## **INDEX**

air compressor intercooler, 56 air distribution, 22, 27 air flow inadequate, 128 air mass velocity optimum, 83 air-cooled steam condensers, 30, 104 airside heat transfer coefficient controlling,	condensing profiles, 2 condensing range, vii, 55, 63, 65, 67, 68 condensing service low pressure, 56 configuration A-frame, 25 horizontal, 25 congealing, 119, 123, 126, 140
30, 48, 78, 81–83, 137 alternative finning, 138 ambient temperature, 8–10, 21, 42, 44, 48, 49, 78, 117, 119, 121, 122, 126, 128, 129, 131, 133, 134, 136 API 661, 17, 21, 23, 24, 33, 41, 75, 76, 86, 109, 128	control switching fans on/off, 4 use of autovariable fans, 4, 121, 126 use of louvers, 4, 121 use of two-speed motors, 4 use of variable-speed drives, 4 conversion of pressure drop to heat transfer,
approach temperature, 6 bank, 13, 46	40, 78, 85, 135 corrosion allowance, 34
bay, 13, 22, 29, 61, 63, 65, 87, 120, 121,	cost
boundary layer separation, 7, 46, 114, 135 channel, 72 chimney height, 139 combination of air and water cooling, 8 combined services, 2, 121, 131 condensate drainage, 25	first, 1, 6, 7, 30, 31, 80, 112, 128, 140 fixed, 30, 32, 45, 75, 105, 136 initial, 6, 30, 43, 45 maintenance, 30 operating, 1, 30–32, 39, 45, 50, 75, 105, 110, 112, 113, 140 overall, 1, 9, 30, 79, 110, 112, 129
condensate film, 57, 58, 60	total operating, 45
condensation dropwise, 56 filmwise, 56 inside vertical tubes, 57 pure-component isothermal, 56 transition region, 57, 63, 65 condensation inside vertical tubes, 57	density, 2, 7, 15, 29, 30, 32, 37, 40, 43, 56, 65, 67, 81, 82, 86, 89, 90, 92, 117, 137 design air temperature, 4, 48, 50, 128 desuperheating, 2, 55, 61, 68, 69, 70, 73, 92 dry wall, 69, 70 penalty associated with, 69, 70 wet wall, 69
condensation of a mixture of vapors, 60	distribution of tubes in various passes, 86
condenser isothermal, 56, 61, 63 narrow range, 63 wide range, 65, 68, 84 condensing heat transfer coefficient, 56, 57, 65, 74	draft forced, 23, 24, 26, 27, 51, 115, 121, 126, 127, 133 induced, 23, 24, 26, 51, 115, 126, 127, 134 natural, 25, 27, 139, 140

economical design, 43, 44, 76, 81	115, 120, 155, 150, 158
fan	fouling layer thickness, viii, 111–113, 114,
autovariable, 21, 108, 121, 122	116–118
blade, 28	fouling resistance, viii, 2, 4, 9, 18, 30, 32,
blade angle, 20, 21, 121, 128, 129	98, 104, 105, 107–109, 111–113
blade width, 21	unduly large, 108
dispersion angle, 22	headers
hub, 21	cover-plate type, 18
low noise, 7, 21, 24, 51	manifold type, 18
manually adjustable, 22	plug type, 18
power consumption, 26, 34, 39, 65, 68,	heat release profile, 2, 31, 34, 72, 73, 89, 93
70, 71, 75, 84, 117	95
ring, 22, 23, 128	heat release profiles
shaft, 20, 23	tabular, 95
tip, 22, 51, 128	heat transfer coefficient
tip clearance, 22	airside, 4, 29, 30, 39, 43, 46, 48, 50, 65,
tip speed, 51	78, 81–85, 104, 112, 113, 117, 137
vendor, 21	overall, 4, 5, 6, 29, 34, 40, 43, 45, 48, 50,
fan blades	57, 60, 61, 69, 70, 77, 78, 82, 84, 85,
FRP, 20	98–100, 103, 107, 108, 111, 114, 135,
fan drive	137, 140
direct, 23	tubeside, 7, 30, 35, 37–41, 43, 44, 45, 46,
gear, 23, 24	50, 61, 63, 65, 67, 68, 70, 76–79, 81,
V-belt, 23	83, 84, 88, 111, 112, 114, 117, 132,
fin density, 15, 30, 43, 79, 81, 82, 85, 87,	135–140
115, 116, 138	heat transfer coefficients
fin height, 2, 15, 30, 39, 46, 61, 63, 65, 75,	typical overall, 37
78, 81	high pour point, 7, 123, 126, 133
fin spacing, 2, 46, 75, 81	high velocity, 106, 108, 109, 133
fin thickness, 46, 116 finned tube	hot air recirculation, 27, 119, 125–128
	humidified air-cooled heat exchanger, 134, 135
bimetallic, 17	
flooding, 72 flow	hydrogen, 92, 93, 116, 117
	hydrogen-hydrocarbon mixtures, 93
annular, 58, 59	interface temperature, 106
cross, 47	laminar flow, 7, 44, 46, 114, 135, 136
laminar, 7, 44, 46, 114, 135, 136	line size, 33
stratified, 59	materials of construction, 30, 33, 108
turbulent, 40	mean temperature difference, 29, 31, 34, 48,
flow maldistribution, 123, 124	126, 128, 129
flow regimes	mechanical design, 1, 2, 29
annular, 58, 59	MTD, 4–6, 27, 29, 34, 46–48, 50, 61, 63,
slug, 59	68–70, 72, 74, 83, 89, 93, 98–100, 104,
flow velocity, 106, 119	117, 126, 128, 129, 133, 139, 141
fouling Co. 4 C 102	multiple operating cases, 34
adverse effects of, 103	natural convection, 2, 3, 25, 27
airside, 15, 40, 83, 104, 116, 117	negative latent heat, 94
categories of, 2, 104	noise, 7, 20, 21, 23, 50, 129, 130
corrosion, 104	noise level, 7, 23, 129, 130
excessive, 126, 136	nozzle sizing, 2, 33
particulate, 104	nozzles, 17, 33, 61, 72, 124
sedimentation, 104	condensate, 72
solidification, 119, 133	Nusselt number, 46
tubeside, viii, 40, 44, 83, 104, 109, 113,	operating pressure, 32, 37, 42, 55, 56, 61,

```
65, 67–69, 90, 117, 119, 125
                                                         44, 48, 49, 55, 61, 63, 65, 67, 69, 73, 75,
operating problems, 2, 123
                                                         91-95, 98, 100, 101, 107, 111-113, 117,
overdesign, 2, 4, 41, 70, 71, 78, 82, 88, 97–
  102, 108, 114, 117, 123, 132, 138
                                                         optimum, 29, 48
  on performance, 98–100
                                                       trim cooler, 8–10, 41, 102, 103, 128, 129
  on surface, 98, 100
                                                       tube bundle, 1, 7, 13, 14, 19, 22–27, 35, 51,
  reasons for providing, 97
                                                         75–77, 83, 85–87, 113, 115, 116, 120,
overdesign factor, 97, 100, 101
                                                          121, 123, 124, 126, 128, 131, 133, 134,
pass partition plates, 17, 35
                                                          137-139, 141
                                                       tube diameter, 35, 36, 41, 56, 76, 109, 110
physical properties, 2, 32, 34, 36, 40, 57, 60,
  89-91, 97, 99, 107
                                                       tube inserts, 2, 114, 135, 136
physical property profiles, 2
                                                          wire fin, 7, 46, 114, 115, 135–137
                                                       tube length, 17, 21, 22, 29, 33, 39, 41, 42,
pipe rack, 7, 33, 42, 44, 75, 131
pipe-rack width, 33, 49, 75, 76
                                                         44, 49, 50, 56, 69, 74–76, 102, 137
plenum chamber, 23, 24, 27, 75, 126
                                                       tube passes
Prandtl number, 35, 36, 46, 58
                                                         number of, 2, 19, 29, 35, 39, 41, 47, 50,
pressure drop
                                                            56, 63, 65, 75–77, 80, 81, 83, 87, 108,
  allowable, 4, 9, 30–32, 35, 41, 42, 50, 56,
                                                            110, 113, 132, 135, 136
     72, 108, 110, 111
                                                       tube pitch, 2, 29, 75, 78, 80, 85, 86
  allowable tubeside, 41-45, 50, 63, 88
                                                         longitudinal, 47
  in nozzles, 72
                                                         transverse, 47
  total, 42, 72
                                                       tube plugging, 102
  tubeside, 15, 32, 34, 39–45, 50, 63, 65,
                                                       tube rows
                                                         number of, 2, 18, 29, 35, 75, 77, 80, 82,
     67, 77, 80, 81, 88, 98, 102, 109, 110,
     112–114, 132, 135, 136
                                                            83, 116
  utilization of, 77
                                                       tube size, 33, 36, 39, 41, 49, 79
pressure drop limiting design, 41, 102
                                                       tube supports, 13, 14
process licensor, 26, 31–34, 42, 43, 45, 90,
                                                       tubes
  91, 101, 102
                                                         bare, 30, 135, 137
radial mixing, 46, 114, 136
                                                         finned, 15–17, 19, 26, 27, 30, 46, 115,
recirculation air-cooled heat exchanger, 26,
                                                            121, 131, 134
  126, 133
                                                       tubesheet, 18, 19
residence time, 135, 136
                                                       tubeside heat transfer coefficient controlling,
run length, 105, 108
                                                          78, 81, 137
sound power level, 50, 51
                                                       tubeside velocity, 31, 35, 38, 41, 43–45,
                                                          108, 110-113, 126, 132, 139
sound pressure level, 51
specific heat, 6, 7, 31, 32, 36, 37, 72, 89, 90,
                                                       tube-to-tubesheet joint, 120
  92, 93, 116, 124
                                                       U-tubes, 18, 35
subcooling, 2, 61, 68, 71, 73, 100, 119
                                                       variation of viscosity with temperature, 90
technological platform, 33
                                                       viscosity, 32, 35–37, 42, 44, 60, 79, 89, 90,
TEMA standards, 32, 47, 90, 108, 109
                                                         92, 99, 110, 136–139
thermal conductivity, 1, 6, 14, 15, 32, 33,
                                                       winterization, 6, 119
  36, 37, 89, 90, 92, 93, 112, 113, 116
thermal design, 1, 2, 13, 29–32, 37, 39, 43,
```