



PETROINDUSTRIAL
REFINERÍA ESMERALDAS
FILIAL DE PETROECUADOR

Seminario de diseño de Procesos
UOP

Volume N° 1

Subject: General Engineering.

Handout:

- * Project Engineering & Scheduling.
- * Process Engineering.
- * Hydrocarbon Properties.
- * Vapor - Liquid Equilibria.
- * Crude Break-ups.
- * Heat & weight balances.
- * Fractionation: Binary & Multicomponent.

Volume N° 2

Handout:

- * Laboratory analysis.

Subject: Process refining design.

Handout:

- * Crude Unit.
- * Vacuum Unit.
- * Hidrotreating.
- * Asphalt oxidizier.
- * Crude Unit Revamp. (HEN pinch method)

Volume N° 3

Subject: Process equipment.

Handout:

- * Heat exchangers.
- * Separators, drums & receivers.
- * Mesh blankets.
- * Pumps, Turbines, compressors & expanders.

Volume N° 4

Subject: Process equipment.

Handout:

- * Column sizing.
- * Flange rating.
- * Vessel design.

Volume N° 5

Subject: Process equipment.

Handout:

- * Metallurgy & Corrosion.
- * Heaters.
- * Line sizing & Hydraulics.
- * Vacuum ejectors.



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Volume N° 6

Subject: Process equipment.

Handout:

- * Instrumentation.

Volume N° 7

Subject: Utilities & support.

Handout:

- * Off sites: Tankage
Waste disposal.
- * Environmental guidelines.
- * Miscellaneous.

Volume N° 8

Subject: Utilities & support.

Handout:

- * Relief systems & flares.

Volume N° 9

Subject: Economics.

Handout:

- * Cost estimating.
- * Refinery economics: Capital investments.
Linear programming.

Subject: Miscellaneous.

Handout:

- * Additives & inhibitors: Chemical
additives. And Process additives.

Volume N° 10

Subject: Miscellaneous.

Handout:

- * Plot plans.
- * Computer survey.

Volume N° 11

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- * Process charts (for hydrocarbon
properties)

ENGINEERING DESIGN SEMINAR

UOP, INC.

LABORATORY TOUR

SEPTEMBER, 1991

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2892 TBP

ASTM D 56

ASTM D 93

ASTM D 92

4/4

FLASH POINT BY TAG
CLOSED TESTER

FLASH POINT BY
PENSKY-MARTENS
CLOSED TESTER

FLASH AND FIRE POINTS
BY CLEVELAND OPEN CUP

SCOPE:

LOWEST TEMPERATURE AT WHICH VAPOR ABOVE SAMPLE IGNITES

SUSTAINS BURNING FOR 5 SEC

VISCOSITY: BELOW 5.5 cSt

ABOVE 5.5 cSt

NOT SPECIFIED

FLASH POINT: (CLOSED CUP)
BELOW 93°C

(CLOSED CUP)
ABOVE 93°C

(OPEN CUP)
ABOVE 79°C

STIRRED:

No

YES

NO

SURFACE FILM:

No

YES

FOR ASPHALT AND PITCH

SUSPENDED

No

YES

SAMPLES WHICH MAY
CONTAIN LIGHT COMPONENTS
AND CANNOT BE STIRRED

SOLIDS:

ASTM D 56 - CONT'D

FLASH POINT BY TAG
CLOSED TESTER

TIME: 1.0 HR

PRECISION:

DEPENDENT UPON TEMPERATURE
1.1 - 1.7°C

ASTM D 93 - CONT'D

FLASH POINT BY
PENSKY-MARTENS
CLOSED TESTER

0.75 HR

ASTM D 92 - CONT'D

FLASH AND FIRE POINTS
BY CLEVELAND OPEN CUP

1.0 HR

8.0°C

SIGNIFICANCE: ONE FACTOR IN ASSESSING OVERALL FLAMMABILITY
USED FOR SHIPPING AND SAFETY REGULATIONS
MAY INDICATE PRESENCE OF VOLATILE COMPONENTS
IN RELATIVELY NON-VOLATILE MATERIAL

ASTM D 86

7A

DISTILLATION OF PETROLEUM PRODUCTS

MANUAL METHOD

AUTOMATED APPARATUS

SCOPE:

ATMOSPHERIC DISTILLATION AT 25-400°C
GASOLINES, NAPHTHAS, KEROSENES, DIESELS, ETC.

OPERATOR READS TEMPERATURE

TEMPERATURES AND TIMES
AUTOMATICALLY RECORDED
ARCHIVES DATA

0.4 HRS PER ANALYSIS

0.2 HRS PER ANALYSIS

PRECISION:

REPEATABILITY DIFFERS BASED ON SLOPE OF DISTILLATION CURVE
GENERALLY WITHIN 5°C

SIGNIFICANCE: PETROLEUM PRODUCT SPECIFICATIONS GENERALLY INCLUDE DISTILLATION
LIMITS TO ASSURE PRODUCTS OF SUITABLE VOLATILITY PERFORMANCE

✓
ASTM D 97

POUR POINT OF PETROLEUM OILS

SCOPE:

FOR USE ON ANY PETROLEUM OIL

LOWEST TEMPERATURE AT WHICH OIL FLOWS WHEN COOLED

TIME FOR ANALYSIS IS 3-7 HOURS FOR GROUP OF 7 SAMPLES

PRECISION:

REPEATABILITY IS 3°C

SIGNIFICANCE:

INDICATES TEMPERATURE AT WHICH OIL MAY BE PUMPED DURING

PROCESSING

INDICATIVE OF OIL COMPOSITION

4A
ASTM D 189

CONRADSON CARBON RESIDUE
OF PETROLEUM PRODUCTS

ASTM D 4530

MICRO CARBON RESIDUE
OF PETROLEUM PRODUCTS

SCOPE: AMOUNT OF CARBON RESIDUE LEFT AFTER EVAPORATION AND PYROLYSIS
APPLICABLE TO HEAVY CRUDE OILS, RESIDUALS, HEAVY FUEL OILS AND
HEAVY GAS OILS

APPROXIMATELY 1 HR/ANALYSIS

APPROXIMATELY 0.25
HR/ANALYSIS
(ELAPSED TIME IS 2.5 HOURS
FOR SET OF 12)

PRECISION: REPEATABILITY RANGE IS .005-5%
ABSOLUTE AT THE .01-30% LEVEL

REPEATABILITY RANGE IS .01-1%
ABSOLUTE AT THE .01-30%
LEVEL

SIGNIFICANCE: APPROXIMATE TENDENCY OF MATERIALS TO FORM CARBONACEOUS-TYPE
DEPOSITS
GUIDE TO DEPOSITING OF CARBON ON CATALYSTS IN CAT. CRACKERS

ASTM D 1298 AND D 287 ✓

ASTM D 4052

DENSITY, SPECIFIC GRAVITY OR API
GRAVITY OF CRUDE PETROLEUM AND
LIQUID PETROLEUM PRODUCTS BY
HYDROMETER METHOD

* DENSITY AND SPECIFIC GRAVITY
OF LIQUIDS BY DIGITAL DENSITY
METER

SCOPE:

MUST BE LIQUID AT TEST TEMPERATURE
STANDARD TEMPERATURE IS 15°C

TEMPERATURE RANGE IS -18-+90°C
VAPOR PRESSURE BELOW 180 KPA
SEPARATE HYDROMETERS GRADUATED
FOR DENSITY, SP.GR., OR API

TEMPERATURE RANGE IS 15-35°C
VAPOR PRESSURE BELOW 80 KPA
NOT FOR USE WITH DARK SAMPLES
WHICH WOULD MASK AIR BUBBLES
CAN CONVERT TO API GRAVITY
USING CONVERSION TABLES

TIME FOR ANALYSIS 0.18 HR

TIME FOR ANALYSIS IS 0.09 HR

ASTM D 323

VAPOR PRESSURE OF PETROLEUM PRODUCTS (REID METHOD)

- SCOPE: PRESSURE EXERTED BY VAPOR OF A LIQUID WHEN IN EQUILIBRIUM WITH THE LIQUID
RVP USED FOR GASOLINES AND OTHER VOLATILE PETROLEUM PRODUCTS EXCEPT LPG
DIFFERS FROM TRUE VAPOR PRESSURE DUE TO SMALL SAMPLE VAPORIZATION AND PRESENCE OF WATER VAPOR AND AIR IN THE CONFINED SPACE
MUST BE FIRST TEST RUN ON A SAMPLE
TIME FOR ANALYSIS IS 0.5 HR
- PRECISION: REPEATABILITY IS 0.25 TO 0.5 PSI (1.7-3.4 kPa) DEPENDING ON GAGE RANGE
- SIGNIFICANCE: INDICATES PRESENCE OF HIGHLY VOLATILE COMPONENTS
DETERMINES THE VAPOR LOCK AND COLD STARTING CHARACTERISTICS OF GASOLINE
SERVES AS A MEANS OF ESTABLISHING AND MAINTAINING GASOLINE QUALITY

ASTM D 445

ASTM D 88

KINEMATIC VISCOSITY OF TRANSPARENT AND
OPAQUE LIQUIDS

SAYBOLT VISCOSITY

SCOPE:

MEASURED TIME OF FLOW PROPORTIONAL TO VISCOSITY

D 445 IS USED UNLESS SAMPLE IS NOT TRANSPARENT OR OPAQUE

REQUIRES SMALLER SAMPLE SIZE
GREATER ACCURACY

FLOW THROUGH CAPILLARY

TEMPERATURE RANGE 15-100°C

APPROXIMATELY 0.5 HR/ANALYSIS

FLOW THROUGH ORIFICE

TEMPERATURE RANGE 21-99°C

APPROXIMATELY 1 HR/ANALYSIS

PRECISION:

REPEATABILITY OF MEAN IS 1.5%

PRECISION AND ACCURACY

ARE UNDER DEVELOPMENT

SIGNIFICANCE:

SELECTION OF LUBRICATING OILS

PRODUCT SPECIFICATIONS, I.E., PIPELINES, INJECTION
NOZZLES AND ORIFICES

ASTM D 1322

SMOKE POINT OF AVIATION TURBINE FUELS

SCOPE: MAXIMUM HEIGHT OF A SMOKELESS FLAME OF FUEL BURNED
IN A WICK-FED LAMP
ESTIMATED TO THE NEAREST 0.5 MM
TIME FOR ANALYSIS IS 1.0 HRS.

PRECISION: REPEATABILITY IS 2 MM

SIGNIFICANCE: WILL VARY WITH HYDROCARBON COMPOSITION OF THE FUEL
INDICATION OF THE FUEL'S COMBUSTION PERFORMANCE

ASTM D 1740

LUMINOMETER NUMBERS OF AVIATION TURBINE FUELS

SCOPE: MEASURES FLAME RADIATION CHARACTERISTICS
GOOD CORRELATION BETWEEN LUMINOMETER NUMBER AND SMOKE POINT
PLOTS FLAME RADIATION VS. TEMPERATURE RISE ACROSS BURNER AND
COMPARES TO STANDARDS
TIME FOR ANALYSIS IS 1.6 HRS

PRECISION: REPEATABILITY IS 6.1 LUMINOMETER NUMBERS

SIGNIFICANCE: INDICATES RELATIVE RADIATION EMITTED BY COMBUSTION PRODUCTS
HIGH LUMINOMETER NUMBER INDICATES FUEL OF LOW RADIATION
CHARACTERISTICS
CORRELATES FUEL CHARACTERISTICS WITH LIFE OF METAL COMPONENTS
IN GAS TURBINES

UOP 614

HEPTANE-INSOLUBLE MATTER IN PETROLEUM OILS
USING A MEMBRANE FILTER

SCOPE: SAMPLES MUST HAVE ABILITY TO BE COMPLETELY DISPERSED
RANGE IS 0.01-20 MASS-% HEPTANE INSOLUBLES
MAY ALSO BE USED TO DETERMINE TOLUENE-INSOLUBLES
HEPTANE-INSOLUBLES ALSO KNOWN AS ASPHALTENES
ELAPSED TIME IS 8 HOURS, LABOR REQUIREMENT IS 5 HOURS

INTERFERENCE: SOLID PARTICULATE MATTER

PRECISION: ALLOWABLE DIFFERENCE IS 0.06-1.5 MASS-% DEPENDING UPON LEVEL

SIGNIFICANCE: PRESENCE OF C₇ INSOLUBLES INDICATES COKING WILL TAKE PLACE
DURING FURTHER PROCESSING
INDICATES FURTHER PREPARATION (EG. FRACTIONATION) MAY BE
REQUIRED

1P 309

COLD FILTER PLUGGING POINT OF DISTILLATE FUELS

- SCOPE: HIGHEST TEMPERATURE AT WHICH FUEL WILL NOT FLOW THROUGH FILTER
 UNDER PRESCRIBED CONDITIONS
 MAY NOT BE APPLICABLE TO FUELS USED IN EQUIPMENT WITH EXPOSED
 PAPER FILTERS IN FUEL SUPPLY SYSTEM
 TIME FOR ANALYSIS IS 1.0 HRS
- PRECISION: REPEATABILITY IS FROM 1.0 TO 2.5°C DEPENDING ON RANGE
- SIGNIFICANCE: DETERMINES LOW TEMPERATURE OPERABILITY OF DISTILLATE FUELS

ES 15

**EMERGENCY STANDARD METHOD FOR
VAPOR PRESSURE OF PETROLEUM PRODUCTS (MINI METHOD)**

SCOPE:

**DETERMINATION OF TOTAL PRESSURE, EXERTED IN VACUUM, BY AIR-CONTAINING,
VOLATILE, PETROLEUM PRODUCTS**

**COVERS THE USE OF AUTOMATED VAPOR PRESSURE INSTRUMENTS THAT PERFORM
MEASUREMENTS ON LIQUID
SAMPLE SIZES IN THE RANGE FROM 1 TO 10 mL**

PRECISION:

REPEATABILITY IS 0.16 psi (1-1 kPa)

SIGNIFICANCE:

INDICATES PRESENCE OF HIGHLY VOLATILE COMPONENTS

**MAXIMUM VAPOR PRESSURE LIMITS FOR GASOLINE ARE LEGALLY MANDATED IN SOME
AREAS AS A MEASURE OF AIR POLLUTION CONTROL**

INDIRECT MEASURE OF THE EVAPORATION RATE OF VOLATILE PETROLEUM SOLVENTS

ASTM D 1298 AND D 287 - CONTINUED

**DENSITY, SPECIFIC GRAVITY OR API
GRAVITY OF CRUDE PETROLEUM AND
LIQUID PETROLEUM PRODUCTS BY
HYDROMETER METHOD**

**PRECISION: API GRAVITY: 0.2
 DENSITY AND SP.GR.: 0.0006**

**SIGNIFICANCE: CORRELATED WITH OTHER PROPERTIES, GRAVITY CAN BE USED TO GIVE
 APPROXIMATE HYDROCARBON COMPOSITION AND HEAT OF COMBUSTION**

**DENSITY OR SPECIFIC GRAVITY IS NECESSARY TO CONVERT MEASURED
VOLUMES TO VOLUMES AT THE STANDARD TEMPERATURE OF 15°C**

ASTM D 4052 - CONTINUED

**DENSITY AND SPECIFIC GRAVITY
OF LIQUIDS BY DIGITAL DENSITY
METER**

DENSITY AND SP.GR.: 0.0001

ASTM D 1160

DISTILLATION OF PETROLEUM PRODUCTS AT REDUCED PRESSURES

SCOPE:

REDUCED PRESSURE - DOWN TO 1 MM HG
BOILING RANGE 200-550 C (CORRECTED FOR VACUUM)
DISCONTINUE WHEN SAMPLE STARTS TO DECOMPOSE
APPROXIMATELY 2 HRS/ANALYSIS

PRECISION:

REPEATABILITY RANGE: 4-6 C DEPENDING UPON PRESSURE

SIGNIFICANCE:

VOLATILITY CHARACTERISTICS ARE INDICATIVE OF PERFORMANCE
D 1160 ENABLES DISTILLATION OF PRODUCTS WHICH DECOMPOSE
WHEN DISTILLED AT ATMOSPHERIC PRESSURE

UOP 1

DISTILLATION RANGE OF HEAVY PETROLEUM OILS
AND DETERMINATION OF COKE RESIDUE

SCOPE:	PROCEDURE A	PROCEDURE B
	FOR BOILING RANGE PRODUCTS ABOVE KEROSENE, E.G. CRUDE, GAS AND FUEL OILS DETERMINES DISTILLATION RANGE	DETERMINES COKE RESIDUE
	OBSERVED THERMOMETER READINGS VOLUMES OF CONDENSATE RECORDED VOL-% BOTTOMS CALCULATED 100 ML CHGE TIME FOR ANALYSIS IS 0.44 HR	NO TEMPERATURE READINGS TAKEN VAPORS DRIVEN OVER TO DRY RESIDUE MASS-% COKE CALCULATED 30 GM. CHGE TIME FOR ANALYSIS 1.3 HR
PRECISION:	NOT REPORTED BUT SHOULD BE COMPARABLE TO D 86	ALLOWABLE DIFFERENCE IS 0.50 MASS-%

UOP 77

CRUDE OIL EVALUATION BY
HEMPEL DISTILLATION

UOP 109

VACUUM DISTILLATION OF TOPPED
CRUDE OILS AND SIMILAR
PETROLEUM PRODUCTS

SCOPE:

DETERMINES GASOLINE AND
KEROSENE CONTENT OF
TOTAL CRUDE OIL

FOR EVALUATING TOPPED CRUDE OILS
AND SIMILAR PETROLEUM PRODUCTS

ATMOSPHERIC

6" GLASS BEAD COLUMN

RANGE = 1BP-275°C

CAN OBTAIN FRACTIONS OF
SPECIFIED ENDPOINT,

FLASH POINT OR API

GRAVITY

4 HRS PER ANALYSIS

VACUUM

ANTI-FOAM HEAD

RANGE = 1BP TO 550°C

CAN PREPARE FRACTIONS OF SPECIFIED
BOILING RANGE, API GRAVITY,

VISCOSITY, OR PENETRATION

4-8 HRS PER ANALYSIS

UOP 77 - CONT'D

CRUDE OIL EVALUATION BY
HEMPEL DISTILLATION

UOP 109 - CONT'D

VACUUM DISTILLATION OF TOPPED
CRUDE OILS AND SIMILAR
PETROLEUM PRODUCTS

PRECISION: NOT REPORTED - INSUFFICIENT DATA

SIGNIFICANCE: YIELDS FRACTIONS WHICH
APPROXIMATES THOSE
THAT WOULD BE OBTAINED
ON A COMMERCIAL UNIT

OBTAINS YIELD DATA AND HEAVY
FRACTIONS ON WHICH ADDITIONAL
TESTS MAY BE PERFORMED

ASTM D 1319

HYDROCARBON TYPES IN LIQUID PETROLEUM PRODUCTS
BY FLUORESCENT INDICATOR ADSORPTION

SCOPE: DETERMINES CONTENT OF AROMATICS (5-99 VOL-%),
OLEFINS (0.3-55 VOL-%), AND SATURATES (1-95 VOL-%)
FOR PETROLEUM FRACTIONS DISTILLING BELOW 315°C
APPROXIMATELY 0.33 HRS PER ANALYSIS

PRECISION: REPEATABILITY DEPENDS ON LEVEL OF COMPONENT

AROMATICS	0.3-1.6 VOL-%
OLEFINS	0.4-2.0 VOL-%
SATURATES	0.3-1.7 VOL-%

SIGNIFICANCE: CHARACTERIZES QUALITY OF PETROLEUM FRACTIONS ...

- ... AS GASOLINE BLENDING COMPONENTS
- ... AS FEEDS TO CATALYTIC REFORMING PROCESSES
- ... FROM CATALYTIC REFORMING
- ... FROM THERMAL AND CATALYTIC CRACKING AS
BLENDING COMPONENTS FOR FUELS

ASTM D 2002

ISOLATION OF REPRESENTATIVE SATURATES FRACTION
FROM LOW-OLEFINIC PETROLEUM NAPHTHAS

SCOPE: HYDROCARBON MIXTURE MUST BE DEPENTANIZED AND
DISTILL BELOW 232°C
SAMPLE CANNOT CONTAIN MORE THAN 1% OLEFINS
APPROXIMATELY 0.75 HRS PER ANALYSIS

PRECISION: VOL-% OF SATURATES RECOVERED SHOULD BE GREATER
THAN 90% OF THE SATURATES OBTAINED IN D 1319

SIGNIFICANCE: SEPARATES SATURATE FRACTION FOR FURTHER
DETERMINATION OF PARAFFIN AND NAPHTHENE CONTENT

UOP 79

FRACTIONATION OF PETROLEUM DISTILLATES

SCOPE: LARGE SCALE DISTILLATION FOR FUTURE PROCESSING
 OR USE OF FRACTIONS
 REMOVAL OF CONDENSABLE AND NON-CONDENSABLE GASES
 COVERS RANGE OF 10-400°C
 TIME FOR ANALYSIS IS 4-12 HRS OR MORE

PRECISION: NOT APPLICABLE

SIGNIFICANCE: BOILING POINT DATA CAN BE USED FOR ESTIMATING
 YIELDS OF VARIOUS FRACTIONS
 FRACTIONS OF SPECIFIC BOILING RANGE ARE
 OCCASIONALLY REQUIRED FOR SUBSEQUENT
 CHARACTERIZATION

UOP 777

HYDROCARBON TYPES IN PETROLEUM FRACTIONS
BY CHROMATOGRAPHY

SCOPE: CALCULATION PROCEDURE TO COMBINE RESULTS FROM SEVERAL
DIFFERENT ANALYTICAL PROCEDURES. REPORTS PARAFFIN,
OLEFIN, NAPHTHENE AND AROMATIC HYDROCARBON TYPES IN
STABILIZED GASOLINES OR FRACTIONS

SUMMARY: UOP METHODS

- | | | |
|----|--------------|---|
| 1. | UOP 870 | AROMATICS, P+N |
| 2. | UOP 690 | C ₈ - DISTRIBUTION |
| 3. | UOP 744 | C ₈ -C ₁₀ AROMATIC DISTRIBUTION |
| 4. | D1319 | OLEFIN SPLIT (FIA) |
| 5. | D2002, D2003 | SILICA GEL SEPARATION NEEDED IF
OLEFINS >5% |

UOP 870

CARBON NUMBER DISTRIBUTION OF PARAFFINS,
NAPHTHENES AND AROMATICS BY GC

SCOPE:

AUTOMATED METHOD FOR DETERMINING PARAFFINS, NAPHTHENES AND
AROMATICS BY CARBON NUMBER
ENDPOINT MAY NOT EXCEED 200C
OLEFINS, IF PRESENT, ARE HYDROGENATED AND INCLUDED INTO THE
PARAFFINS AND NAPHTHENE DISTRIBUTION
LOWER LIMIT OF DETECTION FOR A SINGLE CARBON NUMBER HYDRO-
CARBON TYPE IS 0.05 LV-%

SUMMARY:

SAMPLE IS INJECTED INTO A GAS CHROMATOGRAPHIC SYSTEM EQUIPPED
WITH THREE PACKED COLUMNS AND APPROPRIATE VALVING
COMBINES THE TECHNOLOGY OF U741 AND U394
INTERNAL NORMALIZATION CALCULATION IS USED.

UOP 870 - CONT'D

CARBON NUMBER DISTRIBUTION OF PARAFFINS,
NAPHTHENES AND AROMATICS BY GC

PRECISION:	COMPONENT	CONCENTRATION	ALLOWABLE DIFFERENCE
		MASS-%	MASS-%
	C ₈ PARAFFIN	3.5	.05
	C ₈ NAPHTHENE	0.4	.06
	BENZENE	3.3	.04
	TOLUENE	12.9	.08
	C ₈ AROMATIC	19.5	.11

UOP 690

OCTANES AND LOWER BOILING HYDROCARBONS
IN OLEFIN FREE GASOLINES BY GC

SCOPE: DETERMINES C₈ AND LOWER BOILING PARAFFINS, NAPHTHENES,
BENZENE AND TOLUENE IN OLEFIN-FREE GASOLINES
ENDPOINTS MUST BE LESS THAN 260C
LOWER LIMIT OF DETECTION FOR ANY SINGLE COMPONENT IS
0.05 MASS-%

SUMMARY: SAMPLE IS INJECTED INTO A FUSED SILICA CAPILLARY
CHROMATOGRAPHIC COLUMN
INTERNAL NORMALIZATION CALCULATION IS USED

UOP 690 - CONTINUED

OCTANES AND LOWER BOILING HYDROCARBONS
IN OLEFIN FREE GASOLINES BY GC

PRECISION: COMPONENT	MASS-%	ALLOWABLE DIFFERENCE, MASS-%
<u>N</u> -PENTANE	23.7	0.04
CYCLOPENTANE	2.0	0.03
TOLUENE + 2,3,3-TRIMETHYLPENTANE	3.8	0.04
<u>N</u> -OCTANE + CIS-1,4-DIMETHYLCYCLOHEXANE + TRANS-1,3-DIMETHYLCYCLOHEXANE	5.7	0.03
<u>N</u> -HEXANE	7.5	0.11

UOP 744

AROMATICS IN HYDROCARBONS BY GAS CHROMATOGRAPHY

- SCOPE: DETERMINES C₆ THROUGH C₁₀ AROMATIC COMPOUNDS IN
PETROLEUM DISTILLATES OR AROMATIC CONCENTRATES
ENDPOINT MUST BE LESS THAN 205°C
C₁₁ AND HEAVIER AROMATICS REPORTED AS A GROUP
LOWER LIMIT OF DETECTION FOR ANY SINGLE COMPONENT IS
0.05 MASS-%
- SUMMARY: SAMPLE IS INJECTED INTO A FUSED SILICA CAPILLARY
CHROMATOGRAPHIC COLUMN
INTERNAL NORMALIZATION CALCULATION IS USED

UOP 744 - CONT'D

AROMATICS IN HYDROCARBONS BY GAS CHROMATOGRAPHY

PRECISION:	COMPONENT	MASS-%	ALLOWABLE DIFFERENCE, MASS-%
	NON-AROMATICS	0.7	0.02
	BENZENE	21.0	0.17
	TOLUENE	50.2	0.02
	P-XYLENE	5.5	0.02
	M-XYLENE	12.0	0.06
	1,2,4-TRIMETHYLBENZENE	7.1	0.02
	1,2-DIMETHYL-4- ETHYLBENZENE	1.5	0.03
	C ₁₁ + AROMATICS	6.9	0.47

UOP 394

AROMATICS IN HYDROCARBONS
BY GAS CHROMATOGRAPHY

SCOPE: DETERMINES BENZENE, TOLUENE, TOTAL C₈ AROMATICS AND
TOTAL C₉+ AROMATICS
TYPICALLY C₁₃+ NON-AROMATIC HYDROCARBONS INTERFERE
WITH THE ANALYSIS
RANGE OF DETECTION FOR A SINGLE COMPONENT IS 0.05 TO
80 VOL-%

SUMMARY: A 2-COLUMN CHROMATOGRAPHIC SYSTEM WITH A THERMAL
CONDUCTIVITY DETECTOR IS USED
EXTERNAL STANDARD CALIBRATION IS USED

PRECISION:	COMPONENT	LV-%	ALLOWABLE DIFFERENCE, LV-%
	BENZENE	5.1	0.34
	TOLUENE	10.1	0.61
	C ₈ AROMATICS	26.1	1.75

UOP 741

PARAFFIN AND NAPHTHENE DISTRIBUTION BY CARBON NUMBER
OF SATURATED PETROLEUM DISTILLATES BY GC

SCOPE: DETERMINES PARAFFIN AND NAPHTHENE BY CARBON NUMBER
ENDPOINTS MUST BE LESS THAN 200C
OLEFINS AND AROMATICS INTERFERE AND MUST BE REMOVED VIA
ASTM D2002 OR D2003
LOWER LIMIT OF DETECTION FOR SINGLE CARBON NUMBER HYDROCARBON
TYPE IS 0.05 MASS OR LV-%

SUMMARY: SAMPLE IS INJECTED INTO A CHROMATOGRAPHIC COLUMN PACKED WITH
TREATED MOLECULAR SIEVES
INTERNAL NORMALIZATION CALCULATION IS USED

PRECISION:	COMPONENT	MASS-%	ALLOWABLE DIFFERENCE, MASS-%
	C ₈ PARAFFIN	11.9	0.70
	C ₈ NAPHTHENE	72.6	0.38
	C ₉ PARAFFIN	3.6	0.04

ASTM D 2887

BOILING RANGE DISTRIBUTION OF PETROLEUM FRACTIONS
BY GAS CHROMATOGRAPHY

SCOPE: BOILING RANGE DISTRIBUTION OF PETROLEUM PRODUCTS AND FRACTIONS
BOILING RANGE 55-538C
35 MINUTES PER ANALYSIS

SUMMARY: SAMPLE IS INJECTED INTO GAS CHROMATOGRAPHIC COLUMN WHICH
SEPARATES HYDROCARBONS IN BOILING POINT ORDER
COLUMN TEMPERATURE IS RAISED AT A REPRODUCIBLE RATE
CALIBRATION CURVE OF TIME VS. BOILING POINT IS GENERATED BY
RUNNING A KNOWN MIXTURE OF HYDROCARBONS

PRECISION: REPEATABILITY IS:

IBP	4°C
5%	2°C
10-40%	2°C
40-90%	2°C
95%	3°C
FBP	7°C