```modelica
model FreeFallDuct
  extends Icons.InsulatedDuct;
  parameter Integer n = 10 "number of discretizations";
  parameter Types.Temperature T_o = 20 + 273.15 "ambient
temperature";
  parameter Types.Temperature T_m_0 = 20 + 273.15 "initial
temperature";
  parameter Types.Length perimeter = 1.0 "duct perimeter";
  parameter Types.Length length = 1.0 "duct length";
  parameter Real dx = length / (n - 2) "discretization size";
  parameter Types.Length thickness = 1.0 "duct thickness";
  parameter Types.Area A_s = perimeter * length "duct surface
area";
  parameter Types.Volume V_m = thickness * A_s "duct metal
volume";
  parameter Types.Convection h_loss = 10.0 "external heat loss
convetion coefficient";
  parameter Types.Convection h_s_w = 100 "solid-wall convection
coefficient";
  Types.MassFlowRate m_dot_s_in "inlet mass flow rate";
  Types.MassFlowRate m_dot_s_out "outlet mass flow rate";
  Types.Temperature T_s_in "inlet temperature";
  Types.Temperature T_s_out "outlet temperature";
  Types.Temperature T_m(start = T_m_0) "duct temperature";
  Types.Enthalpy h_s_in "inlet enthalpy";
  Types.Enthalpy h_s_out "outlet enthalpy";
  Types.SpecificHeatCapacity cp_m "duct specific heat";
  Types.Density rho_m "duct density";
  Types.Heat Q_loss "heat loss";
  Interfaces.ParticleFlow ParticleInlet annotation(
    Placement(visible = true, transformation(origin = {-100, 0},
extent = {{-10, -10}, {10, 10}}, rotation = 0),
iconTransformation(origin = {-100, 0}, extent = {{-10, -10},
{10, 10}}, rotation = 0)));
  Interfaces.ParticleFlow ParticleOutlet annotation(
    Placement(visible = true, transformation(origin = {100, 0},
extent = {{-10, -10}, {10, 10}}, rotation = 0),
iconTransformation(origin = {100, 0}, extent = {{-10, -10}, {10,
10}}, rotation = 0)));
equation
// Connections
  m_dot_s_in = ParticleInlet.m_dot;
  m_dot_s_out = -ParticleOutlet.m_dot;
  T_s_in = ParticleInlet.T;
  T_s_out = ParticleOutlet.T;
// Mass Balance
  m_dot_s_in = m_dot_s_out;
```

```
// Energy Balance
  cp_m * V_m * rho_m * der(T_m) = h_s_w * A_s * (T_s_out - T_m)
+ h_loss * A_s * (T_o - T_m);
  h_s_w * A_s * (T_s_out - T_m) + m_dot_s_out * h_s_out =
m_dot_s_in * h_s_in;
  Q_loss = h_loss * A_s * (T_m - T_o);
// Properties
  h_s_in = Media.Particle.Enthalpy(T_s_in);
  h_s_out = Media.Particle.Enthalpy(T_s_out);
  cp_m = Media.StainlessSteel.SpecificHeat();
  rho_m = Media.StainlessSteel.Density();
end FreeFallDuct;
```