



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS C 3651 : 2004

(IEIEJ/JSA)

Installation methods of heating facilities

ICS 91.140.99; 93.080.99

Reference number : JIS C 3651 : 2004 (E)

PROTECTED BY COPYRIGHT

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by The Institute of Electrical Installation Engineers of Japan (IEIEJ)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS C 3651 : 1994** is replaced with this Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Date of Establishment: 1985-02-01

Date of Revision: 2004-11-20

Date of Public Notice in Official Gazette: 2004-11-22

Investigated by: Japanese Industrial Standards Committee
Standards Board
Technical Committee on Electricity
Technology

JIS C 3651 : 2004, First English edition published in 2005-04

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2005

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED BY COPYRIGHT

Contents

		Page
1	Scope	1
2	Normative references	1
3	Definitions	1
4	Heating lines	3
5	Design	3
6	Execution	5
6.1	General	5
6.2	Road heating.....	7
6.3	Floor heating and ceiling heating	8
6.4	Roof heating.....	8
6.5	Pipe line heating.....	9
6.6	Water supply and drainage pipe heating.....	9
6.7	Concrete curing heating	10
6.8	Electric hotbed	10
6.9	Heating in iron structure, facilities, etc.	11
	Attached Table 1 Normative references.....	17
	Annex (normative) Heating lines	18

Installation methods of heating facilities

1 Scope This Japanese Industrial Standard specifies the installation methods of heating facilities in general places of fixed heating lines, fixed heating sheets and fixed heating boards of the working voltage not higher than 600 V in the inside or the surface of the work pieces such as road, parking area, building material and pipe line, or under the ground, on the ground surface, in the air or in the water. This Standard does not apply to the heating line when using heating lines as one of the elements of machine or apparatus.

Remarks : General places mean such places that do not include the following places:

- a) Places in which flammable gas or vapor of inflammable fluid of firing point not higher than 40 °C exist and come to a dangerous concentration or places likely to come to the condition like that.
- b) Places in which deflagrating dust, conductive dust, inflammable dust or flammable fibre exists and, therefore, electrical equipment is likely to be an ignition source to bring about explosion or fire.
- c) Places in which flammable and dangerous materials such as celluloid, match and oils are manufactured or stored.
- d) Power magazine, explosives manufacturing or handling places to which the Explosives Control Law (1950, Law No. 149) applies.

2 Normative references The standards listed in attached table 1 contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) shall be applied.

3 Definitions For the purpose of this Standard, the following definitions apply:

- a) **heating resistor** a conductor which generates Joule heat when passing electric current through it
- b) **heating line** a cord to generate heat for heating up. Some of which are equipped with sheath, reinforcing layer, and the like
- c) **heating sheet** a body in the form of a sheet for generating heat for heating up and of flexibility and resiliency
- d) **heating board** a body in the form of a board for generating heat for heating up and to which the outer hull is added for eliminating flexibility and for resilience
- e) **heating lines** a generic term including heating line, heating sheet and heating board. Cords for connection are included.
- f) **sheath** a covering of tubular coat of uniform and continuous metal or non-metal material which is made for the purpose of preventing the insulator from ambient influences. The layer of insulator provided on the outer layer of the insulator for preventing corrosion of reinforcing layer is included.

- g) **reinforcing layer** a covering for mechanically reinforcing the heating line
- h) **outer hull** mechanical reinforcing material for the heating resistors of heating sheet and heating board and the insulating materials
- i) **highest allowable temperature** the continuously usable highest temperature limited by the quality of heating resistor, insulator and sheath
- j) **highest heating temperature** the highest temperature at which the heating by means of heating apparatus is possible
- k) **cord for connection** cords for direct connection to the heating resistor
- l) **wiring** cords for applying electricity to heating lines
- m) **structure** overall bodies including all things artificially made other than the things naturally existing such as plants and rocks
- n) **road** passage artificially built for the traffic of human beings, vehicles, etc., including non-busy roads such as the road for agricultural use and pedestrian bridges, and excluding the passage like a corridor constructed in a building
- o) **parking area** place in which vehicles stay
- p) **building** of the structures fixed on the ground such as architecture, advertising tower, etc., the structure having a roof and pillar, or wall
- q) **building member** members of which the building is composed
- r) **pipe line** overall facilities which transport petroleum such as crude oil and heavy oil, foods such as chocolate, cream and sugar syrup and the chemical products such as caustic soda, phenol and benzene, using conductors and other structures
- s) **road heating** heating facilities constructed under the ground or on the surface of the road, parking area, etc. using heating lines and the like for the purpose of preventing snowfall or freezing
- t) **floor heating** heating facilities constructed inside the building members of which the floor of building is composed or on their surface providing heating lines for heating up
- u) **ceiling heating** heating facilities constructed inside the building members of which the ceiling or wall of building is composed or on their surface providing the heating lines for heating up
- v) **roof heating** heating facilities constructed inside the building members of which the roof of building is composed or on their surface providing the heating lines for preventing the roof from accumulated snowfall or freezing
- w) **pipeline heating** heating facilities used for pipeline transportation of the fluid of high viscosity or the solid at ordinary temperature by making them the fluid of low viscosity by means of the heating lines provided inside the pipeline or on the surface

- x) **water supply pipe and drainage pipe heating** heating facilities constructed inside the water supply pipe, drainage pipe, rain gutter or water tank or on their surface providing the heating lines for preventing water from freezing, provided that the water work freeze-proofing appliances to which the Electrical Appliance Safety Law applies are excluded
- y) **concrete curing heating** heating facilities constructed inside the concrete or on its surface providing the heating lines for keeping the temperature of the concrete during a period of pouring concrete
- z) **electric hotbed** heating facilities constructed inside the structure or on its surface, underground, on the ground surface, in the air or under water providing the heating lines for the purpose of cultivating the seedlings of vegetables, flowering plants, tobacco, paddy-rice, sweet potato, fruits or mushrooms; chicken rearing; incubation; silk-worm culture or for the purpose like those, provided that the electric nursery cabinet, electric incubator, electric brooder and heater for ornamental plant to which the Electrical Appliance Safety Law applies are excluded
- aa) **heating for iron structure and facilities** heating facilities constructed inside the members of which the iron structure and facilities are composed or on their surface providing the heating lines for preventing the iron structure and facilities from accumulated snowfall or freezing

4 Heating lines The heating lines used for heating facilities shall comply with those given in annex.

5 Design The design of heating facilities shall be as follows:

- a) The voltage to ground in the cable way for supplying electricity to the heating lines is not higher than 150 V. However, when equipping other structure than housing with the heating lines, the voltage to ground may be not higher than 300 V.
- b) The temperature of heating resistor is not higher than either the maximum allowable temperature of insulators given in annex table 3 or the maximum allowable temperature of heating resistor the manufacture expresses, whichever is lower.
- c) The temperature due to the heating up by the heating lines is as follows:
 - 1) Temperature of not more than 80 % of the ignition temperature of the object to be heated (including fluid and its vapour).
 - 2) Not higher than 80 °C in the case where the building materials around the heating lines are inflammable materials such as wood and there are parts which the heat lines touch or are likely to touch.
 - 3) Not higher than 45 °C in the case of the floor surface equipped with floor heating in the residential part.
- d) Building materials are prevented from change in colour or deformation caused by the heat of heating lines.
- e) The selection of the heating lines according to the places to be equipped is as given in table 1.

In addition, the mechanical strength characteristic, weather-proof, heat-proof, oil resistance, acid-proof and alkali-proof of the heating lines shall be taken into consideration according to the places to be equipped.

Remarks : In the case where the outermost layer cladding material of the heating lines which come into contact or are likely to come into contact with the insulator of a vinyl mixture made of styrofoam, those of styrene-proof shall be used

Table 1 Application of heating lines according to the places to be equipped

Place to be equipped	Name and symbol ⁽¹⁾ of heating lines							Method		
	Class 1 heating line	Class 2, class 4 heating line	Class 3 heating line	Class 1 heating sheet	Class 2 heating sheet	Class 1 heating board	Class 2 heating board	Embedding	Concealing	Exposure
	A1	A2, A4	A3	B1	B2	C1	C2			
Roadway, parking area, etc.	×	○	○	×	×	×	×	○	×	×
Floors of refrigerated warehouses, etc. on which heavy appliances are put	×	○	○	○	×	×	×	○	×	×
Footway, poach, entrance of house, hall, roof, etc.	×	○	○	○	×	○	×	○	○	○ ⁽²⁾
Watery floor such as toilet and bath and humid floor like cattle shade	×	○	○	○	×	○	×	○	○	○ ⁽²⁾
Dry floor, wall, ceiling, etc.	×	○	○	○	○	○	○	○ ⁽³⁾	○ ⁽⁴⁾	○ ⁽²⁾
Surface of pipe line or pipes for water supply and drainage, or gutter or water tank	×	○	○	○	×	×	×	×	○	○ ⁽⁵⁾
Inside of pipes for water supply and drainage or gutter	×	○	○	×	×	×	×	×	○	○
Concrete curing	○	○	○	○	×	×	×	○	○	○
Electric hotbed	○	○	○	○	×	○	×	○	○	○
Iron structure, facilities, etc.	×	×	○	×	×	○	×	×	○	○ ⁽⁵⁾

Notes ⁽¹⁾ The meanings of symbols are as follows:

A is heating line, B is heating sheet and C is heating board. In the case of the heating line, 1 means electric hotbed line, 2, 3 and 4 indicate the division of mechanical strength and heat-proof, and in the cases of the heating sheet and heating board, 1 indicates to be for outdoor use or under water use and 2 indicates to be for dry indoor use.

⁽²⁾ Limited only to heating board.

- (3) Limited only to heating line and class 1 heating sheet.
- (4) Limited only to heating line, class 2 heating sheet and class 2 heating board.
- (5) Limited only to class 3 heating line.

Remarks : The means of the symbols are as follows:

○ means to be applicable, and × means not to be applicable.

- f) The heating lines are set up according to any one of the following:
 - 1) **Embedding method** The heating lines are embedded in the strong materials of heat resistance such as cement concrete, asphalt concrete and others. In case where electric hotbed is laid under the ground or in the water, this method does not apply.
 - 2) **Concealing method** In this method, any one of the following is used:
 - 2.1) The heating lines are set up by installing within the inside space of structure.
 - 2.2) The heating lines are installed on the surface of structure and they are covered with building materials, protective materials, etc.
 - 3) **Exposing method** The heating lines are set up on the surface of structure, ground, etc. in a exposed state.
- g) The heating lines are set up so as not to affect electrically, magnetically and thermally the other electrical structure, weak current cord, water pipe, gas pipe or others like those.
- h) The electric path for supplying the power to the heating facilities are equipped with earth leakage breaker or molded case circuit breaker for exclusive use.
- i) Of the following heating facilities, if the working voltage is not higher than 300 V, type D earthing work is executed and if exceeding 300 V, type C earthing work is executed.
 - 1) Metal body used for sheath or reinforcing layer of heating line.
 - 2) Metallic part of the support or protective device of heating lines.
 - 3) Metallic outer hull of heating board.
- j) **Informative attached figure** Examples of equipment of heating lines are shown in the informative attached figures 1 a) to i).

6 Execution

6.1 General

- a) Construct the facilities paying attention to the handling according to the mechanical strength properties of the heating lines and set up so as not to damage the heating lines.
- b) The heating lines shall be set up on the surface of the part finished to be flat and smooth without protrusion.

- c) Sweep carefully the part on which the heating lines are set up and remove those likely to damage the heating lines such as nail, protrusion and so on.
- d) The heating lines themselves are not allowed to touch or overlap directly. However, the case where the heating resistor uses semi-conductor device or other material like those of large temperature coefficient of zero power resistance and the method the manufacturer designates is observed may be excluded.
- e) The heating sheet and heating board are not allowed to be piled up or folded. However, the case where the heating resistor uses semi-conductor device or other material like those of large temperature coefficient of zero power resistance and where the method the manufacturer designates is observed may be excluded.
- f) The heating line, when folded, as follows:
 - 1) When folding the heating line of class 1, class 2, or class 3, care is taken so as not to damage the cover and the radius inside the bent part is not less than six times the external diameter of finished heating line (ten times in the case of the heating line for which metallic material is used as sheath or reinforcing layer).
 - 2) When folding the heating line of class 4, care is taken so as not to damage the cover, and the radius inside the bent part is not less than two times the external diameter of the finished heating line (four times in the case of the heating line for which metallic material is used as sheath or reinforcing layer).
- g) When folding the heating sheet, care shall be taken so as not to damage the cover, and the radius inside the bent part shall be not less than six times the thickness of the finished heating sheet (ten times in the case of heating sheet for which metallic material is used as sheath or reinforcing layer).
- h) The heating lines shall be constructed by fixing on a structure in a way not to be damaged.
- i) The cord for connection to be selected shall be in accordance with the annex, 4.2 and the maximum allowed temperature of the insulator and sheath of which shall be in accordance with the requirements in table 2.

Table 2 Maximum allowed temperature of insulator and sheath of cord for connection according to places of construction

Place of construction	Maximum allowed temperature of insulator and sheath of cord for connection
Pipeline, iron construction, facilities, etc.	Equivalent or superior to the maximum allowed temperature of insulator and sheath of heating resistor
Electric hotbed	60 °C or over and, moreover, the maximum heating up temperature of its electric hotbed or over
Others	75 °C or over and, moreover, the maximum heating up temperature of the heating facilities or over

- j) When constructing the cord for connection on places other than that of construction of heating lines, the works shall be the metallic conduct works, synthetic resin conduct works, flexible conduct works or cable works specified in the interpretation of the technical standards for electrical equipment.
- k) The connection between mutual heating resistors, heating resistor and cord for connection or heating lines and wiring shall be required that the temperature rise at the connecting part caused by the electric current does not become higher than the temperature rise at other parts and shall be as follows:
 - 1) For the connecting part, connection pipe and other devices are used or brazed and its part is sufficiently covered with the material of dielectric strength equivalent or superior to the insulator of heating lines.
 - 2) When connecting the metallic bodies used for sheath or reinforcing layer of the heating lines to each other, the metallic body at its connecting part is connected perfectly electrically.
 - 3) The connecting part is required to be free from tensile force.
 - 4) When connecting the heating resistors to each other or connecting the heating resistor to the cord for connection, the connection is carried out at the place where the heating lines are constructed.
 - 5) When connecting the heating lines to the wiring, the connection is conducted within a box set up near the place in which the heating lines are constructed and the checking is easily carried out. In the case where the wiring serves as the cord for connection as well, and connects directly to the heating resistor, the box may be omitted.
 - 6) When setting up the connection part in a moist place in the outdoor or indoor, the connection part is given water-proofing treatment.
- l) During the execution of the heating lines, the continuity test and the measurement of insulation resist shall be carried out as required.

6.2 Road heating Road heating shall be as follows:

- a) The heating lines are set up so as not to be damaged by carrier, rake, scoop, etc. during the pavement works.
- b) The heating lines are fixed so as not to be moved by the works of pavement.
- c) The digging of road or the embedding of anchor bolts for fixing the road-related facilities is carried out in advance of the setting up of the heating lines or the positions where above works to be done shall be identified in advance to avoid the setting up of the heating lines there.
- d) When embedding the heating lines in segment concrete, the heating lines are set up so as not to be damaged by pouring the concrete or by the vibrator.
- e) If there are expansion and contraction joints or expansion joints within the place where the heating lines are set up, for the parts of these joints, the cords for connection covered with the protective tubes are used and the cords are of sufficient length enough to be free from tensile force.

f) Embedding of the heating lines in asphalt concrete shall be as follows:

- 1) The temperature of the asphalt concrete which is a part of the pavement and is a layer for protecting the heating lines (hereafter referred to as “protective layer”) is not higher than 150 °C when setting up the heating line of class 2 and class 3, and not higher than 180 °C when setting up the heating line of class 4.
- 2) The road roller used for compaction of the protective layer is not heavier than 3 t (nominal) when setting up the heating line of class 2, not heavier than 6 t (nominal) when setting up the heating line of class 3 and not heavier than 12 t (nominal) when setting up the heating line of class 4. At the time of initial rolling compaction, vibration should not be applied.

6.3 Floor heating and ceiling heating The heating shall be as follows:

- a) The heating lines are set up so as not to be damaged by carrier, rake, scoop, etc. during the floor construction.
- b) The heating lines are fixed so as not to be moved by pouring the concrete on site.
- c) Boring the floor surface and embedding the anchor bolts for fixing the building-related facilities are carried out in advance of the setting up of the heating lines or the positions where above works to be done are identified in advance to avoid setting up of the heating lines there.
- d) When embedding the heating lines in segment concrete, the heating lines are set up so as not to be damaged by pouring the cement on site or by the vibrator.
- e) If there are expansion and contraction joints an expansion joints within the place where the heating lines are set up, for the parts of these joints, the cords for connection covered with the protective tubes are used and the cords are of sufficient length enough to be free from tensile force.
- f) When fixing the heating sheet or heating board on the building material, the fixing position or the like shall be as designated by the manufacturer.
- g) The heating lines set up for the floor heating on which the heavy appliances like refrigerator are put shall be set up on a place not touching directly the insulator.

6.4 Roof heating The heating shall be as follows:

- a) The heating lines are set up without applying noticeable mechanical shock by hammer or tools during the works of roofing.
- b) If there are expansion and contraction joints or expansion joints in the place where the heating lines are set up, for the parts of these joints, the cords for connection covered with the protective tubes are used and the cords are of sufficient length enough to be free from tensile force.
- c) When embedding the heating lines in the asphalt concrete, the temperature of the asphalt concrete used for protective layer is not higher than 150 °C when installing the heating line of class 2 and heating line of class 3, and not higher than 180 °C when installing the heating line of class 4.

- d) When fixing the heating boards which serve together as roof materials on the building materials, the position where the materials are fixed is designated by the manufacturer.

6.5 Pipe line heating The heating shall be as follows:

- a) When removing the extraneous material in order to make clean the surface of pipes on which the heating lines are set up, the plating, paint or coating for preventing the pipes from rust are not to be taken away.
- b) The heating lines other than the heating line of class 3 are protected with thermal insulating material, sheathing material, etc. so as not to be changed.
- c) The heating line of class 3 is protected by thermal insulating material, sheathing material, etc., when set up on a place likely to suffer noticeable mechanical shock.
- d) When using thermal insulator of soft material such as glass wool, foamed polyurethane, etc., the heating lines are covered with thin metal plate and the like so as not to directly touch the insulator.
- e) The pipe line is marked on a large and conspicuous place indicating that the heating lines are installed.
- f) When setting up the heating lines on tank, vessel, etc., it is required to pay attention to over heating.
- g) The heating lines are set up in a way unlikely to be touched by the human body and unlikely to be damaged.

6.6 Water supply and drainage pipe heating The heating shall be as follows:

- a) Setting up of the heating lines on the surface of water supply pipe, drainage pipe, gutter, water tank, etc. shall be as follows:
 - 1) The heating lines are set up so as to make good contact with the surface of the pipes.
 - 2) The heating lines themselves are fixed using materials of heat resistance and water resistance avoiding touching or overlapping each other.
 - 3) The heating lines are protected by thermal insulating material, sheathing material, etc. so as not to be touched by the human body and not to be damaged.
- b) Setting up of the heating lines inside the water supply pipe, drainage pipe, gutter etc. shall be as follows:
 - 1) Mutual heating lines do not tangle or touch each other.
 - 2) The heating line is not covered by material of heat insulating property.
 - 3) Setting up at such place where material other than water is likely to flow is not allowed.
 - 4) The heating line is set up so as not to be touched by someone's body.