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February 12, 1993

To Members: General Committee on Exploration and Production
 General Committee on Marketing
 General Committee on Pipelines
 General Committee on Refining
 Committee on Petroleum Measurement

The Ad Hoc Task Force on Crude Oil Quality has completed the preparation of a report on "Protecting Crude Petroleum Quality". A copy of this report is enclosed.

This report provides information about ways to maintain the quality of crude petroleum from the wellhead to the refinery. The report is not a standard but is being published to aid members of the petroleum industry in protecting the quality of common stream crude petroleum from contamination by foreign substances or crude petroleum of unspecified makeup.

The report includes a suggested procedure to encourage communication between the common carrier pipeline operator and the common stream shippers.

Additional copies of this report can be obtained on a cost of reproduction basis from:

American Petroleum Institute
1220 L Street, N.W.
Washington, D.C. 20005
Attn: Pipeline Office

Sincerely,

A handwritten signature in black ink, appearing to read 'C. J. Krambuhl', written over a horizontal line.

cc: Ad Hoc Crude Oil Quality Task Force

Enclosure

PROTECTING CRUDE PETROLEUM QUALITY

A report of the API Ad Hoc Crude Oil Quality Task Force

February 1993

**American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005**



PROTECTING CRUDE PETROLEUM QUALITY

Foreword

This report is the result of work by the API Ad Hoc Crude Oil Quality Task Force under the auspices of the API Transportation and Measurement Coordination Departments. The Task Force was composed of representatives of the production, refining, supply and transportation and measurement functions of the industry.

The contents of this report are for the purposes of study and discussion and do not necessarily represent the views of the Institute or its members.

Comments on this report and the subject it covers should be directed to:

Pipeline Coordinator
Manufacturing, Distribution and Marketing Department
American Petroleum Institute
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PROTECTING CRUDE PETROLEUM QUALITY

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GENERAL DISCUSSION

This report provides information about ways to maintain the quality of crude petroleum from the wellhead to the refinery. The report is not a standard but is being published to aid members of the petroleum industry in protecting the quality of common stream crude petroleum from contamination by foreign substances or crude petroleum of unspecified makeup.

The report is based upon four principles:

1. The integrity of the refining characteristics of crude petroleum streams is the responsibility of all parties involved with crude petroleum -- producers, shippers, buyers, sellers, transporters and refiners.
2. All parties must communicate closely to help ensure crude petroleum quality.
3. The involved parties should work together to develop programs for documenting contamination experiences, testing crude quality, and educating members of the petroleum industry.
4. That effective communication requires a common understanding of the petroleum substances which may be included in a common stream. Such substances usually include crude oil, condensate, natural gasoline, or synthetic crude oil. Other petroleum substances, such as natural gas liquids and unfinished refinery products, are sometimes included in common streams.

The API Task Force recognizes the refining characteristics of crude petroleum can be affected as the material moves across the producing, transportation and refining sectors of the oil industry. Such changes in the quality of crude petroleum can have environmental, safety, operating and economic implications for each sector.

To minimize the impact of negative changes, the Task Force supports the following statement with regard to the protection of the quality of common or segregated crude petroleum streams:

Maintaining the integrity of the refining characteristics of crude petroleum streams should be the responsibility of all parties involved with crude petroleum from the location where it is produced to the location where it is refined.

Close communication is one of the most critical factors in protecting the quality of crude petroleum between the wellhead and the refinery. Producers, shippers, buyers, sellers, transporters, and refiners should interact to ensure that each party is aware of the refining characteristics of specific crude petroleum, and the environmental, safety, health, and economic impacts of compromising those qualities.

The task force encourages cooperative efforts, especially within each transportation system, to develop programs for documenting contamination experiences, crude quality testing, and education to increase awareness. The task force encourages the General Committees on Refining and Pipelines to undertake to develop a resource base that may help to implement such programs. These efforts should recognize the possibility that crude petroleum can be contaminated by highly toxic or corrosive materials through unauthorized dumping into transportation systems.

This report is intended to encourage the recycling of materials in an acceptable and responsible manner and in no way seeks to discourage the recycling of materials in accordance with applicable regulations such as the Resource Conservation and Recovery Act [RCRA].

**TERMS USED IN THIS REPORT TO FACILITATE
COMMUNICATIONS REQUIRED
IN HANDLING AND TRANSPORTING CRUDE PETROLEUM FROM
THE WELLHEAD TO THE REFINERY ***

COMMON STREAM

Crude petroleum moved through any common carrier facility, which is commingled or intermixed with other crude petroleum of like quality and characteristics.

A common stream may be made up of one or more crude petroleum components with quality specifications, as determined by the carrier in consultation with its common stream shippers.

CONDENSATE

A liquid hydrocarbon recovered from gas well gas (either associated or not associated with crude oil production) in lease separators or natural gas field facilities, without the use of refrigeration or expansion process.

Condensate is referred to as "lease condensate" or "plant condensate," depending on where it is recovered.

Condensate may include "drip gasoline" (condensation which drops out at atmospheric temperature) that is recovered between the gas wellhead and the inlet scrubber of gas processing or gas recycling plants.

Condensate is expected to consist primarily of pentanes and heavier hydrocarbons which have been stabilized to not exceed the maximum common carrier Reid Vapor Pressure (RVP). The gravity is generally not expected to exceed 60 degrees API.

CONTAMINANT

Any foreign substance or chemical not normally associated with the production of petroleum hydrocarbons, which is artificially introduced into crude petroleum and may have a harmful effect on refinery process safety, or the environment.

Contaminants include, but are not limited to, materials designated as hazardous waste (as defined by the U. S. Environmental Protection Agency (EPA), waste chemical products, materials containing organic chlorides (halogenated hydrocarbons), solvents, and lead compounds.

CRUDE PETROLEUM

Includes: crude oil, condensate, natural gasoline, and synthetic crude oil.

Crude petroleum streams sometimes include other hydrocarbons as determined by the carrier in consultation with the affected shippers.

CRUDE OIL

A mixture of hydrocarbons that existed in liquid phase in underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities.

Crude oil is commonly referred to as "virgin crude oil."

NATURAL GAS LIQUIDS

Hydrocarbons recovered in natural gas processing or gas recycling plants or refineries, consisting of ethane, propane, isobutane, normal butane and natural gasoline, which may be partially or fully fractionated products.

This product, which is commonly referred to as "NGLs," or "mixed NGLs", or "indirect liquids," has a composition that can vary significantly within a specific gas plant and between different gas plants, depending on the mix ratio of the components. The ethane, propane, and butane components are, of course, distinct and well-defined hydrocarbon compounds and vary little within a specific gas plant or between gas plants except as to amounts of compounds such as sulfur.

NATURAL GASOLINE

Liquid product separated from natural gas in a processing plant or gas recycling plant and expected to consist primarily of pentanes and heavier hydrocarbons which have been stabilized to not exceed the carrier RVP requirements. The gravity is generally not expected to exceed 75 degrees API. This product is sometimes referred to as "indirect

liquids." A mixture of natural gasoline and butanes that exceeds the RVP specifications is sometimes called "B/G mix."

QUALITY BANK

A system of credits and debits to adjust for market value differences in crude petroleum as measured by changes in certain specified crude petroleum characteristics (gravity, sulfur, vapor pressure, etc.), resulting from the intermixing of crude petroleum as it is received and transported through a common carrier pipeline in the same common stream.

**RECLAIMED
PETROLEUM**

Crude petroleum recovered from tank bottoms, or scraper traps, by mechanical, thermal or chemical process acceptable to the refinery process.

SEGREGATED STREAM

Any material moved through a common carrier pipeline that is not commingled or intermixed with any other stream.

The quality and characteristics of the material should be determined by the common carrier in consultation with the shipper or shippers.

SOUR CRUDE

Crude petroleum containing greater than 0.50 percent (by weight) total sulfur at the wellhead.

SWEET CRUDE

Crude petroleum containing 0.50 percent (by weight) or less total sulfur at the wellhead.

SYNTHETIC CRUDE OIL

A hydrocarbon liquid generally possessing the properties of naturally produced crude oil, which is derived or produced by chemical or physical transformation of oil shale, coal or oil sands.

TANK BOTTOMS

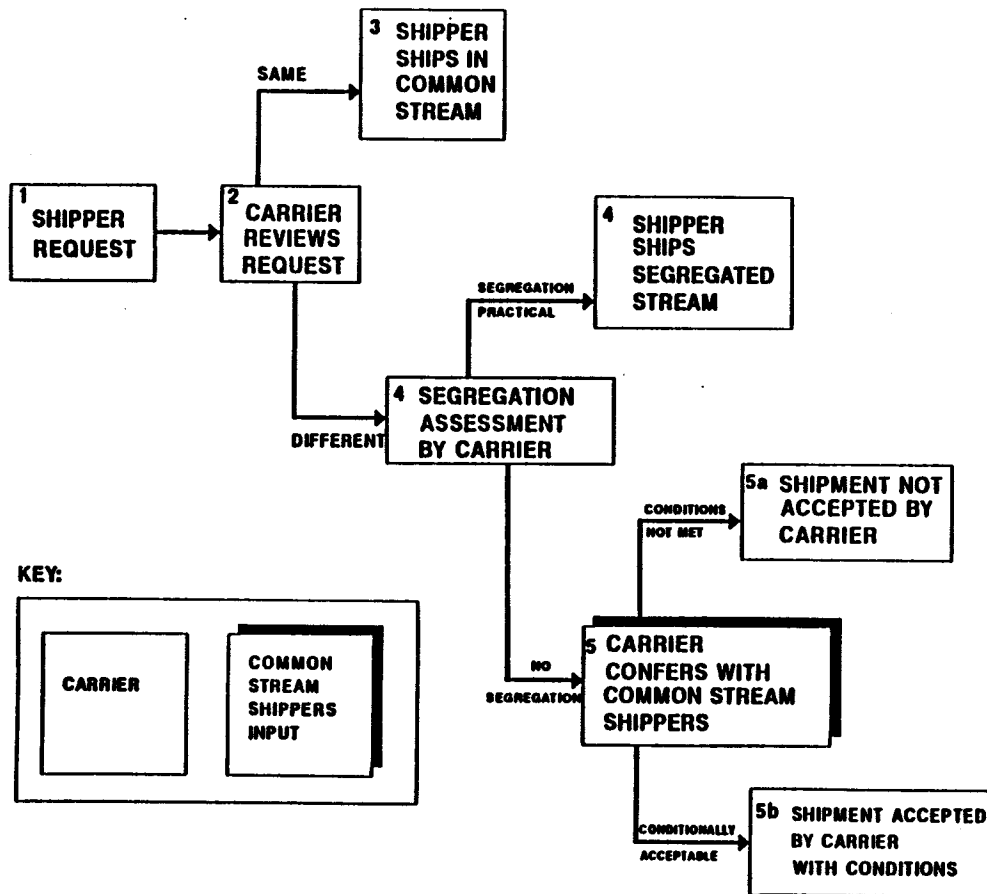
A mixture of crude petroleum/water emulsion, suspended and precipitated solids, and water, which accumulate at the bottom of a tank.

* These definitions are of terms used in the report and are provided for the purpose of facilitating communication among users of the report. Specific terms and definitions used in any particular business agreement are reserved entirely to the discretion of the parties concluding such business agreements.

SUGGESTED PROCEDURE TO ENCOURAGE COMMUNICATION BETWEEN THE COMMON CARRIER PIPELINE OPERATOR & THE COMMON STREAM SHIPPERS WHEN THE CARRIER RECEIVED A REQUEST TO INCLUDE A NEW CRUDE PETROLEUM IN THE COMMON STREAM.

SUGGESTED PROCEDURE STEPS:

1. Shipper notifies common carrier of **Crude Petroleum** he wishes to ship in the **Common Stream**, provides assay data and/or field sources, and indicates whether the **Crude Petroleum** is essentially the same as the **Common Stream** or different.
2. Carrier reviews data and confirms whether the **Crude Petroleum** meets the common stream requirements.
3. If the carrier determines the new **Crude Petroleum** is essentially the same as the **Common Stream** when compared by assay data and/or field source of production, carrier accepts the **Crude Petroleum** in to the **Common Stream**.
4. If the new **Crude Petroleum** is different, carrier in consultation with shipper, considers shipping segregated. If segregated shipment is practical, shipper ships the new stream segregated.
5. If segregation is not selected and shipping in the **Common Stream** is a possible option, carrier confers with all the **Common Stream** shippers and considers their input for final decision as to whether or not to include the new **Crude Petroleum** in the **Common Stream**.
 - 5a. A **Common Stream** shipper may advise that the new **Crude Petroleum** is significantly different and recommend that the **Crude Petroleum** not be included in the **Common Stream**. For instance, in a case where the proposed new **Crude Petroleum** included a stream of natural gasoline and natural gas liquids and the **Common Stream** contained only crude oil and condensate, some **Common Stream** Shippers may find the new stream unacceptable while others may support it being included in the **Common Stream**.
 - 5b. Or, a **Common Stream** shipper may recommend that the **Crude Petroleum** may be included in the **Common Stream** provided various conditions are met. For instance, a proposed new **Crude Petroleum** containing synthetic crude might be allowed in a **Common Stream** as long as gravity and sulfur specifications were not exceeded.



For example: 1) institution of a Quality Bank, or 2) exception to specific **Common Stream** specifications if, for instance, only a small volume is involved or 3) adjustment to **Common Stream** specifications are practical.

CRUDE PETROLEUM QUALITY TESTING PROCEDURES

I. SUMMARY

The API Task Force on Crude Oil Quality surveyed the testing and monitoring procedures that companies are using to determine crude Petroleum quality. The survey covered test methods, test locations and sampling procedures.

II. SURVEY OF TEST METHODS AND PROCEDURES

A survey was generated by requesting participants at the September 19, 1990 task force meeting to list their crude petroleum testing and monitoring procedures. The task force summarized these test methods and procedures and distributed them at the November 14, 1990 task force meeting.

III. TEST METHODS

Test methods reported in the survey included procedures for testing most of the crude petroleum components and properties listed by the task force. Additional test methods were provided by task force members after subsequent discussions. For example, these methods may be applied throughout the transportation system and are used to determine whether the transporter or refiner are dealing with sweet or sour crude petroleum. Likewise tests can be employed to determine the presence in a crude petroleum stream of tank bottoms or reclaimed petroleum. A compilation of test methods for potential crude petroleum components and properties is given in the Table.

IV. TEST LOCATIONS

Testing for crude petroleum components can be done in the field, remotely at testing laboratories, in refinery laboratories, and in centralized research laboratories close to several participants. The survey indicated that most testing is performed at refinery locations. Testing at refineries, of course, is necessary to determine appropriate processing strategies.

Testing at pipeline locations has been performed in the field and at remote laboratories. Field tests have been limited to S&W, gravity, sulfur, RVP, and organochlorine compounds (ARCO Test Kit). The results of pipeline testing often determine the classification of crude petroleum in quality banks. Several refiners have set up remote laboratories at pipeline facilities. The costs for these laboratories are shared among

the refiners receiving crude oil from the pipeline system. Remote testing facilities were established to provide an early warning system for crude petroleum contaminants and quality. Based upon information from test results, shipments can be refused, or refineries alerted so that special handling procedures can be developed before receipt of the suspect crude petroleum. In addition, the source of contamination may also be determined. The proximity of the analysis with respect to location and time allows testers to obtain and analyze composite samples from each pipeline entry point, in this way tracking the contamination to its origin.

Tests for organochlorine compounds, gravity, sulfur, RVP, S&W, salinity and water uptake (to indicate the presence of sulfonates) are currently performed at remote testing laboratories. Any of the tests listed in the Table could be conducted at these remote laboratories.

V. SAMPLING

Sampling protocol is an integral part of proper testing procedures. Sampling protocols include sampling procedures used to obtain a representative sample and sampling strategies pertaining to sampling frequency and location. Two ASTM and API standard procedures have been developed to obtain a representative sample of crude petroleum:

ASTM D4057 Manual Sampling of Petroleum and Petroleum Products (API Manual of Petroleum Measurement Standards, Chapter 8.1).

ASTM D4177 Automatic Sampling of Petroleum and Petroleum Products (API Manual of Petroleum Measurement Standards, Chapter 8.2).

Although sampling procedures have been standardized as noted above, sampling strategies vary among companies and locations. One remote pipeline laboratory, for example, collects three samples from each crude petroleum batch:

1) a grab sample from the first 100 barrels, 2) a grab sample half-way through the batch; and 3) a composite sample representing the entire batch.

Each of these samples is then tested for organochlorine compounds.

TABLE
TESTS FOR POTENTIAL COMPONENTS OR PROPERTIES
OF CRUDE PETROLEUM STREAMS

<p>Gravity</p>	<p>ASTM D287 API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method) (API Standard 2544)</p> <p>ASTM D1298 Density, Relative Density (Specific Gravity) or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method (API Manual of Petroleum Measurement Standards, Ch. 9.1)</p> <p>ASTM D4052 Density and Relative Density of Liquids by Digital Density Meter.</p>
<p>Hydrocarbon Distribution</p>	<p>ASTM D86 Distillation of Petroleum Products</p> <p>ASTM D2892 Distillation of Crude Petroleum (15 Theoretical Plate Column)</p> <p>Gas Chromatography: Simulated Distillation</p> <p>Gas Chromatography: Light Ends Analysis</p>
<p>Organochlorine Compounds</p> <p> Halogenated Hydrocarbons, Solvents, PCBs, Degreasing Agents</p>	<p>ASTM D4929 Determination of Organic Chloride Content in Crude Oil</p> <p>EPA Method 8080 Organochlorine Pesticides and PCBs.</p> <p>Gas Chromatography with either a Hall or an electron capture detector.</p>
<p>Metals</p> <p> Iron, Nickel, Vanadium, Arsenic, Mercury, Sodium, Barium, Calcium, Lead, Lithium, Magnesium, Molybdenum, Phosphorus, Zinc</p>	<p>Atomic Absorption spectroscopy</p> <p>EPA Method 3040</p> <p>Inductively Coupled Plasma - Atomic Emission spectroscopy</p> <p>Wavelength Dispersive X-Ray Fluorescence</p>
<p>Neutralization Number</p>	<p>ASTM D664 Acid Number of Petroleum Products by Potentiometric Titration</p>

TABLE (Continued)
TESTS FOR POTENTIAL COMPONENTS OR PROPERTIES
OF CRUDE PETROLEUM STREAMS

Salt	ASTM D3230 Salts in Crude Oil (Electrometric Method)
Sediment and/or Water	<p>ASTM D96 Sediment and Water in Crude Oils by Centrifuge Method (API Manual of Petroleum Measurement Standards Ch. 10.4)</p> <p>ASTM D473 Sediment in Crude Oils and Fuel Oils by Extraction Method (API Manual of Petroleum Measurement Standards Ch. 10.1)</p> <p>ASTM D4006 Water in Crude Oil by Distillation (API Manual of Petroleum Measurement Standards Ch. 10.2)</p> <p>ASTM D4007 Water and Sediment in Crude Oils by the Centrifuge Method (Laboratory Method) (API Manual of Petroleum Measurement Standards Ch. 10.3)</p> <p>ASTM D4928 Water in Crude Oils by Karl Fischer Titration, (API Manual of Petroleum Measurement Standards Ch. 10.8)</p>
Sulfur	<p>ASTM D129 Sulfur in Petroleum Products (General Bomb Method)</p> <p>ASTM D1552 Sulfur in Petroleum Products (High Temperature Method)</p> <p>ASTM D2622 Sulfur in Petroleum Products (X-Ray Spectrographic Method)</p> <p>Energy-Dispersive X-ray Fluorescence, with method similar to ASTM D4294.</p>
Surfactants Flow Improvers	<p>Field Desorption - Mass Spectrometry</p> <p>Water Uptake</p>
Vapor Pressure	ASTM D323 Vapor Pressure of Petroleum Products (Reid Method)