

AFT Fathom User's Guide

90-degree bend junctions, 93–94, 140, 145

A

abrupt transition losses, 92, 144
absolute change method, 136–37
additional losses, 114
annulus, cylindrical, 76, 78
area-change junctions, 91–93, 92, 140, 144
arrows, on pipes, 54
assigned-flow junctions, 37, 89–90, 139, 140
assigned-pressure junctions, 90–91, 139
assumptions, engineering, 3
atmospheric pressure, 62, 69
Automatic Pipe Adjusting feature, 122

B

background, Workspace, 121
base area, for loss factors, 33–34
bend junctions. *See* 90-degree bend junctions; non-90-degree bend junctions
Bernoulli equation, 131
branch junctions, 86, 87, 140

C

C (flow coefficient), 150
 orifices, 105
 screens, 110
 venturi, 107
 C_d (discharge coefficient), 151
 orifices, 105
 screens, 110
 venturi, 107
 C_v (valve coefficient), 102, 151
calculator, 72
cavitation, 62, 69, 106, 111
 one-way valves, 103

cavitation (*continued*)

 orifices, 105
check valves, 101
checklist requirements, 60–62
Colebrook-White equation, 134
color, of ID numbers, 71
conical transition losses, 92, 144
connecting pipes and junctions, 56–57, 80, 85
connectivity requirements, 58–59
convergence, numerical, 63, 135–39. *See also* initial head/pressure guesses
 troubleshooting problems with, 153–57
Copy command, 43–44, 51–52, 54
Cut command, 43, 51–52
cylindrical annulus, 76, 78

D

Darcy-Weisbach, 78–79, 134–35
 as default pipe loss model, 118–19
 Solver's use of, 130–31
databases, extensible, 117, 123–28
dead-end junctions, 103, 139
defaults
 Output Control formats, 67, 122–23
 Palette, 119–20
 pipe loss factors, 19
 pipe loss model, 118–19, 134
 Solution Control parameters, 15, 135–39
 system parameters, 117–19
 Workspace, 44
defining pipes and junctions, 44, 57–59, 62
density, fluid, 62, 68
diameter, of pipes, 33, 76, 78
digits, number in output, 67
discharge coefficient (C_d), 151
 orifices, 105
 screens, 110
 venturi, 107

AFT Fathom User's Guide

distributed losses, 34, 36, 141. *See also*
pipes: loss factors for
Duplicate command, 43, 44, 54
dynamic viscosity, 68

E

editing
global, 114–15
in Model Data window, 46
Toolbar, 51–52
on Workspace, 43–44, 55
EGL (energy grade line), 133
elevation, 85. *See also* HGL (hydraulic
grade line)
energy grade line (EGL), 133
engineering assumptions, 3
entrance (post-) losses, 35–37. *See also*
specific junction types
environmental properties, 68–69
errors. *See* troubleshooting
exit (pre-) losses, 36–37. *See also*
specific junction types
extensible databases, 117, 123–28

F

FATHOM.INI file, 44, 67, 117, 162
files, AFT Fathom, 161–63
filters, flow-restricting, 109–11
Find Object, 51–52, 71–72
flow coefficient (C), 150
orifices, 105
screens, 110
venturi, 107
flow direction, 32, 54, 80
area-change junctions, 91, 92
assigned-flow junctions, 90
lumped-loss junctions, 113
one-way valves, 100
orifices, 104, 106
reversing, 51–52, 72

flow direction (*continued*)
screens, 109, 111
tee/wye junctions, 96
valves, 99
flow rate, 103, 118, 119
solution tolerances, 63, 135, 136–37
fluids, 70
databases, 123–25
properties, 62, 68
fonts, 121
fouling, 78
frictional losses, 31, 34, 141
solution methods, 78–79, 134–35
specifying loss model, 118–19
.FTH files, 12
FTH_USER.DAT file, 117, 162

G

global editing, 114–15
Graph Results window, 6, 40, 49–50, 123
gravity, 62, 69

H

H-Equation, 129–30
H (piezometric head). *See* HGL (hydraulic
grade line)
hardware requirements, 4
Hazen-Williams, 79, 118–19, 135
head. *See* HGL (hydraulic grade line)
helical tubes, 76, 78
help, 5. *See also* technical support
HGL (hydraulic grade line), 87–88, 118,
129–30
solution tolerances for, 135, 136–37
Solver's method for obtaining, 133
highlights, on required fields, 58, 119
history, of iterations, 64
hydraulic diameter, of pipes, 76
hydraulic grade line, 87–88, 118, 129–30
solution tolerances for, 135, 136–37

AFT Fathom User's Guide

hydraulic grade line (*continued*)

Solver's method for obtaining, 133

I

icon sizes, 122

ID numbers, 71

junctions, 54, 84

pipes, 54, 71, 74

initial flow guesses, 80, 133

initial head/pressure guesses, 85–86, 133

input parameters, checking, 59–60, 80

input windows, 6, 40

Inspecting object data, 59–60, 80

installation, 3–5

troubleshooting, 161–63

irrecoverable losses, 33–34

models for calculating, 135, 150–51

in reservoirs, 87

iterations

history, 64, 138–39

number of, 63, 135, 138

solution tolerance specifications, 136–37

J

Junction Specifications windows, 44,
73–74, 81–114

junctions, 31–32, 43. *See also specific
junction types*

connection to pipes, 35–37, 56–57, 80,
85

defining, 44, 57–59, 62

duplicating, 43, 44, 54

editing, 43, 44, 46, 55, 114–15

elevation, 85, 118, 130

icon size, 122

ID numbers of, 54, 71, 84

initial head/pressure, 85–86, 133

input data, Inspecting, 59–60, 80

moving, 43, 55, 122

naming, 84

junctions (*continued*)

output parameters for, 64–67

placing, 44, 54

pressure losses in, 33–37, 140–43

solutions for, 35–37

status of, 57, 58, 71

types of, 31–32, 82, 139–40

K

K. *See* loss factor (K)

L

laminar flow, 134

limitations, 3, 159

line thickness, 122

locations, of objects, 12

locking objects, 51–52, 55, 57

loss factor (K), 33, 34

flow split dependency, 95

lumped losses, 114

orifices, 105, 147–48

references and theory, 141–51

valves, 99, 102, 147

variable, 99, 102, 105

venturis, 107

loss models, 118–19. *See also* Darcy-
Weisbach; Hazen-Williams

losses, 33–34, 140–43, 150–51. *See also*
frictional losses; loss factor (K);
specific junction types

area-change, 92, 144

distributed, 34, 36, 141

entrance, 35–37

exit, 36–37

irrecoverable, 33–34, 87, 135, 150–51

local, 34

lumped, 34, 113–14, 140

minor, 141, 142

point, 34, 35, 141

post-, 35–37

AFT Fathom User's Guide

losses (*continued*)

- pre-, 36–37
- lumped-loss junctions, 34, 113–14, 140

M

- mass flow rate, 118, 119
 - solution tolerances, 135, 136–37
- materials, for pipes, 76, 77, 126–27
- maximum iterations, 135, 138
- mesh, flow-restricting, 109–11
- minor losses, 141, 142
- Model Data window, 6, 39, 40, 45–46, 73
- modeling pipe systems, 11–15, 153–54
- Moody friction factor calculation, 134
- moving pipes and junctions, 43, 55, 122

N

- names, of junctions, 84
- net positive suction head (NPSH), 62, 69
- net positive suction pressure (NPSP), 69
- Newton-Raphson method, 130, 132–33
- ninety-degree bend junctions, 93–94, 140, 145
- non-90-degree bend junctions, 96, 140, 146
- noncylindrical pipe geometries, 76, 78
- notepad, 72
- NPSH (net positive suction head), 62, 69
- NPSP (net positive suction pressure), 69
- numerical relaxation, 63, 135, 137–38

O

- objects, 11, 44. *See also* junctions; pipes
- one-way valve junctions, 100–103, 139, 140
 - databases for, 127–28
 - Inspecting data, 57–60, 80
 - loss accounting method and, 37
- online help, 5
- orifice junctions, 104–6, 140

orifice junctions (*continued*)

- cavitation and, 69
- loss factors for, 147–48
- output, 64–67
 - customizing, 122–23
 - graphs, 49–50
 - visual maps, 50–51
- Output Control formats, 67, 122–23
- Output window, 6, 47–48

P

- Palette, 41–43, 119–20
- parameters, 64–67
 - output, 64–67
 - Solution Control, 61, 63–64, 135–39
 - system, 117–19
- Paste, 43–44, 51–52, 54
- piezometric head. *See* HGL (hydraulic grade line)
- Pipe Drawing tool, 42–43
- Pipe Specifications window, 44, 73–81
- pipe systems, modeling, 11–15, 153–54
- pipes, 31–32
 - connecting to junctions, 56–57, 80, 85
 - defining, 44, 57–59, 62
 - diameter, 33, 76, 78
 - drawing, 42–43, 44, 53–54
 - duplicating, 43, 44, 54
 - editing, 43–44, 46, 55, 114–15
 - flow assumptions in, 31
 - geometries, 76, 78
 - ID numbers of, 54, 71, 74
 - initial flow guesses, 80, 133
 - input data, Inspecting, 59–60, 80
 - length, 75, 122
 - location on Workspace, 12
 - locking, 55, 57
 - loss factors for, 33, 34, 36, 141, 145
 - loss models for, 78–79, 118–19, 141
 - materials, 76, 77, 126–27

AFT Fathom User's Guide

pipes (*continued*)

- moving, 43, 55, 122
- naming, 75
- number of, maximum, 159
- output parameters for, 65–66
- roughness, 34, 77, 78–79 (*See also* frictional losses)
- selecting, 41–42, 43
- status of, 57, 58, 71
- stretching, 55

plates, perforated, 109

point losses, 34, 35, 141

post-losses, 35–37. *See also specific junction types*

pre-losses, 36–37. *See also specific junction types*

preferences

- output, 122–23
- Palette, 119–20
- parameter, 117–19
- Workspace, 121–22

pressure, 118, 119

- and hydraulic grade line (HGL), 130
- losses (*See* losses)
- solution tolerances, 135, 136–37

pressure, atmospheric, 62, 69

pressure-reducing valves (PRVs), 101

printing, 44, 48, 51, 67, 159

properties, system and fluid, 62, 68–70

PRVs (pressure-reducing valves), 101

pump junctions, 111–12, 140

- cavitation, 62, 69
- databases, 127–28
- point additions, 141

R

- reference positive flow direction, 32, 54, 80
- reversing, 51–52, 72
- relative tolerances, 137

- relaxation, 63, 135, 137–38
- relief valves, 101
- removing AFT Fathom, 165
- reservoir junctions, 87–89, 143
- resistance factor. *See* loss factor (K)
- Restricted Area, 103, 106, 111
- results
 - graphing, 40, 49–50, 123
 - viewing, 47–51, 123
- Reverse Direction, 51–52, 54, 72
- Reynolds numbers, 33, 34
- roughness, pipe, 34, 77, 78–79. *See also* frictional losses

S

- screen junctions, 109–11, 140, 149–50
- selecting objects, 41–42, 43, 55
- Selection Drawing tool, 41–42
- SETUP.EXE file, 3
- Show Object Status, 57, 71
- Solution Control parameters, 61, 63–64, 135–39
- Solution Progress window, 24, 63, 138–39
- solutions
 - convergence tolerances, 63, 135, 136–37
 - at junctions, 35–37
 - techniques, 129–52
- Solver
 - checklist requirements for, 60–62
 - pausing or canceling, 138
 - running, 23, 24
 - solution techniques used, 129–39
- Specifications windows, 44, 73–74
 - junctions, 81–114
 - pipes, 74–81
- starting AFT Fathom, 9
- status, of pipes and junctions, 57, 58, 71
- support, technical, 167–68

AFT Fathom User's Guide

surface elevation. See HGL (hydraulic grade line)

surface pressure, 69, 87–88

system, pipe

parameters, 117–19

properties, 62, 68–70

system requirements, 4

T

technical support, 167–68

tee/wye junctions, 94–96, 140

titles, 67

tolerances, in solutions, 63, 135, 136–37

Toolbar, 51–52

transition flow, 134. See *also* frictional losses

troubleshooting

convergence, 153–57

installation, 161–63

tubes, helical, 76, 78

turbulent flow, 134. See *also* frictional losses

U

Undo, 51–52, 55

units, of output parameters, 66

V

valve coefficient (C_V), 102, 151

valve junctions, 37, 96–99, 139, 140

cavitation and, 69, 103

custom, 96

databases, 127–28

loss factors, 98, 147

one-way, 101–3

vapor pressure, 62, 69

variable K factor, 99, 102, 105

venturi junctions, 106–8, 140

View menu, 44, 51

viewing results, 47–51, 123

viscosity, 62, 68

Visual Results window, 6, 27, 39, 40, 50–51

saving layouts, 123

volumetric flow rate, 118, 119

solution tolerances, 63, 135, 136–37

W

windows, 6, 40. See *also* Workspace

Junction Specifications, 44, 73–74, 81–114

Model Data, 39, 45–46, 73

Output, 47–48

Pipe Specifications, 44, 73–81

Solution Progress, 24, 63, 138–39

Windows plot preparation, 40

Workspace, 6, 39, 40, 41–46, 53

editing objects on, 43–44, 55

locking objects on, 55, 57

preferences, 44, 121–22

relative location of objects, 12

Z

zoom, 44, 51