Outlets (*continued*)
location, 554
selection, 554
types, 553
all-air high pressure, 558
ceiling diffusers, 556
grilles, 554
slot diffusers, 555

P

Peanuts, 135
drying, 135
off-flavor, 135
Peltier effect, 21
Perforated ceilings and outlets, 557
Permeability, 407–410
Permeance, 407–410
of materials, 407
testing, 409
pH factor, 224, 231–237

Physiological considerations for animals, 117
cattle, 117
heat and moisture release, 118
growth rate, 118
production rate, 117
reproduction, 118
poultry, 121
heat and moisture release, 122
sheep, 119
growth rate, 119
heat production, 120
production rate, 119
reproduction, 120
swine, 120
growth rate, 120
heat and moisture release, 121

Physiological considerations for plants, 122
environment and plant growth, 122
air composition, 125
humidity, 124
light, 122
temperature, 123
wind, 124

Physiological principles for humans, 101
chemical vitiation of air, 101
cold acclimatization, 104
comfort chart, 113
comfort zones, 109, 112
effective temperature, 107
environmental conditions and comfort, 109
heat acclimatization, 105
heat stress, 107, 110
high temperature hazards, 104
low temperature hazards, 104
metabolic rates, 104, 108, 109
minimum air required for odor removal, 102
minimum air requirements, 102
physical impurities of air, 102
physiological effect, 108
predicted four-hour sweat rate, 109
thermal interchanges, 120
upper limits of heat, 106
wet-bulb globe temperature, 108

Pipe, 877
applications, 892
economic considerations, 894
dimensions, 878
commercial, 879–881
copper, 880–881
steel, 878, 879

Pipe (*continued*)
expansion, 890
fittings, 882
flexibility, 890
gas line sizing, 813
hangers, 891
heat loss, 450, 451
insulation, 450–453
materials, 877
oil line sizing, 810, 811
properties, 878
copper, 880, 881
steel, 878, 879
supports, 891
threading practice, 881
welding, 889

Pipe fittings, 882
applications, 892, 893
flanged, 883, 884, 886
gaskets, 886
threaded, 882, 883
welded, 887
Pitot tube, 250

Plants, physiological considerations, 117
environment and plant growth, 122
air composition, 125
humidity, 124
light, 122
temperature, 123
wind, 124
Prandtl number, 59, 77

Pressure
absolute, 246
atmospheric, 41, 246
changes in ducts, 561
controllers, 715
differential, 247
instruments, 246
loss
dynamic, 95
frictional, 90
measurement, 246
regulators, 723
taps, 252
Pressure loss
dynamic, 95
frictional, 90
two-phase, 92–95

Properties of materials, 977
food products, 980–982
gases, 977
liquids, 978
solids, 979, 980
vapors, 977

Propylene glycol, 375
boiling point, 376
condensation temperature, 376
freezing point, 375
inhibition, 376
physical properties, 375
service considerations, 378
specific gravity, 377
specific heat, 378
thermal conductivity, 378
viscosity, 377
Protective coatings, 226

Psychrometric charts (inside back cover)
abridgment of chart 1, 42
use of charts, 42

Psychrometrics, 29
degree of saturation, 30

Psychrometrics (*continued*)
perfect gas relations, 30
processes, 43
properties, 29
moist air, 29, 31–34, 47
steam, 39, 40
water at saturation, 29, 35–38
psychrometric charts, 42
thermodynamic wet-bulb, 30
typical air-conditioning processes, 43
U. S. standard atmosphere, 41

Pumps, 863
air elimination, 867
applications, 868
hydraulic system characteristics, 865
installation, 867
laws, 863
location in system, 866
motive power, 867
net positive suction head, 865
noise level, 867
performance curves, 863, 864
selection, 867
sound control, 867
types, 863
construction features, 863

R

Radiation, 51

Radiators, 857
applications, 861
enclosure, paint, humidity effect, 862
heat emission, 857
non-standard conditions, 860
ratings, 857, 858, 860
Radioactive air contaminants, 158
Receivers
liquid, 700

Reciprocating compressors, 633
application, 640
automatic oil separators, 641
heat exchangers, 641
liquid return, 641
motor protection, 640
noise, 642
parallel operation, 641
protective devices, 641
shock, 642
vibration, 642
features, 634, 636
capacity control, 640
connecting rods, 637
crankcase heaters, 640
crankshafts, 636
cylinder cooling, 640
discharge valves, 639
hermetic motors, 639
lubrication, 638
main bearings, 637
oil cooling, 640
piston rings, 638
pistons, 638
seals, 639
suction valves, 639
valve plates, 640
wrist pins, 638
performance, 633
actual, 633
ideal, 633
motor efficiency, 635
motor starting torque, 635
presentation of data, 636
standard rating conditions, 636
suction gas superheat, 635
testing, 636

Refrigerant, refrigerants, 281
cycle calculations (theoretical), 286, 288–290
designations, 281
effect on construction materials, 291
elastomers, 292
metals, 291
plastics, 292
electrical properties, 284, 286, 287
heat properties, 284
heat capacity (specific heat), 284–286
leak detection, 291
ammonia, 291
bubble method, 291
electronic detector, 291
halide torch, 291
sulfur dioxide, 291
performance (theoretical cycles), 286, 288–290
physical properties, 282
heat capacity (specific heat), 284, 285
latent heat of vaporization, 284, 286
safety, 291, 292
thermal conductivity, 284
Underwriters' Laboratories' classification, 290, 291
velocity of sound, 286
viscosity, 283
reversing valves, 729

Refrigerant control, 715
capillary tubes, 734
basic rating curves, 738
capacity balance, 735
critical correction factor, 740
critical pressure chart, 740
flow factor chart, 739
inspection, 736
optimum refrigerant charge, 736
optimum selection, 736
preliminary selection, 737
processing, 736
simplified calculation procedure, 737
special applications, 736
system design factors, 734
theory, 734
control valves, 717
check, 731
condenser pressure regulators, 725
condensing water regulators, 730
constant pressure expansion, 722
evaporator pressure regulators, 723
high-side float, 725
low-side float, 726
refrigerant reversing, 729
relief, 732
solenoid, 726
suction pressure regulators, 724
thermostatic expansion, 717
controllers, 715
differential, 715
float switches, 716
pressure, 715
temperature, 715

Refrigerant systems
charging, 760
automatic, 760
manual, 760
special considerations, 761
contaminant control, 765
design conditions, 767
hermetic motor insulation, 772
lubricants, 771
motor burnouts, 773
operating conditions, 767
refrigerants, 769
tests for material evaluation, 768
contaminants, 765
acid, 765
antifreeze agents, 767

Refrigerant systems (*continued*)
copper plating, 765, 801
dirt, 766
flux, 766
metal, 766
moisture, 758–760, 765, 775
noncondensable gases, 766
sludge, 765
solvents, 766, 773
dehydration (factory), 757
dry air, 757
heat, 757
heat and dry air, 758
heat and vacuum, 758
moisture measurement, 759
special considerations, 759
vacuum, 757
desiccants, 777
adsorption, 779
chemical reactions, 779
equilibrium conditions, 778
driers, 780
acid removal, 781
filtering, 781
flow capacity, 781
rating, 781
selection, 781
testing, 781
drying methods, 776
leak testing, 761
detection methods, 761
special considerations, 762
lubricants, 783
antifoam agents, 799
chemical reactions in solutions, 801
film formation, 799
fluidity, 794
foaming agents, 799
oil return, 793–794
oxidation resistance, 800
phosphate treatments, 800
refrigerant resistance, 801
solubility of air in oils, 798
solubility of water in oils, 797, 802
solubility with refrigerants, 784
viscosity grades, 783
viscosity index, 783
viscosity-temperature curves, 789–801
volatility, 799
wax separation, 796
moisture 775
effects, 775
equilibria curves, 778–779
sources, 775
moisture measurement, 777
performance testing, 762
complete systems, 763
compressors, 762
of component, 764

Refrigerant tables and charts, 293–370

Refrigeration
commercial, 895
compressors, 633
centrifugal, 647
reciprocating, 633
rotary, 643
cycles, 10, 661
load calculations, 531
air changes, 531, 532
lights, 533
motors, 534
people, 533, 535
product load, 531
short method, 534
usage factors, 535
walls, 531, 532
motors, 869
commercial, 876
domestic, 872

Refrigeration (*continued*)
system component balancing, 711
effect of variables, 712
performance diagrams, 711
system performance, 713
trouble diagnosis, 713

Refrigeration, commercial, 895
cabinet construction, 897
condensers, 899
controls, 899
cooling towers, 899
display cases, 896
evaporators, 897
defrosting, 898
insulation, 896
reach-in cabinets, 895
recommended storage temperatures, 895
walk-in coolers, 895

Refrigeration cycles
absorption, 10, 661
absorbent-refrigerant combinations, 12
ammonia-water system data, 14, 665
analysis, 16
basic, 10, 661
chilled water temperature influence, 665, 666
coefficient of performance, 12, 663
condenser water temperature influence, 664–666
heat source temperature influence, 665, 666
lithium bromide-water system data, 15–17, 661
practical, 15
compression, 3
actual basic, 7, 11
coefficient of performance, 4
complex, 9
energy balance, 7, 9
equipment diagrams, 4, 9
ideal basic, 3, 11
performance factors, 4
pressure-enthalpy diagram, 4
reversed Carnot, 4, 11
temperature-entropy diagrams, 5–8, 10

Refrigerators, commercial, 895
cabinet construction, 897
condensers, 899
controls, 899
cooling towers, 899
display cases, 896
evaporators, 897
defrosting, 898
insulation, 896
reach-in cabinets, 895
recommended storage temperatures, 895
walk-in coolers, 895

Refrigerators, household (domestic), 901
absorption units, 907
cabinet design, 902
finishes, 902
insulation, 902
structure, 902
capillary tubes, 734–742, 904
compressor units, 903
hermetic, 903
reciprocating, 903
rotary, 903
condensers, 904
controls, 905
defrosting, 902
evaporators, 905
motors, 869–876, 904