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Crude petroleum and liquid petroleum products — Volumetric metering of viscous hydrocarbons

Pétrole brut et produits pétroliers liquides — Mesurage volumétrique des hydrocarbures visqueux

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9200 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Sub-Committee SC 2, *Dynamic petroleum measurement*.

Annex A of this International Standard is for information only.

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Introduction

This International Standard is intended as a guide to the design, installation, operation and proving of meters and their auxiliary equipment used in metering viscous hydrocarbons.

The objective of this International Standard is to stress the differences between metering high viscosity hydrocarbons and the normal application of metering to less viscous hydrocarbon liquids.

Some operations require purging the viscous liquids from the lines to prevent congealing during idle periods or to prevent contamination. If the air or gas used to displace the liquid is pumped through the meter when refilling the lines, the meter may operate at excessively high rates. This can cause damage to the moving parts of the meter and may result in erroneous meter registration. The recommendations in this International Standard should assist in avoiding misoperation, and the recommendations, if followed, should protect the meter from damage and inaccurate measurement due to entrapment of air or gas. Where alternative procedures are given, the recommendations of the meter manufacturer should be followed.

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Crude petroleum and liquid petroleum products — Volumetric metering of viscous hydrocarbons

1 Scope

This International Standard defines viscous hydrocarbons and describes the difficulties that arise when viscous hydrocarbons are raised to high temperatures. The effects of such temperatures upon meters, auxiliary equipment and fittings are discussed, and advice and warnings to overcome or mitigate difficulties are included.

2 Definition

For the purposes of this International Standard, a viscous hydrocarbon is defined as any liquid hydrocarbon that requires special treatment or equipment in its handling or storage because of its resistance to flow.

Examples of liquid hydrocarbons which are generally considered as viscous are residual fuels with a viscosity greater than 750 m^2/s at 50 °C, bitumens (both penetration grades and cutbacks), most lubricating oils and grease components, as well as some crude oils. Note that viscosity is a parameter in its own right, regardless of temperature.

NOTE 1 It is possible that another liquid not needing these precautions might have some of the characteristics or present some of the measurement problems characteristic of viscous hydrocarbons.

3 Description of metering systems

3.1 Selection and installation of meters and auxiliary equipment

3.1.1 General

Care should be taken in the selection and installation of meters and auxiliary equipment. The selection of air removers (eliminators) is of particular importance when used in viscous liquid service and is discussed separately in 3.1.6.

If the meter is to be installed in a vertical line, special consideration should be given to equipment design. Some types of meters are not designed for such an installation, and the performance of these types could be affected.

Because of the various types of meters available and the wide differences in liquids and measurement conditions, it is important that the meter manufacturer be given complete information on the proposed application. The information that should be provided is listed in 3.1.2.

3.1.2 Special meter construction

Many viscous liquids are heated in order to reduce viscosity and facilitate handling. If the viscous liquids are to be heated, certain special details in the meter's construction and manufacture are required. Extra clearance between moving parts may be provided to prevent interference, to reduce the work load required, and to compensate for the higher temperature and altered viscosity. Certain viscous liquids can contain corrosive materials, and this corrosivity can increase as the liquid temperature increases. Where significant, the metallurgy of the meter, its trim and auxiliary equipment shall be capable of resisting this corrosion. At elevated temperatures, special meter construction materials may be required. Where dissimilar metals are used, the high temperature can result in mechanical interference caused by differences in metal expansion. This is particularly true where liners or lining sleeves are used. The use of devices such as ventilated counter extensions may be necessary to separate the counter and the meter adjuster from the heat source.

Meters used in the transfer of liquids at elevated temperatures are often fitted with automatic temperature compensators that automatically adjust the counter registration to 15 °C. These compensators are designed to cover a certain range of operating temperatures. If a registration adjusted to 15 °C is desired, the range of operating temperatures shall be accurately specified, as well as the density of the liq-

uid or its coefficient of expansion. Operating a temperature compensator at temperatures above its design range will result in inaccurate registration and can damage the device. Standby temperature during idle periods can exceed the design temperature rating and result in damage to the automatic temperature compensator or to the moving parts of the meter.

The meter manufacturer can make recommendations specific for the intended operating conditions to minimize possible problems. The manufacturer should be provided with the following information:

— flow rate range at maximum and minimum viscosities;

— maximum and minimum operating pressures;

— maximum and minimum temperatures;

— anticipated standby (or off-duty) temperature;

— viscosity of fluid at maximum and minimum temperatures (pascal-second, centipoise or any other recognized viscosity indication);

— specific gravity of fluid at maximum and minimum temperatures;

— type of proving equipment under consideration;

— nature and amount of any corrosive elements present;

— nature and amount of any abrasive elements present;

— compatibility (or noncompatibility) of construction material with the fluid.

3.1.3 Displacement meters

Displacement meters have performance characteristics on viscous fluids different from inferential and turbine meters. Performance in a displacement meter is affected by meter slippage. Slippage is the unmetered flow passing through the mechanical clearance between the moving parts of the meter, and is caused by the differential pressure across a heated meter resulting from mechanical and fluid friction. The magnitude of the slippage flow, which can be considered to have a laminar flow regime, is related to the meter flow rate, the size of the clearances, the viscosity and the fluid density. There is considerably less slippage through a meter as liquid viscosity increases. When a high degree of accuracy is required, re-proving is suggested with any viscosity change to re-establish accuracy.

Some types of displacement meters can handle any viscous liquid that can be pumped, whereas others may be limited to handling liquids of specified maximum viscosities. All types, however, have their maximum recommended flow rate reduced as the viscosity increases. The amount of flow rate reduction can vary with equipment from different manufacturers. A maximum limit on flow rate at high viscosity is necessary to maintain the meter pressure drop within the design limits, to prevent cavitation and to reduce the viscous shear load on moving parts.

3.1.4 Inferential and turbine-type meters

For turbine meters, changes in liquid viscosity result in a shift in the meter factor and a change in the range of flow rates over which the turbine meter will perform with close accuracy. A change in fluid viscosity requires re-proving of the meter for best accuracy. Turbine meters are available with viscosity-compensating devices or they can be designed to compensate for changes in viscosity, and are capable of operating over an acceptable flow range. In services where the turbine meter will be operating at flow rates which do not vary greatly, acceptable accuracy can be obtained if the meter is proved and if meter factors are established for the various expected viscosities and rates. These factors should be reproducible.

Since the viscosity of a liquid may change considerably with a change in temperature, all meters should be re-proved for changes in temperature as well as changes in viscosity. Re-proving will establish a basis for determining the frequency of proving that may be required to achieve the desired accuracy of measurement. When the temperature of the metered liquid can vary by more than a few degrees during deliveries, a temperature recorder is recommended.

Because of these viscosity factors, inferential and turbine-type meters for use on viscous hydrocarbons can be limited in performance; however, they should not be ruled out.

3.1.5 Heating methods

If it is necessary to heat the liquid for ordinary pumping and handling, the liquid in the meter and the upstream piping should also be kept heated. The principal objective is to reduce the viscosity to a practical flow condition and prevent solidification during idle periods.

Accessory equipment, such as valves, strainers and air eliminators, must be heated and insulated. This applies particularly to air eliminator venting mechanisms and control valve pilots.

For services in which the liquid is heated while in storage, it is sometimes possible to keep the liquid in the line to the meter and the accessories heated by circulating the liquid through a return line. This method is of particular value on tank trucks where auxiliary heating methods are difficult to provide. Some double-case meters can be installed so that the meter housing is part of the circulating system. In this