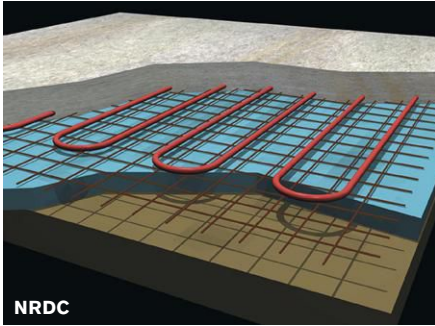


Good, Better & Best Rating

GUIDE GALLERY OF RADIANT SYSTEMS



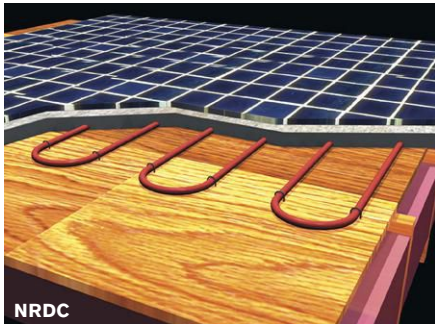
HYDRONIC

Slab on Grade

Radiant tubing is embedded in cement. The tubing is typically attached to metal mesh with plastic ties. A 4-inch slab is most typical. The tubing is best placed in the middle of the slab. Full under-slab insulation is recommended for most residential applications. Slabs have a large thermal mass, which stabilizes temperature swings but slows response. This method is recommended whenever a slab is poured.

Estimated Assembly R-value*: R-0.69 - R-1.0

Best - Most Efficient & Comfortable Radiant Heat, High Mass



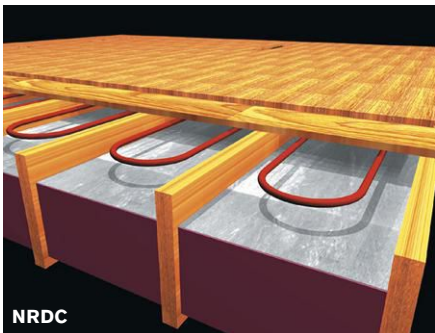
HYDRONIC

Thin Slab on Subfloor

Radiant tubing is attached on top of subfloor with approved staples or plastic clips. A thin slab of gypsum-based cement or cement is poured over the tubing. Typical slabs are 1-1/2 inches thick when using 1/2-inch tubing, but may be as thin as 1-1/4 inch thick when using 3/8-inch tubing. Gypsum cement is lighter than cement, but a little less conductive.

Estimated Assembly R-value*: R-0.69 - R-1.0

Good - Floor system must be insulated with foam sheet insulation. Insulation is not continuous, like insulation above sub-floor.



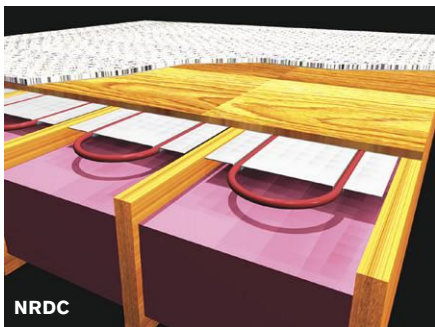
HYDRONIC

Hanging or Attached Below Subfloor

Radiant tubing is hung or attached to the underside of the subfloor in an air space with insulation below. This requires higher water temperatures and has more limited heat output than other systems. It is often used for retrofitting when access from below is possible. Hanging systems have more even joist cavity temperatures than when pipe is attached in contact with subfloor joists.

Estimated Assembly R-value*: R-1.7 - R-2.2 (pipe + 3/4-inch plywood only)

Not recommended, due to poor heat transfer & high water temps. Tubing cannot be accurately placed due to difficulty of working inside floor system below.



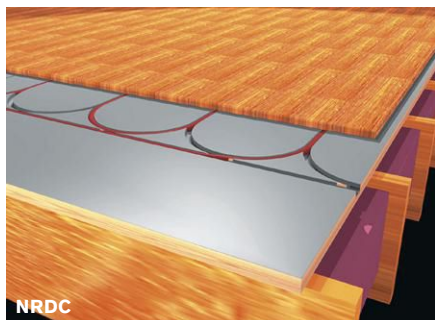
HYDRONIC

With Plates Below Subfloor **Good - Special Conditions Apply**

Radiant tubing is attached to the underside of the subfloor with metal plates to diffuse the heat. Insulation is recommended below the plates. This has higher water temperatures and more limited heat output than above subfloor systems, but plates make it more effective than hanging pipe from under joists. It is often used for retrofitting when access to joist space is available.

Estimated Assembly R-value*: R-1.3 - R-1.8 (pipe + 3/4-inch plywood only)

Not recommended, due to poor heat transfer & high water temps. Tubing cannot be accurately placed due to difficulty of working inside floor system below. Plate noise is possible.



HYDRONIC

Structural Radiant Subfloor with Aluminum and Grooves

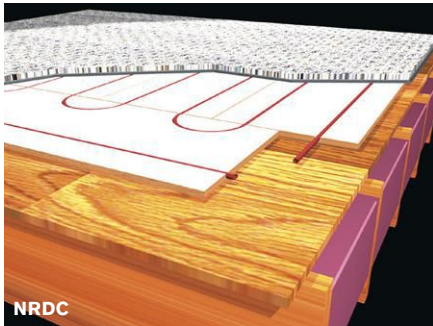
Premanufactured 1-1/8-inch-thick panels have grooves for tubing and an aluminum sheet bonded to the board. In this case, the premanufactured panels serve both as the structural subfloor and as the channel into which the tubing is installed. The aluminum sheet makes the system accelerate rapidly and spreads out the heat. Tubing is installed 12 inches on center in the grooves.

Estimated Assembly R-value*: R-0.6

Not recommended, due to high water temps right next to flooring. Tubing cannot be accurately placed due to designated grooves.

Good, Better & Best Rating

GUIDE GALLERY OF RADIANT SYSTEMS



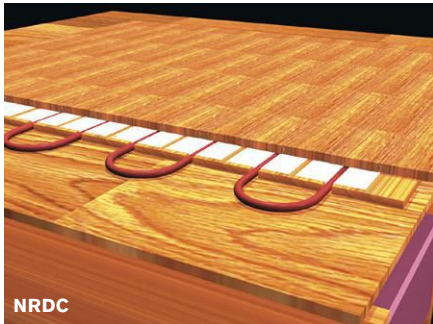
HYDRONIC

Boards with Grooves and Metal, Attached to Top of Subfloor

Several varieties currently exist. One board has metal on the bottom and another on the top. Both serve to spread the heat laterally. Normally they are glued and screwed or stapled to the top of a wooden subfloor. Under some conditions they may be attached on top of existing slabs. These are modular systems with straights and end pieces that are assembled to make a channel for pipe. Different products use different pipe sizes.

Estimated Assembly R-value*: R-0.75 - R-1.1 depending on product

**Not recommended, due to high water temps right next to flooring.
Tubing cannot be accurately placed due to designated grooves.
High cost and labor intensive.**



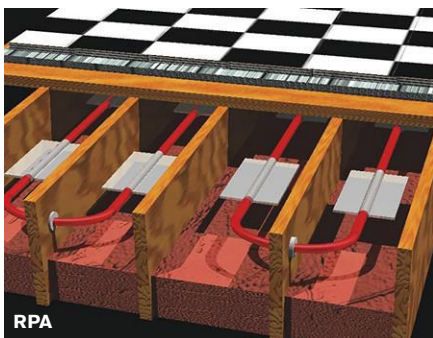
HYDRONIC

Sandwich Method with or without Plates on Top of Subfloor

Typically, 1-by-4-by-3/4-inch sleepers are attached to the top of the subfloor, and pipe is placed in between the sleepers with or without the addition of the metal plates. The metal plates typically cover about 80% of the pipe, adding significantly to the even dispersion of the heat.

Estimated Assembly R-value*: R-1.1 - R-1.5 depending on product and plates

**Not recommended, due to high water temps right next to flooring.
Tubing placement need to be precise for sleepers, increased labor.
High cost and labor intensive.**



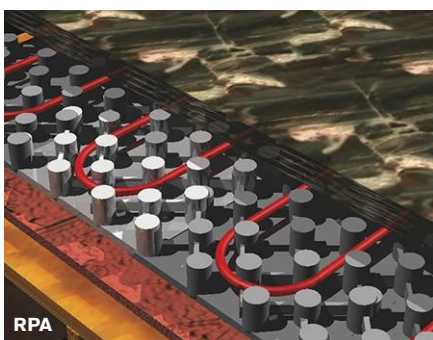
HYDRONIC

Joist Bay Convection Plates

The radiant tubing is suspended in a clear air space beneath the subfloor between the joists with metal plates or fins attached to the tubing. The tubing and metal fins heat the air within the joist space, which, in turn, heats the subfloor. Insulation is mandatory below the plates. Higher water temperatures are required than in systems with the plates in direct contact with the floor. Tubing may be run parallel to the joists or perpendicular if holes are drilled to accommodate the tubing.

Estimated Assembly R-value*: R-1.7 - R-2.2 (pipe + 3/4-inch plywood only)

**Not recommended, due to poor heat transfer & high water temps.
Tubing cannot be accurately placed due to difficulty of working
inside floor system below. Plate noise is highly possible.**



HYDRONIC

Preformed Support Panels

Molded panels designed to hold the radiant tubing cover the entire floor surface. This system may incorporate insulation molded as part of the panel.

Estimated Assembly R-value*: R-0.69 - R-1.0

**Better - Efficient & Comfortable Radiant Heat with lightweight or
concrete over pour. Insulation is integrated, fast install.
High mass of over pour, proven superior performance.**

COMPARATIVE R-VALUES OF FLOORING AND SUBFLOORS

Material	R-value Per Inch	Typical Thickness	Typical R-value
Plywood	1.10	3/4"	0.825
OSB	1.40	3/4"	1.050
Softwood	1.10	3/4"	0.825
Sheet Vinyl	1.60	1/8"	0.200
Vinyl Composition Tile (VCT)	1.60	1/8"	0.200
Linoleum	1.60	1/4"	0.400
Linoleum	1.60	1/8"	0.200
Dense Rubber Flooring	1.30	21/64"	0.250
Recycled Rubber Flooring	2.20	1/2"	1.100
Cork	3.00	3/8"	1.125
Cork/MDF/Laminate	2.35	1/2"	1.175
Brick	2.25	1 1/2"	3.375
Marble	0.80	1/2"	0.400
Ceramic Tile	1.00	1/4"	0.250
Thinset Mortar	0.40	1/8"	0.050
MDF/Plastic Laminate	1.00	1/2"	0.500
Laminate Floor Pad	1.92	5/32"	0.300
Engineered Wood	1.00	1/4"	0.250
Engineered Wood	1.00	3/8"	0.375
Engineered Wood	1.00	5/8"	0.625
Engineered Wood	1.00	3/4"	0.750
Engineered Wood Flooring Pad	1.60	1/8"	0.200
Engineered Bamboo	0.96	3/4"	0.720
Oak	0.85	3/4"	0.638
Ash	1.00	3/4"	0.750
Maple	1.00	3/4"	0.750
Pine	1.30	3/4"	0.975
Fir	1.20	3/4"	0.900
Carpet Pad/Slab Rubber 33 lb.	1.28	1/4"	0.320
Carpet Pad/Slab Rubber 33 lb.	1.28	3/8"	0.480
Carpet Pad/Slab Rubber 33 lb.	1.28	1/2"	0.640
Carpet Pad/Waffle Rubber 25 lb.	2.48	1/4"	0.620
Carpet Pad/Waffle Rubber 25 lb.	2.48	1/2"	1.240
Carpet Pad/Frothed Polyurethane 16 lb.	3.53	1/8"	0.53
Carpet Pad/Frothed Polyurethane 12 lb.	3.48	1/4"	0.87
Carpet Pad/Frothed Polyurethane 10 lb.	3.22	3/8"	1.20
Carpet Pad/Frothed Polyurethane 10 lb.	3.22	1/2"	1.61
Hair Jute	3.88	1/2"	1.940
Hair Jute	3.88	21/64"	1.250
Synthetic Fiber Pad 20 oz.	1.8	15/64"	0.421
Synthetic Fiber Pad 27 oz.	1.98	18/64"	0.545
Synthetic Fiber Pad 32 oz.	2.1	19/64"	0.630
Synthetic Fiber Pad 40 oz.	2.2	11/32"	0.770
Prime Urethane	4.30	21/64"	1.400
Prime Urethane	4.30	1/2"	2.150
Bonded Urethane	4.20	21/64"	1.350
Bonded Urethane	4.20	1/2"	2.100
Carpet	2.80	1/4"	0.700
Carpet	2.80	3/8"	1.050
Carpet	2.80	1/2"	1.400
Carpet	2.80	5/8"	1.750
Carpet	2.80	3/4"	2.100
Wool Carpet	4.20	3/8"	1.575
Wool Carpet	4.20	1/2"	2.100