

# TABLE OF CONTENTS

---

<b>INTRODUCTION .....</b>	<b>i</b>	4.3 Overall Efficiency .....	20
<b>Installation and Safety Standards .....</b>	<b>i</b>	<b>5 Incomplete Combustion .....</b>	<b>20</b>
<b>Obligations of Pellet Appliance Professionals .....</b>	<b>ii</b>	5.1 Creosote .....	21
<b>The HEARTH Education Foundation .....</b>	<b>ii</b>	5.2 Carbon Monoxide .....	21
<b>National Fireplace Institute (NFI) Certification Program .....</b>	<b>ii</b>	<b>6 Summary .....</b>	<b>22</b>
<b>SECTION I. RESIDENTIAL PELLET FUEL COMBUSTION ..</b>	<b>1</b>	<b>SECTION II. PELLET APPLIANCES .....</b>	<b>25</b>
<b>CHAPTER 1. RESIDENTIAL PELLET FUEL .....</b>	<b>3</b>	<b>CHAPTER 3. FUEL DELIVERY SYSTEMS .....</b>	<b>27</b>
<b>1 Pellet Production .....</b>	<b>3</b>	<b>1 Fuel Delivery Components .....</b>	<b>27</b>
1.1 Raw Materials .....	3	1.1 Hopper .....	27
1.2 Manufacturing Process .....	5	1.2 Auger System .....	28
<b>2 Fuel Standards .....</b>	<b>7</b>	1.3 Burn Pot Systems .....	29
2.1 Criteria .....	7	<b>2 Fuel Delivery System Designs .....</b>	<b>30</b>
2.2 Labeling .....	10	2.1 Top Feed .....	30
<b>3 Effects on Performance and Maintenance .....</b>	<b>10</b>	2.2 Bottom Feed .....	31
3.1 Performance .....	10	<b>3 Design Considerations .....</b>	<b>32</b>
3.2 Maintenance .....	12	3.1 Burnback .....	32
<b>4 Summary .....</b>	<b>12</b>	3.2 Fuel Quality .....	33
 		3.3 Maintenance .....	33
<b>CHAPTER 2. SOLID FUEL COMBUSTION .....</b>	<b>13</b>	<b>4 Summary .....</b>	<b>34</b>
<b>1 Combustion Requirements .....</b>	<b>13</b>	 	
1.1 Fuel .....	13	<b>CHAPTER 4. COMBUSTION AIR DELIVERY .....</b>	<b>35</b>
1.2 Air .....	13	<b>1 Components .....</b>	<b>35</b>
1.3 Heat .....	14	1.1 Combustion Air Inlets .....	35
<b>2 Stages of Hydrocarbon Combustion .....</b>	<b>14</b>	1.2 Combustion Chamber .....	36
2.1 Moisture Evaporation .....	14	1.3 Means of Combustion Air Delivery .....	36
2.2 Vaporization of Hydrocarbon Compounds .....	15	<b>2 Air Delivery System Designs .....</b>	<b>39</b>
2.3 Gas Vapor Ignition and Combustion .....	15	2.1 Negative Pressure Air Delivery .....	39
2.4 Char Burning .....	15	2.2 Positive Pressure Air Delivery .....	41
<b>3 Understanding Pellet Combustion .....</b>	<b>16</b>	<b>3 Air Delivery Design Considerations .....</b>	<b>43</b>
3.1 Fuel: Pellets/Cordwood .....	16	3.1 Venting System Specifications .....	43
3.2 Air: Forced/Natural Draft .....	16	3.2 Maintenance .....	43
3.3 Length of Burn .....	17	3.3 Operation .....	43
<b>4 Efficiency .....</b>	<b>18</b>	<b>4 Summary .....</b>	<b>44</b>
4.1 Combustion Efficiency .....	18		
4.2 Heat Transfer Efficiency .....	19		

TABLE OF CONTENTS

<b>CHAPTER 5. HEAT TRANSFER SYSTEMS.....</b>	<b>45</b>	<b>1 Energy Sources for Exhaust Systems.....</b>	<b>67</b>
<b>1 Methods of Heat Transfer .....</b>	<b>45</b>	1.1 Mechanical Exhaust .....	67
1.1 Conduction.....	45	1.2 Natural Draft .....	68
1.2 Radiant .....	45	<b>2 Exhaust System Pressure and Flow .....</b>	<b>69</b>
1.3 Convection .....	46	2.1 Positive Pressure Exhaust System (Mechanical Draft).....	69
<b>2 Heat Transfer Designs .....</b>	<b>46</b>	2.2 Negative Pressure Exhaust System (Natural Draft).....	70
2.1 Radiant Heat Transfer.....	46	<b>3 Factors Affecting Air Movement .....</b>	<b>73</b>
2.2 Convection Heat Transfer .....	46	3.1 Exposure to Cold Temperature .....	73
<b>3 Summary .....</b>	<b>48</b>	3.2 House Pressure.....	74
<b>CHAPTER 6. ELECTRONIC CONTROLS .....</b>	<b>49</b>	3.3 Altitude .....	75
<b>1 Components .....</b>	<b>49</b>	<b>4 Summary .....</b>	<b>76</b>
1.1 Control Board .....	49	<b>CHAPTER 10. PELLET VENTING SYSTEMS.....</b>	<b>79</b>
1.2 Control Panel.....	50	<b>1 Pellet Venting Products .....</b>	<b>79</b>
<b>2 Operating Principles.....</b>	<b>52</b>	1.1 Pellet Venting .....	79
2.1 Fuel and Air Delivery .....	52	1.2 Chimneys .....	80
2.2 Convection Air Delivery .....	53	1.3 Relining Products.....	81
2.3 Normal Appliance Shutdown .....	53	1.4 Single Wall Connector (Stovepipe) .....	82
<b>3 Summary .....</b>	<b>53</b>	<b>2 Performance and Maintenance .....</b>	<b>82</b>
<b>CHAPTER 7. OPERATIONAL AND SAFETY DEVICES .....</b>	<b>55</b>	2.1 Appliance Performance .....	82
<b>1 Safety Systems .....</b>	<b>55</b>	2.2 System Maintenance .....	82
1.1 Safety Switches.....	55	<b>3 Safety Considerations .....</b>	<b>83</b>
1.2 Electronic Safety System .....	57	<b>4 Summary .....</b>	<b>83</b>
<b>2 Emergency/Preventive Shutdown .....</b>	<b>59</b>	<b>SECTION IV. INSTALLATION PLANNING .....</b>	<b>85</b>
<b>3 Summary .....</b>	<b>59</b>	<b>CHAPTER 11. COMBUSTIBLES.....</b>	<b>87</b>
<b>CHAPTER 8. ASH COLLECTION .....</b>	<b>61</b>	<b>1 Framing, Walls, and Ceilings.....</b>	<b>87</b>
<b>1 Ash Receptacles .....</b>	<b>61</b>	<b>2 Floors.....</b>	<b>87</b>
<b>2 Ash Traps .....</b>	<b>62</b>	<b>3 Heat Transfer .....</b>	<b>87</b>
<b>3 Ash Removal .....</b>	<b>62</b>	<b>4 Clearances.....</b>	<b>89</b>
<b>4 Summary .....</b>	<b>63</b>	<b>5 Protection .....</b>	<b>89</b>
<b>SECTION III. PELLET APPLIANCE VENTING.....</b>	<b>65</b>	<b>6 Summary .....</b>	<b>90</b>
<b>CHAPTER 9. EXHAUST SYSTEM: REMOVAL OF COMBUSTION BY-PRODUCTS.....</b>	<b>67</b>	<b>CHAPTER 12. VENTING INSTALLATION PLANNING .....</b>	<b>91</b>
		<b>1 Planning the Venting Installation .....</b>	<b>91</b>

1.1 Venting Type .....	91	1.1 Combustible Surface Penetration .....	125
1.2 Venting System Pressure .....	91	1.2 Vent Assembly and Sealing .....	129
1.3 Determining Vent Size .....	102	<b>2 Relining Installation .....</b>	<b>130</b>
1.4 Determining Vent Length .....	104	<b>3 Chimneys .....</b>	<b>131</b>
<b>2 Safety Precautions .....</b>	<b>106</b>	<b>4 Summary .....</b>	<b>131</b>
<b>3 Summary .....</b>	<b>107</b>	 	
<b>CHAPTER 13. APPLIANCE INSTALLATION PLANNING .....</b>	<b>109</b>	<b>CHAPTER 16. APPLIANCE INSTALLATION GUIDELINES .....</b>	<b>133</b>
<b>1 Freestanding Pellet Appliances .....</b>	<b>109</b>	<b>1 Pre-Installation Preparation .....</b>	<b>133</b>
1.1 Clearance to Combustibles .....	109	<b>2 Appliance Connection .....</b>	<b>134</b>
1.2 Floor Protection .....	110	<b>3 Operational Test .....</b>	<b>134</b>
1.3 Other Appliance Placement Considerations .....	112	3.1 Pre-Burn Procedures .....	134
<b>2 Fireplace Insert .....</b>	<b>113</b>	3.2 Operational Test .....	134
2.1 Fireplace Dimensions and Condition .....	113	<b>4 Communication with Owner .....</b>	<b>135</b>
2.2 Clearances .....	114	<b>5 Summary .....</b>	<b>135</b>
2.3 Floor Protection .....	114	 	
2.4 Other Fireplace Insert Planning Considerations .....	114	<b>SECTION VI. SERVICE .....</b>	<b>137</b>
<b>3 Built-In Appliances .....</b>	<b>115</b>	 	
3.1 Clearances and Framing Dimensions .....	115	<b>CHAPTER 17. SCHEDULED SERVICE .....</b>	<b>139</b>
3.2 Floor Protection .....	116	<b>1 Preliminary Procedures .....</b>	<b>140</b>
3.3 Other Built-In Appliance Considerations .....	116	<b>2 Service Procedures .....</b>	<b>140</b>
<b>4 Mobile Home Appliance Requirements .....</b>	<b>117</b>	2.1 Fuel Delivery Service .....	140
<b>5 Summary .....</b>	<b>117</b>	2.2 Combustion Air System Service .....	141
 		2.3 Venting System Service .....	144
<b>SECTION V. INSTALLATION GUIDELINES .....</b>	<b>119</b>	2.4 Heat Transfer System Service .....	144
 		<b>3 Final Procedures .....</b>	<b>145</b>
<b>CHAPTER 14 INSTALLATION SAFETY .....</b>	<b>121</b>	<b>4 Service Contracts .....</b>	<b>145</b>
<b>1 Personal Safety .....</b>	<b>121</b>	<b>5 Summary .....</b>	<b>146</b>
<b>2 Power Tool Equipment .....</b>	<b>122</b>	 	
<b>3 Ladder Safety .....</b>	<b>122</b>	<b>CHAPTER 18. TROUBLESHOOTING GUIDELINES .....</b>	<b>147</b>
<b>4 Roof Safety .....</b>	<b>124</b>	<b>1 General Guidelines .....</b>	<b>147</b>
<b>5 Electrical Safety .....</b>	<b>124</b>	<b>2 Troubleshooting Categories .....</b>	<b>148</b>
<b>6 Summary .....</b>	<b>124</b>	2.1 Combustion Air Problems .....	148
 		2.2 Fuel Delivery Problems .....	150
<b>CHAPTER 15. VENTING INSTALLATION GUIDELINES .....</b>	<b>125</b>	2.3 Component Problems .....	151
<b>1 Pellet Venting .....</b>	<b>125</b>	2.4 Spillage Problems .....	154
		<b>3 Summary .....</b>	<b>155</b>

<b>SECTION VII. COMMUNICATION WITH PELLET APPLIANCE USERS .....</b>	<b>157</b>
<b>CHAPTER 19. PRELIMINARY EDUCATION .....</b>	<b>159</b>
1 Owner Expectations .....	159
2 Fuel .....	160
3 Heating Capability .....	160
4 System Requirements.....	161
5 Maintenance .....	162
6 Summary.....	162
<b>CHAPTER 20. OWNER COMMUNICATION: OPERATION .....</b>	<b>165</b>
1 Start Up .....	165
2 Normal Operation .....	166
2.1 Normal Appliance Shutdown.....	167
2.2 Unexpected Appliance Shutdown .....	167
3 Safety Considerations .....	168
4 Summary.....	168
<b>CHAPTER 21. OWNER COMMUNICATION: MAINTENANCE .....</b>	<b>171</b>
1 Appliance Inspection and Cleaning.....	171
1.1 Burn Pot and Grate .....	171
1.2 Ash Drawer .....	171
1.3 Heat Exchanger.....	172
1.4 Ash Traps/Baffle.....	172
1.5 Motors and Fans.....	172
2 Venting System Maintenance.....	172
3 Maintenance Needs Indications .....	173
4 Professional Maintenance .....	173
5 Summary.....	174
<b>SECTION VIII. APPENDICES.....</b>	<b>175</b>
<b>APPENDIX A. REGULATIONS, STANDARDS, AND CODES.....</b>	<b>177</b>
1 Regulations .....	177
1.1 Certified Appliances.....	177
1.2 Non-Affected Facilities (Exempt Appliances) .....	178
<b>2 Standards .....</b>	<b>178</b>
2.1 Manufacturing/Testing Standards .....	178
2.2 Installation/Maintenance Standards .....	183
<b>3 Codes .....</b>	<b>183</b>
<b>APPENDIX B. BASIC ELECTRICITY .....</b>	<b>185</b>
<b>1 Background and Theory .....</b>	<b>185</b>
<b>2 Electrical Circuits .....</b>	<b>186</b>
2.1 Circuit Status .....	186
2.2 Types of Circuits .....	187
<b>3 Characteristics of Electrical Current .....</b>	<b>187</b>
3.1 Force .....	187
3.2 Resistance .....	187
3.3 Current Flow.....	188
<b>4 Practical Applications: Measuring and Testing .....</b>	<b>188</b>
4.1 Testing Equipment .....	189
4.2 Testing.....	190
<b>APPENDIX C. FLOOR PROTECTION: CALCULATING MATERIAL REQUIREMENTS .....</b>	<b>193</b>
<b>1 Terminology .....</b>	<b>193</b>
1.1 Thermal Conductivity: k Value .....	193
1.2 Thermal Resistance: R Value.....	193
<b>2 Conversion .....</b>	<b>194</b>
<b>3 Determining Material Thickness Requirements .....</b>	<b>194</b>
<b>4 Calculations .....</b>	<b>195</b>
4.1 k Calculations.....	195
4.2 R Calculations .....	196
<b>5 Thermal Characteristics of Common Hearth Materials.....</b>	<b>197</b>
<b>APPENDIX D. VENTING APPLICATIONS .....</b>	<b>199</b>
<b>1 Equivalent Vent Length (EVL) .....</b>	<b>199</b>
<b>2 Vent Termination: Natural Draft .....</b>	<b>200</b>

---

<b>APPENDIX E. HOUSE PRESSURE TEST</b> .....	<b>203</b>
<b>1 Simplified House Pressure Test</b> .....	<b>203</b>
1.1 House Pressure Test Procedures .....	204
<b>2 Sizing Make-up Air Systems</b> .....	<b>207</b>
<b>3 Adjusting a Make-up Air System</b> .....	<b>209</b>
<b>APPENDIX F. TOOLS</b> .....	<b>211</b>
<b>1 Safety First</b> .....	<b>211</b>
<b>2 Recommended Tools</b> .....	<b>211</b>
<b>3 Recommended Gauges</b> .....	<b>211</b>
<b>4 Miscellaneous</b> .....	<b>212</b>
<b>APPENDIX G. FUEL CORN</b> .....	<b>213</b>
<b>1 Fuel Corn Characteristics</b> .....	<b>213</b>
1.1 Moisture Content .....	213
1.2 Energy Content .....	214
1.3 Combustion Characteristics .....	214
1.4 Storage .....	214
<b>2 Use in Multi-Fuel Appliances</b> .....	<b>214</b>
2.1 Fuel Selection .....	214
2.2 Storage .....	215
2.3 Appliance Operation .....	215
2.4 System Maintenance .....	216
<b>APPENDIX H. GLOSSARY</b> .....	<b>217</b>