

Materials

This article discusses points specific to defining material properties for TMG analysis. For a general discussion of defining material properties in I-DEAS, refer to the Material Data System User's Guide.

- [Creating New Materials](#)

Defining Materials for TMG Analysis

When creating materials for TMG, view the available material properties using the Application filtering mask *Fluid/Thermal* and the Solver filtering mask TMG. This makes it easy to determine which properties are required and which are supported but optional. The *Fluid/Thermal* mask shows a subset of those shown by the *Simulation (Isotropic and Orthotropic)* masks. Therefore, you are free to create TMG thermal models using *Isotropic* or *Orthotropic* masks, provided that you define the required properties. The only time you are required to use the Simulation material property mask is when you want to model orthotropic conductivity. In this case, you must use the *Orthotropic* Material Type mask.

For the sake of clarity in this article, the material properties shown by a given material property mask will be termed a material type. For example, the properties shown by the *Thermal Solid* mask will be called "Thermal Solid type properties."

The recommended procedure for creating a material for TMG analysis is as follows:

1. In the *Meshing* task, select *Materials...*
2. Pick *Create* to define the material.
3. Enter a *Name* for the material. Use a descriptive material name so it is easier to find and choose the material when creating elements.
4. Set the material property filters to show required and optional properties for the type of material and the type of analysis.

For solid materials set the *Material Type* filters to either

- (a) *Fluid/Thermal* and *Thermal Solid*, or
- (b) *Simulation* and *Orthotropic*,

and choose *TMG* under *Show Properties*. Masks for Steady State or Transient will show the required and optional properties for these types of analysis.

For fluid materials, set the *Material Type* filters to *Fluid/Thermal* and either *Liquid* or *Gas*, and choose *TMG* under *Show Properties*. Masks for Steady State or Transient will show the required and optional properties for these types of analysis.

5. Enter the values for the material properties by selecting a property. You can pick Use Default Values first to ensure that some plausible value is entered for all required properties. Default values depend on the material type selected and are taken from reference books. *Thermal Solid* type default values correspond to the properties of steel, *Liquid* type to water and *Gas* type to air.

6. Pick *OK* to define the material.
7. The new material should appear on the list of materials. If not you may need to set the material filter to the material type you just created using *Material Type Filter*.

Supported Material Types and Properties

Thermal Solid (Steady State)

Required Property:

- Thermal Conductivity (isotropic), or Thermal Conductivity (Orthotropic) X, Y and Z (Simulation material type *Orthotropic*)

Optional Properties:

- Mass Density
- Specific Heat Below Phase Change Temp
- Specific Heat Above Phase Change Temp
- Phase Change Temperature
- Latent Heat per Unit Mass
- Emissivity
- Reverse Side Emissivity
- IR Specular Reflectivity
- Reverse Side IR Specular Reflectivity
- IR Transmissivity
- Solar Absorptivity
- Reverse Side Solar Absorptivity
- Solar Specular Reflectivity
- Reverse Side Solar Specular Reflectivity
- Solar Transmissivity
- Index of Refraction
- Reverse Side Index of Refraction
- Electrical Resistivity

Thermal Solid (Transient)

Required Properties:

- Mass Density
- Thermal Conductivity
- Specific Heat Below Phase Change Temp or Specific Heat (Simulation material types *Isotropic* or *Orthotropic*). When defined, this value takes precedence over *Specific Heat Below Phase Change Temperature* and *Specific Heat Above Phase Change Temperature*. **This property does not support phase change.**

Optional Properties:

- Emissivity
- Specific Heat Above Phase Change Temp
- Solar Transmissivity
- Solar Specular Reflectivity
- Solar Absorptivity
- Phase Change Temperature
- Latent Heat per Unit Mass
- Reverse Side Emissivity
- Reverse Side Solar Absorptivity
- Reverse Side Solar Specular Reflectivity
- IR Specular Reflectivity
- IR Transmissivity
- Reverse Side IR Specular Reflectivity
- Electrical Resistivity
- Index of Refraction
- Reverse Side Index of Refraction

Liquid or Gas (Steady State or Transient)

Required Properties:

- Mass Density
- Thermal Conductivity
- Specific Heat At Constant Pressure
- Viscosity (Dynamic)

- Gas Constant (Gas only)

Optional Properties:

- Coefficient of Thermal Expansion
- Specific Heat At Constant Volume

Properties for Specific Modeling Applications

Certain types of modeling entities in TMG require specific additional properties to be defined. Other properties related to the entity type are also worth noting. The following list, provided for convenience, is not comprehensive. Consult the User's Guide articles on the specific modeling entity for complete details.

Infrared Spectrum (IR) Radiation

Additional Required Property:

- Emissivity

Optional IR Properties:

- IR Specular Reflectivity
- IR Transmissivity
- Reverse Side Emissivity
- Reverse Side IR Specular Reflectivity

Solar Spectrum Radiation

Additional Required Property:

- Solar Absorptivity

Optional Solar Properties:

- Solar Specular Reflectivity
- Solar Transmissivity
- Index of Refraction
- Reverse Side Solar Absorptivity
- Reverse Side Solar Specular Reflectivity
- Reverse Side Index of Refraction

Joule Heating

Additional Required Property:

- Electrical Resistivity

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