

Appendix A

Applied Units and Conversions

Table A.1 Base units of the International System of Units (SI) (Système International d'Unités)

Description	Name	Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Electric current	Ampere	A
Absolute temperature	Kelvin	K
Amount of a substance	Mole	Mol
Light intensity	Candela	Cd
Flat angle	Radian	R
Rigid angle	Steradian	Sr

Table A.2 Supplementary units of the International System of Units (SI) (Système International d'Unités)

Description	Name	Definition
Frequency	Hertz	$1 \text{ Hz} = \text{s}^{-1}$
Strength	Newton	$1 \text{ N} = 1 \text{ kg m s}^{-2} = 10^5 \text{ dyn}$
	Pond	$1 \text{ p} = 9.807 \times 10^{-3} \text{ N}$
	Dyn	$1 \text{ dyn} = 10^{-5} \text{ N}$
	Conversions	
	Poundal	$1 \text{ pdl} = 0.138 \text{ N}$
	Pound-force	$1 \text{ lbf} = 4.448 \text{ N}$
	Ton-force	$1 \text{ tonf} = 9.964 \text{ kN}$
Mechanical tension	Pascal	$1 \text{ Pa} = 1 \text{ N m}^{-2}$
	Phys.	$1 \text{ atm} = 1.01325 \times 10^5 \text{ Pa} = 760 \text{ Torr} = 1.01325$
	atmosphere	$\text{bar} = 1.03327 \text{ at}$

(continued)

Table A.2 (continued)

Description	Name	Definition
	Techn. atmosphere	1 at = 0.980623×10^5 Pa = 735.559 Torr = 10 m WS = 10^4 kp m ⁻² = 0.96780 atm
	Torr	1 Torr = 133.3 Pa = 1.333 mbar = 1 mm Hg
	Pascal	1 Pa = 9.86923×10^{-6} atm = 7.50062×10^{-3} Torr = 10^{-5} bar
	Bar	1 bar = 1 dyn m ⁻² = 10^5 Pa
	Kilopond per m ²	1 kp m ⁻² = 9.807 Pa = 9.678×10^{-5} atm = 10^{-4} at
		Conversions
	Pound per square inch	1 psi = 6,894.757 Pa
	Pound-weight per square foot	1 lbf ft ⁻² = 47.88 Pa
	Poundal per square foot	1 pdl ft ⁻² = 1.488 Pa
	Ton-weight per square foot	1 ton ft ⁻² = 107.3 kPa
Energy	Joule	1 J = 1 N m = 1 Ws = 0.2388 cal = 0.102 kp m = 2.778×10^{-7} kWh
	Volt-Ampere second	1 V A s = 1 J = 10^7 erg = 0.101kp m = 0.238846 cal = 6.241×10^{18} eV
	Electron volt	1 eV = 1.60219×10^{-19} J = 1.6335×10^{-20} kp m = 96.485 kJ mol ⁻¹ = 23.061 kcal mol ⁻¹
	Calorie	1 cal = 4.187 J = 0.427 kp m = 3.97×10^{-3} BTU
	Meter kilopond	1 kp m = 9.807 J = 2.342 cal = 6.122×10^{19} eV
	Kilowatt hour	1 kW h = 1.341 HP h = 860 kcal = 367,097 kp m = 3.6×10^6 J = 3,412 BTU
		Conversions
	Pound-weight foot	1 lbf ft = 0.138 kp m = 1.356 J
	British thermal unit	1 BTU = 0.252 kcal = 107.6 kp m = 1 055.56 J
	Ton of coal equivalent	1 tce = 2.931×10^{10} J
	Ton of oil equivalent	1 toe = 4.187×10^{10} J
	Horse- power hour (UK, US)	1 HPhr = 0.7457 kWh = 641.616 kcal = 273 959 kp m = 2.649×10^6 J
Performance	Watt	1 W = 1 J s ⁻¹ = 0.856 kcal h ⁻¹ = 1.36×10^{-3} HP = 0.101 972 kp m s ⁻¹
		Conversions
	Horsepower	1 HP = 550 lbf ft s ⁻¹ = 745.670 W
	Pound-weight foot per second	1 lbf ft s ⁻¹ = 1.356 W
	British thermal unit per hour	1 BTU hr ⁻¹ = 0.2931 W
Electricity	Volt	1 V = 1 W A ⁻¹
Temperature	Temperature difference	1 K = t _C + 273.15 = 5/9 (t _F - 32) + 273.15
	Degree Celsius	1°C = t _K - 273.15 t _C = 5/9 (t _F - 32)
	Degree Fahrenheit	1°F = 9/5 (t _K - 273.15) + 32 t _F = 9/5 t _C + 32

Table A.3 Additional units of the International System of Units (SI) (Système International d'Unités)

Description	Name	Symbol	Definition
Time	Minute	min	1 min = 60 s
	Hour	h	1 h = 3.6×10^3 s
	Day	d	1 d = 8.64×10^4 s
	Year	a	1 a = nrl. 3.155×10^7 s
	Mega year	Ma	1 Ma = 10^6 years = 3.155×10^{13} s
	Giga year	Ga	1 Ga = 10^9 years = 3.155×10^{16} s
Flat angle	Degree	°	1° = $(\pi/180)$ rad
Length	Meter	m	1 m = 100 centimeter (cm) = 10^3 millimeter (mm)
	Kilometer	km	1 km = 1,000 m = 10^6 mm = 0.621 mi
Conversions			
	Statute mile	mi	1 mi = 1 760 yd = 1.609 km
	Nautical mile	nmi	1 nmi = 1.852 km
	Inch	in	1 in = 2.54 cm
	Foot	ft	1 ft = 12 in = 0.305 m
	Yard	yd	1 yd = 3 ft = 0.914 m
	League	lq	1 lq = 3 mi = 4.828 km
	Fathom	fa	1 fa = 6 feet = 1.829 m
	Cable	cl	1 cl = 608 feet = 185.31 m
	Sea league	slq	1 slq = 3 nmi = 5.556 km
Area	Square meter	m ²	1 m ² = 10^4 square centimeter (cm ²) = 10^6 square millimeter (mm ²)
	Square kilometer	km ²	1 km ² = 100 hectare (ha) = 10^4 Ar (a) = 10^6 m ²
Conversions			
	Square inch	in ²	1 in ² = 6.45 cm ² = 6.45×10^{-4} m ²
	Square foot	ft ²	1 ft ² = 144 sq in = 0.093 m ²
	Square rod	r ²	1 r ² = 30.25 sq ya = 25.29 m ²
	Square yard	yd ²	1 yd ² = 9 sq ft = 0.836 m ²
	Acre	ac	1 ac = 4,840 sq yd = 4 047 m ²
	Square mile	mi ²	1 mi ² = 2,589 km ²
Volume	Liter	l	1 l = 1 dm ³ = 0.264 gal (US) = 0.22 gal (UK)
	Cubic meter	m ³	1 m ³ = 10^3 cubic decimeter (dm ³) = 10^3 liter (l) = 10^6 cubic centimeter (cm ³) = 10^6 milliliter (ml)
Conversions			
	Cubic foot	cu ft	1 ft ³ = 1,728 in ³ = 28.317 dm ³
	Cubic yard	cu yd	1 yd ³ = 27 ft ³ = 0.765 m ³
	Cubic inch	cu in	1 in ³ = 16.387 cm ³
	Pint (US)	pt (US)	1 pt (US) = 0.473 l
	Pint (UK)	pt (UK)	1 pt (UK) = 0.568 l
	Quart (US)	qt (US)	1 qt (US) = 2 pints (US) = 0.946 l
	Quart (UK)	qt (UK)	1 qt (UK) = 2 pints (UK) = 1.137 l
	Gallon (US)	gal (US)	1 gal (US) = 4 quarts (US) = 3.785 l
	Gallon (UK)	gal (UK)	1 gal (UK) = 4 quarts (UK) = 4.546 l
	Barrel (US)	bbl	1 bbl = 42 gal (US) = 158.987 l = 0.159 m ³
	Dry barrel (US)	dbbl	1 dbbl = 0.1156 m ³
	Gross register tonnage	GRT	1 GRT = 100 ft ³ = 2.8317 m ³

(continued)

Table A.3 (continued)

Description	Name	Symbol	Definition
Mass	Kilogram	kg	1 kg = 10 ³ gram = 10 ⁶ milligram = 2.205 lb
	Ton	t	1 t = 10 ³ kg
	Kiloton	kt	1 kt = 10 ⁶ kg
Conversions			
	Pound	lb	1 lb = 16 ounces (oz) = 0.454 kg
	Ounce	oz	1 oz = 28.35 g
	Hundredweight (UK)	cwt	1 cwt = 112 lb = 50.802 kg
	Long ton (UK)	ltn	1 ltn = 20 cwt = 2,240 lb = 1.016 metric t = 1,016 kg
	Short ton (US)	shtn	1 shtn = 2,000 lb = 0.907 metric t = 907 kg
	Slug	sl	1 sl = 14.594 kg
Density	Kilogram per liter	kg dm ⁻³	1 kg dm ⁻³ = 1 t m ⁻³ = 1 g cm ⁻³ = 10 ³ kg m ⁻³
	Pound per cubic foot	lb ft ⁻³	1 lb ft ⁻³ = 16.018 kg m ⁻³ = 0.016018 kg t ⁻¹
	Pound per gallon (UK)	1 lb gal ⁻¹ (UK)	1 lb gal ⁻¹ (UK) = 0.099776 t m ⁻³
	Pound per gallon (US)	lb gal ⁻¹ (US)	1 lb gal ⁻¹ (US) = 0.11983 t m ⁻³
Speed	Meter per second	m s ⁻¹	1 m s ⁻¹ = 3.6 km h ⁻¹ = 2.237 mph
	Foot per minute	ft min ⁻¹	1 ft min ⁻¹ = 5.08 × 10 ⁻³ m s ⁻¹ = 1.83 × 10 ⁻² km h ⁻¹ = 1.14 × 10 ⁻² mph
	Miles per hour	mph	1 mph = 1.609 km h ⁻¹ = 0.447 m s ⁻¹
	Knot	kn	1 kn = nautical or sea mile per hour = nmi h ⁻¹ = 1.852 km h ⁻¹ = 0.514 m s ⁻¹
Fuel consumption	Liter per 100 km	1 × 100 km ⁻¹	1 l × 100 km ⁻¹ = 282/impg (UK) = 235/mpg (US)
	Conversions		
	Miles by gallon (US)	mpg (US)	1 mpg (US) = 235.21 l × 100 km ⁻¹
	Miles by gallon (UK)	mpg (UK)	1 mpg (UK) = 282.48/l × 100 km ⁻¹
	Miles by gallon (UK/US)	mpg (UK/US)	1 mpg (UK) = 1.2 mpg (US)
	Gram per kilowatt hour	g kWh ⁻¹	1 g kWh ⁻¹ = 10.527 × 10 ⁻⁶ oz BTU ⁻¹
	Gram per horsepower hour	g HPh ⁻¹	1 g HPh ⁻¹ = 1.360 g kWh ⁻¹
	Lower heating value of fuel	LHV	1 LHV = 10,200 kcal kg ⁻¹ = 42,707 kJ kg ⁻¹
Specific emissions	Gramm per kilometer	g km ⁻¹	1 g km ⁻¹ = 56.8 × 10 ⁻³ oz mi ⁻¹
	Ounce per mile	oz mi ⁻¹	1 oz mi ⁻¹ = 17.543 g km ⁻¹
Radiation forcing	Milliwatt per square meter	mW m ⁻²	1 mW m ⁻² = 636 lbf ft (s yd ²) ⁻¹
Dynamic viscosity	Poise	P	1 P = 0.010 (kp s) m ⁻² = 0.1 N s m ⁻²
Conversions			
	Pound per foot and second	lb (ft s) ⁻¹	1 lb (ft s) ⁻¹ = 1.487 N s m ⁻²
	Pound-force second per square foot	lbf s ft ⁻²	1 lbf s ft ⁻² = 47.88 N s m ⁻²
Kinematic viscosity	Square meter per second	m ² s ⁻¹	1 m ² s ⁻¹ = 10 ⁶ cSt = 3.6 × 10 ³ m ² h ⁻¹
	Centistoke	cSt	1 cSt = 10 ⁻⁶ m ² s ⁻¹ = 10 ⁻² St
Conversions			
	Square foot per second	ft ² s ⁻¹	1 ft ² s ⁻¹ = 0.0929 m ² s ⁻¹
	Square foot per hour	ft ² h ⁻¹	1 ft ² h ⁻¹ = 2.5806 × 10 ⁻⁵ m ² s ⁻¹

Table A.4 Prefixes of the SI International System of Units ((Système International d'Unités)

Factor	Name	Symbol
10^{18}	Exa	E
10^{15}	Peta	P
10^{12}	Tera	T
10^9	Giga	G
10^6	Mega	M
10^3	Kilo	K
10^2	Hecto	H
10	Deca	Da
10^{-1}	Deci	d
10^{-2}	Centi	c
10^{-3}	Milli	m
10^{-6}	Micro	μ
10^{-9}	Nano	n
10^{-12}	Pico	p
10^{-15}	Femto	f
10^{-18}	Atto	a

Table A.5 Units of concentration

Name	Symbol	Definition
Percent parts per hundred	%	
Parts per million	ppm (v)	10^{-6} to volume
Parts per million	ppm (m)	10^{-6} to mass
Parts per billion	ppb	10^{-9}
Parts per trillion	ppt	10^{-12}

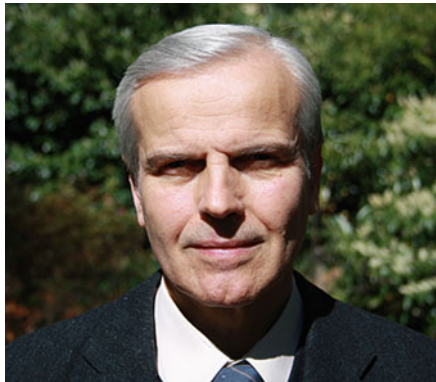
Table A.6 Conversion factors

Unit	PJ	TWh	10^6 t CU coal unit	10^6 t ROU Crude Oil Unit
1 Petajoule (PJ)	1	0.2778	0.0341	0.0239
1 Terawatt hour (TWh)	3.6	1	0.123	0.0861
10^6 t CU	29.308	8.14	1	0.7
10^6 t ROU	41.69	11.63	1.429	1

Table A.7 Calculation of weight to volume

Physical properties			
Fuel sorts	Density by 15°C (59°F) g ml ⁻¹ (lb ft ⁻³)	1 ton equals	
		liter l	barrel bbl
Mineral oil (medium)	ca. 0.862 (53.82)	ca. 1,160	ca. 7.3
Gasoline	0.725–0.780 (45.26–48.69)	1,280–1,380	8.1–8.7
Diesel oil	0.820–0.845 (51.19–52.75)	1,180–1,220	7.4–7.7

About the Author



Professor Palocz-Andresen studied mechanical engineering and energy systems at the TU Montan University Mining Academy Freiberg, Saxony Germany. Finishing his PhD in 1978, he later became a scientist at the University of Karlsruhe at the Engler-Bunte-Institute and received his habilitation in 1993. At Maihak AG, Hamburg, he was the head of Environmental Application Analysis. He is a professor for Environmental and Climate Protection at the University of West Hungary in Sopron (Oedenburg). At the Leuphana University in Lüneburg he is has been offered a guest chair for Sustainable Transportation.

Professor Palocz-Andresen holds 50 German and 3 international patents which are registered in approximately 40 countries. He has directed 35 technical scientific projects in the energy industry, in gas supply technology, in water and waste water analysis technology, in mobility research, in micro measurement techniques, and in climate protection.

Professor Palocz-Andresen is a member of the Committee “New Innovations” of the Chamber of Commerce Hamburg and of the “Meeting of the Respectable Merchants” in Hamburg.

In this book, covering all areas of transportation such as road vehicles, airplanes, and ships, solutions for economical and environmentally friendly technology are being examined. Fuel consumption, combustion processes, control, and the limitation of pollutants in exhaust gas are important environmental problems, for which guidelines such as 98/69/EC, 99/96, and 582/2011 determine the measuring technology and the processes for the reduction of fuel consumption and exhaust gas emissions. In addition to technological solutions, the consequences of international legislation and its effects on environmental and climate protection, and sustainability in the area of transportation are discussed.

Index

A

Acceleration and brake phase, 211
Acceleration resistance, 55
Acid rain, 83, 228
Active filter system, 38, 291
Active sound reduction, 278
Additive, 15, 19, 26
Aerodynamic condition, 279
Aerodynamic resistance , 114, 124, 278
Aeronautical information, 215
Aerosol, 228
Aggressive driving characteristic, 175
Agricultural area, 246
Air conditioning, 110, 123, 176
Air corridor, 234
Air resistance, 110, 118, 126
Air space, 45
Air traffic control clearance, 214
Air traffic service, 214
Airbag, 55, 98
Airfoil, 51, 112, 113
Airframe, 113, 126, 132
Airline timetable, 233
Airplane, 55, 65, 92
Airplane manufacturer, 205, 277
Airspace block, 219
Airspace congestion, 219
Airworthiness requirement, 178, 180, 182
All-electric airplane, 282
Altitudes of flight, 232
Aluminum-lithium alloy, 277
Ambient or outside air, 175
Angle of attack, 279
Anti-corrosion protection, 23

Approach control service, 215
Aromatic hydrocarbon, 15, 17, 28
Arrival route, 214, 218
Artificial laminar flow, 280
Asphaltene, 28
Atmosphere, 93, 241
Automatic transmission, 123
Auxiliary device, 95, 175, 222
Average noise emission level, 242
Aviation infrastructure, 214, 215

B

Basic pollution level, 175
Battery, 268, 281
Beacon technology, 221
Benzene, 15
Biogenic fuel, 21, 26, 246
Biomass, 22, 124, 227
Blended fuel, 287
Boiling point, 19
Boundary layer, 280
Braking, 39, 123, 211
Bulk carrier, 75, 159, 254
Bunker fuel, 258, 288
Bunker tank, 27
Burner, 38, 65, 143
Butane gas, 24

C

Cabin noise, 51
Calculation of risk, 202
CAN bus communication, 193

C (*cont.*)

Carbon dioxide, 1, 91
 Carbon monoxide, 1, 91
 Cargo heating, 237
 Cargo vessel, 50
 Catalyst function, 193
 Catalyst heating, 193
 Catamaran, 53, 54, 56
 Certified analyzer, 175
 Charcoal, 21
 Charging air pressure, 197
 Chemical composition, 3
 Chemical reformation, 19
 Cirrus cloud formation, 241
 Civil air transportation, 276
 Civil aviation, 24, 179, 252
 Civilian airports, 284
 Classification society, 183
 Cleaning process, 39
 Climate change, 184, 234, 250
 Climate gas, 1, 240
 Climate protection, 159, 240
 Climbing, 217, 218, 224
 Coastal surveillance, 221
 Cockpit, 66, 101, 252
 Cockpit and cabin personnel, 251
 Cold start, 62, 143
 Collision with ground, 217
 Combustion chamber, 19, 86, 138
 Combustion process, 3, 21, 167
 Commercial vehicle, 34, 35, 177
 Composite and fiber glass strengthened material, 239
 Composite material, 51, 130, 277
 Compression ratio, 139, 278
 Compressor, 154, 167, 265
 Computer aided traffic steering, 55
 Computer display, 175
 Computer supported diagnostic method, 192
 Condensation of water vapor, 174
 Conductivity, 51, 59
 Congestion, 55, 211, 270
 Consumption quota, 3
 Container ship, 46, 49, 115
 Control cycle, 3, 176, 177
 Control system, 101, 183, 291
 Controlled area, 215
 Conventional fuel, 26, 29, 246
 Conventional jet airplane, 258
 Conversion of methane to hydrogen, 276
 Conversion of real operation, 8
 Convertible, 35, 248
 Cooling, 123, 143, 165

Cost of automobile, 248
 Crack component, 16, 19
 Cracking, 24, 28
 Crankshaft, 143, 144, 265
 Crew member, 75, 202, 203
 Cross section area, 278
 Cruise ship, 49, 285, 289
 Cruising, 45, 254, 277
 Cryogenic tank, 21
 Cryogenization, 275
 Crystallization, 19
 Curved trajectory, 279
 Customized change, 251
 Cyclone, 234
 Cylinder, 138, 139, 167

D

Data recorder, 203
 Data transfer system, 193
 Deactivator, 16
 Decomposition time, 149, 229, 300
 De-icing, 279
 Delayed start of the catalyst, 266
 Developing country, 228, 249
 Diagnostic function, 195
 Diesel engine, 132, 159, 163
 Diesel fuel, 13, 16, 23
 Digital distress signal, 221
 Diluted exhaust gas, 174
 Dimethyl ether, 23
 Dirigible, 293
 Disc brake, 39
 Distillation process, 24
 Distress communication, 183
 Distribution of lift force, 279
 Double side bulk, 256
 Driving assistant, 213
 Driving cycle, 174, 175, 177
 Driving route, 175
 Durability, 248, 253, 274

E

Economic calculation, 251
 Efficiency, 112, 124, 203
 Electric booster, 266
 Electric motor vehicle, 137, 271, 275
 Electric powered propeller, 281
 Electrochemical technique, 6
 Electrodes of the fuel cell, 276
 Electromagnetic compatibility, 188
 Electronic checkpoint, 211

Electronic detection of errors, 193
 Electronic stability program, 55
 Embedded electronic module, 254
 Emergency fuel, 27
 Emergency response operation, 221
 Emergency service, 249
 Emission, 82
 Empty weight, 47, 251, 281
 Emulsion, 23, 285, 293
 Energy density, 26
 Engine control device, 194
 Engine technology, 170, 171, 197
 Environmental and climate protection, 170, 185, 240
 Environmentally friendly vehicle fuel, 14
 Equipment of the aircraft, 216
 Erosion in the compressor, 200
 Established route structure, 292
 Ethanol, 22, 26
 Euro 5 and Euro 6 norms, 15
 European directive, 10
 Evaporation, 16, 24, 228
 Excessive braking, 265
 Exhaust gas, 84, 160, 267
 Exhaust gas after treatment system, 84, 160, 267
 Exhaust gas quality, 23, 163, 174
 Exhaust gas refeeding, 39, 193
 Extended flap, 218, 277

F

Fast re-distribution of weight, 279
 Fast regulated loudspeakers, 278
 Fatal accidents, 249
 Fermentation, 22
 Ferry, 52, 257
 Field elevation, 218
 Fighter, 51, 253, 281
 Filter system, 38, 292
 Financing cost, 252
 Fire fighting, 279
 Fireproof and corrosion resistant material, 182
 Fischer-Tropsch synthesis, 22, 29
 Fishing vessel, 51
 Flammable substance, 27
 Flash point, 19, 24, 26
 Fleet management, 75, 159, 210
 Flight by radar, 218
 Flight condition, 214
 Flight frequency, 233
 Flight profile, 218, 224
 Flight test for production, 251
 Flow rate, 174, 175, 180

Flywheel, 268
 Fossil fuel, 23, 240, 275
 Four-seat family-car, 264
 Framework, 184, 240
 Free flying area, 217, 224, 293
 Freight transportation, 4, 204, 264
 Freighter, 48, 281, 283
 Friction loss, 169
 Friction resistance, 280
 Fuel cell, 274, 278, 290
 Fuel consumption, 1, 117, 237
 Fuel level detection, 10
 Fuel saving economy, 45
 Fuel saving technology, 159
 Fuselage, 113, 281, 283

G

Gas bubble, 16
 Gas station, 13
 Gas turbine, 26, 132, 149
 Gasoline, 13, 257
 Gear, 121, 123, 132
 General aviation aircraft, 41
 Geothermal energy, 260
 Glass fiber strengthened composite material, 51
 Glide ratio, 280
 Global transportation, 245
 Global warming on the Earth, 227
 Gradual distillation, 16
 Ground control, 227
 Ground handling equipment, 277
 Guideline, 42, 175

H

Harbor, 93, 204, 260
 Hazardous material, 183
 Heat insulation, 51, 141, 241
 Heating value, 13, 19, 25
 Heavy commercial vehicle, 177, 187
 Heavy duty vehicles, 39, 63, 187
 Heavy marine fuel oil, 71, 258
 Heavy metal, 238
 Heavy storm with constant rain, 290
 Helicopter, 41, 51
 Heterocyclic nitrogen, 28
 Hexane, 24
 High durability, 72, 156, 253
 High sea, 214
 High speed four-stroke marine diesel engine, 162
 High strength aluminum alloy, 40

H (*cont.*)

Holding time, 176
 Homogenous mixing, 229
 Honeycomb sandwich construction module, 283
 Horizontal distance, 215
 Hot start, 16, 177, 187
 Hot-test, 176
 Humidity, 9, 93, 234
 Hurricane, 234
 Hydrocarbon, 82, 180, 228
 Hydrocracking, 275
 Hydrodynamic, 109, 117, 260
 Hydrodynamic lubrication, 19
 Hydrogen, 26, 274, 290
 Hydrogen to carbon relationship, 19

I

Ignition quality, 19
 Improved maneuvering, 278
 Industrial current connection, 270
 In-flight data exchange, 224
 Infrastructure, 11, 260, 293
 Inhibition of the catalyst, 276
 Initial climb, 217
 Injection system, 16, 137, 167
 Inland and coast navigation, 294
 Inland shipping, 116, 117, 225
 Inland waterway, 119, 188, 224
 Inspection, 191, 192, 205
 Insulation blanket, 51
 Insurance cost, 252
 Integrated telecommunication system, 209
 Intelligent monitoring technology, 301
 Intelligent recharging station, 272
 Internal combustion engine, 125, 271, 291
 International trade, 28
 Interpretation of time intervals, 297
 Irregular operation of engine, 193, 195

J

Japanese 10+15 mode, 177
 Jet engine, 149, 200, 259
 Jet fuel A, 24
 Jet fuel B, 24

K

Kerosene, 13, 24, 26
 Kevlar, 51

L

Lack of time limit, 297
 Landing and navigation fee, 252
 Landing cycle, 199
 Landing gear, 198, 218
 Last minute change in infrastructure, 293
 Lead emission, 250
 Lead-acid battery, 270
 Leakage of exhaust gas, 182
 Level of emission, 90, 241, 287
 Life cycle of ship, 255
 Light duty vehicle, 10, 38, 62
 Light gasoil, 27
 Light plastic, 239
 Lightning strike, 234
 Ligneous cellulose, 22
 Limited airspace, 232
 Limiting value, 3, 10, 90
 Linear extrapolation, 245
 Liquid fuel, 13, 26, 185
 Liquid hydrogen, 275
 Liquid paraffin, 19, 21
 Liquidity of the shipping company, 255
 Lithium-ion battery, 270, 274
 Load of the engine, 9, 65
 Local environment, 211
 Long distance transport, 263, 271
 Long range flight, 26, 280
 Low boiling end point, 15

M

Main engine, 28, 99, 237
 Main propulsion, 117
 Maintenance cost, 47, 127, 192
 Maintenance philosophy, 199
 Malfunction, 105, 196, 205
 Maneuvering load, 279
 Marine diesel engine, 160, 168, 285
 Marine pollution, 221
 Market forecast, 255
 Mass transportation, vi, 241, 272
 Maximal exhaust gas temperature, 265
 Maximum freight load, 47
 Maximum takeoff weight, 47, 254
 Mechanical deterioration, 195
 Medium speed, 160, 162
 Megacities, 271, 292
 Member state, 178
 Merchant fleet, 51
 Merchant ship, 170, 254
 Metal container, 270

Metal hydrid, 21
 Meteorological and navigation information, 220
 Methane, 26, 83, 276
 Methanol, 22, 26, 276
 Methyl tertiary butyl ether, 16
 Metric unit system, 1
 Micro controller, 5, 8
 Micro particle sensor, 197
 Micro, mild and full hybrid vehicle, 269
 Middle distance airplane, 114
 Middle distillate, 27
 Mid-size car, 4, 62, 257
 Mid-size performance, 268
 Military airplane, 41, 51, 99
 Military airport, 284
 Military aviation, 51
 Misfires, 195, 197
 Mixed fuel, 22
 Mixture adaptation, 193
 Mixture tank, 27
 Mock up, 251
 Modified propeller drive, 278
 Molecule, 24, 28, 241
 Monitoring operation condition, 203
 Motor octane number, 16
 Motor vehicle, 18, 173, 272

N

Narrow body airplane, 45
 National authority in aviation, 178
 Natural gas, 19, 255, 276
 Navigation, 209, 219, 235
 Navigational warning, 221
 Navy gasoil, 27
 New distribution system, 288
 New energy storage system, 259
 New propfan engine, 278
 New technology, 242, 268, 300
 Nitrogen dioxide, 1, 91
 Nitrogen monoxide, 1, 91
 Nitrogen oxide emission, 185, 285
 Noise insulation of the fuselage, 278
 Noise level, 242
 Nomenclature of components, 193
 Nominal condition, 8, 59
 Non-perishable good, 258
 Normal aging process, 195
 Nose landing gear, 198
 Nuclear power, 293
 Number of revolution, 97, 160, 265

O

Obstructions in the vicinity of the airport, 216
 Oceanographic forecast, 221
 Octane number, 16
 Oil fired boiler, 51
 Oil production, 245
 On-board electricity, 290
 Open rotor jet engine, 252
 Operating cost, 203, 251
 Operation parameter, 138, 141, 155
 Optical sensor, 209, 222
 Optimal bunkering, 260
 Organic lithium electrolytic solution, 270
 Overhaul interval, 202
 Oversized glider, 280, 282
 Oxygen, 13, 95, 195
 Ozone, 227, 228, 241

P

Particle, 81, 197, 291
 Particle filter, 160, 268, 291
 Passenger airplane, 257, 281, 293
 Passenger car, 175–177
 Passenger kilometer, 1, 241
 Passenger mile, 1
 Passive filter system, 38
 Payload, 55, 113
 Peak travel time, 41
 Pentane, 24
 Performance, 49, 128, 144
 Permissible engine temperature, 271
 Petrol, 13, 15, 27
 Petroleum refining, 27
 Photovoltaic solar power, 290
 Pilot-controller communication, 217
 Pilot rating, 217
 Piston engine, 278
 Pollutant, 126, 211, 292
 Position of vehicle, 209
 Positive displacement compressor, 266
 Power factor, 271
 Pre-defined norm, 4
 Present data, 6
 Pressure regulator, 60
 Pressure sensor, 86, 92, 103
 Preventive maintenance, 202, 205
 Prices of gasoline and diesel oil, 276
 Private jet, 41
 Professional decommissioning, 239
 Propane, 19
 Propeller, 116, 128, 278

P (*cont.*)

Propulsion system, 115, 121, 132
 Protected sea area, 72
 Public parking place, 272
 Public transportation, 241, 255

Q

Qualification of the crew, 217

R

Radar coverage, 227
 Radio and satellite navigation, 224
 Radio navigation procedure, 216
 Radio wave, 214
 Rear area of the wing, 277
 Rebuilt airplane, 276
 Recreational and offshore ship, 220
 Recycling, 238–240
 Recycling of ships, 240
 Refined maritime type of petroleum, 258
 Refinery and manufacturer, 288
 Refinery process, 19
 Reformation of methanol, 276
 Refueling, 260, 275
 Refueling time, 275
 Regular commercial service, 279
 Regular supervision, 183
 Renewable energy source, 260, 285, 292
 Replacing old ships, 255
 Research octane number, 16
 Resistance to wear, 293
 Retrofitting cost, 276
 Revolution sensor, 197
 Reynolds number, 115, 280
 Road traffic, 87, 209, 230
 Road vehicle, 34, 55, 121
 Roller test bench, 175
 Rolling resistance, 111, 118, 124
 Rough running, 195, 197
 Route network, 233
 Rudder assembly, 277
 Runtime, 173, 202

S

Safety communication, 221
 Safety standard, 25, 179, 292
 Sampling orifice, 180
 Sandwich construction, 46, 283

Satellite and terrestrial radio communication, 220
 Scenario, 83, 240, 300
 Seaborne trade, 47
 Seagoing ship, 4, 27
 Secondary air system, 193, 195
 Sediments of liquid paraffin crystal, 19
 Self ignition engine, 139, 257, 264
 Sensor signal, 9, 98, 205
 Separator system, 28
 Service time interval, 279
 Settling tank, 27, 72, 73
 Ship construction, 33, 128, 168
 Ship exhaust gas, 9
 Shipping schedule, 204
 Shore power, 204, 260
 Short distance airplane, 251
 Short time power, 270
 Single-aisle airplane, 252, 283
 Single sky initiative, 292
 Slow speed two-stroke marine diesel engine, 168, 170, 293
 Slow steaming, 129, 242
 Slurry fuel, 28
 Smooth driving, 40
 Solar, 259, 283, 290
 Solar cell powered airplane, 283
 Solar cell technology, 290
 Soot, 23, 91, 288
 Spacecraft, 274
 Spark ignition engine, 137, 138, 193
 Spatial disorientation, 217
 Spoiler, 51, 109, 277
 Spoilers in landing gear, 277
 Spraying, 24, 140, 171
 Stainless steel, 85, 129, 180
 Starting phase, 4, 9
 Station wagon, 33, 35, 110
 Statutory inspection, 184
 Steady wind, 289
 Steam boiler, 237
 Steam engine, 51, 128, 298
 Steam turbine, 51, 298
 Steel and aluminum, 118, 166, 239
 Steel sheet, 40
 Stopping, 131, 174
 Storage capacity, 205
 Storage of electricity, 273
 Storage of hydrogen, 21, 275
 Storage of the data, 258
 Storage tank, 27

Stratosphere, 227, 228
 Strengthened wall, 270
 Submarine, 132, 274, 290
 Substantially changed part, 173
 Substitute new fuel type for traditional fuel, 301
 Sugar cane, 22, 27, 278
 Sulphur, 19, 184, 287
 Sulphur content, 19, 28, 184
 Sulphur dioxide, 83
 Sunflower, 22, 23
 Super fuel, 16
 Supply tank, 27
 Supporting service, 221
 Suspension, 40, 121, 131
 Sustainable transportation, 231
 Synthetic fuel, 30, 240
 System trials, 251

T

Takeoff weight, 47, 217, 254
 Tank, 49, 66, 72
 Tank leak diagnosis, 193, 195
 Tank ventilation system, 193, 195
 Tank volume, 39, 255
 Taxiing, 278
 Taxiing noise level, 242
 Technical improvement, 251
 Teflon bag, 174
 Temperature sensor, 160
 Test bench, 6, 59, 84
 Test procedure, 175
 Thermal effectiveness, 170, 293
 Three-cylinder engine, 265
 Thunderstorm zone, 234
 Tight steering, 40
 Tightness of the filler cap, 195
 Tornado, 234
 Total CO₂ emissions, 245
 Total life of parts, 200
 Tow kite system, 289
 Tower control, 215
 Traffic incident report, 215
 Traffic jam, 292
 Traffic organization, 55, 211, 218
 Trailing edge, 51, 279
 Trailing flap, 279
 Transmission factor, 39
 Transportation by road, 53
 Transportation by water, 53, 258
 Transporter, 279, 281

Tropical storm, 234
 Troposphere, 227, 232
 Trucking firm, 211
 Turbine engine, 24, 182
 Turbine wheel, 197
 Turbocharger, 137, 167, 265
 Turbofan engine, 101, 102, 150
 Turbo lag, 266
 Turboprop engine, 46, 132, 251
 Turboshift engine, 149
 Twin-engine, 68
 Type approval, 59, 173, 186
 Type certification, 173, 181, 258

U

Unburned hydrocarbon, 93, 180, 228
 Unloaded weight, 39
 Unmanned aircraft with hydrogen fuel cell, 282
 Unmanned airplane, 252
 Upper class car, 38
 Upstream to the catalyst, 9
 Urban sprawl, 55

V

Vacuum gasoil, 27
 Vapor lock, 16
 Vapor pressure, 16
 Variable wing profile, 277
 Vehicle, 34, 55, 109
 Very large airliner, 258
 Vessel, 74, 104, 219
 Viscosity, 19
 Visible emission, 186
 Volatile component, 16
 Volatility, 16, 90
 Voltage regulator of the engine, 270
 Volume specific heating value, 13

W

Waiting time at harbor, 260
 Waste product, 1
 Water, 15, 16, 74
 Water-gas, 21
 Water vapor, 82, 174, 228
 Weather information, 215
 Weight of airplane, 258
 Weight of vehicle, 231
 Weight saving, 277

W (*cont.*)Whole life cycle, [3](#), [84](#), [201](#)Wide body airplane, [45](#), [46](#)Wind, [69](#), [74](#), [93](#)Wing, [51](#), [113](#), [126](#)Wing aspect ratio, [280](#), [281](#)Wing box, [277](#)Wing geometry, [277](#)Wing stabilizer, [51](#)Woody sources, [22](#)World oil consumption, [245](#), [301](#)**Z**Zirconium dioxide, [6](#), [86](#)