

# ThermalModel

5.1

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# Chapter 1

## Module Index

### 1.1 Modules

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## Chapter 2

# Namespace Index

### 2.1 Namespace List

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## Chapter 3

# Hierarchical Index

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## Chapter 4

# Data Structure Index

### 4.1 Data Structures

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## Chapter 5

# File Index

### 5.1 File List

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## Chapter 6

# Module Documentation

### 6.1 Models

#### Modules

- [Interactions](#)

#### 6.1.1 Detailed Description

## 6.2 Interactions

### Modules

- [ThermalRider](#)

### 6.2.1 Detailed Description

## 6.3 ThermalRider

### Files

- file [class\\_declarations.hh](#)  
*Forward declaration of classes defined in Thermal\_rider model.*
- file [thermal\\_facet\\_rider.hh](#)  
*Defining the thermal characteristics of surface facets.*
- file [thermal\\_integrable\\_object.hh](#)  
*Define an IntegrableObject class adapted to thermal integration.*
- file [thermal\\_messages.hh](#)  
*Define the class ThermalMessages, the class that specifies the message IDs used in the model.*
- file [thermal\\_model\\_rider.hh](#)  
*Defining the thermal functionality.*
- file [thermal\\_params.hh](#)  
*A virtual base class for thermal facet parameters, used to add to the parameter lists for specific-model facets in their respective InteractionSurfaceFactorys.*
- file [thermal\\_facet\\_rider.cc](#)  
*ThermalFacetRider interaction model.*
- file [thermal\\_integrable\\_object.cc](#)  
*Encapsulates an integrator for a single facet.*
- file [thermal\\_messages.cc](#)  
*Implement the class ThermalMessages.*
- file [thermal\\_model\\_rider.cc](#)  
*ThermalModelRider interaction model.*
- file [thermal\\_params.cc](#)  
*Thermal Parameter definition.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### Macros

- `#define PATH "utils/thermal_rider/"`

#### 6.3.1 Detailed Description

#### 6.3.2 Macro Definition Documentation

##### 6.3.2.1 `#define PATH "utils/thermal_rider/"`

Definition at line 37 of file `thermal_messages.cc`.



## Chapter 7

# Namespace Documentation

### 7.1 jeod Namespace Reference

Namespace jeod.

#### Data Structures

- class [ThermalFacetRider](#)  
*Defining the thermal characteristics of surface facets.*
- class [ThermalIntegrableObject](#)  
*Encapsulates a thermal integrator for a facet.*
- class [ThermalMessages](#)  
*Specifying the message IDs used in the model.*
- class [ThermalModelRider](#)  
*Defining the thermal functionality.*
- class [ThermalParams](#)  
*A virtual base class for thermal facet parameters, used to add to the parameter lists for specific-model facets in their respective InteractionSurfaceFactorys.*

#### 7.1.1 Detailed Description

Namespace jeod.





## Chapter 8

# Data Structure Documentation

### 8.1 jeod::ThermalFacetRider Class Reference

Defining the thermal characteristics of surface facets.

```
#include <thermal_facet_rider.hh>
```

#### Public Member Functions

- [ThermalFacetRider](#) ()  
*Constructor.*
- virtual [~ThermalFacetRider](#) ()  
*Destructor.*
- void [initialize](#) (double temperature, double surface\_area)  
*Initialize the thermal aspects of the facet.*
- void [accumulate\\_thermal\\_sources](#) (void)  
*Collects together all surface and internal thermal sources that affect a facet.*
- double [integrate](#) (void)  
*Runge-Kutta 4th order integration of the temperature variation.*

#### Data Fields

- double [d\\_temperature](#)  
*Change in temperature.*
- double [power\\_absorb](#)  
*Rate at which energy is absorbed from the environment, vehicle, and surface.*
- double [power\\_emit](#)  
*Rate at which energy is thermally radiated from the facet.*
- double [heat\\_capacity](#)  
*Heat capacity of the facet.*
- double [rad\\_constant](#)  
*Combination of variables that are held constant for any given facet.*
- InteractionFacet \* [facet](#)  
*Pointer back to facet that contains this thermal rider.*
- bool [active](#)  
*Flag set to indicate whether the facet to which this rider is attached has a dynamic temperature variability.*
- double [thermal\\_power\\_dump](#)

*Rate at which thermal energy is transferred to the facet from within the vehicle.*

- double [emissivity](#)

*Fraction of  $\sigma \cdot T^4$  (potential for emissive radiation) that is actually emitted.*

- [ThermalIntegrableObject](#) [integrable\\_object](#)

*The encapsulation of a first order integrator which can optionally be used to integrate the temperature.*

## Static Public Attributes

- static double [cycle\\_time](#) = 0.0

*Time since the last temperature calculation for the particular model under consideration.*

## Static Protected Attributes

- static const double [stefan\\_boltzmann](#) = 5.6704004E-08

*Stefan-Boltzmann constant.*

## Private Member Functions

- [ThermalFacetRider](#) & [operator=](#) (const [ThermalFacetRider](#) &rhs)
- [ThermalFacetRider](#) (const [ThermalFacetRider](#) &rhs)

## Private Attributes

- double [next\\_temperature](#)

*The predicted value of temperature at the next time-step.*

- double [dynamic\\_temperature](#)

*The dynamic value of the facet kinetic temperature.*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_ThermalFacetRider](#) ()

### 8.1.1 Detailed Description

Defining the thermal characteristics of surface facets.

Definition at line 83 of file [thermal\\_facet\\_rider.hh](#).

### 8.1.2 Constructor & Destructor Documentation

#### 8.1.2.1 [jeod::ThermalFacetRider::ThermalFacetRider](#) ( void )

Constructor.

Definition at line 60 of file [thermal\\_facet\\_rider.cc](#).

References [active](#), [d\\_temperature](#), [dynamic\\_temperature](#), [emissivity](#), [facet](#), [heat\\_capacity](#), [next\\_temperature](#), [power\\_absorb](#), [power\\_emit](#), [rad\\_constant](#), and [thermal\\_power\\_dump](#).

### 8.1.2.2 jeod::ThermalFacetRider::~~ThermalFacetRider ( void ) [virtual]

Destructor.

Definition at line 313 of file thermal\_facet\_rider.cc.

### 8.1.2.3 jeod::ThermalFacetRider::ThermalFacetRider ( const ThermalFacetRider & rhs ) [private]

## 8.1.3 Member Function Documentation

### 8.1.3.1 void jeod::ThermalFacetRider::accumulate\_thermal\_sources ( void )

Collects together all surface and internal thermal sources that affect a facet.

Definition at line 82 of file thermal\_facet\_rider.cc.

References power\_absorb, power\_emit, and thermal\_power\_dump.

### 8.1.3.2 void jeod::ThermalFacetRider::initialize ( double temperature, double surface\_area )

Initialize the thermal aspects of the facet.

Parameters

in	<i>temperature</i>	temperature of facet Units: K
in	<i>surface_area</i>	area of facet surface Units: M*M

Definition at line 138 of file thermal\_facet\_rider.cc.

References dynamic\_temperature, emissivity, jeod::ThermalMessages::incomplete\_setup\_error, jeod::ThermalIntegrableObject::initialize(), integrable\_object, next\_temperature, rad\_constant, and stefan\_boltzmann.

### 8.1.3.3 double jeod::ThermalFacetRider::integrate ( void )

Runge-Kutta 4th order integration of the temperature variation.

Returns

void

Definition at line 184 of file thermal\_facet\_rider.cc.

References active, cycle\_time, d\_temperature, dynamic\_temperature, heat\_capacity, jeod::ThermalMessages::invalid\_integration\_operation, next\_temperature, pow4, power\_absorb, power\_emit, and rad\_constant.

### 8.1.3.4 ThermalFacetRider& jeod::ThermalFacetRider::operator= ( const ThermalFacetRider & rhs ) [private]

## 8.1.4 Friends And Related Function Documentation

### 8.1.4.1 void init\_attrjeod\_\_ThermalFacetRider ( ) [friend]

### 8.1.4.2 friend class InputProcessor [friend]

Definition at line 85 of file thermal\_facet\_rider.hh.

### 8.1.5 Field Documentation

#### 8.1.5.1 `bool jeod::ThermalFacetRider::active`

Flag set to indicate whether the facet to which this rider is attached has a dynamic temperature variability.

trick\_units(—)

Definition at line 142 of file `thermal_facet_rider.hh`.

Referenced by `integrate()`, and `ThermalFacetRider()`.

#### 8.1.5.2 `double jeod::ThermalFacetRider::cycle_time = 0.0` `[static]`

Time since the last temperature calculation for the particular model under consideration.

trick\_units(s)

Definition at line 95 of file `thermal_facet_rider.hh`.

Referenced by `integrate()`, and `jeod::ThermalModelRider::update()`.

#### 8.1.5.3 `double jeod::ThermalFacetRider::d_temperature`

Change in temperature.

trick\_units(—)

Definition at line 100 of file `thermal_facet_rider.hh`.

Referenced by `integrate()`, and `ThermalFacetRider()`.

#### 8.1.5.4 `double jeod::ThermalFacetRider::dynamic_temperature` `[private]`

The dynamic value of the facet kinetic temperature.

THIS VALUE IS USED ONLY BY THE THERMAL INTEGRATOR, AND SHOULD NOT BE SET EXTERNALLY.

trick\_units(K)

Definition at line 185 of file `thermal_facet_rider.hh`.

Referenced by `initialize()`, `integrate()`, and `ThermalFacetRider()`.

#### 8.1.5.5 `double jeod::ThermalFacetRider::emissivity`

Fraction of  $\sigma T^4$  (potential for emissive radiation) that is actually emitted.

trick\_units(—)

Definition at line 158 of file `thermal_facet_rider.hh`.

Referenced by `initialize()`, and `ThermalFacetRider()`.

#### 8.1.5.6 `InteractionFacet* jeod::ThermalFacetRider::facet`

Pointer back to facet that contains this thermal rider.

trick\_units(—)

Definition at line 134 of file `thermal_facet_rider.hh`.

Referenced by `ThermalFacetRider()`.

**8.1.5.7 double jeod::ThermalFacetRider::heat\_capacity**

Heat capacity of the facet.

trick\_units(-)

Definition at line 120 of file thermal\_facet\_rider.hh.

Referenced by jeod::ThermalIntegrableObject::compute\_temp\_dot(), integrate(), and ThermalFacetRider().

**8.1.5.8 ThermalIntegrableObject jeod::ThermalFacetRider::integrable\_object**

The encapsulation of a first order integrator which can optionally be used to integrate the temperature.

trick\_units(-)

Definition at line 164 of file thermal\_facet\_rider.hh.

Referenced by initialize().

**8.1.5.9 double jeod::ThermalFacetRider::next\_temperature [private]**

The predicted value of temperature at the next time-step.

THIS VALUE IS USED ONLY BY THE THERMAL INTEGRATOR, AND SHOULD NOT BE SET EXTERNALLY.-

trick\_units(K)

Definition at line 179 of file thermal\_facet\_rider.hh.

Referenced by initialize(), integrate(), and ThermalFacetRider().

**8.1.5.10 double jeod::ThermalFacetRider::power\_absorb**

Rate at which energy is absorbed from the environment, vehicle, and surface.

trick\_units(-)

Definition at line 106 of file thermal\_facet\_rider.hh.

Referenced by accumulate\_thermal\_sources(), jeod::ThermalIntegrableObject::compute\_temp\_dot(), jeod::ThermalIntegrableObject::integrate(), integrate(), and ThermalFacetRider().

**8.1.5.11 double jeod::ThermalFacetRider::power\_emit**

Rate at which energy is thermally radiated from the facet.

trick\_units(-)

Definition at line 111 of file thermal\_facet\_rider.hh.

Referenced by accumulate\_thermal\_sources(), jeod::ThermalIntegrableObject::compute\_temp\_dot(), integrate(), and ThermalFacetRider().

**8.1.5.12 double jeod::ThermalFacetRider::rad\_constant**

Combination of variables that are held constant for any given facet.

trick\_units(-)

Definition at line 129 of file thermal\_facet\_rider.hh.

Referenced by jeod::ThermalIntegrableObject::compute\_temp\_dot(), initialize(), jeod::ThermalIntegrableObject::integrate(), integrate(), and ThermalFacetRider().

**8.1.5.13** `const double jeod::ThermalFacetRider::stefan_boltzmann = 5.6704004E-08` `[static], [protected]`

Stefan-Boltzmann constant.

`trick_io(*o) trick_units(-)`

Definition at line 171 of file `thermal_facet_rider.hh`.

Referenced by `initialize()`.

**8.1.5.14** `double jeod::ThermalFacetRider::thermal_power_dump`

Rate at which thermal energy is transfered to the facet from within the vehicle.

`trick_units(-)`

Definition at line 148 of file `thermal_facet_rider.hh`.

Referenced by `accumulate_thermal_sources()`, and `ThermalFacetRider()`.

The documentation for this class was generated from the following files:

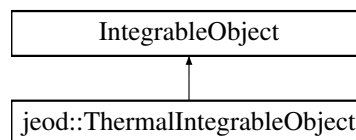
- [thermal\\_facet\\_rider.hh](#)
- [thermal\\_facet\\_rider.cc](#)

## 8.2 jeod::ThermalIntegrableObject Class Reference

Encapsulates a thermal integrator for a facet.

`#include <thermal_integrableObject.hh>`

Inheritance diagram for `jeod::ThermalIntegrableObject`:



### Public Member Functions

- [ThermalIntegrableObject](#) ()  
*ThermalIntegrableObject* default constructor.
- [~ThermalIntegrableObject](#) () override  
*ThermalIntegrableObject* destructor.
- void [initialize](#) (double temperature, [ThermalFacetRider](#) &associated\_rider)  
*Initialize temperature and cache a pointer to the ThermalFacetRider.*
- void [create\\_integrators](#) (const `er7_utils::IntegratorConstructor` &generator, `er7_utils::IntegrationControls` &controls, const `er7_utils::TimeInterface` &time\_if) override  
*Create the first order integrator for this IntegrableObject.*
- void [destroy\\_integrators](#) () override  
*Destroy integrators for this IntegrableObject.*
- void [reset\\_integrators](#) () override  
*Reset the integrator.*
- `er7_utils::IntegratorResult` [integrate](#) (double dyn\_dt, unsigned int target\_stage) override  
*Integrate the thermal state.*
- void [compute\\_temp\\_dot](#) ()

*Compute emitted power and the time derivative of temperature.*

- double [get\\_temp](#) ()  
*Get the temperature.*
- double [get\\_temp\\_dot](#) ()  
*Get the temperature time derivative.*

## Data Fields

- bool [active](#)  
*If true, this IntegrableObject will integrate temperature.*

## Private Member Functions

- [ThermalIntegrableObject](#) & [operator=](#) (const [ThermalIntegrableObject](#) &rhs)
- [ThermalIntegrableObject](#) (const [ThermalIntegrableObject](#) &rhs)

## Private Attributes

- RestartableScalarFirstOrderODEIntegrator [integrator](#)  
*Integrates temperature on one facet.*
- [ThermalFacetRider](#) \* [rider](#)  
*Cached pointer to the associated [ThermalFacetRider](#).*
- double [temp](#)  
*Temperature of the facet.*
- double [temp\\_dot](#)  
*Time derivative of temperature.*
- double [t\\_pow4](#)  
*Fourth power of current temperature.*

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_ThermalIntegrableObject](#) ()

### 8.2.1 Detailed Description

Encapsulates a thermal integrator for a facet.

Definition at line 87 of file thermal\_integrable\_object.hh.

### 8.2.2 Constructor & Destructor Documentation

#### 8.2.2.1 [jeod::ThermalIntegrableObject::ThermalIntegrableObject](#) ( )

[ThermalIntegrableObject](#) default constructor.

Definition at line 47 of file thermal\_integrable\_object.cc.

References [integrator](#).

**8.2.2.2** `jeod::ThermalIntegrableObject::~~ThermalIntegrableObject ( ) [override]`

[ThermalIntegrableObject](#) destructor.

Definition at line 60 of file `thermal_integrable_object.cc`.

References `destroy_integrators()`, and `integrator`.

**8.2.2.3** `jeod::ThermalIntegrableObject::ThermalIntegrableObject ( const ThermalIntegrableObject & rhs ) [private]`

### 8.2.3 Member Function Documentation

**8.2.3.1** `void jeod::ThermalIntegrableObject::compute_temp_dot ( void )`

Compute emitted power and the time derivative of temperature.

Definition at line 163 of file `thermal_integrable_object.cc`.

References `jeod::ThermalFacetRider::heat_capacity`, `jeod::ThermalFacetRider::power_absorb`, `jeod::ThermalFacetRider::power_emit`, `jeod::ThermalFacetRider::rad_constant`, `rider`, `t_pow4`, and `temp_dot`.

**8.2.3.2** `void jeod::ThermalIntegrableObject::create_integrators ( const er7_utils::IntegratorConstructor & generator, er7_utils::IntegrationControls & controls, const er7_utils::TimeInterface & time_if ) [override]`

Create the first order integrator for this `IntegrableObject`.

Parameters

<i>generator</i>	Integrator constructor that creates the integrator.
<i>controls</i>	Integration controls that mediates the integrations.
<i>time_if</i>	Unused.

Definition at line 74 of file `thermal_integrable_object.cc`.

References `integrator`.

**8.2.3.3** `void jeod::ThermalIntegrableObject::destroy_integrators ( void ) [override]`

Destroy integrators for this `IntegrableObject`.

Definition at line 87 of file `thermal_integrable_object.cc`.

Referenced by `~ThermalIntegrableObject()`.

**8.2.3.4** `double jeod::ThermalIntegrableObject::get_temp ( ) [inline]`

Get the temperature.

Returns

Facet temperature.

Definition at line 125 of file `thermal_integrable_object.hh`.

References `temp`.

**8.2.3.5** `double jeod::ThermalIntegrableObject::get_temp_dot ( ) [inline]`

Get the temperature time derivative.



**Returns**

Facet temperature time derivative.

Definition at line 134 of file thermal\_integrable\_object.hh.

References temp\_dot.

### 8.2.3.6 void jeod::ThermalIntegrableObject::initialize ( double *temperature*, ThermalFacetRider & *associated\_rider* )

Initialize temperature and cache a pointer to the [ThermalFacetRider](#).

**Parameters**

<i>temperature</i>	– initial temperature
<i>associated_rider</i>	– the associated <a href="#">ThermalFacetRider</a>

Definition at line 148 of file thermal\_integrable\_object.cc.

References rider, t\_pow4, and temp.

Referenced by jeod::ThermalFacetRider::initialize().

### 8.2.3.7 er7\_utils::IntegratorResult jeod::ThermalIntegrableObject::integrate ( double *dyn\_dt*, unsigned int *target\_stage* ) [override]

Integrate the thermal state.

**Parameters**

in	<i>dyn_dt</i>	Dynamic time step, in dynamic time seconds.
in	<i>target_stage</i>	The stage of the integration process that the integrator should try to attain.

**Returns**

The status (time advance, pass/fail status) of the integration.

Definition at line 113 of file thermal\_integrable\_object.cc.

References integrator, jeod::ThermalMessages::invalid\_integration\_operation, jeod::ThermalFacetRider::power\_ - absorb, jeod::ThermalFacetRider::rad\_constant, rider, t\_pow4, temp, and temp\_dot.

### 8.2.3.8 ThermalIntegrableObject& jeod::ThermalIntegrableObject::operator= ( const ThermalIntegrableObject & *rhs* ) [private]

### 8.2.3.9 void jeod::ThermalIntegrableObject::reset\_integrators ( void ) [override]

Reset the integrator.

Definition at line 98 of file thermal\_integrable\_object.cc.

References integrator.

## 8.2.4 Friends And Related Function Documentation

### 8.2.4.1 void init\_attrjeod\_\_ThermalIntegrableObject ( ) [friend]

### 8.2.4.2 friend class InputProcessor [friend]

Definition at line 89 of file thermal\_integrable\_object.hh.

## 8.2.5 Field Documentation

### 8.2.5.1 `bool jeod::ThermalIntegrableObject::active`

If true, this IntegrableObject will integrate temperature.

`trick_units(-)`

Definition at line 145 of file `thermal_integrable_object.hh`.

### 8.2.5.2 `RestartableScalarFirstOrderODEIntegrator jeod::ThermalIntegrableObject::integrator` `[private]`

Integrates temperature on one facet.

`trick_units(-)`

Definition at line 153 of file `thermal_integrable_object.hh`.

Referenced by `create_integrators()`, `integrate()`, `reset_integrators()`, `ThermalIntegrableObject()`, and `~ThermalIntegrableObject()`.

### 8.2.5.3 `ThermalFacetRider* jeod::ThermalIntegrableObject::rider` `[private]`

Cached pointer to the associated [ThermalFacetRider](#).

`trick_units(-)`

Definition at line 158 of file `thermal_integrable_object.hh`.

Referenced by `compute_temp_dot()`, `initialize()`, and `integrate()`.

### 8.2.5.4 `double jeod::ThermalIntegrableObject::t_pow4` `[private]`

Fourth power of current temperature.

`trick_units(K*K*K*K)`

Definition at line 173 of file `thermal_integrable_object.hh`.

Referenced by `compute_temp_dot()`, `initialize()`, and `integrate()`.

### 8.2.5.5 `double jeod::ThermalIntegrableObject::temp` `[private]`

Temperature of the facet.

`trick_units(K)`

Definition at line 163 of file `thermal_integrable_object.hh`.

Referenced by `get_temp()`, `initialize()`, and `integrate()`.

### 8.2.5.6 `double jeod::ThermalIntegrableObject::temp_dot` `[private]`

Time derivative of temperature.

`trick_units(K/s)`

Definition at line 168 of file `thermal_integrable_object.hh`.

Referenced by `compute_temp_dot()`, `get_temp_dot()`, and `integrate()`.

The documentation for this class was generated from the following files:

- [thermal\\_integrable\\_object.hh](#)

- [thermal\\_integrable\\_object.cc](#)

## 8.3 jeod::ThermalMessages Class Reference

Specifying the message IDs used in the model.

```
#include <thermal_messages.hh>
```

### Static Public Attributes

- static char const \* [incomplete\\_setup\\_error](#)  
*Generic error; the model was not set up correctly.*
- static char const \* [invalid\\_integration\\_operation](#)  
*The integration is invalid, usually because the integration step is too large.*

### Private Member Functions

- [ThermalMessages](#) (void)
- [ThermalMessages](#) (const [ThermalMessages](#) &)
- [ThermalMessages](#) & [operator=](#) (const [ThermalMessages](#) &)

### Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_ThermalMessages](#) ()

#### 8.3.1 Detailed Description

Specifying the message IDs used in the model.

Definition at line 81 of file `thermal_messages.hh`.

#### 8.3.2 Constructor & Destructor Documentation

8.3.2.1 `jeod::ThermalMessages::ThermalMessages ( void )` `[private]`

8.3.2.2 `jeod::ThermalMessages::ThermalMessages ( const ThermalMessages & )` `[private]`

#### 8.3.3 Member Function Documentation

8.3.3.1 `ThermalMessages& jeod::ThermalMessages::operator= ( const ThermalMessages & )` `[private]`

#### 8.3.4 Friends And Related Function Documentation

8.3.4.1 `void init_attrjeod__ThermalMessages ( )` `[friend]`

8.3.4.2 `friend class InputProcessor` `[friend]`

Definition at line 84 of file `thermal_messages.hh`.

### 8.3.5 Field Documentation

#### 8.3.5.1 `char const * jeod::ThermalMessages::incomplete_setup_error` [static]

##### Initial value:

```
=
    "utils/thermal_rider/" "incomplete_setup_error"
```

Generic error; the model was not set up correctly.

trick\_units(-)

Definition at line 93 of file thermal\_messages.hh.

Referenced by jeod::ThermalFacetRider::initialize().

#### 8.3.5.2 `char const * jeod::ThermalMessages::invalid_integration_operation` [static]

##### Initial value:

```
=
    "utils/thermal_rider/" "invalid_integration_operation"
```

The integration is invalid, usually because the integration step is too large.

trick\_units(-)

Definition at line 100 of file thermal\_messages.hh.

Referenced by jeod::ThermalIntegrableObject::integrate(), and jeod::ThermalFacetRider::integrate().

The documentation for this class was generated from the following files:

- [thermal\\_messages.hh](#)
- [thermal\\_messages.cc](#)

## 8.4 jeod::ThermalModelRider Class Reference

Defining the thermal functionality.

```
#include <thermal_model_rider.hh>
```

### Public Member Functions

- [ThermalModelRider](#) ()  
*Constructor.*
- virtual [~ThermalModelRider](#) ()  
*Destructor.*
- void [update](#) (InteractionSurface \*surface\_ptr)  
*update the thermal aspects of all facets*

### Data Fields

- bool [active](#)  
*Flag to allow thermal variation of facets.*
- bool [include\\_internal\\_thermal\\_effects](#)  
*Flag to include facet-to-facet conduction, and vehicle-to-facet thermal sources and sinks.*

## Private Member Functions

- [ThermalModelRider](#) & [operator=](#) (const [ThermalModelRider](#) &rhs)
- [ThermalModelRider](#) (const [ThermalModelRider](#) &rhs)

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_ThermalModelRider](#) ()

### 8.4.1 Detailed Description

Defining the thermal functionality.

Definition at line 84 of file `thermal_model_rider.hh`.

### 8.4.2 Constructor & Destructor Documentation

#### 8.4.2.1 `jeod::ThermalModelRider::ThermalModelRider ( void )`

Constructor.

Definition at line 53 of file `thermal_model_rider.cc`.

References `active`, and `include_internal_thermal_effects`.

#### 8.4.2.2 `jeod::ThermalModelRider::~~ThermalModelRider ( void )` `[virtual]`

Destructor.

Definition at line 83 of file `thermal_model_rider.cc`.

#### 8.4.2.3 `jeod::ThermalModelRider::ThermalModelRider ( const ThermalModelRider & rhs )` `[private]`

### 8.4.3 Member Function Documentation

#### 8.4.3.1 `ThermalModelRider& jeod::ThermalModelRider::operator= ( const ThermalModelRider & rhs )` `[private]`

#### 8.4.3.2 `void jeod::ThermalModelRider::update ( InteractionSurface * surface_ptr )`

update the thermal aspects of all facets

Parameters

<code>in</code>	<code>surface_ptr</code>	pointer the surface.
-----------------	--------------------------	----------------------

Definition at line 65 of file `thermal_model_rider.cc`.

References `active`, `jeod::ThermalFacetRider::cycle_time`, and `include_internal_thermal_effects`.

### 8.4.4 Friends And Related Function Documentation

#### 8.4.4.1 `void init_attrjeod__ThermalModelRider ( )` `[friend]`

#### 8.4.4.2 `friend class InputProcessor` `[friend]`

Definition at line 86 of file `thermal_model_rider.hh`.

### 8.4.5 Field Documentation

#### 8.4.5.1 `bool jeod::ThermalModelRider::active`

Flag to allow thermal variation of facets.

`trick_units(-)`

Definition at line 92 of file `thermal_model_rider.hh`.

Referenced by `ThermalModelRider()`, and `update()`.

#### 8.4.5.2 `bool jeod::ThermalModelRider::include_internal_thermal_effects`

Flag to include facet-to-facet conduction, and vehicle-to-facet thermal sources and sinks.

`trick_units(-)`

Definition at line 98 of file `thermal_model_rider.hh`.

Referenced by `ThermalModelRider()`, and `update()`.

The documentation for this class was generated from the following files:

- [thermal\\_model\\_rider.hh](#)
- [thermal\\_model\\_rider.cc](#)

## 8.5 `jeod::ThermalParams` Class Reference

A virtual base class for thermal facet parameters, used to add to the parameter lists for specific-model facets in their respective `InteractionSurfaceFactory`s.

```
#include <thermal_params.hh>
```

### Public Member Functions

- [ThermalParams](#) ()  
*Constructor.*
- virtual [~ThermalParams](#) ()  
*Destructor.*

### Data Fields

- double [emissivity](#)  
*Fraction of  $\sigma \cdot T^4$  (potential for emissive thermal) that is actually emitted.*
- double [heat\\_capacity\\_per\\_area](#)  
*Heat Capacity per unit area of surface.*
- double [thermal\\_power\\_dump](#)  
*Rate at which thermal energy is dumped (positive) / extracted (negative) into a facet from within the vehicle.*

### Private Member Functions

- [ThermalParams](#) & `operator=` (const [ThermalParams](#) &rhs)
- [ThermalParams](#) (const [ThermalParams](#) &rhs)

## Friends

- class [InputProcessor](#)
- void [init\\_attrjeod\\_\\_ThermalParams](#) ()

### 8.5.1 Detailed Description

A virtual base class for thermal facet parameters, used to add to the parameter lists for specific-model facets in their respective InteractionSurfaceFactorys.

Definition at line 85 of file thermal\_params.hh.

### 8.5.2 Constructor & Destructor Documentation

#### 8.5.2.1 jeod::ThermalParams::ThermalParams ( void )

Constructor.

Definition at line 47 of file thermal\_params.cc.

References [emissivity](#), [heat\\_capacity\\_per\\_area](#), and [thermal\\_power\\_dump](#).

#### 8.5.2.2 jeod::ThermalParams::~~ThermalParams ( void ) [virtual]

Destructor.

Definition at line 58 of file thermal\_params.cc.

#### 8.5.2.3 jeod::ThermalParams::ThermalParams ( const ThermalParams & rhs ) [private]

### 8.5.3 Member Function Documentation

#### 8.5.3.1 ThermalParams& jeod::ThermalParams::operator= ( const ThermalParams & rhs ) [private]

### 8.5.4 Friends And Related Function Documentation

#### 8.5.4.1 void init\_attrjeod\_\_ThermalParams ( ) [friend]

#### 8.5.4.2 friend class InputProcessor [friend]

Definition at line 86 of file thermal\_params.hh.

### 8.5.5 Field Documentation

#### 8.5.5.1 double jeod::ThermalParams::emissivity

Fraction of  $\sigma T^4$  (potential for emissive thermal) that is actually emitted.

[trick\\_units\(-\)](#)

Definition at line 94 of file thermal\_params.hh.

Referenced by [ThermalParams\(\)](#).

#### 8.5.5.2 `double jeod::ThermalParams::heat_capacity_per_area`

Heat Capacity per unit area of surface.

`trick_units(-)`

Definition at line 99 of file `thermal_params.hh`.

Referenced by `ThermalParams()`.

#### 8.5.5.3 `double jeod::ThermalParams::thermal_power_dump`

Rate at which thermal energy is dumped (positive) / extracted (negative) into a facet from within the vehicle.

Used for radiators and the like.`trick_units(-)`

Definition at line 106 of file `thermal_params.hh`.

Referenced by `ThermalParams()`.

The documentation for this class was generated from the following files:

- [thermal\\_params.hh](#)
- [thermal\\_params.cc](#)



## Chapter 9

# File Documentation

### 9.1 `class_declarations.hh` File Reference

Forward declaration of classes defined in Thermal\_rider model.

#### Namespaces

- [jeod](#)

*Namespace jeod.*

#### 9.1.1 Detailed Description

Forward declaration of classes defined in Thermal\_rider model.

Definition in file [class\\_declarations.hh](#).

### 9.2 `thermal_facet_rider.cc` File Reference

ThermalFacetRider interaction model.

```
#include <cstdint>
#include <cmath>
#include "utils/message/include/message_handler.hh"
#include "../include/thermal_facet_rider.hh"
#include "../include/thermal_messages.hh"
```

#### Namespaces

- [jeod](#)

*Namespace jeod.*

#### Macros

- `#define pow4(x) pow4_temp = (x) * (x), pow4_temp *= pow4_temp`

### 9.2.1 Detailed Description

ThermalFacetRider interaction model.

Definition in file [thermal\\_facet\\_rider.cc](#).

### 9.2.2 Macro Definition Documentation

9.2.2.1 `#define pow4( x ) pow4_temp = (x) * (x), pow4_temp *= pow4_temp`

Referenced by `jeod::ThermalFacetRider::integrate()`.

## 9.3 thermal\_facet\_rider.hh File Reference

Defining the thermal characteristics of surface facets.

```
#include "utils/sim_interface/include/jeod_class.hh"
#include "thermal_integrable_object.hh"
```

### Data Structures

- class [jeod::ThermalFacetRider](#)  
*Defining the thermal characteristics of surface facets.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.3.1 Detailed Description

Defining the thermal characteristics of surface facets.

Definition in file [thermal\\_facet\\_rider.hh](#).

## 9.4 thermal\_integrable\_object.cc File Reference

Encapsulates an integrator for a single facet.

```
#include <cmath>
#include "../include/thermal_facet_rider.hh"
#include "../include/thermal_integrable_object.hh"
#include "../include/thermal_messages.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.4.1 Detailed Description

Encapsulates an integrator for a single facet.

Definition in file [thermal\\_integrable\\_object.cc](#).

## 9.5 thermal\_integrable\_object.hh File Reference

Define an IntegrableObject class adapted to thermal integration.

```
#include "er7_utils/integration/core/include/integrable_object.hh"
#include "er7_utils/integration/core/include/integrator_result.hh"
#include "utils/integration/include/restartable_state_integrator.hh"
#include "utils/sim_interface/include/jeod_class.hh"
```

### Data Structures

- class [jeod::ThermalIntegrableObject](#)  
*Encapsulates a thermal integrator for a facet.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.5.1 Detailed Description

Define an IntegrableObject class adapted to thermal integration.

Definition in file [thermal\\_integrable\\_object.hh](#).

## 9.6 thermal\_messages.cc File Reference

Implement the class ThermalMessages.

```
#include "../include/thermal_messages.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*

### Macros

- `#define` [PATH](#) "utils/thermal\_rider/"

### 9.6.1 Detailed Description

Implement the class ThermalMessages.

Definition in file [thermal\\_messages.cc](#).

## 9.7 thermal\_messages.hh File Reference

Define the class ThermalMessages, the class that specifies the message IDs used in the model.

```
#include "utils/sim_interface/include/jeod_class.hh"
```

### Data Structures

- class [jeod::ThermalMessages](#)  
*Specifying the message IDs used in the model.*

### Namespaces

- [jeod](#)  
*Namespace jeod.*

#### 9.7.1 Detailed Description

Define the class ThermalMessages, the class that specifies the message IDs used in the model.

Definition in file [thermal\\_messages.hh](#).

## 9.8 thermal\_model\_rider.cc File Reference

ThermalModelRider interaction model.

```
#include <cmath>
#include "../include/thermal_model_rider.hh"
#include "utils/surface_model/include/interaction_surface.hh"
#include "../include/thermal_facet_rider.hh"
```

### Namespaces

- [jeod](#)  
*Namespace jeod.*

#### 9.8.1 Detailed Description

ThermalModelRider interaction model.

Definition in file [thermal\\_model\\_rider.cc](#).

## 9.9 thermal\_model\_rider.hh File Reference

Defining the thermal functionality.

```
#include "utils/sim_interface/include/jeod_class.hh"
```

## Data Structures

- class [jeod::ThermalModelRider](#)  
*Defining the thermal functionality.*

## Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.9.1 Detailed Description

Defining the thermal functionality.

Definition in file [thermal\\_model\\_rider.hh](#).

## 9.10 thermal\_params.cc File Reference

Thermal Parameter definition.

```
#include "../include/thermal_params.hh"
#include "utils/surface_model/include/interaction_surface.hh"
```

## Namespaces

- [jeod](#)  
*Namespace jeod.*

### 9.10.1 Detailed Description

Thermal Parameter definition.

Definition in file [thermal\\_params.cc](#).

## 9.11 thermal\_params.hh File Reference

A virtual base class for thermal facet parameters, used to add to the parameter lists for specific-model facets in their respective InteractionSurfaceFactorys.

```
#include "utils/sim_interface/include/jeod_class.hh"
```

## Data Structures

- class [jeod::ThermalParams](#)  
*A virtual base class for thermal facet parameters, used to add to the parameter lists for specific-model facets in their respective InteractionSurfaceFactorys.*

## Namespaces

- [jeod](#)

*Namespace jeod.*

### 9.11.1 Detailed Description

A virtual base class for thermal facet parameters, used to add to the parameter lists for specific-model facets in their respective InteractionSurfaceFactorys.

Definition in file [thermal\\_params.hh](#).

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