Specification for Aluminum Conductor Aluminum Clad Steel Reinforced

1. General

1.1 Scope

This specification is applicable to aluminum conductors aluminum clad steel reinforced (hereafter referred to as stranded conductors) used for overhead transmission lines of the Kansai Electric Power Co., Inc. (hereafter referred to as KANSAI)

The stranded conductors specified in this specification are mainly used for electric lines on overhead transmission lines.

1.2 Classes of stranded conductors

The stranded conductors shall be classified according to the nominal cross sectional area.

The nominal cross sectional area shall be as shown in Table 2.3.

1.3 Designation of a product

Stranded conductor shall be designated as shown in the following example:

Example: Aluminum conductor aluminum clad steel reinforced 610 mm^2: (ACSR/AC610 mm^2)

1.4 Standards to which this specification conforms

(1)	JEC-3404:	Aluminium conductors and aluminium conductors steel-reinforced
(2)	Standards pertaining to electric power A241:	Aluminium conductor steel reinforced type conductor
(3)	IEC60889:	Hard-drawn aluminium wire for overhead line conductors
(4)	IEC61089:	Round wire concentric lay overhead electrical stranded conductors
(5)	IEC61232:	Aluminium-Clad Steel Wires for Electrical Purposes
(6)	JIS C 3001:	Resistance of Copper Materials for Electrical Purposes
(7)	JIS C 3002:	Testing methods of electrical copper and aluminium wires
(8)	JIS C 3108:	Hard-drawn aluminium wires for electric purposes
(9)	JIS G 3506:	High carbon steel wire rods

2. Structure, materials, and performance characteristics

2.1 Wires

Individual wires composing a stranded conductor shall meet the following requirements:

2.1.1 Hard-drawn aluminum wire

(1) Quality

A hard-drawn aluminum wire shall be made of aluminum that complies with JIS C 3108 “Hard-drawn aluminum wires for electrical purposes”, section 7.1 (Components) and shall be homogeneous in quality, have a smooth surface, and be free from all imperfections such as flaws, rust, and fissures or other defects which may endanger the performance of the product.

A hard-drawn aluminum wire shall have no joint except wires have been completely finished by wire drawing

(2) Diameter and tolerances on diameter

The size of a hard-drawn aluminum wire shall be expressed in the diameter (mm). The classes of diameter are given in Table 2.1. Tolerances on diameter shall be as shown in Table 2.1.

(3) Conductivity

The conductivity shall not be less than 61% when the conductivity at 20°C of standard annealed copper specified in JIS C 3001 “Resistance of Copper Materials for Electrical Purposes” is supposed to be 100%.

In the case, the temperature correction of electrical resistance shall follow the formula below:

$R_t = R_{20} \{1 + \alpha_{20} (t - 20)\}$

R_t: Electrical resistance at t°C

R_{20}: Electrical resistance at 20°C

α_{20}: Constant-mass temperature coefficient of resistance at 20°C; The coefficient per one degree Celsius is 0.0040.

(4) Tensile strength and elongation

The tensile strength and the elongation of hard-drawn aluminum wires shall be as shown in Table 2.1.

Table 2.1 Performance characteristics of hard-drawn aluminum wires

Diameter (mm)	Tolerances on diameter (mm)	Tensile strength (MPa) {kgf/mm^2}		Elongation (%)
		Minimum	Average	
4.5	±0.04	159 {16.2}	165 or more {16.8}	2.0 or more
4.0	±0.04	159 {16.2}	165 or more {16.8}	1.9 or more
3.8	±0.04	162 {16.5}	169 or more {17.2}	1.8 or more
3.2	±0.04	162 {16.5}	172 or more {17.5}	1.7 or more
2.6	±0.03	169 {17.2}	179 or more {18.3}	1.5 or more
2.3	±0.03	176 {17.9}	186 or more {19.0}	1.5 or more

Note: 1. Values specified in this table mean the values at 20°C.

2. Average tensile strength refers to the average value of tensile strength of a group of specimens.

3. Density of a hard-drawn aluminum shall be 2.7 g/cm^3.

2.1.2 Aluminum clad steel wire

(1) Quality

Aluminum clad steel wires shall be steel wires that are made of wire materials conforming to JIS G 3506 “High carbon steel wire rods” and are clad evenly and perfectly with aluminum conforming to JIS C 3108 “Hard-drawn aluminum wires for electrical purposes,” section 7.1 (Components). There shall be no exfoliation at the contact layer between the two metals. The

surfaces of aluminum clad steel wires shall be smooth and free from all imperfections such as flaws, rust, and fissures or other defects which may endanger the performance of the product.

(1) Diameter and tolerances on diameter

The size of an aluminum clad steel wire shall be expressed in the diameter (mm). The classes of diameter are given in Table 2.2. Tolerances on diameter shall be as shown in Table 2.2.

(3) Conductivity

The conductivity shall be as shown in Table 2.2 when the conductivity at 20°C of standard annealed copper specified in JIS C 3001 “Resistance of Copper Materials for Electrical Purposes” is supposed to be 100%.

In the case, the temperature correction of electrical resistance shall follow the formula below:

$R_t = R_{20}\ \{1 + \alpha_{20}\ (t - 20)\}$

R_t: Electrical resistance at t°C

R_{20}: Electrical resistance at 20°C

α_{20}: Constant-mass temperature coefficient of resistance at 20°C; The coefficient per one degree Celsius is 0.0036.

(4) Tensile strength, elongation, and number of twists

The tensile strength, the elongation, and the number of twists of aluminum clad steel wires shall be as shown in Table 2.2.

(5) Characteristics of aluminum

The characteristics of aluminum used in aluminum clad steel wires shall be as shown in Table 2.2.

Table 2.2 Performance characteristics of aluminum clad steel wires

Diameter (mm)	Tolerances on diameter (mm)	Tensile strength (MPa) {kgf/mm^2}	Elongation (%)	Number of twists (times)	Conductivity (%)	Aluminum characteristics
						Minimum aluminum thickness (mm)
3.8	±0.07	1270 or more {130}	1.5 or more	16 or more	23 or more	0.21
3.5	±0.07	1270 or more {130}	1.5 or more	16 or more	23 or more	0.19
3.2	±0.06	1270 or more {130}	1.5 or more	16 or more	23 or more	0.18
3.1	±0.06	1270 or more {130}	1.5 or more	16 or more	23 or more	0.17
2.6	±0.05	1320 or more {135}	1.5 or more	20 or more	20.3 or more	0.12
2.3	±0.05	1320 or more {135}	1.5 or more	20 or more	20.3 or more	0.10

Note: 1. Values specified in this table mean the values at 20°C.

2. Density of an aluminum clad steel wire shall be 6.27 g/cm^3 for a wire with a conductivity of 23% or more and be 6.53 g/cm^3 for a wire with a conductivity of 20.3% or more.

2.2 Stranded conductor

The structure and performance characteristics of stranded conductors shall meet the following requirements depending on the combination of individual wires specified in section 2.1.

The surface of a stranded conductor shall be evenly coated with oil that does not deteriorate easily nor dry up quickly.

2.2.1 Aluminum conductor aluminum clad steel reinforced

(1) Quality

The surface of a stranded conductor shall be smooth and free from all imperfections such as flaws, rust, and fissures or other defects which may endanger the performance of the product.

(2) Stranding

Stranded conductors shall be made up of aluminum clad steel wires specified in section 2.1.2 and hard-drawn aluminum wires specified in section 2.1.1. The aluminum clad steel wires shall be concentrically stranded as shown in Table 2.3, and the hard-drawn aluminum wires shall be stranded evenly, closely and concentrically around the stranded aluminum clad steel wires.

The lay ratio*1 for the aluminum clad steel wire layers shall be 20 to 40. The lay ratio for the external and inner layers of hard-drawn aluminum wires shall be 20 or less.

*1 Lay ratio means the ratio of the lay length*2 to the external diameter of the corresponding layer of wires in the stranded conductor.

*2 Lay length means the axial length of one complete turn of the helix formed by an individual wire in stranded conductor.

Adjacent wire layers shall be stranded with reverse lay direction. The direction of lay of the external layer shall be in “left hand (anti-clockwise direction)” shown below.

(3) Cross section and stranded conductor composition

The size of a stranded conductor shall be expressed by the nominal cross sectional area (mm^2) of the aluminum wire. The classes of nominal cross sectional area are given in Table 2.3. The composition of stranded wires shall be as shown in Table 2.3.

(4) Tensile strength

The tensile strength of a stranded conductor shall be shown in Table 2.3.

(5) Joints of wires

The joints of wires shall conform to the followings.

a. An aluminum clad steel wire shall have no joint.

b. Only one joint on a hard drawn aluminum wire may be made by welding or pressure welding during stranding process. The joint shall not be closer than 15 m from a joint on any other aluminum wire in each layer of the completed stranded conductor.

Table 2.3 Performance characteristics of aluminum cable steel reinforced

Nominal cross section (mm^2)	Stranded conductor composition: Number of wires/ Wire diameter (pcs.)/(mm)		Calculated cross sectional area (mm^2)		External diameter (mm)		Tensile strength (kN) {kgf}	Standard unit length (m)
	Aluminum	Steel	Aluminum	Steel	Aluminum	Steel		
610	54/3.8	7/3.8	612.4	79.38	34.2	11.4	180.0 or more {18,350}	1,600
410	26/4.5	7/3.5	413.4	67.35	28.5	10.5	136.1 or more {13,880}	1,600
330	26/4.0	7/3.1	326.8	52.84	25.3	9.3	107.2 or more {10,930}	2,000
240	30/3.2	7/3.2	241.3	56.29	22.4	9.6	99.5 or more {10,150}	2,000
160	30/2.6	7/2.6	159.3	37.16	18.2	7.8	68.4 or more {6,970}	2,000
120	30/2.3	7/2.3	124.7	29.09	16.1	6.9	54.3 or more {5,540}	2,000

Note: 1. Values specified in this table mean the values at 20°C.
2. Values of calculated cross sectional area and external diameter are based on the standard diameter of each of individual wires.
3. The tensile strength shown in this table is calculated as 90% of the sum of the minimum tensile strength of hard-drawn aluminum wire multiplied by the number of the aluminum wires, plus the tensile strength of aluminum clad steel wire multiplied by the number of the steel wires.

3. Test items and methods

3.1 Test items and methods for individual wires

(1) External Appearance

Bundled or reeled sample wires shall be examined according to JIS C 3002 “Testing methods of electrical copper and aluminum wires,” section 3.

Reeled or drum-winding sample wires may be used in the test when quality can be assured by means of a flaw detector or another equipment.

(2) Structure

The structure shall be examined according to JIS C 3002 “Testing methods of electrical copper and aluminum wires”, section 4.

(3) Tensile strength and elongation

The tensile strength and elongation shall be examined according to JIS C 3002 “Testing methods of electrical copper and aluminum wires,” section 5.

For aluminum clad steel wire, the elongation at the time of fracture may be determined.

(4) Conductivity

The conductivity shall be examined according to JIS C 3002 “Testing methods of electrical copper and aluminum wires,” section 6.

The length of the specimen used for the measurement of conductivity should be about 1 m to avoid errors in the measurement, but when there are unavoidable circumstances, the length may be shortened up to 500 mm.

(5) Number of twists

A specimen used for this test shall be cut off from the end of sample wire. The length of the specimen between grips shall be 100 times the nominal diameter of the wire. A torsion test shall be conducted at the rate of 60 r.p.m. or less, and the number of twists to failure shall be determined. When the length of specimen between grips varies due to condition of machine, the number of twists to failure shall be changed in proportion to the length between grips

(6) Characteristics of aluminum

a. Aluminum thickness of an aluminum clad steel wire

A specimen used for the measurement of the aluminum thickness shall be cut off from the end of sample wire. The specimen shall be grinded until the cross section of the specimen becomes flat and perpendicular to the axis of the wire, and the minimum aluminum thickness shall be measured by using a 50-to-100-time enlarging projector, a measuring microscope or electrical indicating instruments operating on the penetration principle.

3.2 Test items and methods for stranded conductors

(1) External Appearance

Bundled or reeled samples of stranded conductors shall be examined according to JIS C 3002 “Testing methods of electrical copper and aluminum wires,” section 3.

(2) Structure

The structure shall be examined according to JIS C 3002 “Testing methods of electrical copper and aluminum wires,” section 4.

(3) Tensile strength

The tensile strength shall be examined according to JIS C 3002 “Testing methods of electrical copper and aluminum wires,” section 5.

The length of specimen between grips shall be 1,000 mm or more.

(4) Stress-elongation characteristic

The correlation between stress and elongation shall be determined by the tensile test.

4. Inspection

4.1 Types of inspections

The following 3 types are applied to inspections.

(1) Type inspection

Type inspection refers to the inspection on the product purchased by KANSAI. Based on the specifications for supplied products, KANSAI conducts strict tests and examinations to verify whether all the conditions required as standard products of KANSAI have been met. If necessary, KANSAI also examines the performance of the products within actual power network and considers the condition of quality control which the manufacturer conducts for the future maintenance and improvement of product quality levels. KANSAI then make a technical judgement based on the results of these examinations and considerations

(2) Individual acceptance inspection

Individual acceptance inspection refers to the inspection that is conducted so that KANSAI can make a technical judgement at the time of the individual acceptance of type approved products and products subject to individual acceptance inspections, based on the specifications for supplied products.

(3) Quality control inspection

Quality control inspection refers to the inspection that is conducted so that KANSAI can verify whether the individual acceptance inspection can be omitted or not. KANSAI conducts strict tests to verify whether the quality standards for type approved products are being maintained and improved based on the specifications for supplied products. KANSAI also considers the quality control conditions of the manufacturer. KANSAI then makes a technical judgement based on the results of these tests and considerations.

4.2 Inspection Method

(1) Type inspections

a. Inspection items and methods

The manufacturer's quality level shall be inspected by means of the quality assurance plan submitted by the manufacturer and the witnessing at the factory, while the performance characteristics of products shall be inspected based on the type inspection items in Table 4.1 by the test methods described in section 3.1 and 3.2.

b. Sample wires for tests and the quantities of the samples

The tests for the stranded conductors stipulated in section 1.2 shall be conducted as specified in Table 4.1 and 4.2. Sample wires and the quantities of the samples for each of test items shall be as shown in Table 4.2. As a rule, specimens of tests except for external appearance test shall be taken from sample wires excluding the wires which other specimens are taken from. However, such specimens may be taken from both ends of the sample wires used for external appearance test. The quantities may be increased depending on the consultation with KANSAI.

Regarding similar products which are expected to bring similar results, part or the whole of inspection items may be omitted by the consultation with KANSAI.

c. Items that manufacturers should state expressly

The manufacturer shall submit documents that clearly state the following items before the type inspection and shall consult with KANSAI in advance.

(a) Type inspection plan

(b) Quality assurance plan

The items specified in Table 4.3 shall be stated in the quality assurance plan. The manufacturer that has acquired ISO 9001 accreditation may use its quality manual for this purpose. When items to be included in Table 4.3 are not stated in the manual, the manufacturer shall submit the manual which the items are added to.

(c) Survey of manufacturing status

i. Track records of production and major customers

ii. Manufacture process control chart

(d) Reference data

i. In-house test results

ii. Technical guidance documents

iii. Statistic control chart

This document shall provide histograms of the below items and state the average value of the population and the estimated values of the standard deviation.

- Individual wire: Diameter, mill sheet for ingots, tensile strength, elongation, conductivity, number of twists, and aluminum thickness
- Stranded conductor: Tensile strength

d. Submission of the type inspection records

The manufacturer shall submit the type inspection result report clearly stating the results of the tests on the following items:

(a) Date of inspection
(b) Person responsible for witnessing the inspection and persons witnessing the inspection
(c) Inspection site
(d) Classes and quantities of samples
(e) Inspection items and results of inspection
(f) Inspection conditions and equipment used in the inspection
(g) Problems found during the test and the solution adopted by the manufacturer

The following points shall be noted when the test result report is submitted:

- All conditions such as the weather conditions (the weather, temperature, and humidity) that are expected to affect the test results shall be included in the records of the test results.
- When a measured value is converted, the calculation process for the conversion shall be clearly described.
- One copy of the data taken on the witnessed type inspection shall be submitted to each of the persons who witnessed the test on the same day of the test. The test result report shall be organized and prepared as specified and be submitted to KANSAI as early as possible.

e. Pass/fail evaluation

Products shall be judged as having passed the type inspection regarding them when the following requirements are met:

All sample wires and sample stranded conductors shown in Table 4.2 comply with the criteria specified in Table 4.1;

The products are judged as conforming to the requirements in comparison with the submitted statistical control chart; and

The examination of the necessary matters such as the manufacturer's quality level has proved the adequacy of the manufacturer's quality level.

f. Control of changes in a type-approved product

The manufacturer shall notify KANSAI of the following matters concerning a type-approved product as immediately as possible. In addition, the manufacturer shall consult with KANSAI and take procedures such as the change of type design as required.

- Changes in specification details, manufacture process control charts, suppliers, outsource companies (including change to in-house manufacturing), and the like
- Actual or anticipated occurrence of serious trouble in products delivered to KANSAI
- Anticipated serious effects on the maintenance of quality arising from changes in control and the like.

(2) Individual acceptance inspection

a. Inspection items and pass/fail criteria

The inspection items and the pass/fail criteria are as shown in Table 4.1.

b. Test method
The test methods shall be as shown in 3.1 and 3.2.

c. Definition of a lot
The quantity to be accepted in one delivery for each class of stranded conductor shall form one lot. The volume of a lot is expressed using the number of bundles, reels, or drums.

d. Number of sample wires
Sampling of wires shall be performed at random for each inspection item as specified in Tables 4.4, 4.5, and 4.6.
Which of the normal, the tightened, or the reduced inspection shown in Tables 4.4, 4.5, and 4.6 should be applied will be adjusted by KANSAI in consideration of the results of individual acceptance inspections and those of control inspection. In the early stage of a contract, however, the normal inspection shall be applied as a rule.

e. Submission of the individual acceptance inspection result report
After the completion of an individual acceptance inspection, the manufacturer shall organize and prepare the individual acceptance inspection test result report as required and submit it before the delivery of the products.
The individual acceptance inspection test result report shall include the following items:
(a) Date of inspection
(b) Person responsible for witnessing the inspection and persons witnessing the inspection
(c) Inspection site
(d) Classes and quantities of the delivered products and place of delivery
(e) Classes and quantities of samples
(f) Inspection items and results of inspection
(g) Inspection conditions and equipment used in the inspection
(h) Problems found during the test and the solution adopted by the manufacturer
The following points shall be noted when the test result report is submitted:
- All conditions such as the weather conditions (the weather, temperature, and humidity) that are expected to affect the test results shall be included in the records of the test results.
- When a measured value is converted, the calculation for the conversion shall be clearly described.
- One copy of the data taken at the witnessed test shall be submitted to each of the persons who witnessed the test on the same day of the test.

f. Judgement of acceptance/rejection of a lot
The acceptance/rejection of a lot shall be judged as follows depending on the number of defective products that do not conform to the criteria specified in Table 4.1. The number of defective products shall be counted for each inspection items classified in Table 4.1.
(a) When the number of defective products is not more than the number for acceptance shown in Tables 4.4, 4.5, and 4.6, the lot is accepted excluding the defective products.
(b) When the number of defective products is not less than the numbers for rejection shown in Tables 4.4, 4.5, and 4.6, the lot is rejected.
(c) In the case of a normal or tightened inspection, when the number of defective products is between the number for acceptance and the number for rejection, the additional inspections shown in Tables 4.3, 4.4 and 4.5 will be conducted for the inspection items for which defective products have been found. When the total of the number of defective products in the first inspection and the number of those in the additional inspection is not more than the number for acceptance applied to the additional inspection, the lot is accepted excluding the

defective products. Conversely, when the total is not less than the number for rejection, the lot is rejected.

(d) In the case of a reduced inspection, when the number of defective products is between the number for acceptance and the number for rejection, the lot is accepted excluding the defective products, and the normal inspection will be applied from the next inspection on.

g. Omission of attendance for individual acceptance test

Part or the whole of tests in presence of KANSAI at the factory may be replaced with the in-house test described in the next item with KANSI's permission.

h. In-house test

The manufacturer shall conduct test of products to be delivered in accordance with the inspection items and methods specified in section 4.2 (2) a to d and shall submit the in-house test result report prepared in accordance with the individual acceptance inspection results report.

(3) Quality control inspection

a. Inspection method

The manufacturer's quality level shall be inspected by means of the quality assurance plan submitted by the manufacturer and witnessing at the factory, while performance characteristics of products shall be inspected based on the control inspection items in Table 4.1 by the test methods described in section 3.1 and 3.2.

b. Inspection method

The inspection shall be conducted once in the year when KANSAI judges that the inspection is necessary. Principally, the inspection shall be conducted together with an individual acceptance inspection.

c. Sample wires and the quantities of samples

Sample wires and the quantities of samples shall be in conformity with an individual acceptance inspection.

d. Matters to be stated clearly by the manufacturer

The manufacturer shall submit documents that clearly state the following items before the control inspection and shall consult with KANSAI in advance.

(a) Inspection plan

(b) Quality assurance plan

The items shown in Table 4.3 shall be stated in quality assurance plan. The manufacturer that has acquired ISO 9001 accreditation may use its quality manual for this purpose. When items to be included in Table 4.3 are not stated in the manual, the manufacturer shall submit the manual which the items are added to.

(c) Survey of manufacturing status

i. Track record of delivery

ii. Manufacture process control chart

(d) Reference data (the same as in the type inspection)

i. In-house test results

ii. Technical guidance documents

iii. Statistic control chart

This document shall provide histograms of the below items and state the average value of the population and the estimated values of the standard deviation.

- Individual wire: Diameter, mill sheet for ingots, tensile strength, elongation, conductivity, number of twists, and aluminum thickness

- Stranded conductor: Tensile strength

e. Submission of the quality control inspection result report

The manufacturer shall submit the control inspection result report clearly stating the results of the tests on the following items:

(a) Date of inspection
(b) Person responsible for witnessing the inspection and persons witnessing the inspection
(c) Inspection site
(d) Classes and quantities of wires subjected to the quality control inspection
(e) Inspection items and results of inspection
(f) Inspection conditions and equipment used in the inspection
(g) Problems indicated during the test and the solution adopted by the manufacturer

The following points shall be noted when the test result report is submitted:

- All conditions such as the weather conditions (the weather, temperature, and humidity) that are expected to affect the test results shall be included in the records of the test results.
- When a measured value is converted, the calculation for the conversion shall be clearly described.
- One copy of the data taken at the witnessed control inspection shall be submitted to each of the persons who witnessed the test on the same day of the test. The test result report shall be organized and prepared as specified and submitted to KANSAI as early as possible.

f. Pass/fail evaluation

Products shall be judged as having passed the control inspection regarding them when the following requirements are met:

The performance characteristics comply with the criteria specified in Table 4.1; and

The examination of the necessary matters such as the manufacturer’s quality level has proved the adequacy of the manufacturer’s quality level.

The inspection class may be put to adjustment as required.

Table 4.1 Inspection items and pass/fail criteria

Kind of wire		Inspection item		Type inspection	Individual acceptance inspection	Quality control inspection	Pass/fail criteria
Individual Wires	Hard-drawn aluminum wires	External appearance		○	○	○	2.1.1 (1), Note 3
		Structure		○	○	○	2.1.1 (2)
		Tensile strength		○	○	○	2.1.1 (4)
		Elongation		○	○	○	2.1.1 (4)
		Conductivity		○	○	○	2.1.1 (3)
	Aluminum clad steel wires	External appearance		○	○	○	2.1.2 (1), Note 3
		Structure		○	○	○	2.1.2 (2)
		Tensile strength		○	○	○	2.1.2 (4)
		Elongation		○	○	○	2.1.2 (4)
		Conductivity		○	○	○	2.1.2 (3)
		Number of twists		○	○	○	2.1.2 (4)
		Aluminum characteristics	Aluminum thickness	○	○	○	2.1.2 (5)
Stranded conductors	Aluminum conductor aluminum clad steel reinforced	External appearance		○	○	○	2.2.1 (1), Note 3
		Structure		○	○	○	2.2.1 (2) (3) (5)
		Tensile strength		○	○	○	2.2.1 (4)
		Stress-elongation characteristic		○	—	○	No abnormalities such as remarkable curved sections allowed

Note: 1. Items indicated with a circle (○) require inspection.

2. Wires are in the condition prior to stranding.

3. The fail criteria for the appearance inspection shall be as follows, but the criteria may not be applied to defects that cause no practical problems.

a) Flaws

Flaws that are considered to lower the tensile strength and the elongation of a wire below the standard values. Other flaws that are otherwise detrimental to its use.

b) Rust

Rust formed by aluminum hydroxide on the surface of a wire.

c) Fissures

All wires with fissures shall be rejected.

d) Other practically detrimental defects

(i) Flaws or spots that may cause corrosion on the conductor in the future

(ii) Splitting or peeling of the conductor surface

(iii) Remarkable strand loosening, etc.

Table 4.2 Quantities of samples for the type inspection

Sample wire type	Inspection items	
	Appearance inspection	Inspections other than an appearance inspection
	(Number of bundles, reels, or drums)	(Number of specimens)
wires	5	10
Stranded conductors	1	2

Note: 1. Wires are in the condition prior to stranding

Table 4.3 Items to be included in the quality assurance plan

Item	Details to be entered
i. Basic policy of quality assurance	Corporate view on quality assurance activities and policy of implementation
ii. Quality assurance organization and the like	Quality control organization and business operations system for the concerned product • Quality control based on the organizational chart, division of duties, the responsibilities and authorities of departments and sections, and the like • Clarifying the positioning of the quality assurance sector • The system of operating individual duties is described in the item below and the ones following it.
iii. Document control	• Method of controlling the preparation, review, and approval of a document • Method of controlling the issue, distribution, change, and storage of a document "Document" refers to planning documents, guidelines, procedures, drawings, strength calculation sheets, manufacturing schedules, specifications, applications, and the like produced in the steps of order placing, manufacturing, execution and trial running. • List of quality control rules
iv. Design control	• Method of control aimed at accurately reflecting KANSAI's quality requirements on design documents (specifications, drawings, and the like) (including methods of design review) • Method of demonstrating and checking by means of the reliability evaluation and the use of models and actual machines
v. Control of details of an order	Methods of accurately communicating the specifications and conditions at the time of placing an order and various particulars of consultation to related sectors in the company
vi. Outsourcing control	• Methods of clearly stating the requirements to outsource companies in procurement documents such as specifications and order slips with the aim of procuring materials, parts, products, and services of adequate quality • Methods of selecting outsource companies • Methods of verifying that materials, parts, products, and services comply with the quality requirements. (Methods of acceptance inspections and tests) • Methods implemented by the order receiver to check the quality control framework of its outsource company • Methods of checking the delivery time • List of major outsourced products and the outsourcing management policy (including the situation in which outsource companies are given guidance) • List of outsourced products (Product names, outsource company names, specification numbers, and the like)

Item	Details to be entered
vii. Control of materials and equipment	• Methods of controlling the identification of materials and depots and the reception and shipment • Methods of preventing defective or non-inspected products from being used • Methods of controlling the handling, storage, washing, packaging, shipping, and transportation of materials and equipment with the aim of preventing them from deteriorating quality-wise, being damaged, or being lost • Conditions in which products (in the product warehouse) are taken care of
viii. Control of manufacture and installation	Descriptions shall be divided between manufacture and installation. • Methods of controlling operations and facilities related to the manufacture and installation • Methods of establishing the steps of manufacture and installation and controlling the steps on the basis of various "guidelines, procedures, construction schedules, and QC process charts" applied to different processes • Methods of controlling processes in manufacture and installation by using the means such as check sheets • Methods of operations in a special process "Special processes" refers to operation processes such as welding, heat treatment, washing, and surface treatment whose results rely highly on the control of the process implemented or the skill of the operator or both and in which the required quality cannot be evaluated easily by inspection or tests. • Methods of controlling jigs, tools and facilities used for the manufacture and installation • Overview of the implementation of education of operators • List of manufacturing facilities (facility names, manufacturers, and methods of control)
ix. Quality control record	Method of preparing, collecting, and storing quality records and the period of their storage
x. Audit	• Planning of an in-house audit and its method • Planning of a quality control audit of an outsource company implemented by the order receiver and the method of the audit
xi. First piece control	• Steps of implementing a process change • Procedure of checking the quality of a first product • Roles taken by different sectors for a first product
xii. Investigation and research for quality improvement	Overview of the investigation and research conducted to improve quality
xiii. Other details	Company overview (such as a company guide) and business site and plant overview

Table 4.4 Individual Acceptance Inspection of Wires
(for the appearance and aluminum characteristic inspections)

Inspection class	Normal inspection							Tightened inspection							Reduced inspection		
Lot size	Criterion																
	Number of sample wires	Number for acceptance	Number for rejection	Additional inspection				Number of sample wires	Number for acceptance	Number for rejection	Additional inspection				Number of sample wires	Number for acceptance	Number for rejection
				Number of added sample wires	Total sample wires	Number for acceptance	Number for rejection				Number of added sample wires	Total sample wires	Number for acceptance	Number for rejection			
90 or less	3	0	1	—	—	—	—	5	0	1	—	—	—	—	2	0	2
91–280	8	0	2	8	16	1	2	13	0	2	13	26	1	2	5	1	2
281–500	13	0	3	13	26	3	4	13	0	2	13	26	1	2	5	1	2
501–1200	20	1	4	20	40	4	5	20	0	3	20	40	3	4	8	1	3
1201–3200	32	2	5	32	64	6	7	32	1	4	32	64	4	5	13	2	4
3201–10000	50	3	7	50	100	8	9	50	2	5	50	100	6	7	13	2	4

Table 4.5 Individual Acceptance Inspection of Wires

Inspection grade	Normal inspection							Tightened inspection							Reduced inspection		
Lot size	Criterion																
	Number of sample wires	Number for acceptance	Number for rejection	Additional inspection				Number of sample wires	Number for acceptance	Number for rejection	Additional inspection				Number of sample wires	Number for acceptance	Number for rejection
				Number of added sample wires	Total sample wires	Number for acceptance	Number for rejection				Number of added sample wires	Total sample wires	Number for acceptance	Number for rejection			
280 or less	8	0	1	—	—	—	—	13	0	1	—	—	—	—	3	0	1
281–500	20	0	2	20	40	1	2	32	0	2	32	64	1	2	3	0	1
501–1200	20	0	2	20	40	1	2	32	0	2	32	64	1	2	13	1	2
1201–3200	32	0	3	32	64	3	4	32	0	2	32	64	1	2	13	1	2
3201–10000	50	1	4	50	100	4	5	50	0	3	50	100	3	4	13	1	2

Table 4.6 Individual Acceptance Inspection of stranded conductor

Inspection class	Normal inspection			Tightened inspection			Reduced inspection		
Lot size	Criterion								
	Number of sample wires	Number for acceptance	Number for rejection	Number of sample wires	Number for acceptance	Number for rejection	Number of sample wires	Number for acceptance	Number for rejection
50 or less	2	0	1	2	0	1	2	0	2
51–500	3	0	1	3	0	1	2	0	2

5. Packaging

5.1 Style of Packing

Stranded conductors shall be closely wound around a robust drum and well fixed, and perfectly packaged to prevent it from being damaged during transportation.

When a wooden drum is used, it shall be well dried to prevent it from shrinking.

The end of a stranded conductor shall be fastened to the drum either by the construction that allows the conductor to be released from the inner ring of the drum or by providing an extra length section, prepared by the manufacturer, to allow the conductor to be cut.

When an extra length section is provided, it shall be marked with a tape or the like so that the section can be easily identified.

5.2 Indication

The following items shall be indicated on the drum by an adequate means.

When a foreign language is used for markings, ones in Japanese shall be written side by side.

(1) Name of the stranded conductor (ACSR/AC)
(2) Nominal cross sectional area
(3) Stranded conductor composition
(4) Unit length
(5) Total mass
(6) Rotational direction of drum
(7) Winding end position of the drum
(8) Drum number
(9) Approval number of type inspection
(10) Purchaser’s company name (Kansai Electric Power Co., Inc.)
(11) Manufacturer’s name
(12) Date of manufacture
(13) Other required items

6. Appendix item

The manufacturer shall submit the following documents in connection with the arrangement for KANSAI’s purchase unless otherwise specified.

(1)	Estimate:	No later than the date specified by KANSAI:	1 copy
(2)	Estimate specification:	Simultaneously with this estimate, only on the items differing from this specification:	1 copy
(3)	Contract specification:	Within 10 days of the order reception, only on the items differing from this specification:	1 copy
(4)	Inspection plan:	No later than 7 days before the execution of inspection:	2 copies
(5)	In-house test results:	No later than the day of the witnessed inspection (no later than 3 days before the day of shipment in cases of individual acceptance inspection without witnessing):	2 copies
(6)	Control inspection result report:	As soon as possible:	2 copies
(7)	Shipment schedule (with the weight and packing type entered):	No later than 7 days before the arrival of the products:	1 copy
(8)	Invoice:	Simultaneously with shipment:	1 copy