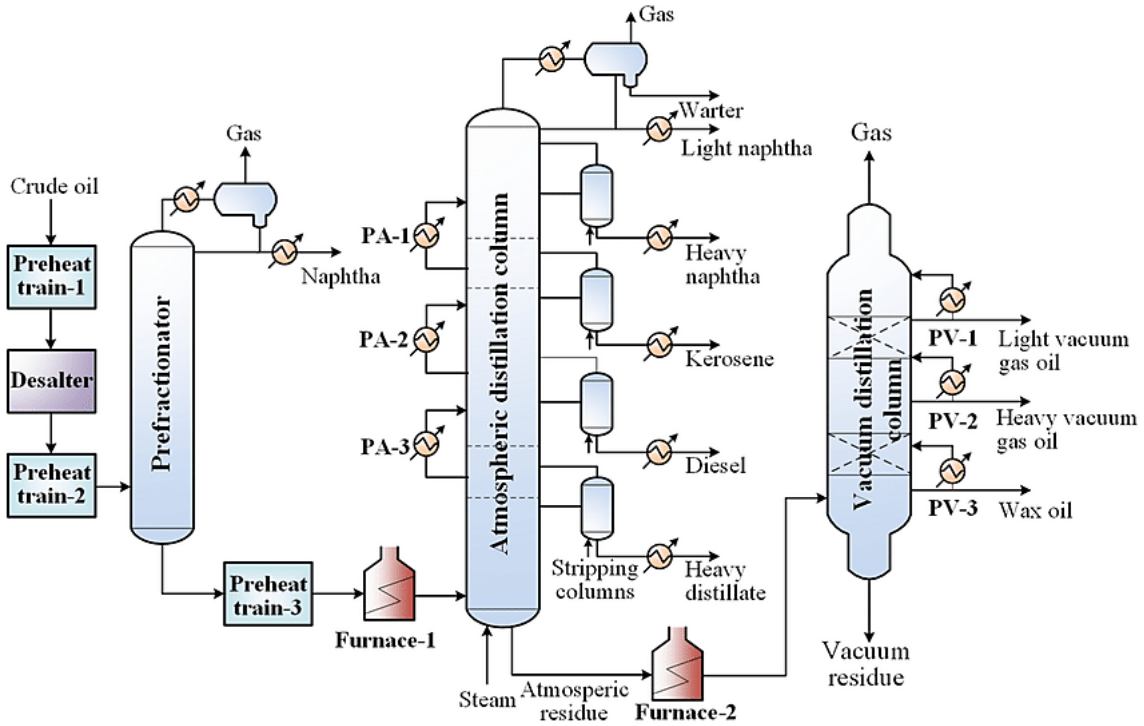
Petroleum fractions from crude distillation unit



Crude distillation unit CDU

1- Overhead Gases (Less than 20°C)

- ✓ **Natural Gas (C_1 plus traces of other gases like C_2)**
- ✓ **LPG : liquefied petroleum gases (C_2, C_3 , C_4)**
- ➢ For transportation, these gases are liquefied through **pressurizing**.
- ➢ LPG is **colorless liquid**
- ➢ Pure LPG has **no smell**, but for safety an **odorant agent**, a mercaptan, is added to aid detection at very low concentrations.
- ➢ **The heating value of LPG** on a volume basis is significantly higher (propane, **95 MJ/m^3**; butane, **121 MJ/m^3**) compared with that of **natural gas (38 MJ/m^3)**.
- ➢ **LPG** as a **liquid is 250 times denser than LPG as vapor**, so a large quantity can be stored in a relatively small spherical or cylindrical vessels.
- ➢ **LPG uses** in central heating, space heating, and hot water supply, as well as in a large number of appliances, such as ovens, and stoves.
- ➢ The low **sulfur and very low levels of nitrogen oxides** (NO_x) emissions during its combustion make **LPG a most environmentally friendly source of energy.**
- ➢ **Automotive LPG**, or auto-gas, refers to the LPG used in automotive applications.
- ➢ The **disadvantage** is that LPG has a **lower heating value per unit volume**, and thus the vehicle has to refuel more frequently.

2- Naphtha cut (C_5-C_{10}) (Sp.gr. 0.620-0.735 g/cm^3)

Total naphtha TN is **the lightest liquid** distillate of crude oil boiling between **38°C to 180°C**.

Naphtha cut may be classified by its boiling range or by its end use:

- ✓ **Light straight run (LSR) naphtha (C_5 to 80°C),** highly paraffinic (greater than 80 vol %), has a **low RON of approximately 60**, and feedstock for isomerization unit to make a light gasoline (**RON 80**).

Note: Isomerate is a very useful blend component used to reduce high aromatic content of gasoline blending in gasoline pool.

LSR naphtha specifications

Property	Units	Limit	Value	Test method
Color, saybolt			+20	ASTM D 156
Density	kg/L	Min.	0.645	ASTM D 1298
		Max.	0.700	
Distillation				ASTM D 86
IBP			Report	
10 vol %	°F	Max.	131	
50 vol %	°F	Max.	149	
90 vol %	°F	Max.	239	
End point	°F	Max.	320	
Lead content	ppb	Max.	50	IP 224
PONA				Chromatography
Paraffins	Vol %	Min.	80	
Olefins	Vol %	Max.	1.0	
Naphthene	Vol %	Max.	18.0	
Aromatics	Vol %	Max.	5.0	
Sulfur	Wt %	Max.	0.03	ASTM D 1266
Vapor pressure, Reid	kPa @100°F	Max.	91	ASTM D 323

- ✓ **Wide straight run (WSR) naphtha (C_7-180°C),** the heaviest part is used as a feedstock for the **catalytic reforming** unit for the production of **reformate** (high gasoline **RON 98**).

WSR naphtha specifications

Property	Units	Limit	Value	Test method
Color, Saybolt			Report	ASTM D 156
Density	kg/L	Min.	0.690	ASTM D 1298
		Max.	0.735	
Distillation				ASTM D 86
IBP			Report	
10 vol %	°F	Min.	109	
		Max.	210	
50 vol %	°F	Min.	174	
		Max.	270	
90 vol %	°F	Min.	230	
		Max.	351	
End point	°F	Max.	399	
Lead content	ppb	Max.	200	IP 224
Olefins	Vol %	Max.	1.0	ASTM D 1319
or				
Bromine number		Max.	1.0	ASTM D 1159
PONA			Report	
Sulfur	Wt %	Max.	0.07	ASTM D 1266
Vapor pressure, Reid	kPa @100°F	Max.	75	ASTM D 323

- ✓ **Petrochemical naphtha (C_5-C_6)**
- ➢ Straight run & hydrocracker naphtha blend.
- ➢ Major petrochemical feedstock, highly paraffinic (**minimum 70 vol %)** and low aromatic content (**less than 11 vol %**).

Petrochemical naphtha specifications

Property	Units	Limit	Value	Test method
Color, Saybolt		Min.	+20	ASTM D 156
Density, 60/60°F	kg/L	Min.	0.680	ASTM D 1298
		Max.	0.725	
Distillation				ASTM D 86
IBP			Report	
10 vol %	°F	Min.	Report	
		Max.		
50 vol %	°F	Min.	122	
		Max.	248	
90 vol %	°F	Min.	167	
		Max.	320	
End point	°F	Max.	356	
Lead content	ppb	Max.	200	IP 224
Olefins	Vol %	Max.	1.0	ASTM D 1319
PONA				
Paraffins	Vol %	Min.	70	Chromatography
Olefins	Vol %	Max.	1.0	
Naphthene	Vol %		Report	
Aromatics	Vol %		Report	
Sulfur	Wt %	Max.	0.07	ASTM D 1266
Vapor pressure, Reid	kPa @100°F	Max.	91	ASTM D 323

3- Gasoline (C_5 - C_{11}) 40-200°C finished product

- ➢ Volatile flammable liquid hydrocarbon **blend** used as a fuel in **spark- internal combustion engines ICE**.
- ➢ **Blended gasoline** is a mixture of **n-butane**, **reformate**, **isomerate**, **alkylate**, **gasoline** form **catalytic cracker**, and **coker gasoline**.
- **Straight run gasoline** cut contains: **50 percent alkanes (n and iso paraffins), 40 percent cyclic alkanes (naphthenes) and 10 percent aromatics.**
- **Flash point: -45°C.**
- **Auto-ignition temperature: 495°F (257°C).**
- **Vapor density: 3 to 4 times that of air.**
- **Viscosity: Slightly less than water**

Gasoline is classified by octane ratings into three grades:

- ➢ **Regular gasoline**: Gasoline having antiknock index, i.e. **RON**, greater than or equal to **85 and less than 88**.
- ➢ **Mid-grade gasoline**: **RON: 88 to 90**
- ➢ **Premium or super gasoline**: **RON greater than 90**.

Gasoline Blend components

Property	Units	N-Butane	Isomerate	Light cat naphtha	Heavy cat naphthas	Cat reformate	Alkylate	Coker light naphtha	MTBE	LSR
SG (specific gravity)		0.5844	0.641	0.7083	0.8441	0.7811	0.700	0.69	0.74	0.667
RON		95	84	92.9	95.0	96.4	96.0	74	116.0	68.0
MON		92	81.3	81.3	80.4	84.8	94.0	68.8	100	63
RVP	lb/in^2	51.92	13.5	8.4	0.4	9.5	6.2	13.1	9	10.1
Aromatics	Vol %	0	0	15	59	62.5	0	8	0.6	2.4
Olefins	Vol %	0	0	35	10	1	0	56	0	0

4- Kerosene cut ($C_{10} – C_{16}$) (Sp.gr. 0.720-0.830 g/cm^3)

- Kerosene cut boiling between **174 and 260°C**.
- Kerosene is **heavier** than naphtha and gasoline cut but **lighter** than diesel cut.

Physical Description: A pale yellow or clear oily liquid.

Chemical compositions:

- **35% paraffins, 60% naphthenes, and 15% aromatics**.
- **Flash point: l00°F-165°F (38-74°C).**
- **Auto-ignition temperature: 444°F (229°C).**
- **Vapor density: 4.5 times that of air.**
- **Smoke point (17 mm) minimum.**
- **Pour point: 0°F (-18°C).**
- Kerosene used in space heaters, cook stoves, and suitable for use as a light source.
- Kerosene used in aircrafts is called **"aviation turbine fuel ATF." Kerosene was considered as aviation fuel because of:**
- **High flash point**: allowed safer handling, transportation, and storage of fuel.
- **Lower volatility** compared with that of naphtha.
- **Very low freezing point**, allowing planes to fly at high altitudes.

Three main grades of turbine fuels are in use for civil commercial aircrafts:

- **Jet A-1**
- **Jet A**
- **Jet B**

Jet A-1 is a kerosene cut: has a minimum flash point of 100°F and a maximum freezing point of (-47°C) (-52.6°F). Jet A-1 meets the specifications of ASTM D 1655.

Jet A is identical to Jet A-1: with a higher freezing point (-40°C).

Jet B is a wide-cut distillate fuel containing naphtha and kerosene fractions.

- It can be used as an alternative to Jet A-1, but it has a lower flash point and higher flammability. It is more difficult to handle. It is used in very cold weather operations. It is generally produced to Canadian specifications CAN/CGSB 3.23.

Military Jet Fuel Specifications

The major **difference between military fuels and commercial fuels is the use of additives**, such as anti-icing, corrosion inhibitors, lubricity improvers, antioxidants, thermal stability improvers, and conductivity improvers.

JP-4: blend of **60 % (vol%)** LSR naphtha and medium straight run naphtha, and **40 % straight run** kerosene. JP-4 has corrosion inhibitor and anti-icing additives.

JP-4 meets the requirements of U.S. military specifications MIL-DTL-5624U grade JP-4. It also meets requirements of British specifications DEF STN 91-88 AVTAG/FSII.

JP-4 can be considered the military equivalent of Jet B.

JP-5: is a **high flash point kerosene** meeting the requirements of U.S. military specifications MIL-DTL-5624U grade JP-5. JP-5 also meets the requirements of British specifications DEF STN 91-87 AVTUR /FSII.

JP-5 is mainly used by the U.S. Navy for its aircrafts based on aircraft carriers.

Its high flash point provides a **higher degree of safety in fuel handling**.

JP-7: is a highly refined, high thermal stability fuel developed in the 1960s to meet the high heat sink demand of supersonic air crafts and **missiles.**

- It is thermally stable to **550°F.**
- It has high flash, **very low aromatic content** (maximum 5%), a high hydrogen content, and a **high heat of combustion**.
- It is a blend of **kerosene coming from hydrocracker** and straight run **desulfurized kerosene** for **HDS process**.

5- Atmospheric Gasoil (LGO and HGO) (boiling range 200-340°C) ($C_{11} – C_{20}$)

- **Physical Description**: A yellow viscous liquid used for compression ICE
- **Chemical composition**: **30%** (paraffins), **45%** (naphthenes) and **25%** aromatics.
- AGO must go through a distillate hydrotreater unit **to remove sulphur**.
  - ✓ **Diesel (blend of different HCBN in the AGO boiling range) is blended** from the **straight run diesel** (LAGO) and **heavy kerosene** from CDU, **HDS diesel**, diesel from **hydrocracker**, **HT LCO** from FCCU, and **HT coker gasoil**.
- The quality of diesel fuels can be **expressed as cetane number or cetane index**.
- The **cetane number (CN)** is expressed in terms of the volume percent of **cetane ($C_{16}H_{34}$)** which has high ignition (**CN = 100**) in a mixture with **HMN ($C_{16}H_{34}$)** which has low ignition quality (**CN = 0**).

Diesel Blends components

Property	Units	SRD	Kero	LCO	Hydrocracker diesel	Coker diesel
Specific gravity		0.8495	0.786	0.8825	0.8488	0.879
Sulfur	Wt %	1.29	0.103	0.24	0.036	0.79
Pour point	°F	10.4	−71	−13	40	38.1
Cetane index		50.6			55	
Diesel index		55.3	64	30.2		30
50% ASTM distillation	°F	547	372	541	596	612
95% ASTM distillation	°F	626	433	664	710	711

SRD = Straight run diesel ex crude distillation; Kero = Kerosenes; LCO = Light cycle gas oil ex FCCU unit.

Diesel Blends Specifications

		Grades									
Property	Limit	1	2	3	4	5	6	7	8	9 (1)	10 (2)
Accelrated stability;											
Total insolubles, mg/100 mL	Max.	2.5	2.5		1.5	1.5	2.5				
Acid number, mg KOH/100g;	Max.										
Strong		Nil	Nil	Nil			Nil	Nil	Nil	Nil	
Total		0.5	0.5	0.3	0.3	0.3	0.25	0.2	0.2	0.5	
Appearance visual, 20–25°C								Clear	Clear		Clear and bright
Ash, mass %	Max.	0.01	0.01	0.01	0.005	0.005	0.01	0.01	0.01	0.02	0.01
Color, ASTM	Max.	3.0	3.0	3.5	3.0	3.0	3.0	2.0	2.0		1.5
Carbon residue, ramesbottom;											
On 10 % distillation residue, mass %	Max.	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20		0.35
Conradson carbon	Max.									2.0	
Cetane index	Min.			47	46	46	50	48	48		41
Corrosion, Cu, strip, 3 h at 100°C,	Max.	1	1	1	1	1	2	1	1		1B
Classification											
Demulsification Time, Min	Max.				10	10	10				
Density at 15°C, kg/L	Min.			0.820				0.820	0.820	0.850	
	Max.			0.880				0.860	0.860	0.900	0.876
Diesel index	Min.	45	45								
Cloud point, °C	Max.			−4	−1	−12		+1	−7		
CFPP								−11	−19		−12
Distillation, recovered at 350°C Vol %	Min.			85				95	95		95
Distillation, recovered at 366°C Vol %	Min.	90	90								
End Point, °C	Max.				385	385					
Flash point, Penskey-Martein,											
Closed cup, °C	Min.	60	60	61	60	60	60	60	60	60	52
Pour point, °C	Max.	+6	0	−6	−6	−18	−3			3	
Sediment by extraction, mass %	Max.	0.05	0.05							0.1	
Sediment and water by centrifuge, mass %				0.01			0.03	0.01	0.01	0.2	0.05
Sulfur, mass %	Max.	1.0	1.0	1.0	1.0	0.4	1.0	0.19	0.19	1.6	0.0015
Thermal value, gross, MJ/kg	Min.									44.2	
Viscosity, kinematic At 38°C, cSt											
	Min	2.0	2.0	1.7	1.7	1.7	1.5	2.0	2.0	3.0	1.9
	Max.	7.5	7.5	4.3	4.3	4.3	6.0	4.0	4.0	9.0	4.1
Water by distillation	Max.	0.05	0.05				0.05			0.10	
Conductivity, pS/M	Min.									50.00	
Lubricity(3) 60°C, Micron	Max.										520

Diesel grades:

No.1 diesel (Super-diesel) which has **cetane number of 45** and it is used in high speed engines, trucks and buses.

No.2 diesel has **CN: 40**.

No.4 a heavy distillate fuel or blend of distillate and residual oil, for use in low and medium speed diesel engines with lower cetane numbers.

6- Fuel Oil (LFO and HFO) C20+

➢ *The term fuel oil includes any liquid fuel that is burned in a furnace or boiler to generate heat (heating oils), or used in an engine to generate power (as motor fuels)*

- ✓ **Physical Description:** Very viscous, dark liquid.
- ✓ **Chemical composition**: **15%** (paraffins), **15%** polar compounds, containing nitrogen, oxygen, or sulfur, **25%** aromatics, **45%** (naphthenes).
- ✓ **Viscosity**: **180 cSt to 450 cSt** at 120°F.
- ✓ **Flash point** above **65°C** (150°F)

Fuel oil specifications

Property	Units	1	2	3	4	5	6
Ash	Mass %, Max.	0.1	0.1	0.1	0.1	0.1	0.25
Carbon residue micro	Mass %	15.0			15.0	15.0	20.0
Density, 15°C	kg/L, Max.	0.980	0.980	0.991	0.990	0.985	0.990
Elements, trace	mg/kg, Max.						
Vanadium		55				550	
Aluminum						30	
Sodium		25					
Explosiveness	Vol %, Max.				50		
Flash point, Penskey Martin							
Closed cup	°C, Min.	66	66	66	66	66	60
Pour point	°C, Max.	24	21	–9	20	12	21
Fluidity			Fluid at 0°C				Fluid at 15°C
Pumpability, viscosity, 9°C	Poise, Max.			20			
Sediment by extraction	Mass %, Max.	0.1	0.12		0.12	0.15	
Stability							
ASTM spot test rating	Max.	2	2	2	2	2	2
Compatibility							
ASTM spot test rating	Max.				2		
Sulfur	Mass %, Max.	2.8	3.5	3.5	3.5	3.5	4.00
Thermal stability rating					No. 1 tube		
Thermal value gross	MJ/kg, min.	43.03					
	Btu/lb					18300	
Total sediment	Mass %, Max.	0.15	0.15	0.15	0.15	0.15	
Viscosity, kinematic, 50°C	cSt, Max.	180	80	75	48	180	380
	cSt, Min.			11.8			
Water by distillation	Vol %, Max.	0.5	0.5	0.5	0.5	0.5	
Water and sediment by Centrifuge	Vol %, Max.						0.6

7- Atmospheric residue AR: Reduced crude residue RCR

- **RCR** have boiling points above **(450°C)**.
- These cuts cannot be vaporized in the atmospheric distillation tower because they begin to **crack or break down**.
- Atmospheric bottoms is sent to a secondary distillation tower, **the vacuum distillation unit**.

8- Vacuum residue VR

Vacuum residue from crude oil distillation can be split into: **50-60 wt% saturates** and **aromatic**, **25 wt% resins**, and **20 wt% asphaltenes**. Asphaltenes are high-molecular compounds insoluble in n-hexane and n-pentane

Disadvantages of asphaltenes in crude oil

- block the **pores of rock formations**, well heads and surface processing equipment.
- **Transportation problems** because they increase gravity and viscosity of crude oils.
- **Coke formation** and metal deposition on catalyst surface causing catalyst deactivation.

Physical Properties of Petroleum hydrocarbons

Compound	Formula	N_C	M	T_M, °C	T_b, °C	SG, at 60°F	d_{20}, g/cm³	n_{20}	T_C, °C	P_C, bar	V_C, cm³/mol	Z_C	ω
Paraffins													
Methane	CH_4	1	16.0	−182.5	−161.5	0.2999	...	...	−82.59	45.99	98.65	0.2864	0.0115
Ethane	C_2H_6	2	30.1	−182.8	−88.6	0.3554	0.3386	...	32.17	48.72	145.48	0.2792	0.0995
Propane	C_3H_8	3	44.1	−187.7	−42.0	0.5063	0.4989	...	96.68	42.48	200.14	0.2765	0.1523
n-Butane	C_4H_{10}	4	58.1	−138.3	−0.5	0.5849	0.5791	1.3326	151.97	37.96	255.09	0.2740	0.2002
n-Pentane	C_5H_{12}	5	72.2	−129.7	36.1	0.6317	0.6260	1.3575	196.55	33.70	313.05	0.2702	0.2515
n-Hexane	C_6H_{14}	6	86.2	−95.3	68.7	0.6651	0.6605	1.3749	234.45	30.25	371.22	0.2661	0.3013
n-Heptane	C_7H_{16}	7	100.2	−90.6	98.4	0.6902	0.6857	1.3876	267.05	27.40	427.88	0.2610	0.3495
n-Octane	C_8H_{18}	8	114.2	−56.8	125.7	0.7073	0.7031	1.3974	295.55	24.90	486.35	0.2561	0.3996
n-Nonane	C_9H_{20}	9	128.3	−53.5	150.8	0.7220	0.7180	1.4054	321.45	22.90	543.67	0.2519	0.4435
n-Decane	$C_{10}H_{22}$	10	142.3	−29.6	174.2	0.7342	0.7302	1.4119	344.55	21.10	599.58	0.2463	0.4923
n-Undecane	$C_{11}H_{24}$	11	156.3	−25.6	195.9	0.7439	0.7400	1.4151	365.85	19.50	658.69	0.2418	0.5303
n-Dodecane	$C_{12}H_{26}$	12	170.3	−9.6	216.3	0.7524	0.7485	1.4195	384.85	18.20	715.67	0.2381	0.5764
n-Tridecane	$C_{13}H_{28}$	13	184.4	−5.4	235.5	0.7611	0.7571	1.4235	401.85	16.80	774.60	0.2319	0.6174
n-Tetradecane	$C_{14}H_{30}$	14	198.4	5.9	253.6	0.7665	0.7627	1.4269	419.85	15.70	829.82	0.2261	0.6430
n-Pentadecane	$C_{15}H_{32}$	15	212.4	9.9	270.7	0.7717	0.7680	1.4298	434.85	14.80	888.49	0.2234	0.6863
n-Hexadecane	$C_{16}H_{34}$	16	226.4	18.2	286.9	0.7730	0.7729	1.4325	449.85	14.00	944.33	0.2199	0.7174
n-Heptadecane	$C_{17}H_{36}$	17	240.5	22.0	302.2	0.7752	0.7765	1.4348	462.85	13.40	999.83	0.2189	0.7697
n-Octadecane	$C_{18}H_{38}$	18	254.5	28.2	316.7	0.7841	0.7805	1.4369	473.85	12.70	1059.74	0.2167	0.8114
n-Nonadecane	$C_{19}H_{40}$	19	268.5	31.9	329.9	0.7880	0.7844	1.4388	484.85	12.10	1119.82	0.2150	0.8522
n-Eicosane	$C_{20}H_{42}$	20	282.6	36.4	343.8	0.7890	0.7871	1.4405	494.85	11.60	1169.50	0.2125	0.9069
n-Heneicosane	$C_{21}H_{44}$	21	296.6	40.2	356.5	0.7954	0.7906	1.4440	504.85	11.10	1229.41	0.2110	0.9420
n-Docosane	$C_{22}H_{46}$	22	310.6	44.0	368.6	0.7981	0.7929	1.4454	513.85	10.60	1289.49	0.2089	0.9722
isobutane (2-Methylpropane)	C_4H_{10}	4	58.1	−159.6	−11.7	0.5644	0.5584	...	134.99	36.48	262.71	0.2824	0.1808
isopentane (2-Methylbutane)	C_5H_{12}	5	72.2	−159.9	27.8	0.6265	0.6213	1.3537	187.28	33.81	305.84	0.2701	0.2275
2-Methylpentane	C_6H_{14}	6	86.2	−95.3	60.3	0.6577	0.6529	1.3715	224.35	30.05	371.22	0.2661	0.2774
2-Methylhexane	C_7H_{16}	7	100.2	−118.3	90.1	0.6822	0.6778	1.3849	257.22	27.34	421.00	0.2610	0.3277
2-Methylheptane	C_8H_{18}	8	114.2	−109.0	117.7	0.7029	0.6987	1.3949	286.49	24.84	487.78	0.2604	0.3772
2,2,4-Trimethylpentane (isooctane)	C_8H_{18}	8	114.2	−107.4	99.2	0.6988	0.6945	1.3915	270.81	25.68	467.81	0.2656	0.3022
2-Methyloctane	C_9H_{20}	9	128.3	−80.4	143.3	0.7176	0.7134	1.4031	313.60	22.90	541.27	0.2541	0.4212
2-Methylnonane	$C_{10}H_{22}$	10	142.3	−74.7	167.0	0.7307	0.7266	1.4100	336.85	21.20	582.70	0.2436	0.4723
Olefins													
Ethene (Ethylene)	C_2H_4	2	28.1	−169.2	−103.7	0.1388	...	...	9.19	50.40	131.00	0.2813	0.0865
Propene (Propylene)	C_3H_6	3	42.1	−185.3	−47.7	0.5192	0.5111	...	92.42	46.65	188.36	0.2891	0.1398
1-Butene	C_4H_8	4	56.1	−185.4	−6.3	0.6001	0.5938	...	146.80	40.43	239.24	0.2770	0.1905
1-Pentene	C_5H_{10}	5	70.1	−165.2	30.0	0.6456	0.6402	1.3715	191.63	35.13	295.10	0.2683	0.2312
1-Hexene	C_6H_{12}	6	84.2	−139.8	63.5	0.6790	0.6740	1.3879	230.88	31.40	354.13	0.2654	0.2804
1-Heptene	C_7H_{14}	7	98.2	−118.9	93.6	0.7015	0.6971	1.3998	264.14	28.30	413.15	0.2617	0.3310
1-Octene	C_8H_{16}	8	112.2	−101.7	121.3	0.7181	0.7140	1.4087	293.50	25.68	460.26	0.2509	0.3764
1-Nonene	C_9H_{18}	9	126.2	−81.4	146.9	0.7330	0.7290	...	320.10	23.30	528.04	0.2494	0.4171
1-Decene	$C_{10}H_{20}$	10	140.3	−66.3	170.6	0.7450	0.7410	...	343.25	22.18	584.08	0.2528	0.4800
Acetylene	C_2H_2	2	26.0	−80.8	−83.8	...	0.4001	...	35.17	61.39	112.97	0.2706	0.1873
1,3-Butadiene	C_4H_6	4	54.1	−108.9	−4.4	...	0.6219	...	152.02	42.77	220.49	0.2668	...
Naphthenes													
Cyclopentane	C_5H_{10}	5	70.1	−93.8	49.3	0.7502	0.7456	1.4065	238.61	45.02	257.89	0.2729	0.1959
Methylcyclopentane	C_6H_{12}	6	84.2	−142.4	71.8	0.7540	0.7491	1.4097	259.64	37.85	318.92	0.2725	0.2302
Ethylcyclopentane	C_7H_{14}	7	98.2	−138.4	103.5	0.7712	0.7667	1.4198	296.37	33.98	375.14	0.2692	0.2716
Propylcyclopentane	C_8H_{16}	8	112.2	−117.3	131.0	0.7811	0.7768	1.4263	322.85	30.20	428.03	0.2609	0.3266
n-Butylcyclopentane	C_9H_{18}	9	126.2	−108.0	156.6	0.7893	0.7851	1.4316	347.85	27.20	483.11	0.2545	0.3719
n-Pentylcyclopentane	$C_{10}H_{20}$	10	140.3	−83.0	180.5	0.7954	...	1.4352	370.65	24.50	536.79	0.2457	0.4184
n-Hexylcyclopentane	$C_{11}H_{22}$	11	154.3	−73.0	202.9	0.8006	...	1.4386	390.95	22.20	592.40	0.2382	0.4646
n-Heptylcyclopentane	$C_{12}H_{24}$	12	168.3	−53.0	223.9	0.8051	...	1.4416	409.45	20.10	647.30	0.2293	0.5100
n-Octylcyclopentane	$C_{13}H_{26}$	13	182.4	−44.0	243.5	0.8088	...	1.4446	426.35	18.30	702.38	0.2210	0.5525
n-Nonylcyclopentane	$C_{14}H_{28}$	14	196.4	−29.0	262.0	0.8121	...	1.4467	441.75	16.70	757.64	0.2129	0.5956
n-Decylcyclopentane	$C_{15}H_{30}$	15	210.4	−22.1	279.4	0.8149	...	1.4486	455.95	15.30	811.76	0.2049	0.6314
n-Undecylcyclopentane	$C_{16}H_{32}$	16	224.4	−10.0	295.8	0.8175	...	1.4503	469.05	14.00	867.27	0.1968	0.6741
n-Dodecylcyclopentane	$C_{17}H_{34}$	17	238.5	−5.0	311.2	0.8197	...	1.4518	481.25	12.80	921.48	0.1881	0.7163
n-Tridecylcyclopentane	$C_{18}H_{36}$	18	252.5	5.0	325.9	0.8217	...	1.4531	492.45	11.80	977.26	0.1812	0.7582
n-Tetradecylcyclopentane	$C_{19}H_{38}$	19	266.5	9.0	340.0	0.8235	...	1.4543	502.85	10.90	1031.55	0.1743	0.7949
n-Pentadecylcyclopentane	$C_{20}H_{40}$	20	280.5	17.0	353.0	0.8252	...	1.4554	512.55	10.00	1087.59	0.1665	0.8395
n-Hexadecylcyclopentane	$C_{21}H_{42}$	21	294.6	21.0	366.0	0.8267	...	1.4564	521.55	9.20	1141.97	0.1590	0.8755
n-Heptadecylcyclopentane	$C_{22}H_{44}$	22	308.6	27.0	377.0	0.8280	...	1.4573	538.01	11.91	1198.28	0.2115	0.9060
Cyclohexane	C_6H_{12}	6	84.2	6.5	80.7	0.7823	0.8021	1.4262	280.43	40.73	307.89	0.2725	0.2096
Methylcyclohexane	C_7H_{14}	7	98.2	−126.6	100.9	0.7748	0.7702	1.4231	299.04	34.71	367.79	0.2684	0.2350
Ethylcyclohexane	C_8H_{16}	8	112.2	−111.3	131.8	0.7926	0.7884	1.4330	336.00	30.40	430.13	0.2582	0.2455
Propylcyclohexane	C_9H_{18}	9	126.2	−94.9	156.8	0.7981	0.7940	1.4371	366.00	28.07	476.81	0.2519	0.2595
n-Butylcyclohexane	$C_{10}H_{20}$	10	140.3	−74.7	181.0	0.8033	0.7993	1.4408	393.85	25.70	534.16	0.2476	0.2743
Aromatics													
Benzene	C_6H_6	6	78.1	5.5	80.1	0.8832	0.8780	1.5011	289.01	48.98	258.94	0.2714	0.2100
Methylbenzene (Toluene)	C_7H_8	7	92.1	−95.0	110.6	0.8741	0.8685	1.4969	318.65	41.06	315.80	0.2635	0.2621
Ethylbenzene	C_8H_{10}	8	106.2	−95.0	136.2	0.8737	0.8678	1.4959	344.05	36.06	373.81	0.2627	0.3026
Propylbenzene	C_9H_{12}	9	120.2	−99.6	159.2	0.8683	0.8630	1.4920	365.23	32.00	439.71	0.2651	0.3447
n-Butylbenzene	$C_{10}H_{14}$	10	134.2	−87.9	183.3	0.8660	0.8610	1.4898	387.40	28.87	496.89	0.2612	0.3938
n-Pentylbenzene	$C_{11}H_{16}$	11	148.2	−75.0	205.5	0.8624	0.8583	1.4878	406.75	26.04	549.74	0.2532	0.4378
n-Hexylbenzene	$C_{12}H_{18}$	12	162.3	−61.2	226.1	0.8622	0.8581	1.4864	424.85	23.80	592.64	0.2431	0.4790
n-Heptylbenzene	$C_{13}H_{20}$	13	176.3	−48.0	246.1	0.8617	0.8576	1.4854	440.85	21.80	648.27	0.2381	0.5272
n-Octylbenzene	$C_{14}H_{22}$	14	190.3	−36.0	264.4	0.8602	0.8562	1.4845	455.85	20.20	703.41	0.2344	0.5670
n-Nonylbenzene	$C_{15}H_{24}$	15	204.4	−24.2	282.1	0.8596	0.8557	1.4838	467.85	18.95	752.70	0.2315	0.6331
n-Decylbenzene	$C_{16}H_{26}$	16	218.4	−14.4	297.9	0.8590	0.8551	1.4832	479.85	17.70	812.55	0.2297	0.6797
n-Undecylbenzene	$C_{17}H_{28}$	17	232.4	−5.2	313.3	0.8587	0.8548	1.4828	490.85	16.72	867.64	0.2284	0.7333
n-Dodecylbenzene	$C_{18}H_{30}$	18	246.4	2.8	327.6	0.8595	0.8556	1.4824	506.85	15.60	923.08	0.2221	0.7333
n-Tridecylbenzene	$C_{19}H_{32}$	19	260.5	10.0	341.3	0.8584	0.8545	1.4821	516.85	14.80	977.25	0.2202	0.7799
n-Tetradecylbenzene	$C_{20}H_{34}$	20	274.5	16.0	354.0	0.8587	0.8553	1.4818	526.85	14.00	1029.88	0.2168	0.8130
n-Pentadecylbenzene	$C_{21}H_{36}$	21	288.5	22.0	366.0	0.8587	0.8540	1.4815	535.85	13.30	1089.71	0.2155	0.8567
n-Hexadecylbenzene	$C_{22}H_{38}$	22	302.5	27.0	378.0	0.8586	0.8541	1.4813	544.85	12.70	1140.80	0.2130	0.8996
o-xylene (*o*-dimethylbenzene)	C_8H_{10}	8	106.2	−25.2	144.4	0.8849	0.8799	...	357.18	37.34	369.17	0.2630	0.3104
m-xylene	C_8H_{10}	8	106.2	−47.9	139.1	0.8691	0.8643	1.4972	343.90	35.36	375.80	0.2590	0.3259
p-xylene	C_8H_{10}	8	106.2	13.3	138.4	0.8654	0.8608	1.4958	343.08	35.11	379.11	0.2598	0.3215
isopropylbenzene	C_9H_{12}	9	120.2	−96.0	152.4	0.8682	0.8632	1.4915	357.95	32.09	426.95	0.2611	0.3258
1,2,3-Trimethylbenezene	C_9H_{12}	9	120.2	−25.4	176.1	0.8985	0.8942	1.5130	391.38	34.54	414.20	0.2590	0.3664

Compound	Formula	N_C	API gravity	K_W	$P,^{sat}$ at 100°F bar	Viscosity, cSt $\nu_{38(100)}$	Viscosity, cSt $\nu_{99(210)}$	CH	T_F °C	AI, °C	AP, °C	Flammability range, vol.% Min	Flammability range, vol.% Max	RON clear
Paraffins														
Methane	CH_4	1	340.3	19.53	344.737	...	...	2.98	...	...	536.9	5.00	1.00	...
Ethane	C_2H_6	2	266.6	19.49	55.1579	...	...	3.97	...	...	471.9	2.90	13.00	1.6
Propane	C_3H_8	3	148.0	14.74	12.9621	0.1775	...	4.47	...	...	449.9	2.10	9.50	1.8
n-Butane	C_4H_{10}	4	110.4	13.49	3.5608	0.2533	0.1686	4.77	...	83.2	287.9	1.80	8.40	93.8
n-Pentane	C_5H_{12}	5	92.5	13.02	1.0745	0.3394	0.2643	4.96	−40.0	70.8	242.9	1.40	8.30	61.7
n-Hexane	C_6H_{14}	6	81.2	12.79	0.3435	0.4152	...	5.11	−21.7	68.7	224.9	1.20	7.70	24.8
n-Heptane	C_7H_{16}	7	73.5	12.67	0.1112	0.5046	0.3515	5.21	−4.1	...	203.9	1.00	7.00	0.0
n-Octane	C_8H_{18}	8	68.6	12.66	0.0370	0.6364	0.3997	5.30	12.9	...	205.9	0.96	...	...
n-Nonane	C_9H_{20}	9	64.5	12.66	0.0125	0.8078	0.4694	5.36	30.9	...	204.9	0.87	2.90	...
n-Decane	$C_{10}H_{22}$	10	61.2	12.67	0.0042	1.0154	0.5537	5.42	45.9	...	200.9	0.78	2.60	...
n-Undecane	$C_{11}H_{24}$	11	58.7	12.71	0.0014	1.2588	0.6397	5.46	65.0	...	201.9	...	...	...
n-Dodecane	$C_{12}H_{26}$	12	56.6	12.74	0.0005	1.5452	0.7469	5.50	73.9	...	202.9	...	...	...
n-Tridecane	$C_{13}H_{28}$	13	54.4	12.76	0.0002	1.8634	0.8624	5.53	78.9	...	201.9	...	...	...
n-Tetradecane	$C_{14}H_{30}$	14	53.1	12.82	0.0001	2.2294	0.9885	5.56	100.0	...	199.9	...	...	...
n-Pentadecane	$C_{15}H_{32}$	15	51.9	12.87	0.0000	2.6415	1.1328	5.59	113.9	...	201.9	...	...	...
n-Hexadecane	$C_{16}H_{34}$	16	51.6	12.97	0.0000	3.1229	1.2859	5.61	135.1	...	201.9	...	...	...
n-Heptadecane	$C_{17}H_{36}$	17	51.0	13.05	0.0000	3.6045	1.4413	5.63	147.8	...	201.9	...	...	...
n-Octadecane	$C_{18}H_{38}$	18	49.0	13.01	0.0000	4.1620	1.5815	5.64	165.1	...	201.9	...	...	...
n-Nonadecane	$C_{19}H_{40}$	19	48.1	13.04	0.0000	4.6090	1.7940	5.66	167.9	...	201.9	...	...	...
n-Eicosane	$C_{20}H_{42}$	20	47.8	13.12	0.0000	5.3165	1.9889	5.67	166.9	...	201.9	...	...	...
n-Heneicosane	$C_{21}H_{44}$	21	46.4	13.11	...	...	2.1703	5.69	176.9	...	201.9	...	...	...
n-Docosane	$C_{22}H_{46}$	22	45.8	13.15	...	...	2.4099	5.70	184.9	...	201.9	...	...	...
isobutane (2-Methylpropane)	C_4H_{10}	4	119.2	13.78	5.0199	0.2773	0.1873	4.77	...	107.7	460.1	1.80	8.40	0.1
isopentane (2-Methylbutane)	C_5H_{12}	5	94.4	13.01	1.4110	0.3066	...	4.96	−57.2	70.8	420.1	1.40	8.30	92.3
2-Methylpentane	C_6H_{14}	6	83.6	12.82	0.4666	0.3862	...	5.11	−35.2	73.8	...	1.20	7.70	73.4
2-Methylhexane	C_7H_{16}	7	75.9	12.72	0.1562	0.4730	...	5.21	−23.2	74.1	...	1.00	7.00	42.4
2-Methylheptane	C_8H_{18}	8	69.8	12.65	0.0528	0.5908	0.3635	5.30	4.1	73.9	...	0.98	...	20.6
2,2,4-Trimethylpentane (isooctane)	C_8H_{18}	8	71.0	12.52	0.1181	0.6077	0.3738	5.30	−12.2	79.5	...	1.00	...	100.0
2-Methyloctane	C_9H_{20}	9	65.7	12.66	0.0177	0.7382	0.4329	5.36	22.9	...	...	...	...	...
2-Methylnonane	$C_{10}H_{22}$	10	62.1	12.66	0.0058	0.9636	0.5401	5.42	40.9	...	...	...	...	...

Compound	Formula	N_C	API gravity	K_W	$p,^{sat}$ at 100°F bar	Viscosity, cSt $\nu_{38(100)}$	Viscosity, cSt $\nu_{99(210)}$	CH	T_F °C	AI, °C	AP, °C	Flammability range, vol.% Min	Flammability range, vol.% Max	RON clear
Olefins														
Ethene (Ethylene)	C_2H_4	2	888.0	48.49	...	...	...	5.96	...	...	...	2.30	32.30	...
Propene (Propylene)	C_3H_6	3	141.0	14.26	15.7812	0.1801	...	5.96	−108.2	...	455.1	2.00	11.00	100.2
1-Butene	C_4H_8	4	104.3	13.05	4.2953	...	...	5.96	...	...	383.9	1.60	9.30	97.4
1-Pentene	C_5H_{10}	5	87.7	12.66	1.3203	...	...	5.96	−18.2	19.1	272.9	1.50	8.70	90.9
1-Hexene	C_6H_{12}	6	76.9	12.46	0.4143	0.3415	...	5.96	−31.2	22.8	253.1	1.00	7.50	76.4
1-Heptene	C_7H_{14}	7	70.2	12.41	0.1353	0.4317	0.3043	5.96	0.1	27.3	263.1	0.80	6.90	54.5
1-Octene	C_8H_{16}	8	65.5	12.42	0.0453	0.5657	0.3590	5.96	20.9	32.6	230.1	0.80	6.80	28.7
1-Nonene	C_9H_{18}	9	61.5	12.43	0.0152	0.7004	0.4294	5.96	26.9	38.1	236.9	0.60	6.00	...
1-Decene	$C_{10}H_{20}$	10	58.4	12.45	0.0051	0.8848	0.5027	5.96	47.1	44.2	235.1	0.55	5.70	...
Acetylene	C_2H_2	2	...	...	...	...	...	11.92	−18.2	...	305.1	2.50	80.00	...
1,3 Butadiene	C_4H_6	4	...	...	4.0906	0.2030	0.2248	7.94	...	...	428.9	...	...	...
Naphthenes														
Cyclopentane	C_5H_{10}	5	57.1	11.12	0.6839	0.4973	...	5.96	−39.2	16.8	361.1	1.40	9.40	100.1
Methylcyclopentane	C_6H_{12}	6	56.2	11.31	0.3106	0.5646	...	5.96	−27.2	33.1	328.9	1.20	8.35	91.4
Ethylcyclopentane	C_7H_{14}	7	52.0	11.39	0.0970	0.6199	...	5.96	−4.1	36.8	260.1	1.10	6.70	67.2
Propylcyclopentane	C_8H_{16}	8	49.7	11.51	0.0325	0.7257	0.4613	5.96	15.9	44.5	269.1	0.95	6.40	31.2
n-Butylcyclopentane	C_9H_{18}	9	47.8	11.63	0.0108	0.9118	0.5148	5.96	31.9	48.8	250.1	0.80	5.90	97.0
n-Pentylcyclopentane	$C_{10}H_{20}$	10	46.4	11.75	...	1.1280	0.6200	5.96	...	...	...	0.74	5.47	...
n-Hexylcyclopentane	$C_{11}H_{22}$	11	45.2	11.86	...	1.4150	0.7300	5.96	...	...	...	0.68	5.20	...
n-Heptylcyclopentane	$C_{12}H_{24}$	12	44.3	11.97	...	1.7480	0.8500	5.96	...	...	...	0.62	5.06	...
n-Octylcyclopentane	$C_{13}H_{26}$	13	43.5	12.07	...	2.1300	0.9800	5.96	...	...	...	0.57	5.01	...
n-Nonylcyclopentane	$C_{14}H_{28}$	14	42.7	12.16	...	2.5700	1.1200	5.96	...	...	...	0.53	5.07	...
n-Decylcyclopentane	$C_{15}H_{30}$	15	42.1	12.25	...	3.0500	1.2700	5.96	...	...	...	0.50	5.24	...
n-Undecylcyclopentane	$C_{16}H_{32}$	16	41.6	12.33	...	3.6300	1.4400	5.96	...	...	...	0.47	5.53	...
n-Dodecylcyclopentane	$C_{17}H_{34}$	17	41.1	12.41	...	4.2500	1.6100	5.96	...	...	...	0.44	5.95	...
n-Tridecylcyclopentane	$C_{18}H_{36}$	18	40.7	12.48	...	4.9500	1.7800	5.96	...	...	...	0.41	6.53	...
n-Tetradecylcyclopentane	$C_{19}H_{38}$	19	40.3	12.55	...	5.7100	1.9800	5.96	...	...	...	0.39	7.33	...
n-Pentadecylcyclopentane	$C_{20}H_{40}$	20	40.0	12.61	...	6.5600	2.1900	5.96	...	...	...	0.37	8.38	...
n-Hexadecylcyclopentane	$C_{21}H_{42}$	21	39.7	12.67	...	7.4900	2.4000	5.96	...	...	...	0.35	9.79	...
n-Heptadecylcyclopentane	$C_{22}H_{44}$	22	39.4	12.73	...	...	...	5.96	...	...	...	0.34	11.67	...
Cyclohexane	C_6H_{12}	6	49.4	11.00	0.2274	0.9419	...	5.96	−20.0	31.1	260.1	1.30	8.00	83.0
Methylcyclohexane	C_7H_{14}	7	51.1	11.31	0.1106	0.7640	0.4757	5.96	−5.9	41.1	285.1	1.15	7.20	74.8
Ethylcyclohexane	C_8H_{16}	8	47.0	11.35	0.0333	0.8629	0.5122	5.96	22.1	43.8	261.9	0.90	6.60	45.6
Propylcyclohexane	C_9H_{18}	9	45.8	11.50	0.0117	1.0010	0.5759	5.96	30.9	49.8	248.1	0.95	5.90	17.8
n-Butylcyclohexane	$C_{10}H_{20}$	10	44.6	11.64	0.0040	1.2539	0.6100	5.96	47.9	54.4	246.1	0.85	5.50	...
Aromatics														
Benzene	C_6H_6	6	28.7	9.74	0.2216	0.5927	0.3306	11.92	−11.2	−30.0	560.1	1.40	7.10	...
Methylbenzene (Toluene)	C_7H_8	7	30.4	10.11	0.0710	0.5604	0.3433	10.43	4.9	−30.0	480.1	1.20	7.10	105.8
Ethylbenzene	C_8H_{10}	8	30.5	10.34	0.0257	0.6540	0.3970	9.53	15.1	−30.0	430.1	1.00	6.70	100.8
Propylbenzene	C_9H_{12}	9	31.5	10.59	0.0100	0.7977	0.4534	8.94	30.1	−30.0	456.1	0.88	6.00	101.5
n-Butylbenzene	$C_{10}H_{14}$	10	31.9	10.82	0.0033	0.9483	0.5186	8.51	50.1	−30.0	410.1	0.80	5.80	100.4
n-Pentylbenzene	$C_{11}H_{16}$	11	32.6	11.03	0.0011	1.1824	0.6295	8.19	65.1	...	...	0.80	5.50	...
n-Hexylbenzene	$C_{12}H_{18}$	12	32.6	11.19	0.0004	1.4419	0.7334	7.94	80.1			0.70	5.30	
n-Heptylbenzene	$C_{13}H_{20}$	13	32.7	11.35	0.0001	1.7546	0.8546	7.75	95.1	...	...	0.70	5.10	...
n-Octylbenzene	$C_{14}H_{22}$	14	33.0	11.50	0.0000	2.0974	0.9763	7.58	107.1	...	...	0.70	4.90	...
n-Nonylbenzene	$C_{15}H_{24}$	15	33.1	11.63	0.0000	2.5329	1.1089	7.45	98.9	...	...	0.60	4.70	...
n-Decylbenzene	$C_{16}H_{26}$	16	33.2	11.75	0.0000	3.0119	1.2490	7.33	106.9	...	...	0.60	4.60	...
n-Undecylbenzene	$C_{17}H_{28}$	17	33.3	11.86	0.0000	3.5672	1.3983	7.23	143.9	...	...	0.60	4.40	...
n-Dodecylbenzene	$C_{18}H_{30}$	18	33.1	11.94	0.0000	4.1857	1.5509	7.15	140.9	...	...	0.60	4.30	...
n-Tridecylbenzene	$C_{19}H_{32}$	19	33.3	12.05	0.0000	4.9566	1.7258	7.07	164.9	...	...	0.50	4.20	...
n-Tetradecylbenzene	$C_{20}H_{34}$	20	33.3	12.13	0.0000	5.7107	1.8853	7.01	173.9	...	...	0.50	4.10	...
n-Pentadecylbenzene	$C_{21}H_{36}$	21	33.3	12.20	0.0000	6.5716	2.0862	6.95	182.9	...	...	0.50	4.00	...
n-Hexadecylbenzene	$C_{22}H_{38}$	22	33.3	12.28	0.0000	7.4138	2.2939	6.90	192.9	...	...	0.50	3.90	...
o-xylene (*o*-dimethylbenzene)	C_8H_{10}	8	28.4	10.27	0.0182	...	0.4238	9.53	16.9	...	463.1	1.00	6.00	...
m-xylene	C_8H_{10}	8	31.3	10.42	0.0226	0.5936	0.3644	9.53	25.1	−30.0	465.1	1.10	7.00	104.0
p-xylene	C_8H_{10}	8	32.0	10.46	0.0237	0.6167	0.3704	9.53	25.1	−30.0	528.1	1.10	7.00	103.4

Arabian crude and straight run products specifications

	Light	Medium	Heavy
Crude, °API	38.8	30.7	28.2
Sulfur, % wt	1.1	2.51	2.84
Light naphtha			
Cut range, °F	68–212	68–212	68–212
Yield, % vol	10.5	9.4	7.9
Gravity, °API	77.4	78.4	80.1
Sulfur, % wt	0.056	0.007	0.0028
RVP, Psi	6.9	7.9	10.2
Paraffins, % vol	87.4	89.7	89.6
Naphthenes, % vol	10.7	8.8	9.5
Aromatics, % vol	1.9	1.5	0.9
RON clear	54.7	48.2	58.7
Heavy naphtha			
Cut range, °F	212–302	212–302	212–302
Yield, % vol	9.4	7.4	6.8
Gravity, °API	58.8	59.6	60.6
Sulfur, % wt	0.057	0.019	0.018
Paraffins, % vol	66.3	67.8	70.3
Naphthenes, % vol	20.0	20.8	21.4
Aromatics, % vol	13.7	11.4	8.3
Kerosene			
Cut range, °F	302–455	302–455	302–455
Yield, % vol	18.4	13.5	12.5
Gravity, °API	48.0	48.9	48.3
Sulfur, % wt	0.092	0.12	0.19
Paraffins, % vol	58.9	59.9	58.0
Naphthenes, % vol	20.5	21.9	23.7
Aromatics, % vol	20.6	18.2	18.3
Freeze point, °F	−67	−72	−84
Smoke point, mm	26	23	26
Luminometer no.	57	55	60
Aniline point, °F	133	139	138
Kin cSt at –30 °F	5.09	4.63	4.74
Kin cSt at 100 °F	1.13	1.09	1.12

All °F readings must be converted to °C

$$°C = \frac{°F - 32}{1.8}$$

Light gas oil			
Cut range, °F	455–650	455–650	455–650
Yield, % vol	21.1	17.4	16.4
Gravity, °API	37.3	37.2	35.8
Sulfur, % wt	0.81	1.09	1.38
Pour point, °F	10	0	5
Aniline point, °F	166	156	156
Kin cSt at 100 °F	3.34	3.15	3.65
Kin cSt at 210 °F	1.32	1.22	1.4

	Light	Medium	Heavy
Heavy gas oil			
Cut range, °F	650–1,049	650–1,049	650–1,049
Yield, % vol	30.6	30.5	26.3
Gravity, °API	24.8	22	21.8
Sulfur, % wt	1.79	2.87	2.88
Pour point, °F	100	75	90
Aniline point, °F	195	172	172
Kin cSt at 100 °F	49.0	62.2	62.5
Kin cSt at 210 °F	6.65	7.25	7.05
Atmos. residue			
Cut range, °F	+650	+650	+650
Yield, % vol	38.0	50.0	53.1
Gravity, °API	21.7	14.4	12.3
Sulfur, % wt	2.04	4.12	4.35
Pour point, °F	75	55	55
Con carb, % wt	4.5	10.0	13.2
Kin cSt at 100 °F	146	1,570	5,400
Kin cSt at 210 °F	12.4	54.0	106
Vacuum residue			
Cut range, °F	+1,049	+1,049	+1,049
Yield, % vol	7.4	19.5	26.8
Gravity, °API	11.5	3.8	4.0
Sulfur, % wt	3.0	5.85	5.6
Pour point, °F	80	120	120
Con carb, % wt	19	22.8	24.4
Kin cSt at 210 °F	392	19,335	13,400
Kin cSt at 275 °F	40.1	743	490
Vanadium, ppm	12	249	171
Nickel, ppm	7	55	53
Iron, ppm	36	79	28

All °F readings must be converted to °C