraffins and wax on cold tanker bulkheads.

Carriage at temperatures greater than 40°C will result in light end loss thereby contributing to the overall outturn loss.

(05/02)
High vapour space H_2S levels have been reported above this grade.

Further up-to-date reports can be found on the HM L-4 website at www.oil-transport.info or via the EI website www.energyinst.co.uk.

ANNEX D

CRUDE OIL DATA

Explanations for the assay categories can be found in Section 5. The following codes should be referred to in conjunction with the data sheets that follow. For ease of viewing it was decided to display the tabulated data in landscape mode, thus qualities and remarks concerning each crude are spread over two pages.

The committee has made every attempt to ensure that the data are correct. However, differences may be experienced from that described in this section since the quality of crude oil can change rapidly in a short time, especially if it is blended from a number of small fields.

Should the user of this publication become aware of any information that may be relevant under the scope of this document, please forward the information to the Institute on the form provided in Annex A.

D.1 COW CODES

D.1.1 Clean Ballast Tankers (CBT)

A1 Minimum MARPOL. Maximum possible safe trim for stripping tanks and lines. Strip all cargo tanks at least twice, three times if time permits.

Note: Minimum MARPOL: is that defined in Section 6.1 of the *Revised specifications for the design, operation and control of crude oil washing systems* found in IMO publication *Crude oil washing systems*, fourth edition 2000.

A2 Minimum MARPOL: plus a bottom wash of remaining cargo tanks.

A3 Full cycle wash of all cargo tanks.

A4 Minimum MARPOL: plus a full wash of remaining wing tanks and a bottom wash of remaining centre tanks.

A5 No COW, except with a suitable crude oil or cutter stock such as heated gas oil. Otherwise treat as heavy fuel oil with maximum possible safe trim for stripping.

A6 Cargoes are small, normally carried in heavy fuel oil tankers, and treated in the same way as heavy fuel oil.

A7 Minimum MARPOL: plus a bottom wash of remaining cargo tanks, using the contents of the slop tanks. Oil in the slop tanks should be heated to at least 10°C above the average cargo temperature.

A8 Full cycle wash of all cargo tanks, using the contents of the slop tanks for COW. The COW medium should be heated to at least 10°C above the average cargo temperature.

D.1.2 Segregated ballast tankers (SBT) (Heavy Weather ballast tanks are subject to MARPOL COW requirements, see D.1.1)

B1 No COW. Maximum possible safe trim for stripping tanks and lines. Strip all tanks at least twice, three times if time permits.

B2 Bottom wash only required.

B3 Full cycle wash of all cargo tanks.

B4 Full cycle wash for cargo wing tanks and a bottom wash for cargo centre tanks.

B5 No COW, except with a suitable crude oil or cutter stock such as heated gas oil. Otherwise treat as heavy fuel oil with maximum possible safe trim for stripping.

B6 Cargoes are small, normally carried in heavy fuel oil tankers, and treated in the same way as heavy fuel oil.

B7 Bottom wash all cargo tanks, using the contents of the slop tanks. Oil in the slop tanks should be heated to at least 10°C above the average cargo temperature.

B8 Full cycle wash of all cargo tanks, using the contents of the slop tanks for COW. The COW medium should be heated to at least 10°C above the average cargo temperature.

ANNEX D.2

CRUDE OIL DATA SHEETS

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Abu Al Bu Khoosh	Feb-02	33,6	4,70	-	1,15	5,50	-37	-12	14	32	20	9,95	40	5,72	-		-
Abu Safah	Apr-98	28,90	3,10	-	6,50	-	-29	-18	-	-	20	24,31	40	11,88	13,0		-
ACG Blend	Jul-98	34,60	-	-	0,85	6,51	-3	-	24	29	20	15,62	40	6,74	-		-
Airlie Blend	May-96	43,70	1,80	-	0,95	4,17	-18	-15	2	7	20	2,48	30	2,05	-		-
Aksai Condensate	Nov-00	44,3	-	-	1,08	5,0	-9	-	21	-	20	2,72	-	-	280	**X**	-
Aktubinsk	Jan-01	41,8	-	-	2,13	6,0	-48	-	18	-	20	4,4	-	-	12		-
Al Rayyan	Sep-97	24,50	-	-	0,75	8,00	-18	-	23	24	20	63,90	40	28,30	1500	**X**	-
Al Shaheen	Dec-96	29,00	-	-	0,85	6,00	-18	-	16	18	20	21,45	30	14,71	9	**X**	-
Alaskan North Slope	Jun-02	31,90	4,30	-	2,50	4,36	-18	-	14	15	20	11,04	40	6,42	<2		-
Alba	Jan-02	19,70	0,10	-	0,10	2,03	-42	-	-11	2	30	195,00	50	65,70	-	**X**	-
Alexandria LSAR	Jun-01	21,90	-	-	0,00	23,83	39	-	44	46	60	41,15	-	-	-		-
Algerian Condensate	Dec-92	64,80	7,68	9,50	3,99	0,16	<-60	-46	-40	-28	20	0,81	30	0,73	-		-
Amal	Aug-94	36,50	-	-	0,88	-	-	-	-	-	30	18,00	40	9,45	-		-
Amna	Jun-99	36,80	0,40	3,98	0,85	14,41	21	-	32	34	40	8,54	60	5,18	0,6	**X**	0,13
Anaco Wax	Dec-93	40,75	5,80	-	1,80	9,43	3	15	30	32	40	1,81	60	1,36	-		0,75
Anasuria	Sep-00	39,70	6,60	-	2,30	6,76	-30	-	17	21	20	4,74	40	3,08	<1		-
Angus 10	Dec-92	41,00	-	-	-	-	-	-	-	-	20	4,54	40	3,03	-		-
Anoa	Sep-91	45,40	1,60	3,60	0,70	14,64	10	15	31	36	30	2,51	50	1,73	-		-
Antan	Jun-01	26,50	2,90	3,40	0,55	2,45	-39	-	1	11	20	25,65	40	11,84	<1		-
Aquila	Sep-93	34,48	-	-	3,16	-	< -33	-	-	-	-	-	-	-	-		-
Arabian Extra Light	Feb-03	38,80	3,70	4,90	1,45	5,00	-33	-12	4	19	20	4,81	40	3,36	<2	**X**	0,12
Arabian Heavy	Apr-98	28,42	3,60	6,90	5,13	3,53	-51	-23	12	46	20	43,33	30	26,96	0 - 15	**X**	0,07
Arabian Light	Apr-98	33,36	4,20	4,60	5,67	4,10	-54	-21	-5	26	20	10,19	40	6,02	1 - 21	**X**	0,11
Arabian Medium	Feb-02	28,90	3,00	5,60	0,95	6,89	-24	-	14	22	20	21,10	40	10,89	0,7 - 18	**X**	0,08

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Abu Al Bu Khoosh	No Heat	No Heat	No Heat	A2	B2	
Abu Safah	-	-	-	-	-	More information required.
ACG Blend	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Airlie Blend	No Heat	No Heat	No Heat	A1	B1	
Aksai Condensate	-	No Heat	No Heat	A2	B2/B1	
Aktubinsk	-	No Heat	No Heat	A2/A1	B2/B1	
Al Rayyan	No Heat	No Heat	No Heat	A3/A2	B3/B2	This crude may be subject to wax laydown in cold conditions. Very high H_2S/Mercaptans.
Al Shaheen	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Alaskan North Slope	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Alba	-	35	35	A1	B1	Heating to reduce viscosity.
Alexandria LSAR	-	50	50	-	-	Unsuitable medium for COW.
Algerian Condensate	No Heat	No Heat	No Heat	None	-	Washing is unnecessary. May result in high tank pressures.
Amal	-	-	-	-	-	More information required.
Amna	30	30	40	A7	B7	
Anaco Wax	-	30	30	A3	B3	
Anasuria	No Heat	No Heat	No Heat	A1	B2	This crude may be subject to wax laydown in cold conditions.
Angus 10	-	-	-	-	-	More information required.
Anoa	-	35	35	A8	B8	Cargo temperature may be reduced to 30°C in the summer. Slop tanks to be at least 40°C in all cases.
Antan	-	-	-	A2/A1	B1	
Aquila	No Heat	No Heat	No Heat	A2	B2	More information required.
Arabian Extra Light	No Heat	No Heat	No Heat	A2/A1	B1	
Arabian Heavy	No Heat	No Heat	No Heat	A3/A2	B3/B2	
Arabian Light	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions.
Arabian Medium	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Arabian Super Light	Apr-98	50,75	6,00	9,80	12,35	-	-39	-29	9	-	20	1,83	50	1,32	2,0		-
Ardeshir	Apr-79	26,20	-	-	0,90	3,96	-30	-	12	-	-	-	-	-	-		-
Ardjuna	Jul-02	38,00	6,70	7,00	2,00	16,83	24	27	36	37	40	2,65	60	1,98	<2		-
Arne																	
Arun Condensate	Jun-97	57,50	5,20	-	1,00	0,25	-54	-	-47	-9	20	0,84	40	0,65	-		-
Arzanah	Feb-94	43,95	4,20	5,00	1,83	1,58	-51	-9	10	25	20	2,60	50	1,50	-		-
Asgaard	Nov-02	43,60	5,40	-	2,50	7,00	-9	-3	19	20	20	3,44	40	2,40	<1		-
Asgaard Condensate	Oct-03	51,20	-	-	4,15	3,50	-45	-	9	-	20	1,27	-	-	<5		-
Ashtart	Dec-96	30,05	1,50	2,20	0,70	10,50	-6	9	22	29	30	11,61	50	6,56	3,0		-
Attaka	Sep-97	43,50	6,10	7,00	3,00	5,50	-32	0	10	15	20	1,91	40	1,39	-		-
Attaka Badak	Jul-93	48,55	7,90	-	1,32	6,08	-42	-40	16	21	20	1,20	50	0,80	-		-
Azeri Light	Jun-03	34,80	2,00	-	0,97	8,50	-7	-	29	-	20	11,88	40	6,53	0,5		-
Bach Ho	Mar-99	40,20	-	-	0,85	28,65	36	-	43	48	50	4,92	60	4,00	0,2		-
Bachaquero (BCF-17)	Nov-98	16,65	1,42	3,50	0,35	1,10	-29	-15	4	29	20	1561,00	40	351,00	0,1		-
Bachaquero (BCF-22)	May-89	21,80	2,50	-	0,99	-	-32	-	-	-	20	193,57	40	64,10	0,1		-
Bachaquero (BCF-24)	Apr-92	24,20	4,20	-	-	-	-18	-	-	-	20	102,92	40	34,19	0,1		-
Badak	Jan-98	41,30	-	-	1,30	10,00	-12	-	24	27	20	2,02	40	1,36	-		-
Badin	Nov-94	44,60	-	-	1,1	16,87	15	-	26	35	20	3,20	40	2,05	-		-
Balder	Mar-00	23,10	3,10	-	0,20	3,72	-24	-1	11	24	20	83,30	40	27,20	1		-
Banff	Aug-02	37,90	-	-	1,20	6,64	-6	-	21	-	20	7,45	40	4,17	<2		-
Barents Sea	Aug-96	46,70	-	-	0,25	4,05	-24	-	10	14	20	2,48	30	2,07	-		-
Barrow Island	Jun-99	36,20	2,20	-	0,45	-	-54	-	-	-	20	3,07	40	2,08	-		-
Basra Light	Sep-01	30,80	5,80	-	1,25	4,95	-60	-	10	16	30	11,72	50	6,79	<2	**X**	-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Arabian Super Light	No Heat	No Heat	No Heat	None	None	COW with this crude may result in high tank pressures.
Ardeshir	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Ardjuna	38	45	45	A8/A7	B7	
Arne						See South Arne.
Arun Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Arzanah	No Heat	No Heat	No Heat	A1	B1	
Asgaard	No Heat	No Heat	No Heat	A2	B2	This crude oil may be subject to wax laydown in cold conditions.
Asgaard Condensate	No Heat	No Heat	No Heat	-	-	
Ashtart	-	30	30	A8	B8/B7	Cargo temperature may be reduced to 25°C in the summer. Slop tanks to be at least 30°C in all cases.
Attaka	No Heat	No Heat	No Heat	A1	B1	This crude may be subject to wax laydown in cold conditions. Bottom washing may be required.
Attaka Badak	No Heat	No Heat	No Heat	A2	B2	
Azeri Light	-	-	25	A4	B2	
Bach Ho	-	50	50	A5	B5	
Bachaquero (BCF-17)	-	57	57	B1	B1	Treat as fuel oil.
Bachaquero (BCF-22)	-	-	-	-	-	More information required.
Bachaquero (BCF-24)	-	-	-	-	-	More information required.
Badak	No Heat	No Heat	No Heat	A3/A2	B3/B2	This crude may be subject to wax laydown in cold conditions. Tanks may require washing using heated crude from the slop tanks.
Badin	-	30	30	A3	B3	
Balder	-	-	-	-	B2/B1	More information required.
Banff	No Heat	No Heat	No Heat	-	B2	This crude may be subject to wax laydown in cold conditions. Minimum temperature of 20°C in winter conditions.
Barents Sea	No Heat	No Heat	No Heat	A1	B1	
Barrow Island	No Heat	No Heat	No Heat	A1	B1	
Basra Light	No Heat	No Heat	No Heat	A2/A1	B1	

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Bay Marchand	Jun-00	34,90	-	-	0,45	3,14	-30	-6	3	5	20	9,42	40	4,87	1		-
Beatrice	Mar-02	37,80	5,60	-	1,10	20,73	24	-	34	38	40	7,45	60	4,39	<2	**X**	-
Belayim Blend	Aug-94	27,32	5,90	-	1,36	4,20	-15	3	27	43	20	53,90	30	33,60	-		-
Belayim Land	Jan-90	22,30	-	-	0,80	-	6	-	-	-	20	482,50	-	-	-		-
Belayim Marine	Oct-93	30,03	4,00	-	1,34	-	-12	15	-	-	20	25,77	-	-	-		-
Belida	Apr-94	45,80	4,10	-	1,65	10,80	12	15	30	31	40	2,41	60	1,77	-		-
Benchamas	Apr-02	42,40	-	-	0,80	31,09	33	-	40	43	60	2,82	100	1,67	<2		-
Benevento-San Marco	May-93	45,73	-	-	0,07	-	-6	-	-	-	20	3,04	-	-	-		-
Beryl	Aug-00	39,20	6,60	-	2,20	7,58	6	-	22	25	20	5,31	40	2,85	<1		-
Bima	Mar-92	19,80	-	-	0,05	13,00	-1	15	12	37	40	394,00	60	136,50	-		-
Bintulu	May-98	36,50	-	-	1,35	9,00	-21	-3	23	24	20	3,27	40	2,08	-		-
Bintulu Condensate	Feb-98	59,80	-	-	3,30	0,02	<-51	-35	-55	-	20	0,68	30	0,61	-		-
Blenheim	May-95	37,90	3,20	-	2,4	4,12	-18	-	17	23	30	3,98	50	2,75	-		-
Bolivar Coast 24	May-92	23,80	-	-	0,60	1,60	-51	-33	6	19	20	138,00	40	48,30	2,5		0,06
Bolivian Blend	Dec-00	55,40	-	-	2,95	3,61	-42	-	2	4	20	1,42	40	1,10	-		-
Bonny Light	Jun-02	34,94	6,70	-	1,45	6,38	-6	8	20	26	30	4,71	50	3,07	1 - 12		0,20
Bonny Medium	Jun-94	27,60	2,40	3,40	0,55	3,50	-48	-24	5	18	20	12,90	40	6,83	1,0		0,19
Bontang	Nov-94	50,80	-	-	1,60	6,01	-24	-	17	18	20	1,10	40	0,86	-		-
Bouri	Mar-93	25,79	2,84	-	0,35	9,50	-12	15	16	39	40	19,05	60	10,60	-		-
Bow River	Jun-97	24,90	-	-	0,95	1,54	-54	-	4	20	20	62,40	40	22,70	-		-
Brass River	Apr-03	39,80	6,60	-	2,75	8,00	-15	15	24	25	20	2,74	40	1,91	1 - 7		0,31
Brega	Dec-93	41,15	6,20	-	1,85	8,50	-1	3	25	30	20	5,70	40	3,28	-	**X**	0,19
Brent Blend	Oct-99	38,00	6,20	10,10	2,25	6,74	3	-	20	24	30	4,37	40	3,54	1,4	**X**	0,43
Britannia Condensate	Apr-94	48,50	-	-	1,70	1,46	-3	-	3	-	20	1,57	40	1,19	-		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Bay Marchand	No Heat	No Heat	No Heat	A1	B1	
Beatrice	-	45	45	A4	B4	
Belayim Blend	-	25	25	A3/A7	B3/B7	Cargo temperature may be reduced to 20°C in the summer. Slop tanks to be at least 25°C in all cases.
Belayim Land	16	-	-	-	-	More information required.
Belayim Marine	27	30	30	-	-	More information required.
Belida	-	30	30	A8/A7	B8/B7	Cargo temperature may be reduced to 25°C in the summer. Slop tanks to be at least 30°C in all cases.
Benchamas	50	50	50	A5	B5	Very high wax content.
Benevento-San Marco	-	-	-	-	-	More information required.
Beryl	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Bima	-	50	50	A4	B2	
Bintulu	No Heat	No Heat	No Heat	A2	B2	
Bintulu Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Blenheim	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Bolivar Coast 24	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Bolivian Blend	No Heat	No Heat	No Heat	A1	B1	
Bonny Light	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Bonny Medium	No Heat	No Heat	No Heat	A1	B1	
Bontang	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Bouri	No Heat	No Heat	No Heat	A3	B3	Maintain load temperature or heat to 25°C in winter.
Bow River	No Heat	No Heat	No Heat	A1	B1	
Brass River	No Heat	No Heat	No Heat	A4/A2	B2	
Brega	No Heat	No Heat	25	A4/A1	B2/B1	
Brent Blend	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 20°C and bottom washing may be required.
Britannia Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Bronte Gasolina	Jul-93	71,86	-	-	4,52	-	< -36	-	-	-	20	0,56	-	-	-		-
Brunei Condensate	Oct-92	66,70	10,60	-	4,32	0,00	-54	-34	-72	-70	20	0,60	50	0,50	-		-
Brunei Light	Oct-00	41,10	-	-	-	-	6	-	-	-	-	-	-	-	-		-
Bu Attifel	Dec-97	42,75	2,10	-	0,63	-	32	45	57	-	50	6,50	60	4,92	-		-
Buffalo	Feb-00	52,70	-	-	0,60	5,42	-60	-	6	10	20	1,37	40	1,05	1,00		-
Bunga Kekwa	Mar-98	36,90	-	-	0,20	31,69	36	-	38	44	50	5,18	60	4,16	-		-
Bunju	Dec-90	32,55	-	-	0,20	9,16	12	16	24	25	20	3,73	40	2,40	-		-
Buzachinskaya	Jul-92	24,80	2,10	-	0,17	2,85	-12	18	15	21	20	81,40	30	47,60	-		0,15
Cabinda	Jun-00	32,70	4,80	5,50	1,45	8,40	10	27	27	31	30	18,07	50	9,91	10	**X**	-
Camar	Sep-91	36,00	-	-	1,40	10,50	-33	15	30	31	40	3,03	60	2,08	-		-
Canadon Seco	Aug-02	24,90	1,71	-	0,20	9,67	-14	3	22	34	30	220,00	50	79,90	<2		-
Candela Gasolina	Apr-93	65,99	-	-	0,97	-	-	-	-	-	20	0,67	-	-	-		-
Cano Limon	Mar-93	29,27	1,70	1,80	0,10	7,00	-21	6	22	24	40	13,93	60	7,99	-		-
Captain	Apr-97	19,30	-	-	0,00	0,35	-27	-	-27	-3	20	535,00	40	133,50	-		-
Carassai Gasolina	Feb-93	26,34	-	-	0,00	-	< -36	-	-	-	20	5,43	-	-	-		-
Caripito	Oct-94	21,60	4,50	-	0,60	-	-30	-21	22	-	20	132,48	50	33,39	-		-
Carmopolis	Mar-92	25,10	3,90	-	-	-	-18	-	-	-	20	172,64	40	72,60	-		-
Castilla	Jan-00	12,80	-	-	0,25	6,67	-9	-	18	72	40	1619,00	60	380,00	-		-
Cavone	Mar-92	24,10	-	-	0,74	-	18	-	-	-	20	364,00	-	-	-		-
Ceiba	Oct-02	31,20	-	-	1,50	4,99	-18	-	14	16	30	13,87	50	7,77	<2		-
Cerro Negro	Apr-97	7,60	-	-	0,00	0,44	30	-	-24	74	60	6000,00	80	1135,00	-		-
Cerro Negro SCO	Jun-03	16,00	0,90	-	0,29	-	-32	-	-	-	20	424,50	40	121,46	77,0	**X**	-
Challis	Jun-98	39,90	4,20	-	1,25	4,90	-15	-	6	11	20	3,04	40	2,10	-		-
Champion	Oct-02	28,80	2,00	2,50	0,35	0,10+	<-60	-30	6	-	25	6,28	60	3,99	-	**X**	-
Charenton Barge	May-02	42,40	-	-	1,20	4,86	-18	-	4	8	20	2,84	40	1,97	-		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Bronte Gasolina	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Brunei Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Brunei Light	-	-	-	-	-	More information required.
Bu Attifel	55	55	55	A2	B2	
Buffalo	No Heat	No Heat	No Heat	A2	B2	This crude oil may be subject to wax laydown in cold conditions.
Bunga Kekwa	-	55	55	A7	B7	Treat as Heavy Fuel Oil, Washing may be possible at high temperature. More information required.
Bunju	No Heat	No Heat	No Heat	A2	B2	Previously Bunyu.
Buzachinskaya	No Heat	No Heat	No Heat	A2	B2	
Cabinda	30	30	30	A7/A2	B7/B2	Good results have been obtained using crude at 40°C from slop tanks.
Camar	No Heat	No Heat	No Heat	A2	B2	
Canadon Seco	No Heat	No Heat	No Heat	A4/A2	B4/B2	
Candela Gasolina	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Cano Limon	No Heat	No Heat	No Heat	A2	B2	
Captain	-	50	50	None	B1	Treat as Heavy Fuel Oil.
Carassai Gasolina	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Caripito	-	-	-	-	-	More information required.
Carmopolis	-	-	-	-	-	More information required.
Castilla	60	60	60	A5	B5	
Cavone	-	-	-	-	-	More information required.
Ceiba	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Cerro Negro	-	-	-	A5	B5	Due to high viscosity at high temperature this crude may require to be carried on a specialist vessel. More information required.
Cerro Negro SCO	-	-	-	A1	B1	
Challis	No Heat	No Heat	No Heat	A2	B2	
Champion	No Heat	No Heat	No Heat	A1	B1	
Charenton Barge	No Heat	No Heat	No Heat	A2/A1	B2/B1	

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Cheleken	Feb-02	34,50	-	-	0,30	10,41	9	-	28	32	40	6,85	60	4,29	1,6		-
Cinta	Jun-92	30,95	-	-	0,25	26,80	32	41	47	-	20	290,89	40	50,70	-		-
Clair 1	Feb-93	21,70	-	-	-	-	-18	-	-	-	20	150,05	40	56,30	-		-
Coban	Feb-02	16,50	-	-	0,75	7,10	-18	-	20	44	30	279,00	50	94,70	790	**X**	-
Cold Lake Vancouver	Jun-03	21,20	6,70	-	0,59	0,78	-54	-18	-5	-	20	177,48	40	61,62	-		-
Congo Composite (CoCo)	Jun-00	31,60	-	-	0,75	9,89	27	-	38	-	30	22,30	40	15,80	0,0		-
Cooper Basin	Feb-90	48,85	5,30	-	1,20	15,01	6	9	21	29	20	2,71	40	1,89	-		-
Cossack	Jan-00	47,70	-	-	2,80	5,85	-12	-	16	-	20	1,91	40	1,42	<1		-
CPC Blend		47,00	-	-	-	-	-41	-	-	-	-	-	-	-	-		-
Cupiagua	Apr-99	43,10	-	-	2,45	13,74	15	-	32	33	30	2,43	50	1,67	1,10		-
Curlew	May-01	49,30	9,30	-	3,40	5,97	-27	-	15	19	20	1,56	40	1,16	1,00		-
Cusiana	Nov-00	42,20	-	-	2,75	9,55	6	-	24	26	30	2,39	50	1,70	1		-
Dai Hung	Jan-01	29,50	2,40	-	0,50	14,00	24	32	33	44	40	12,28	60	7,09	-		-
Daqing	Aug-94	32,10	-	-	0,30	16,13	24	36	39	44	50	23,60	80	11,00	1,0		-
Darius	May-95	34,00	5,70	-	1,94	7,24	-18	-	13	-	38	6,02	-	-	-		-
Dauntless	Aug-97	32,60	-	-	1,50	6,35	-9	-	13	23	20	16,30	40	8,00	-		-
Diana Hoover	Sep-01	30,90	-	-	1,55	1,26	-60	-	-13	-2	20	17,72	40	9,65	-		-
Didon	Feb-02	35,40	-	-	1,60	10,11	-9	3	22	28	30	5,84	50	3,60	0,6		-
Djeno	Mar-93	27,70	10,80	-	1,59	8,30	3	12	25	42	20	81,81	30	49,50	-		0,30
Doba Blend (Early Prod)	Jun-03	24,98	1,40	-	0,12	-	-1	-	-	-	20	536,70	40	110,77	-		-
Doba Blend (Later Prod)	Jun-03	20,79	1,20	-	0,06	-	-4	-	-	-	20	1638,20	40	327,67	-		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Cheleken	-	30	30	A8/A7	B4/B2	
Cinta	-	50	55	A5	B5	
Clair 1	-	-	-	-	-	More information required.
Coban	-	-	-	A4	B2	
Cold Lake Vancouver	No Heat	No Heat	No Heat	A3/A2	B3/B2	May require heating to reduce viscosity. More information required.
Congo Composite (CoCo)	-	40	40	A4	B4	
Cooper Basin	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 20°C and bottom washing may be required.
Cossack	No Heat	No Heat	No Heat	A2/A1	B2/B1	
CPC Blend	No Heat	No Heat	No Heat	A2	B2	More information required.
Cupiagua	30	30	30	A8/A7	B8/B7	Gas may be evolved during transportation and COW due to the need to heat. Wash with crude from slop tank heated to 10°C above average cargo temperature.
Curlew	No Heat	No Heat	No Heat	A2/A1	B2/B1	COW should be minimised to reduce gas evolution but be aware that under cold conditions there may be some wax laydown.
Cusiana	No Heat	No Heat	No Heat	A8	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C and bottom washing may be required.
Dai Hung	-	45	45	A8	B7	
Daqing	-	55	55	A4	B4	
Darius	No Heat	No Heat	No Heat	A1	B1	
Dauntless	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Diana Hoover	No Heat	No Heat	No Heat	A1	B1	
Didon	-	25	25	A8	B8/B7	
Djeno	No Heat	No Heat	No Heat	A4	B4	This crude may be subject to wax laydown in cold conditions. Heating to 30°C and bottom washing may be required.
Doba Blend (Early Prod)	-	-	-	-	-	More information required.
Doba Blend (Later Prod)	-	-	-	-	-	More information required.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Donan	Feb-92	39,00	-	-	2,10	6,11	-6	-	22	25	20	5,03	40	3,07	-		-
Dortyol	Aug-98	32,7	-	-	0,23	5,5	-15	-	15	-	20	13,7	-	-	1,3	**X**	-
Draugen	Nov-02	39,90	4,19	-	2,90	3,70	-18	-	13	17	20	3,90	50	2,14	-		-
Dubai Export	Jul-01	30,40	1,00	6,00	1,40	6,03	-43	-9	12	18	20	13,65	40	7,54	1 - 9	**X**	0,23
Duc (Danish)	Oct-94	33,90	8,80	-	1,37	3,60	-45	-18	-	-	20	8,36	40	5,14	-		-
Dulang	Aug-02	37,60	-	-	0,10	30,13	33	-	38	43	50	3,81	60	3,12	<2		-
Duri	Jun-94	20,92	0,30	-	0,00	25,00	3	35	27	34	40	292,00	60	98,80	-		-
Durward	Aug-97	36,00	-	-	1,75	6,29	-15	-	22	-	20	8,86	40	4,63	-		-
Dutch Offshore	Oct-92	29,50	2,80	-	-	-	-18	-	-	-	20	72,25	40	17,88	-		-
E4 (Baltic)	Jul-02	19,40	-	-	0,00	8,67	-6	-	25	32	40	139,00	60	49,75	-		-
E4 Heavy	Jul-98	18,00	-	-	0,00	6,16	15	-	25	29	40	183,50	60	61,50	-		-
E4 Light	Jul-98	19,80	-	-	0,00	8,27	6	-	27	32	40	132,50	60	41,00	-		-
Ea Blend	Jul-03	34,7	-	-	0,94	3,50	0	9	21	-	20	4,51	40	2,85	<1		0,13
East Texas	Jun-95	40,00	-	-	3,45	-	6	-	33	-	20	5,18	40	3,33	-		-
East Zeit	Nov-92	39,30	8,40	10,80	2,60	7,79	-3	3	27	29	20	6,12	40	3,00	-		-
Ebome	Sep-00	32,10	-	-	0,35	3,90	-63	-	13	19	20	5,35	40	3,25	<1		-
Egiziano Temsah 4 (Condensate)	May-94	45,42	-	-	1,53	-	12	-	-	-	20	2,15	-	-	-		-
Ekofisk	Jun-00	37,90	2,20	6,50	1,60	7,00	-9	3	18	24	20	8,16	50	3,62	1 - 2		0,35
El Hajeb	Aug-91	31,20	-	-	-	-	-18	-	-	-	20	18,50	40	8,15	-		-
El Sharara	Apr-98	43,20	-	-	1,45	2,36	-60	-	-17	-2	20	3,02	40	2,07	-		-
Elang	Jun-01	56,90	-	-	4,85	6,00	-63	-	8	14	20	1,12	40	0,89	<1		-
Emerald	Aug-93	23,10	1,20	-	-	-	-18	-	-	-	20	76,73	40	32,40	-		-
Emilio 7	Oct-90	8,60	-	-	0,36	-	3	-	-	-	-	-	-	-	-		-
Eocene	Jan-00	19,00	-	-	0,40	3,77	-45	-	6	14	20	336,00	40	102,00	1,00	**X**	-
Es Sider	Dec-93	36,60	5,60	6,12	1,70	6,61	0	9	26	29	20	10,50	40	6,01	4 - 82	**X**	0,06

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
				(COWT)	(SBT)	
	LOAD	CARRIAGE	DISCHARGE	AW/AS	BW/BS	
Donan	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 20°C and bottom washing may be required.
Dortyol	No Heat	No Heat	-	A2/A1	B2/B1	
Draugen	No Heat	No Heat	No Heat	A1	B1	
Dubai Export	No Heat	No Heat	No Heat	A1	B1	
Duc (Danish)	No Heat	No Heat	No Heat	A1	B1	More information required.
Dulang	-	50	50	A5	B5	
Duri	-	40	45	A5	B5	
Durward	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Dutch Offshore	-	-	-	-	-	More information required.
E4 (Baltic)	-	-	-	-	-	More information required.
E4 Heavy	-	40	40	A5	B5	
E4 Light	-	40	40	A5	B5	
Ea Blend	25	No Heat	No Heat	A2/A1	B2/B1	
East Texas	-	-	-	-	-	More information required.
East Zeit	No Heat	No Heat	No Heat	A2/A1	B2/B1	More information required.
Ebome	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Egiziano Temsah 4 (Condensate)	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Ekofisk	No Heat	No Heat	No Heat	A2/A1	B2/B1	
El Hajeb	-	-	-	-	-	More information required.
El Sharara	No Heat	No Heat	No Heat	A1	B1	
Elang	No Heat	No Heat	No Heat	A1	B1	
Emerald	-	-	-	-	-	More information required.
Emilio 7	-	-	-	-	-	More information required.
Eocene	40	40	40	A1	B1	Heating is required to reduce viscosity.
Es Sider	No Heat	No Heat	No Heat	A2/A1	B2/B1	

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Escalante	Apr-01	23,40	2,00	-	0,20	10,92	-6	7	21	24	40	270,00	60	101,00	1	**X**	-
Escravos	Dec-95	34,50	1,60	4,30	1,05	8,50	-12	7	23	28	30	4,56	50	3,08	0,1		-
Espoir	Sep-02	32,70	-	-	0,90	4,94	-3	-	16	22	20	11,81	40	6,09	<2		-
Etame Marin	Apr-03	35,1	-	-	0,85	24,0	27	-	48	-	40	20,3	-	-	<2		-
Ezzaouia	May-01	39,50	2,60	-	0,70	25,27	30	-	38	41	50	4,55	60	3,72	-	**X**	0,04
F3 Condensate	Feb-98	64,60	-	-	7,00	0,33	<-63	-	-	-	20	0,82	40	0,68	-		-
Fife	May-02	37,00	-	-	1,80	6,87	-21	0	20	21	20	7,36	40	4,33	<1		-
Flotta Mix	Apr-99	36,90	9,70	9,80	2,75	6,75	-46	-3	21	27	20	7,07	40	3,26	1 - 7	**X**	-
Foinaven	Jun-00	26,10	0,90	-	0,00	7,46	-18	9	21	-	20	64,40	40	22,70	1	**X**	-
Forcados Blend	Jul-97	29,70	1,70	5,90	0,65	5,84	-36	-4	15	17	20	10,82	40	5,62	1	**X**	0,14
Foroozan	Dec-95	31,40	-	-	1,25	4,82	-42	-	10	16	20	15,00	40	8,17	-	**X**	-
Forth Central	Apr-92	19,00	-	-	-	-	-18	-	-	-	20	427,54	40	105,20	-		-
Forties Blend	Feb-03	44,40	5,80	6,80	2,80	6,73	-18	5	19	25	20	3,08	40	2,09	<2	**X**	0,53
Fosterton	May-97	23,80	-	-	0,80	1,23	-51	-	2	27	20	110,50	40	42,50	-		-
Fulmar	Nov-93	40,40	7,40	8,70	3,10	5,85	-18	3	23	-	20	4,47	40	2,81	2,0		-
Furial	Jul-94	28,75	4,30	-	0,96	-	-18	-	-	-	20	18,70	30	12,90	<1,0		0,19
Gaggiano	Mar-92	36,40	-	-	1,42	-	-18	-	-	-	20	10,22	-	-	-		-
Gagliano	Jun-93	66,76	-	-	2,74	-	< -36	-	-	-	20	0,63	-	-	-		-
Galeota Mix	Nov-99	36,60	-	-	0,80	6,72	0	-	18	24	20	4,81	40	2,74	2		-
Geisum	Sep-92	18,65	3,40	-	0,28	6,15	3	21	29	45	30	767,00	40	337,00	-		-
Gela	Jun-93	14,56	-	-	0,21	-	-9	-	-	-	-	-	-	-	-		-
Geragai	Nov-01	48,20	-	-	2,45	7,58	-42	-	20	-	20	1,82	40	1,26	<2		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Escalante	-	50	50	A7	B2	
Escravos	No Heat	No Heat	No Heat	A3/A2	B3/B2	
Espoir	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Etame Marin	50 50	45 45	-	A4	B2	
Ezzaouia	40	57	57	A6	B6	See comments 'Annex C'.
F3 Condensate	No Heat	No Heat	No Heat	None	None	Wax content very low. COW with this crude may result in high tank pressures.
Fife	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 20°C and bottom washing may be required.
Flotta Mix	No Heat	No Heat	No Heat	A2	B2	See comments 'Annex C'.
Foinaven	No Heat	No Heat	20	A4/A2	B2	
Forcados Blend	No Heat	No Heat	No Heat	A1	B1	
Foroozan	No Heat	No Heat	No Heat	A1	B1	
Forth Central	-	-	-	-	-	More information required.
Forties Blend	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Fosterton	-	30	50	A2	B2	
Fulmar	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 20°C and bottom washing may be required.
Furial	-	-	-	-	-	More information required.
Gaggiano	-	-	-	-	-	More information required.
Gagliano	-	-	-	-	-	More information required.
Galeota Mix	No Heat	No Heat	No Heat	A2	B2	Heating may be required with cold ambient conditions to prevent wax laydown.
Geisum	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 30°C and bottom washing may be required.
Gela	-	-	-	-	-	More information required.
Geragai	No Heat	No Heat	No Heat	A1	B1	Heating may be required with cold ambient conditions to prevent wax laydown. A full bottom wash may be required but be aware of vapour loss and high tank pressures.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
German Local	Jul-02	26,70	-	-	0,50	16,05	9	-	20	27	60	38,55	100	13,19	-		-
Giaurone	Apr-91	12,90	-	-	0,30	-	-12	-	-	-	20	0,00	-	-	-		-
Gippsland Blend	Jun-03	48,70	3,40	-	1,44	16,72	-12	-	27	34	20	1,70	40	1,34	1,0		0,15
Girassol	Jan-02	31,10	2,70	-	1,09	5,81	-24	-	18	19	20	19,94	40	9,77	<2		-
Glitne	Sep-01	32,20	-	-	1,10	7,15	3	-	23	25	30	12,83	50	7,42	<1		-
Gombe Marin	Mar-92	23,00	4,90	-	-	-	-18	-	-	-	20	315,86	40	95,60	-		-
Gorm Blend	Dec-97	35,50	-	-	2,40	2,31	-42	-37	0	15	20	6,49	40	3,98	<0,2		-
Grand Isle	Oct-97	33,55	-	-	0,50	2,76	-21	-6	9	19	20	12,73	40	6,66	-		-
Grane	Oct-03	19,10	0,50	-	0,15	1,10	-30	-	17	-	20	361,10	40	96,44	-		-
Griffin	May-01	54,00	-	-	2,70	2,58	-30	-	-5	-2	20	1,30	40	1,01	<1		-
Grottammare Gasolina	Feb-93	56,92	-	-	2,61	-	< -36	-	-	-	20	0,93	-	-	-		-
Gryphon	Apr-03	23,00	0,00	-	0,00	1,00	-54	-39	-32	-8	20	182,83	40	53,40	<2		-
Gulf of Suez	Apr-00	29,90	2,70	5,50	1,15	10,03	-9	10	28	-	30	14,65	50	8,23	<1	**X**	0,29
Gullfaks 'A'	Jul-01	36,80	-	-	2,00	5,08	-21	-	16	18	20	6,97	40	4,16	<1		-
Gullfaks 'C'	Dec-01	36,50	4,40	7,10	1,75	5,76	-15	-	17	21	30	5,03	50	3,34	-		-
Handil	Aug-02	43,00	4,00	6,20	1,10	4,50	-27	30	19	-	20	1,86	-	-	0,0		-
Hanze	Mar-03	39,20	-	-	3,10	2,00	-42	-	-6	3	30	3,99	50	2,87	<2		-
Harding	Jul-02	20,70	-	-	0,05	0,98	-45	-	-26	1	30	124,00	50	43,20	<2		-
Hawtah	May-92	50,20	6,70	-	-	-	-18	-	-	-	20	1,87	40	1,41	-		-
Heidrun	Aug-03	27,00	2,13	-	0,4	2,5	-60	-18	0	1	20	25,80	50	8,83	<2		-
Helm Blend	Jun-98	28,85	-	-	0,35	6,61	-9	6	25	30	20	78,90	40	27,05	-		-
Hibernia	Sep-00	35,30	3,60	6,10	1,15	8,69	-1	13	25	29	40	5,19	60	3,41	1		-
High Island	Jun-98	37,50	-	-	0,95	3,69	-12	-	8	10	20	6,29	40	3,56	-		-
Hudson	Aug-93	33,30	4,20	8,10	1,65	5,81	0	7	22	30	30	7,99	50	4,65	-		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
German Local	25	25	25	A4/A2	B4/B2	This crude oil may be subject to wax laydown in cold conditions.
Giaurone	-	-	-	-	-	More information required.
Gippsland Blend	-	20	20	A7/A2	B7/B2	
Girassol	No Heat	No Heat	No Heat	A4/A2	B4/B2	
Glitne	No Heat	No Heat	No Heat	A2	B2	Heating may be required with cold ambient conditions to prevent wax laydown.
Gombe Marin	-	-	-	-	-	More information required.
Gorm Blend	No Heat	No Heat	No Heat	A1	B1	
Grand Isle	No Heat	No Heat	No Heat	A1	B1	
Grane	30	30	30	A1	B1	
Griffin	No Heat	No Heat	No Heat	A1	B1	
Grottammare Gasolina	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Gryphon	-	25	25	A1	B1	
Gulf of Suez	No Heat	No Heat	No Heat	A8	B3	This crude may be subject to wax laydown in cold conditions. Loaded temperature should be maintained.
Gullfaks 'A'	No Heat	No Heat	No Heat	A1	B1	
Gullfaks 'C'	No Heat	No Heat	No Heat	A1	B1	
Handil	-	No Heat	No Heat	A1	B2	Reported properties vary considerably.
Hanze	No Heat	No Heat	No Heat	A1	B1	
Harding	-	No Heat	30	A1	B1	This crude requires heating for viscosity reduction.
Hawtah	-	-	-	-	-	More information required.
Heidrun	No Heat	No Heat	No Heat	A1	B1	
Helm Blend	-	30	30	A2	B2	
Hibernia	25	25	25	A4/A3	B3/B2	This crude oil may be subject to wax laydown in cold conditions.
High Island	No Heat	No Heat	No Heat	A2	B2	
Hudson	No Heat	No Heat	No Heat	A8	B3/B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Hydra	Apr-91	38,65	-	-	1,37	8,57	3	9	24	26	20	7,41	40	4,35	-		-
Hz 26	Mar-91	37,40	-	-	0,09	-	33	-	-	-	-	-	-	-	-		-
Ima	Feb-01	45,20	-	-	2,45	14,43	15	-	26	32	40	1,72	60	1,35	<1		-
Intan	Jun-90	30,00	-	-	-	40,50	48	-	53	54	50	38,50	80	11,85	-		-
Iranian Heavy	Dec-96	30,35	6,00	-	1,60	6,50	-36	-18	16	21	20	16,83	40	8,51	1 - 58	**X**	0,15
Iranian Light	May-02	33,60	5,97	7,00	1,50	6,50	-32	-9	20	21	20	11,29	40	5,74	0,1	**X**	0,17
Irminio	Jul-93	33,11	-	-	1,33	-	0	-	-	-	20	15,76	-	-	-		-
Isis	Apr-02	35,00	-	-	0,85	10,88	6	-	25	28	40	5,42	60	3,49	<2		-
Isthmus	Mar-02	32,70	4,40	6,90	1,15	4,88	-39	-	6	14	20	12,79	40	6,83	150	**X**	-
Jabiru	Jun-98	42,30	4,00	4,50	1,65	11,95	15	-	21	26	20	3,67	40	2,32	-		-
Jackson	Jan-97	43,65	1,20	8,30	0,85	22,70	15	24	24	39	20	3,93	40	2,62	-		-
Jarn Yaphour	May-95	51,90	-	-	2,95	3,44	-54	-	1	7	30	1,13	50	0,89	-		-
Jotun	Jun-03	37,70	3,90	-	1,43	-	10	-	-	-	20	8,43	40	4,60	-		-
Kaji Semoga	Jun-01	38,10	-	-	1,80	16,05	18	-	34	-	40	3,33	60	2,36	<1		-
Kalingrad	May-93	41,00	-	-	1,95	6,69	-6	-	18	-	20	6,68	40	3,91	-		-
Karachaganak	Oct-03	45,40	-	-	2,50	6,00	-60	-	20	-	20	2,38	-	-	21,0	**X**	-
Katapa	Feb-91	48,95	2,90	-	1,80	0,91	-54	-25	-27	-3	20	1,31	30	1,13	-		-
Kerapu	Mar-98	46,50	-	-	0,80	25,00	30	-	37	42	40	4,25	60	2,64	-		-
Khafji	Jan-99	28,00	6,40	7,80	1,55	5,73	-57	-21	14	17	20	46,40	40	18,73	<1		-
Kiame	Dec-98	29,30	-	-	1,75	9,00	3	-	22	29	20	25,65	40	12,57	0,6		-
Kirkuk	Jun-99	35,05	5,00	6,90	1,05	5,06	-45	-15	16	19	20	10,78	40	5,76	5	**X**	-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Hydra	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Hz 26	-	-	-	-	-	More information required.
Ima	30	30	30	A8	B8/B7	
Intan	-	60	60	A5	B5	
Iranian Heavy	No Heat	No Heat	No Heat	A3/A2	B3/B2	
Iranian Light	No Heat	No Heat	No Heat	A2	B2	See comments 'Annex C'.
Irminio	-	-	-	-	-	More information required.
Isis	30	30	30	A4	B4/B2	
Isthmus	No Heat	No Heat	No Heat	A1	B1	
Jabiru	-	25	25	A3/A2	B3/B2	This crude may be subject to wax laydown in cold conditions. Heating to 30°C may be required.
Jackson	-	35	35	A4	B4	
Jarn Yaphour	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 30°C may be required.
Jotun	-	-	-	-	-	More information required.
Kaji Semoga	35	35	35	A7	B7	
Kalingrad	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 20°C and bottom washing may be required.
Karachaganak	No Heat	No Heat	No Heat	A1	B1	
Katapa	No Heat	No Heat	No Heat	A1	B1	
Kerapu	-	45	45	A8	B3	
Khafji	No Heat	No Heat	No Heat	A2	B2/B1	
Kiame	No Heat	No Heat	No Heat	A4	B3/B2	
Kirkuk	No Heat	No Heat	No Heat	A4/A1	B2	This crude is affected by ambient conditions, especially sea temperature. Heating during winter months will be needed. Heat to 25°C or maintain loaded temperature (whichever is greater). Bottom washing may be required.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Kitina	Jun-00	36,69	-	-	1,15	-	0	-	21	-	20	5,05	-	-	-		-
Kittiwake	Jun-03	40,20	5,20	6,80	2,10	-	-18	-	-	-	20	5,70	40	3,43	-		-
Kole Marine Blend	Apr-03	31,60	4,50	5,80	0,85	5,85	-21	-9	20	29	20	13,39	40	7,22	1		0,30
Kuito	Jan-03	20,00	-	-	0,10	3,50	-42	-	2	19	20	352,00	40	95,30	<1	**X**	-
Kumkol	Nov-99	39,83	-	-	1,60	15,98	15	-	28	33	30	5,53	50	3,29	<1		-
Kutubu	Jun-03	44,40	7,10	-	2,80	9,12	-1	6	18	27	20	2,02	40	1,49	-		-
Kuwait Export	Dec-96	30,50	6,40	7,40	1,40	8,00	-57	-15	5	17	30	13,54	40	9,96	1 - 5	**X**	-
Kyle	Apr-01	37,40	-	-	1,40	7,01	-6	-	21	24	40	4,34	60	2,93	<1		-
Kyzylorda	Sep-00	38,20	-	-	1,05	14,81	21	-	29	33	30	6,77	50	3,94	9		-
Labuan	Jun-95	31,60	2,20	-	0,50	10,00	9	24	20	23	20	4,47	40	2,86	-		-
Lagomedio	Nov-92	32,35	4,60	4,90	1,11	4,66	-40	-26	0	16	20	16,80	30	12,20	-		0,20
Lagotreco	Feb-95	31,40	3,70	4,30	0,93	4,09	-39	-21	12	15	20	18,00	30	12,40	-		0,14
Lagotreco Mediano	Jul-94	22,02	3,80	-	0,61	-	-34	-21	23	67	20	138,38	50	38,96	-		-
Lalang	Nov-93	39,10	-	-	0,55	29,73	30	32	40	45	40	7,37	60	4,70	-		-
Laminaria	Apr-99	60,0	-	-	2,95	1,0	-54	-	-1	-	20	1,05	-	-	-		-
Lavan Blend	Mar-97	33,85	-	-	2,15	5,50	-30	-24	3	18	20	9,43	40	5,60	-		-
Leadon	Apr-02	17,80	-	-	0,00	1,06	-30	-	-7	5	40	170,40	60	55,40	<2		-
Legendre	Jun-01	43,00	-	-	1,80	9,25	12	-	18	24	20	2,51	40	1,75	<1		-
Leona	Oct-92	23,20	3,00	3,50	0,55	3,31	-45	-36	12	21	40	39,10	60	18,30	-		-
Light Louisiana Sweet	Jul-98	36,35	-	-	0,95	3,30	-24	-15	8	16	20	5,62	40	3,54	-		-
Likouala	Apr-89	32,00	-	-	0,82	-	9	-	-	-	-	-	-	-	-		-
Lion	Jul-94	36,00	-	-	-	-	18	-	-	-	-	-	-	-	-		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Kitina	No Heat	No Heat	No Heat	-	-	More information required.
Kittiwake	-	-	-	-	-	More information required.
Kole Marine Blend	No Heat	No Heat	25	A4/A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C and bottom washing may be required.
Kuito	-	30	30	A2/A1	B2/B1	
Kumkol	30	30	30	A4/A2	B2	
Kutubu	No Heat	20	20	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C and bottom washing may be required. However, be aware of the relatively high gas content.
Kuwait Export	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Kyle	No Heat	No Heat	No Heat	A2	B2	This crude oil may be subject to wax laydown in cold conditions.
Kyzylorda	30	30	30	A8	B8/B7	
Labuan	-	30	30	A8	B8/B7	
Lagomedio	No Heat	No Heat	No Heat	A1	B1	
Lagotreco	No Heat	No Heat	No Heat	A1	B1	This crude may be subject to wax laydown in cold conditions. Heating to 20°C and bottom washing may be required.
Lagotreco Mediano	-	30	30	A2	B2	
Lalang	-	45	45	A4	B4	
Laminaria	No Heat	No Heat	No Heat	A1	B1	
Lavan Blend	No Heat	No Heat	No Heat	A1	B1	
Leadon	40	40	50	A1	B1	Heating required to reduce viscosity.
Legendre	25	25	25	A2	B2	
Leona	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 20°C may be required.
Light Louisiana Sweet	No Heat	No Heat	No Heat	A1	B1	
Likouala	-	-	-	-	-	More information required.
Lion	-	-	-	-	-	More information required.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Liu Hua	Sep-96	22,80	-	-	0,00	12,00	6	-	2	24	40	78,20	60	32,30	-		-
Liverpool Bay Blend	Jan-99	44,70	-	-	1,95	10,09	-27	0	26	29	20	4,87	40	2,16	-	**X**	-
Lloydminster	Jun-97	22,50	-	-	0,70	1,02	-51	-	-5	27	20	145,50	40	55,20	-		-
Loango	Apr-89	26,10	-	-	0,52	-	3	-	-	-	20	195,80	-	-	-		-
Lokele	Mar-93	20,35	1,50	2,28	0,52	0,60	-51	-37	-53	22	20	113,13	50	23,90	<2		-
Loreto	Jan-00	18,30	-	-	-	-	-27	-	-	-	-	-	-	-	-		-
Lufeng	Nov-98	32,50	0,00	-	0,00	38,00	40	42	46,00	48,00	50	16,52	60	12,03	<1		-
M100 At Res	Sep-99	14,80	-	-	0,00	8,87	24	-	33	33	40	980,00	60	245,00	-		-
Machar	Jun-94	40,15	-	-	0,80	-	-3	-	23	-	20	7,38	40	3,52	-		-
Makat	Mar-00	34,30	-	-	0,55	5,15	-21	-	15	16	30	12,23	50	6,52	2,00		-
Malampaya	Oct-93	30,0	-	-	-	-	6	-	-	-	-	-	-	-	-		-
Malampaya Condensate	Jul-01	52,5	-	-	-	-	-36	-	-	-	-	-	-	-	-		-
Malongo	Nov-89	31,50	-	-	0,56	-	15	-	-	-	20	62,23	-	-	-		-
Malossa	Jun-84	52,50	-	-	0,60	-	-30	-	-	-	20	1,34	-	-	-		-
Mandji	Mar-01	29,30	6,20	-	0,80	9,09	-18	12	27	29	30	24,90	50	11,73	<1		0,50
Mante Alpi	Apr-93	37,70	-	-	1,61	-	-24	-	-	-	20	4,76	-	-	-		-
Maralago	Jun-98	20,90	-	-	0,50	7,00	-18	-	19,00	28,00	30	189,50	40	103,50	-		-
Margham Condensate	Feb-03	57,40	11,40	-	7,20	0,50	-60	-15	-25	8	20	0,80	-	-	<2		-
Marib Light	Jun-99	48,40	8,40	-	3,10	4,97	-40	-4	19	33	20	1,80	40	1,37	-		3,70
Marlim	Sep-96	19,89	-	-	0,31	2,5	-39	-	28	-	30	177	-	-	-	**X**	-
Mars	Feb-02	30,50	-	-	1,80	2,82	-39	-	7	10	20	17,68	40	9,53	-		-
Masa	Jul-99	43,20	-	-	1,30	6,09	-24	-	12	19	20	3,72	40	2,41	3,10		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
				(COWT)	(SBT)	
	LOAD	CARRIAGE	DISCHARGE	AW/AS	BW/BS	
Liu Hua	30	30	30	A8/A7	B8/B7	This crude may be subject to wax laydown in cold conditions. Heating to 20°C may be required.
Liverpool Bay Blend	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required. High H_2S/Mercaptans.
Lloydminster	-	30	50	A2	B2	More information required.
Loango	-	-	-	-	-	More information required.
Lokele	No Heat	No Heat	No Heat	A1	B1	
Loreto	-	-	-	-	-	More information required.
Lufeng	55	55	55	A5	B5	
M100 At Res	-	-	-	-	-	
Machar	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Makat	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Malampaya	-	-	-	-	-	More information required.
Malampaya Condensate	-	-	-	-	-	More information required.
Malongo	-	-	-	-	-	More information required.
Malossa	-	-	-	-	-	More information required.
Mandji	25	25	25	A8/A7	B8/B7	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Mante Alpi	-	-	-	-	-	More information required.
Maralago	-	40	57	A7	B7	More information required.
Margham Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Marib Light	No Heat	No Heat	No Heat	A1	B1	
Marlim	30	30	30	A1	B1	
Mars	No Heat	No Heat	No Heat	A1	B1	
Masa	No Heat	No Heat	No Heat	A2/A1	B2/B1	

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Masila	Dec-02	31,40	1,90	12,00	0,50	6,88	-9	9	21	24	30	11,63	50	6,39	<2	**X**	-
Maui Condensate	Sep-99	52,50	-	-	2,40	1,76	<-60	-42	-50	-24	20	1,04	40	0,82	-		-
Maya	Feb-01	21,10	6,20	6,70	0,55	4,03	-21	-	17	40	30	161,50	50	54,80	108,0	**X**	1,70
McKee	Mar-01	44,20	-	-	0,45	19,35	18	-	25	34	20	4,37	40	2,74	<1		-
Medanitos	Jan-95	32,95	3,20	4,50	0,82	-	-3	7	9	-	20	24,90	40	9,95	-		-
Menemota	Sep-93	18,85	-	-	0,45	-	-32	-24	22	-	20	258,29	50	59,93	-		-
Merey	Nov-94	16,60	0,20	1,70	0,15	1,71	-23	-18	1	39	20	2091,94	30	881,04	26,0		-
Mesa 28	Dec-90	27,30	-	-	0,65	4,82	-24	-	16	20	20	29,55	40	13,14	-		-
Mesa 30	Nov-94	30,00	5,60	5,80	0,78	5,53	-46	0	15	23	20	11,90	50	5,50	-		-
Minas	Jan-99	35,25	2,30	2,60	0,30	21,41	-1	38	42	45	40	22,55	60	8,13	-		-
Miri Light	Dec-96	32,40	3,30	-	0,85	4,50	-9	6	10	24	20	5,01	30	3,89	-		-
Miskar Condensate	Jul-01	54,20	-	-	3,35	2,16	-21	-	-58	-24	20	1,02	40	0,83	<1	**X**	-
Mississippi Sour	May-02	39,00	-	-	1,70	3,83	-63	-	8	-	20	4,66	40	3,14	-		-
Mittelp Dieksand	Nov-01	23,70	-	-	-	-	-3	-	-	-	-	-	-	-	-		-
Mittelp Insel	Nov-01	21,60	-	-	-	-	-24	-	-	-	-	-	-	-	-		-
Moudi	May-01	36,50	2,90	4,70	1,70	1,56	-63	-	-10	1	20	5,18	40	3,33	<1		-
Mubarek	Oct-91	43,00	3,20	-	2,10	5,70	-24	-12	15	-	20	1,91	30	1,63	-		-
Mudi	Aug-98	38,00	-	-	0,30	29,66	27	-	40	43	40	6,49	60	3,67	<0,5		-
Murban	Jul-95	39,90	1,60	4,40	1,43	6,17	-34	-12	16	23	20	5,47	40	3,16	1 - 20	**X**	0,21
Nanhai	Jun-96	38,80	-	-	0,70	25,50	24	33	34	42	40	6,36	60	4,06	-		-
Nemba	Jun-00	38,50	3,00	-	2,25	8,00	4	9	23	27	20	5,57	40	3,33	-		-
Neuquen Rio Negro	Jan-92	35,30	-	-	1,05	5,69	-3	-	19	20	20	11,15	40	6,07	-		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
				(COWT)	(SBT)	
	LOAD	CARRIAGE	DISCHARGE	AW/AS	BW/BS	
Masila	No Heat	No Heat	No Heat	A2	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Maui Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Maya	30	30	30	A8/A7	B5	Washing with Maya is possible. Slop tank may require heating. See comments 'Annex C', High H_2S.
McKee	-	45	45	A8	B8/B7	
Medanitos	No Heat	No Heat	No Heat	A1	B1	
Menemota	-	-	-	-	-	More information required.
Merey	-	57	57	A1	B1	
Mesa 28	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Mesa 30	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Minas	38	50	50	A5	B5	Washing with Minas is possible. Slop tank will require heating.
Miri Light	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Miskar Condensate	No Heat	No Heat	No Heat	-	-	Washing with this grade may cause unacceptably high tank pressures. See comments 'Annex A'.
Mississippi Sour	No Heat	No Heat	No Heat	A2/A1	B1	
Mittelp Dieksand	-	-	-	-	-	More information required.
Mittelp Insel	-	-	-	-	-	More information required.
Moudi	No Heat	No Heat	No Heat	A1	B1	
Mubarek	No Heat	No Heat	No Heat	A2	B2	
Mudi	-	45	45	A5	B5	
Murban	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Nanhai	-	45	45	A7	B7	
Nemba	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 30°C may be required. Used as wash medium if loaded with Cabinda.
Neuquen Rio Negro	No Heat	No Heat	No Heat	A2/A1	B2/B1	

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Nile Blend	May-99	34,90	-	-	0,05	20,26	36	-	42	49	40	21,35	60	12,51	-		-
Njord	May-02	43,70	6,40	-	2,35	6,26	-32	-18	19	20	20	3,36	40	2,32	<2		-
N'Kossa	Sep-98	48,30	7,05	-	2,75	7,00	-12	12	18	21	20	2,76	40	1,74	1		-
Norne	Dec-01	32,70	-	-	0,50	11,29	18	21	30	32	20	5,92	50	4,59	<1		-
NW Shelf Condensate	Mar-97	60,30	6,10	-	4,95	0,30	-60	-36	-49	-15	20	0,82	30	0,73	-		-
Odudu	Aug-00	31,80	4,00	-	1,05	5,79	-3	3	18	25	20	7,51	40	4,26	<1	**X**	-
Oguendjo	Nov-01	32,00	5,00	7,80	1,55	9,02	12	-	26	28	30	14,81	50	7,98	<1		0,30
Okono	Sep-03	41,1	-	-	1,24	9,6	18	-	-	-	20	2,7	40	1,82	-		0,13
Olmeca	May-94	39,15	2,40	-	1,68	5,72	-51	-32	8	15	20	4,50	50	2,50	2,0		-
Oman Export	Mar-94	32,87	3,70	4,20	0,84	3,82	-42	-23	-3	9	20	19,77	50	7,63	1 - 7	**X**	-
Ombrina	Apr-90	21,50	-	-	0,95	-	< -33	-	-	-	20	89,34	-	-	-		-
Onako	Jul-01	47,23	-	-	2,55	7,40	-15	-	20	23	30	2,07	50	1,56	<1		-
Onako Medium	Nov-98	38,50	-	-	1,80	7,50	-24	-	17	20	20	5,76	40	3,41	30	**X**	-
Oriente	Jan-93	28,55	4,50	5,50	1,00	6,02	-12	-1	23	27	20	34,70	40	15,05	-		-
Oseberg	Nov-00	38,00	4,84	5,50	2,15	4,73	-36	-9	15	20	30	4,36	50	2,94	<2		0,32
Oso Condensate	Jun-97	47,40	10,90	11,30	5,07	10,63	-9	18	23	26	20	2,02	50	1,25	0,0		-
Ostrica	Jun-00	34,40	3,70	-	1,10	2,60	-39	-21	3	4	20	8,47	40	4,87	1,0		-
P15 (Dutch) Condensate	Feb-94	54,00	-	-	4,35	1,82	-24	-	-27	-	20	1,07	40	0,85	-		-
Pagerungan	Aug-95	61,30	-	-	5,65	0,36	<-54	-	<-60	-	20	0,80	40	0,65	-		-
Palanca	Dec-96	37,35	5,30	-	1,75	9,00	-15	9	21	27	30	5,27	50	3,44	1 - 2	**X**	0,17

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Nile Blend	50	50	50	A7	B7	See comments 'Annex A'.
Njord	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude oil may be subject to wax laydown in cold conditions.
N'Kossa	No Heat	No Heat	No Heat	A2	B2	More information required.
Norne	-	30	30	A4	B8/B7	This crude may be subject to wax laydown in cold conditions. Heating to 35°C may be required.
NW Shelf Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Odudu	No Heat	No Heat	No Heat	A4/A2	B2	
Oguendjo	No Heat	No Heat	No Heat	A4/A2	B2	
Okono	30	30	30	-	-	
Olmeca	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Oman Export	No Heat	No Heat	No Heat	A1	B1	
Ombrina	-	-	-	-	-	More information required.
Onako	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 25°C and bottom washing may be required.
Onako Medium	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Oriente	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Oseberg	No Heat	No Heat	No Heat	A1/A2	B1/B2	
Oso Condensate	No Heat	No Heat	No Heat	None	-	This crude may be subject to wax laydown in cold conditions so bottom washing may be required. However, the gas content is very high which may lead to vapour losses and high cargo tank pressures.
Ostrica	No Heat	No Heat	No Heat	A1	B1	
P15 (Dutch) Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Pagerungan	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Palanca	-	25	25	A8	B7	May be washed with heated crude from slop tanks (10°C above carriage temperature) or with gas oil diluent. Success of discharge varies with no apparent pattern. See comments 'Annex C'.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Pennington Light	Apr-97	35,75	-	-	0,80	5,45	-4	7	15	20	20	5,29	40	3,31	-		1,30
Phet	Nov-92	38,90	-	-	-	-	-18	-	-	-	20	16,02	40	7,70	-		-
Pierce	May-00	38,10	-	-	1,35	7,29	-6	-	20	24	20	6,86	40	4,14	2,00		-
Pilon	Dec-94	13,80	0,50	-	-	-	-3	-	-	-	-	-	-	-	-		-
Pisticci	Mar-94	9,42	-	-	0,17	-	9	-	-	-	-	-	-	-	-		-
Poseidon	Dec-99	31,30	-	-	1,65	3,04	-30	-	-2	4	20	15,80	40	8,35	-		-
Prezioso	Feb-90	19,00	-	-	0,09	-	6	-	-	-	20	1564,00	-	-	-		-
Prinos Blend	Dec-97	27,90	-	-	1,50	13,00	-45	-9	28	33	30	17,20	-	-	-		-
Prinos North	Mar-97	20,80	-	-	0,55	8,50	-21	-12	23	39	30	29,55	40	19,03	-		-
Qatar Condensate (North Field)	Jun-99	58,10	9,80	-	2,71	0,52	-54	-	-34	-13	20	1,05	40	0,83	-		-
Qatar Export (Qatar Land)	Dec-92	41,05	8,00	10,20	3,19	5,07	-49	-9	11	13	20	3,56	50	2,20	>200	**X**	-
Qatar Marine	Nov-98	34,40	3,00	6,50	1,15	6,53	-39	-12	6	20	20	11,65	40	6,50	>200	**X**	-
Qin Huang Dao	Nov-01	16,60	-	-	0,00	5,70	-12	-	4	20	40	836,00	60	211,70	-		-
Qua Iboe	Aug-03	36,70	1,40	7,40	1,36	7,50	7	13	21	27	20	8,30	40	3,62	1 - 8		0,18
Rabi Blend	Jun-00	34,10	2,50	-	0,07	-	17,8	-	29	-	-	-	-	-	-		-
Rabi Light	Jun-00	34,80	2,50	-	0,60	18,08	3	29	41	-	20	90,50	40	14,60	-		-
Ragusano	Aug-93	19,56	-	-	0,29	-	-6	-	34	-	20	850,40	-	-	-		-
Rang Dong	Sep-98	39,90	-	-	1,15	26,50	33	-	35	42	40	6,65	60	3,62	<1		-
Ras Budran	Oct-94	24,70	5,40	6,10	1,10	5,79	-12	0	25	31	20	111,89	30	62,26	-		-
Ras El Bahar Blend	Oct-91	36,30	-	-	1,71	-	-3	-	-	-	-	-	-	-	-		-
Ras Garra	Apr-92	32,10	-	-	1,05	-	9	-	-	-	20	81,05	-	-	-		-
Ras Gharib	Nov-01	22,00	0,50	4,20	0,45	11,11	1	10	29	34	30	102,00	50	37,05	<2		-
Ras Laffan	Oct-99	55,70	-	-	3,55	1,17	-30	-	-89	-16	20	1,07	40	0,87	-		-
RasGas Condensate	Jun-00	55,40	7,30	-	3,74	-	-31	-	-	-	20	1,16	40	0,90	-		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Pennington Light	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Phet	-	-	-	-	-	More information required.
Pierce	No Heat	No Heat	No Heat	A2	B2	This crude oil may be subject to wax laydown in cold conditions.
Pilon	-	57	57	-	-	More information required.
Pisticci	-	-	-	-	-	More information required.
Poseidon	No Heat	No Heat	No Heat	A1	B1	
Prezioso	-	-	-	-	-	More information required.
Prinos Blend	-	30	30	A8	B3	
Prinos North	-	35	35	A8	B3/B2	
Qatar Condensate (North Field)	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Qatar Export (Qatar Land)	No Heat	No Heat	No Heat	A1	B1	
Qatar Marine	No Heat	No Heat	No Heat	A1	B1	
Qin Huang Dao	60	60	60	A5	B5	Heating required to reduce viscosity.
Qua Iboe	-	No Heat	No Heat	A8/A3	B3/B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Rabi Blend	-	-	-	-	-	More information required.
Rabi Light	-	45	45	A3	B3	
Ragusano	-	-	-	-	-	More information required.
Rang Dong	-	45	45	A8	B8	
Ras Budran	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 30°C may be required.
Ras El Bahar Blend	-	-	-	-	-	More information required.
Ras Garra	-	-	-	-	-	More information required.
Ras Gharib	-	30	30	A3	B3	
Ras Laffan	No Heat	No Heat	No Heat	-	-	Washing with this grade may cause unacceptably high tank pressures.
RasGas Condensate	-	-	-	-	-	

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Ratawi	Jan-00	24,00	4,50	4,60	1,05	6,75	-21	-	13	19	20	93,10	40	33,45	1	**X**	-
Rhemoura	Dec-96	32,00	-	-	1,05	6,53	-24	3	25	27	30	12,26	40	9,04	-		-
Rijn	Aug-90	34,80	-	-	0,60	8,70	3	-	26	29	30	9,25	50	5,28	-		-
Rimal Katib	Jul-91	37,20	-	-	0,19	-	43	-	-	-	-	-	-	-	-		-
Rincon de los sauc	May-94	35,30	3,10	-	0,59	-	-9	-	18	-	20	10,16	50	3,91	-		-
Romashkino (Urals Light)	Aug-95	33,52	6,00	-	1,50	4,59	-12	1	13	31	20	15,10	40	8,34	-		-
Rospo di Mare	Mar-94	11,94	0,70	-	0,41	-	-1	12	91	-	20	12531,65	40	1505,00	-		-
Ross	Oct-99	38,80	-	-	1,95	8,48	3	-	25	27	-	-	-	-	2,0		-
Ruby	May-99	35,70	10,00	-	0,80	22,00	30	-	36	39	40	8,40	60	4,57	0,9		-
Russian Condensate	Feb-01	44,50	-	-	1,34	3,50	-45	-	10,00	-	20	1,61	-	-	320	**X**	-
Russian Export Blend																	
Sable Island Condensate	Jun-00	51,40	5,50	-	1,42	-	-54	-	-	-	20	0,89	40	0,72	-		-
Saharan Blend	Mar-01	45,70	6,40	10,50	3,10	2,78	-59	-18	1	9	30	2,09	50	1,61	<1	**X**	0,28
Sajaa Condensate	Dec-92	57,50	-	-	5,85	0,58	-45	-	-17	-10	20	0,76	40	0,67	-		-
Saladin	May-93	48,15	-	-	1,85	2,63	-39	-18	-5	1	20	1,71	30	1,47	-		-
Samgori	Dec-97	37,60	-	-	0,50	8,50	9	-	23	28	20	5,64	30	4,30	-		-
San Benedetto Gasolina	Mar-93	27,85	-	-	0,00	-	< -36	-	-	-	20	4,77	-	-	-		-
San Joaquin Valley	May-88	15,10	1,60	-	0,39	-	-21	-	62	-	20	3701,17	50	236,60	-		-
San Salvo Gasolina	Feb-87	73,30	-	-	7,86	-	0	-	-	-	20	0,53	-	-	-		-
San Sebastian	Mar-00	69,10	-	-	4,75	0,00	-60	-	-72	-60	20	0,67	40	0,55	<1		-
Santa Barbara	Jan-97	33,70	-	-	0,95	5,12	-21	-	20	24	30	5,62	50	3,60	-		-
Sarago	Mar-90	11,40	-	-	0,21	-	-15	-	-	-	-	-	-	-	-		-
Sarago 1	Mar-91	8,20	-	-	0,30	-	0	9	-	-	-	-	-	-	-		-
Saratov	Oct-03	41,6	-	-	2,16	11,0	-3	-	25	-	20	4,92	-	-	<5		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Ratawi	No Heat	No Heat	No Heat	A4/A2	B2	Previously Wafra Ratawi. More information required.
Rhemoura	30	30	30	A3/A2	B3/B2	This crude may be subject to wax laydown in cold conditions. Heating to 20°C and bottom washing may be required.
Rijn	No Heat	No Heat	No Heat	A3/A2	B3/B2	This crude may be subject to wax laydown in cold conditions. Heating to 30°C may be required.
Rimal Katib	-	-	-	-	-	More information required.
Rincon de los sauc	No Heat	No Heat	No Heat	A3	B3	
Romashkino (Urals Light)	No Heat	No Heat	No Heat	A1	B1	
Rospo di Mare	-	57	57	A5	B5	
Ross	No Heat	No Heat	No Heat	A3	B3	
Ruby	-	40	40	A7	B7	
Russian Condensate	No Heat	No Heat	No Heat	-	-	COW with this crude may result in high tank pressures.
Russian Export Blend						See Urals.
Sable Island Condensate	-	-	-	-	-	More information required.
Saharan Blend	No Heat	No Heat	No Heat	A1	B1	
Sajaa Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Saladin	No Heat	No Heat	No Heat	A1	B1	
Samgori	No Heat	25	25	A3	B3/B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
San Benedetto Gasolina	No Heat	No Heat	No Heat	None	-	More information required.
San Joaquin Valley	-	57	57	A5	B5	
San Salvo Gasolina	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
San Sebastian	No Heat	No Heat	No Heat	A1	B1	Washing with this grade may cause unacceptably high tank pressures.
Santa Barbara	No Heat	25	25	A8/A7	B3/B2	
Sarago	-	-	-	-	-	More information required.
Sarago 1	-	-	-	-	-	More information required.
Saratov	No Heat	No Heat	-	A4	B4/B2	

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Sarir	Aug-02	37,10	5,00	-	1,85	18,84	24	27	36	37	50	6,63	100	2,85	<2	**X**	0,08
Schiehallion	Apr-03	25,50	-	-	0,20	7,00	-6	12	21	26	20	50,80	40	17,26	<2		-
Sedgewick	Nov-93	21,40	-	-	-	-	-18	-	-	-	20	119,51	40	36,90	-		-
Sedigi	Feb-90	46,50	5,90	-	-	-	-18	-	-	-	20	2,05	40	1,48	-		-
Sembilang	Aug-94	36,00	-	-	0,30	35,58	42	-	39	47	50	13,54	60	8,15	-		-
Seme	Sep-90	22,75	1,70	-	0,40	3,46	-40	-21	13	22	20	147,39	30	83,83	-		-
Senipah Condensate	Aug-01	52,40	-	-	3,55	1,01	-63	-	-52	-38	20	0,91	40	0,73	<1		-
Seria Light	Sep-02	36,36	4,30	-	1,45	6,00	9	13	17	19	20	2,70	40	1,80	-		-
Sharjah Condensate	Jan-93	64,00	-	-	5,50	-	-40	-	-26	-	20	3,37	50	1,84	-		-
Shell Delta	Jun-00	36,60	-	-	1,35	3,96	-24	-	1	8	20	6,67	40	3,88	-		-
Shengli	Jan-91	24,75	6,00	-	0,29	13,21	21	30	32	37	20	937,50	50	50,30	-		-
Shukheir Gamma	Oct-91	41,50	-	-	2,15	-	0	-	-	-	20	4,30	-	-	-		-
Siberian Light	Sep-95	35,58	6,00	-	1,35	5,56	-6	0	16	25	20	8,78	40	5,00	-	**X**	-
Siri (North Sea)	Mar-00	37,30	4,44	-	2,55	8,29	3	6	23	34	30	5,55	50	3,51	1		-
Sirri (Iran)	Oct-99	32,10	-	-	1,50	6,18	-12	-	17	19	20	11,15	40	5,88	<1		-
Sirtica Blend	Sep-94	40,25	7,40	-	1,67	7,31	-6	3	22	26	20	5,66	30	4,38	1 - 33	**X**	0,15
Skua	Apr-93	42,00	5,50	-	1,70	10,76	9	13	20	26	20	3,42	40	2,14	-		-
Sleipner Condensate	Feb-03	59,80	4,82	8,70	5,43	<3	<-54	-26	-19	-6	20	0,75	50	0,57	-		-
Soroosh	Jan-03	20,0	-	-	0,96	7,5	-27	-	41	-	40	157	-	-	-		-
Souedie	Oct-03	24,5	5,80	6,50	1,44	4,00	-42	-24	21	-	20	77,50	30	47,80	>32	**X**	0,15
South Arne	Oct-00	37,71	-	-	2,65	7,08	0	-	21	24	20	7,47	40	4,23	<1		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Sarir	32	40	40	A8/A7	B7	
Schiehallion	-	25	25	A7	B7	This crude may be subject to wax laydown in cold conditions or on long voyages. Heating to 30°C may be required. COW may need to be increased.
Sedgewick	-	-	-	-	-	More information required.
Sedigi	-	-	-	-	-	More information required.
Sembilang	-	57	57	A5	B5	
Seme	No Heat	No Heat	No Heat	A1	B1	
Senipah Condensate	No Heat	No Heat	No Heat	-	-	Washing with this grade may cause unacceptably high tank pressures.
Seria Light	-	25	25	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Sharjah Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Shell Delta	No Heat	No Heat	No Heat	A1	B1	
Shengli	38	45	45	A5	B5	
Shukheir Gamma	-	-	-	-	-	More information required.
Siberian Light	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Siri (North Sea)	No Heat	No Heat	No Heat	A2	B2	This crude oil may be subject to wax laydown in cold conditions.
Sirri (Iran)	No Heat	No Heat	No Heat	A2	B2	
Sirtica Blend	No Heat	No Heat	No Heat	A7/A2	B2	This crude may be subject to wax laydown in cold conditions. Slop tanks should be heated to 25°C if necessary and used for COW.
Skua	No Heat	25	25	A3/A2	B3/B2	This crude may be subject to wax laydown in cold conditions. Slop tanks should be heated to 25°C if necessary and used for COW.
Sleipner Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Soroosh	No Heat	No Heat	-	A4/A3	B3/B2	
Souedie	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Slop tanks should be heated to 25°C if necessary and used for COW.
South Arne	No Heat	No Heat	No Heat	A2	B2	This crude oil may be subject to wax laydown in cold conditions.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
South Pars Condensate	Jun-02	56,6	-	-	-	-	-36	-	-	-	-	-	-	-	-		-
Soyo	Jul-96	38,70	5,90	-	1,50	13,00	15	18	30	35	40	4,53	60	3,02	-	**X**	-
Spilamberto Gasolina	Nov-92	58,10	-	-	0,77	-	0	-	-	-	20	0,74	-	-	-		-
Stag	Feb-99	18,40	-	-	0,00	0,56	-42	-30	-34	5	20	124,00	40	36,90	0,4		-
Statfjord	Apr-02	39,43	4,29	6,60	2,50	7,10	-18	6	20	30	20	5,59	50	3,32	1,5		0,44
Surat	Jan-97	50,15	-	-	1,00	12,39	<-60	12	15	28	20	3,01	40	2,08	-		-
Syrian Light	Dec-01	37,80	3,70	4,27	1,05	8,80	-10	9	24	25	40	4,12	60	2,86	<2	**X**	0,23
Talakanskaya	Jan-03	35,3	-	-	0,99	2,5	-51	-	-3	-	20	15,3	-	-	<2		-
Tantawan	Jun-99	43,00	-	-	1,60	13,99	-12	-	28	36	20	4,53	40	1,88	<0,2		-
Tapis Blend	Jun-98	45,80	4,80	7,10	2,13	16,35	16	-	25	33	20	3,18	40	2,39	0,0		-
Tazerka	Dec-95	32,05	4,30	-	0,50	3,37	-18	-12	12	20	20	13,60	40	7,52	-		-
Tchatamba	Jan-01	43,96	-	-	3,50	7,50	-6	9	21	25	30	2,50	50	1,93	<1		-
Tempa Rossa	Jul-01	21,60	-	-	1,10	4,45	-36	-	16	36	30	44,85	50	23,45	-		-
Tempa Rossa 2																	
Tengiz	Apr-97	46,60	-	-	3,00	5,63	-21	-	18	20	20	2,21	40	1,50	75,0	**X**	-
Terengganu	Oct-94	47,40	-	-	2,25	14,42	12	-	26	30	30	2,19	50	1,56	-		-
Terengganu Condensate	Jun-96	74,50	11,90	-	5,40	-	-54	-	-35	-	20	0,75	40	0,50	-		-
Terra Nova	Feb-02	32,58	2,20	4,30	0,60	9,00	-9	4	27	30	20	19,84	40	9,01	<2		-
Thammama 'F' Condensate	May-90	51,70	-	-	1,95	1,23	-21	-	-1	4	20	1,36	30	1,19	-		-
Thevenard	Nov-01	39,20	1,20	-	1,05	1,27	-63	-48	-16	-3	20	3,00	40	2,07	<2		-
Tia Juana Light	Sep-94	31,95	3,40	5,00	0,99	3,64	-42	-24	3	6	20	23,80	30	16,40	-		0,23
Tia Juana Pesado	Apr-01	11,20	0,40	-	0,00	-	-3	7	38	-	40	3080,00	60	707,00	-		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
South Pars Condensate	-	-	-	-	-	More information required.
Soyo	-	35	35	A8	B8/B7	
Spilamberto Gasolina	-	-	-	-	-	More information required.
Stag	No Heat	No Heat	No Heat	A1	B1	
Statfjord	No Heat	No Heat	No Heat	A1	B1	COW with this crude may result in high tank pressures.
Surat	No Heat	No Heat	No Heat	A2	B2	Prior to COW if no residues are detected COW should be minimised to prevent losses through vapour emissions.
Syrian Light	-	30	30	A8/A7	B8/B7	This crude is affected by ambient conditions, especially sea temperature. Heating during winter months may need to be increased. See comments 'Annex C'.
Talakanskaya	No Heat	No Heat	No Heat	A1	B1	
Tantawan	35	35	35	A4	B4	
Tapis Blend	-	30	30	A5	B5	This crude may be subject to wax laydown in cold conditions. Heating to 30°C may be required.
Tazerka	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Tchatamba	No Heat	No Heat	No Heat	A2/A1	B1	Washing with this grade may cause unacceptably high tank pressures. Wax laydown may occur in cold conditions.
Tempa Rossa	No Heat	No Heat	No Heat	A2	B2	
Tempa Rossa 2						See Tempa Rossa.
Tengiz	No Heat	No Heat	No Heat	A1	B1	COW with this crude may result in high tank pressures.
Terengganu	-	25	25	A2	B2	Excessive heating and COW with this crude may result in high tank pressures and losses. More information required.
Terengganu Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Terra Nova	25	25	25	A3	B2	
Thammama 'F' Condensate	No Heat	No Heat	No Heat	None	-	COW with this crude may result in high tank pressures.
Thevenard	No Heat	No Heat	No Heat	A1	B1	
Tia Juana Light	No Heat	No Heat	No Heat	A1	B1	
Tia Juana Pesado	57	60	60	A5	B5	

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Tierra Del Fuego	Mar-00	43,20	5,60	-	1,95	6,64	-20	-6	19	23	20	3,91	40	2,46	<1		-
Tona	Apr-93	29,39	-	-	0,32	-	-9	-	-	-	20	9,21	-	-	-		-
Topacio	Jun-03	26,20	-	-	0,84	-	-37	-	-	-	20	27,53	40	12,83	-		-
Triton	Aug-00	39,30	6,60	-	2,10	8,66	-6	-	22	26	30	4,60	50	3,05	<1		-
Troll	Feb-02	27,10	-	-	0,40	2,22	-48	-33	-2	3	20	24,00	40	11,37	<1		-
Turkish Indigenous	Jul-98	29,25	1,10	-	0,30	4,10	-18	-15	14	15	20	13,68	40	7,49	-		-
Udang	Mar-94	38,05	-	-	0,15	34,00	35	39	41	46	60	6,55	80	4,34	-		-
Ukpokiti	Feb-01	41,70	5,50	-	1,40	11,35	12	16	26	-	30	2,74	50	1,92	<1		-
Umm Shaif	Jan-00	37,20	4,80	7,00	1,40	6,07	-30	-9	18	-	20	5,96	40	3,54	31	**X**	-
Urals (Baltic)	May-01	32,20	-	-	1,55	4,26	-18	-	12	15	20	12,10	40	6,60	2,00	**X**	0,06
Urals (Black Sea)	Mar-01	32,50	-	-	1,40	7,42	-9	-	21	-	30	10,11	50	5,97	2,00	**X**	0,06
Urals Heavy (2)	Mar-93	27,99	5,12	-	1,29	3,98	-24	-15	17	23	20	26,65	40	13,43	-		0,06
Val d'Agri	May-03	39,0	-	-	3,74	5,0	-39	-	14	-	20	3,73	-	-	<5	**X**	-
Varandey	Jun-01	25,50	-	-	0,95	2,34	-57	-	1	7	20	26,90	40	13,04	9,00	**X**	-
Varanus	Apr-02	47,30	-	-	2,60	4,71	-24	-	7	11	20	1,79	40	1,33	<2		-
Varg	Aug-01	36,31	2,55	-	1,25	9,23	12	-	25	26	30	5,67	50	3,54	<1		-
Vasconia	Jan-03	24,9	-	-	0,45	7,0	-6	-	30	-	30	38,9	-	-	<2		-
Vega	Jun-95	18,30	-	-	0,14	-	-9	-6	70	-	20	8371,00	-	-	-		-
Villa Fortuna	Mar-96	43,20	-	-	2,70	5,88	-36	-	1	16	30	3,27	50	2,30	-		-
Vityaz	Jul-02	34,40	-	-	-	-	-54	-	-	-	-	-	-	-	-		-
Wabasca	Oct-99	20,00	-	-	0,65	2,54	-54	-	-7	25	30	120,50	50	46,15	-		-
Wafra Ratawi																	
Walio	Nov-98	36,30	2,50	3,00	0,55	10,04	-23	7	27	28	20	7,37	40	3,64	<1		-

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Tierra Del Fuego	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Tona	-	-	-	-	-	More information required.
Topacio	-	-	-	-	-	More information required.
Triton	No Heat	No Heat	No Heat	A3	B3	This crude oil may be subject to wax laydown in cold conditions.
Troll	No Heat	No Heat	No Heat	A1	B1	
Turkish Indigenous	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 20°C may be required.
Udang	-	55	55	A5	B5	
Ukpokiti	30	30	30	A8	B8/B7	
Umm Shaif	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Urals (Baltic)	No Heat	No Heat	No Heat	A2/A1	B1	May be called Russian Export Blend. See comments 'Annex A'.
Urals (Black Sea)	No Heat	No Heat	No Heat	A2/A1	B2	May be called Russian Export Blend. This crude oil may be subject to wax laydown in cold conditions. See comments 'Annex A'.
Urals Heavy (2)	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Val d'Agri	No Heat	No Heat	No Heat	A2/A1	B1	
Varandey	No Heat	No Heat	No Heat	A1	B1	
Varanus	No Heat	No Heat	No Heat	A2/A1	B1	More information required.
Varg	25	25	25	A4	B4	
Vasconia	No Heat	No Heat	No Heat	A4/A2	B2	
Vega	-	57	57	A5	B5	
Villa Fortuna	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude oil may be subject to wax laydown in cold conditions.
Vityaz	-	-	-	-	-	More information required.
Wabasca	No Heat	No Heat	No Heat	A3	B2	
Wafra Ratawi						See Ratawi.
Walio	No Heat	No Heat	No Heat	A2	B2	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Wandoo	Aug-97	19,40	-	-	0,00	1,00	-42	-33	-52	-7	20	171,00	40	48,60	-		-
West Desert	Aug-03	41,0	-	-	2,55	13,5	-3	-	33	-	20	4,65	-	-	<5		-
West Texas Intermediate	Jan-02	39,80	7,80	-	0,95	4,74	-36	-18	14	19	20	4,92	40	3,08	5,3		-
West Texas Sour	Oct-86	32,30	5,60	-	1,03	-	-27	-12	17	-	-	-	-	-	-		-
Wet Yombo																	
Widuri	May-92	32,80	-	-	0,05	44,91	43	46	48	63	50	24,61	60	16,41	-		-
Woollybutt	Jun-03	48,60	2,30	-	0,24	-	-43	-	-	-	20	1,71	40	1,25	-		-
Wytch Farm	Jul-01	41,20	4,60	9,20	2,00	6,21	-15	-	18	24	30	4,54	50	3,11	<1		-
Xi Xiang	Oct-97	32,20	-	-	0,00	21,26	36	-	42	45	40	22,50	60	9,51	-		-
Yanga	Apr-89	29,20	-	-	0,59	-	-6	-	-	-	20	68,94	-	-	-		-
Yizheng	Jan-85	28,45	-	-	0,40	17,13	30	33	41	44	40	45,10	60	18,80	-		-
Yme	May-97	38,00	-	-	2,25	7,24	9	-	24	27	20	6,29	40	3,66	-		-
Yombo	Sep-99	17,70	1,80	-	0,25	7,11	-9	-	15	28	40	817,00	60	224,00	-		-
Zaafarana	Jun-95	23,10	-	-	0,75	6,34	6	-	30	34	40	41,00	60	19,84	-		-
Zafiro	Jun-03	31,90	5,50	-	1,39	2,63	-48	-9	10	20	20	10,77	40	5,94	<2		-
Zagorskoye	Jun-02	41,2	-	-	-	-	-18	-	-	-	-	-	-	-	-		-
Zaire Export																	
Zakinskaya	Feb-02	46,8	-	-	-	-	-15	-	-	-	-	-	-	-	-		-
Zakum (Lower)	Nov-00	39,80	4,80	6,90	1,85	6,50	-18	-9	17	19	20	4,40	40	2,79	2	**X**	-
Zakum (Upper)	May-96	33,70	6,20	7,90	1,90	4,58	-51	-24	3	20	30	8,09	40	6,30	3 - 5		-
Zarzaitine	Aug-03	43,20	6,70	8,40	2,22	2,00	-21	0	17	22	20	4,69	30	3,70	1 - 8	**X**	0,23

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Wandoo	No Heat	No Heat	25	A1	B1	The wax content is so low, washing is unnecessary.
West Desert	25	25	25	A7	B4/B3	
West Texas Intermediate	No Heat	No Heat	No Heat	A1	B1	
West Texas Sour	-	No Heat	No Heat	-	-	More information required.
Wet Yombo						See Yombo.
Widuri	-	60	60	A5	B5	
Woollybutt	-	-	-	-	-	More information required.
Wytch Farm	No Heat	No Heat	No Heat	A2/A1	B2/B1	
Xi Xiang	-	50	50	A8	B8/B7	Treat as Fuel Oil. Washing may be possible at high temperature. More information required.
Yanga	-	-	-	-	-	More information required.
Yizheng	-	45	45	A3	B3	
Yme	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 30°C may be required.
Yombo	-	60	60	A5	B5	
Zaafarana	-	30	30	A8	B7	
Zafiro	No Heat	No Heat	No Heat	A2/A1	B1	
Zagorskoye	No Heat	No Heat	-	A2/A1	B2/B1	More information required.
Zaire Export						See Congo Composite.
Zakinskaya	-	-	-	-	-	More information required.
Zakum (Lower)	No Heat	No Heat	No Heat	A2/A1	B2/B1	This crude may be subject to wax laydown in cold conditions. Heating to 25°C may be required.
Zakum (Upper)	No Heat	No Heat	No Heat	A1	B1	
Zarzaitine	No Heat	No Heat	No Heat	A2/A1	B1	This crude may be subject to wax laydown in cold conditions. Heating to 25°C and bottom washing may be required. However, there will be an associated loss of light ends from the cargo.

CRUDE TYPE	UPDATED	API GRAVITY (Typical)	VAPOUR PRESSURE (psig) (Range)		GAS<C4 (% m/m)	TOTAL WAX (% m/m)	POUR POINT (°C) (Range)		CLOUD POINT(Calc) (°C) (Range)		VISCOSITY mm^2/s				H_2S Oil Phase (ppm) (Typical)	H_2S Vapour Phase Confirmed	Benzene (% m/m)
											T_1	V_1	T_2	V_2			
Zeit Bay	Dec-94	35,30	1,60	6,54	2,48	5,06	-9	3	21	38	20	8,17	50	3,52	-		-
Zuata Medium	Jun-03	28,5	-	-	1,28	0,5	-60	-	-4	-	20	15,7	-	-	<2		-
Zueitina	Mar-96	39,00	4,80	5,00	0,80	8,60	0	6	28	32	20	8,81	30	6,01	0,1	**X**	0,12

CRUDE TYPE	MINIMUM TEMPERATURE REQUIRED (°C)			COW CODES REQ		REMARKS
	LOAD	CARRIAGE	DISCHARGE	(COWT) AW/AS	(SBT) BW/BS	
Zeit Bay	No Heat	No Heat	No Heat	A1	B1	This crude may be subject to wax laydown in cold conditions. Heating to 25°C and bottom washing may be required. However, there will be an associated loss of light ends from the cargo.
Zuata Medium	No Heat	No Heat	No Heat	A1	B1	
Zueitina	No Heat	No Heat	No Heat	A3/A2	B3/B2	This crude may be subject to wax laydown in cold conditions. Heating to 30°C and full cycle washing may be required.