

JIS

JAPANESE INDUSTRIAL STANDARD

Synchros

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In the event of any doubt arising,
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Synchros

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1. Scope

This Japanese Industrial Standard specifies synchros to be used in circuits, at a frequency of 50, 60 Hz, or 50/60 Hz, at an a.c. voltage of 250 V or less, for the purpose of transmitting and indicating angular signals.

Remarks 1. The following Standards are cited in this Standard:

JIS C 0911-Vibration Testing Procedure for Electric Machines and Equipment

JIS C 0912-Shock Testing Procedure for Electric Machines and Equipment

JIS C 3306-Polyvinyl Chloride Insulated Flexible Cords

2. The units and numerical values given in { } in this Standard are based on the traditional unit system and are appended for informative reference.

2. Definitions

For the purposes of this Standard, the following principal definitions apply.

- (1) synchro A kind of analog converter between electrical and mechanical energies relating to the angle of rotation, namely to convert, by electromagnetic induction, a rotor angular position into an electric signal that is a function of the rotor angular position, or to make reverse conversion.
- (2) torque synchro A synchro used for obtaining mechanical output to operate a mechanical apparatus. This includes a synchro torque transmitter, synchro torque receiver, synchro torque differential transmitter, and synchro torque differential receiver.
- (3) control synchro A synchro used for obtaining an electric signal to control a mechanical apparatus. This includes a synchro control transmitter, synchro control differential transmitter, and synchro control transformer.
- (4) synchro torque transmitter A torque synchro to transmit an electric signal corresponding to the angular displacement.
- (5) synchro torque receiver A torque synchro to receive an electric signal from the synchro torque transmitter and to convert it into an angular displacement corresponding to the electric signal.
- (6) synchro torque differential transmitter A torque synchro that is connected to a synchro torque transmitter and transmits an electric signal corresponding to the sum or difference of angular displacements of the above transmitter and this machine.

- (7) synchro torque differential receiver A torque synchro that receives electric signals transmitted by two synchro torque transmitters and converts them to the sum or difference of angular displacements corresponding to the respective electric signals.
- (8) synchro control transmitter A control synchro to transmit an electric signal corresponding to an angular displacement.
- (9) synchro control differential transmitter A control synchro that is connected to a synchro control transmitter electrically and transmits an electric signal corresponding to the sum or difference of angular displacements of the above transmitter and this machine.
- (10) synchro control transformer A control synchro that receives an electric signal from a synchro control transmitter or synchro control differential transmitter and transmits the difference between the angular displacement corresponding to the signal and angular displacement of this transformer as a voltage corresponding to the electric signal.
- (11) torque A torque produced when an angular displacement is given between the transmitter and receiver, the transmitter and receiver being connected electrically.
- (12) inherent torque rate Torque output produced in a torque synchro body; the slope of an angle-torque curve.
- (13) electrically zero position Relative reference position between the stator and rotor taken as the base of the electric angle, in order to give interchangeability to synchros.
- (14) residual voltage Voltage remaining at the position where the output voltage curve of a control synchro becomes theoretically zero.

The total value of the residual voltage, including higher harmonic components, is called the total value (T), and the value of the fundamental component only, excluding higher harmonic components, the fundamental component value (F).

- (15) electric error Difference between the theoretically ideal electric angle and the rotor angle of a synchro.
- (16) indication error Difference between the indication angle of a standard synchro torque transmitter and that of a synchro torque receiver or synchro torque differential receiver.
- (17) transformation ratio Ratio of the rated secondary voltage (V_P) ⁽¹⁾ to the rated primary voltage (V_s) ⁽¹⁾ of a synchro.

Note ⁽¹⁾ Here the rated primary voltage is the excitation voltage applied to the primary winding of a synchro and the rated secondary voltage is the no load maximum voltage induced in the secondary winding.

3. Service conditions

3.1 Normal service conditions The synchros are regarded to be under normal service conditions when all the following service conditions are fulfilled.

- (1) Ambient temperature does not exceed a maximum 50°C and minimum - 20°C, and the mean ambient temperature over 24 h does not exceed 35°C.
- (2) Altitude does not exceed 1000 m.
- (3) When none of the Special service conditions of 3.2 apply.

3.2 Special service conditions The synchros are regarded to be under special service conditions when any one of the following service conditions applies.

In such case, it is necessary to specify the special service condition.

- (1) When used at a place where the altitude or ambient temperature is outside the range specified in 3.1, Normal service conditions.
- (2) When used in a place markedly subjected to a salty breeze.
- (3) When used in a damp place.
- (4) When used in a place where there is excessive water vapor or oil vapor.
- (5) When used in a place where there is explosive, inflammable or other harmful gas or it is likely to be attached by such a gas.
- (6) When used in a very dusty place.
- (7) When used in a place subject to abnormal vibration or shock.
- (8) When used in a place where ice or snow is especially heavy.
- (9) When used under other special conditions.

4. Type designation

4.1 Types and symbols The types are designated by the maximum external diameter of synchro with the symbols given in Table 1.

Table 1. Types and symbols

Maximum external diameter mm	Type symbol
37	S37
45	S45
60	S60
95	S95

4.2 Kinds of machine and symbols The machine types and symbols shall be as shown in Table 2.

Table 2. Machine types and symbols

Machine type	Symbol	Use
Synchro torque transmitter	TX	For torque
Synchro torque receiver	TR	
Synchro torque differential transmitter	TDX	
Synchro torque differential receiver	TDR	
Synchro control transmitter	CX	For control
Synchro control differential transmitter	CDX	
Synchro control transformer	CT	

4.3 Rated frequency, rated supply voltage and symbol The rated frequency, rated supply voltage and symbols shall be as given in Table 3.

Table 3. Rated frequency, rated supply voltage and symbols

				Unit: V
Item				Symbol
Rated frequency	50/60 Hz use			5
Rated supply voltage	50 Hz	60 Hz	Supply voltage abbreviation	
	26	29	26 V system	L
	100	110	100 V system	M
	200	220	200 V system	H

4.4 Rated primary voltage for each kind of machine The rated primary voltage for each kind of machine shall be as given in Table 4.

Table 4. Rated primary voltages for each kind of machine

Unit: V				
Rated primary voltage	Supply voltage	50 Hz	60 Hz	Kind of machine
	26 V system	26	29	TX, TR, CX
		11.8	13.1	CDX, CT
	100 V system	100	110	TX, TR, CX
		78	86	TDX, TDR, CDX, CT
	200 V system	200	220	TX, TR, CX

4.5 Types of each kind of machine The type of each kind of machine shall be as given in Table 5.

Table 5. Type of each kind of machine

Supply voltage Kind of machine \ Type	26 V system		100 V system			200 V system		
	S37	S45	S45	S60	S95	S45	S60	S95
TX	—	○	○	○	○	○	○	○
TR	—	○	○	○	○	○	○	○
TDX	—	—	—	○	○	—	—	—
CX	○	○	○	○	○	○	○	○
CDX	○	○	○	○	—	—	—	—
CT	○	○	○	○	○	—	—	—

4.6 Structure of type designation The type designation shall be formed by arranging the symbols as follows:

Symbol denoting type	Symbol denoting kind of machine	Symbol denoting rated frequency	Symbol denoting rated supply voltage
(See sub-clause 4.1)	(See sub-clause 4.2)	(See sub-clause 4.3)	(See sub-clause 4.3)
Example: S 45	CDX	5	M

5. Performance

5.1 Electrically zero position When the mark printed on the bracket and that on the shaft are set to coincide, the position shall not differ by more than ± 10 degrees from the electrically zero position obtained by the method of 8.3.4.

5.2 Winding resistances When the test is made by the method of 8.3.5, the values of winding resistances shall be within the range as set previously by the manufacturer.

5.3 Electrical error When the test is made by the method of 8.3.6, the maximum value (absolute value) of electrical error shall not exceed the value of Table 6 to Table 10.

5.4 Indication error When the test is made by the method of 8.3.7, the maximum values of indication error shall not exceed the value of Table 6 to Table 10.

5.5 Transformation ratio When the test is made by the method of 8.3.8, the transformation ratio shall be within the range of 97 to 103 % of the value of Table 6 to Table 10.

5.6 No load exciting current When the test is made by the method of 8.3.9, the no load exciting current shall not exceed the value of Table 6 to Table 10.

5.7 Residual voltage When the test is made by the method of 8.3.10, the maximum values of the total residual voltage and fundamental component residual voltage shall not exceed the relevant values of Table 6 to Table 10.

5.8 Inherent torque ratio When the test is made by the method of 8.3.11, the inherent torque ratio shall be not less than the value of Table 6 to Table 10.

5.9 Friction torque When the test is made by the method of 8.3.12, the friction torque shall not exceed the value of Table 6 to Table 10.

5.10 Temperature rise When the test is made by the method of 8.3.13, the temperature rise of the various windings shall not exceed the values of Table 6 to Table 10.

5.11 Spinning When the test is made by the method of 8.3.14, the rotor of the synchro torque receiver or synchro torque differential receiver shall stabilize at the synchronizing position from any initial angular position without spinning.

5.12 Stability When the test is made by the method of 8.3.15, the synchro torque receiver or synchro torque differential receiver shall have a synchronizing time no greater than the value of Table 6 to Table 10.

5.13 Insulation resistance When the test is made by the method of 8.3.16, the insulation resistance shall be not less than 10 MΩ at ordinary temperature.

5.14 Dielectric withstand voltage When the test is made by the method of 8.3.17, the synchro shall withstand the test voltage.

5.15 Moisture resistance When the test is made by the method of 8.3.18, the synchro shall comply with the requirements of 5.3, 5.4, 5.13 and 5.14.

5.16 Endurance When the test is made by the method of 8.3.19, the synchro shall satisfy the performances of 5.3, 5.4, 5.9 and 5.12, immediately after the test.

5.17 Vibration resistance When the test is made by the method of 8.3.20, the synchro shall satisfy the performances of 5.3, 5.4, 5.6, 5.7, 5.9, 5.11, 5.12, 5.13 and 5.14, immediately after the test.

5.18 Shock resistance When the test is made by the method of 8.3.21, the synchro shall satisfy the performances of 5.3, 5.4, 5.6, 5.7, 5.9, 5.11, 5.13, 5.13 and 5.14, immediately after the test.

Table 6. Performance of each type designation

Type designation Items		S 37 CX 5 L	S 37 CT 5 L	S 37 CDX 5 L
No load exciting current (A)		0.1	0.06	0.1
Transformation ratio V_s/V_p		0.454	2.203	1.154
Indication error (min)		—	—	—
Electrical error (min)		20	20	20
Inherent torque ratio (mN · m/degree {gf-cm/degree})		—	—	—
Stability (s)		—	—	—
Residual voltage (mV)	Total value	45	45	45
	Fundamental component value	35	35	35
Friction torque (mN · m {gf-cm})		0.98 {10}	0.98 {10}	1.47 {15}
Temperature rise (°C)		40	40	40

Table 7. Performance of each type designation

Type designation Items		S 45 TX 5 L	S 45 TR 5 L	S 45 CX 5 L	S 45 CT 5 L	S 45 CDX 5 L
No load exciting current (A)		0.55	0.55	0.4	0.15	0.4
Transformation ratio V_s/V_p		0.454	0.454	0.454	2.203	1.154
Indication error (min)		—	±60	—	—	—
Electrical error (min)		20	—	20	20	20
Inherent torque ratio (mN · m/degree {gf-cm/degree})		0.098 {1}	0.098 {1}	—	—	—
Stability (s)		—	4	—	—	—
Residual voltage (mV)	Total value	—	—	40	40	40
	Fundamental component value	—	—	30	30	30
Friction torque (mN · m {gf-cm})		1.47 {15}	—	1.47 {15}	1.47 {15}	1.96 {20}
Temperature rise (°C)		60	60	40	40	40

Table 8. Performance of each type designation

Type designation	S 45	S 45	S 45	S 45	S 45	S 45	S 45	S 45
Items	TX 5 M	TX 5 H	TR 5 M	TR 5 H	CX 5 M	CX 5 H	CT 5 M	CDX 5 M
No load exciting current (A)	0.15	0.08	0.15	0.08	0.1	0.05	0.07	0.15
Transformation ratio V_s/V_p	0.783	0.39	0.783	0.39	0.783	0.39	0.735	1.154
Indication error (min)	—	—	±60	±60	—	—	—	—
Electrical error (min)	20	20	—	—	20	20	20	20
Inherent torque ratio (mN · m/degree {gf-cm/degree})	0.098 {1}	0.098 {1}	0.098 {1}	0.098 {1}	—	—	—	—
Stability (s)	—	—	4	4	—	—	—	—
Residual voltage (mV)	Total value	—	—	—	130	130	130	130
	Fundamental component value	—	—	—	90	90	90	90
Friction torque (mN · m {gf-cm})	1.47 {15}	1.47 {15}	—	—	1.47 {15}	1.47 {15}	1.47 {15}	1.96 {20}
Temperature rise (°C)	60	60	60	60	40	40	40	40

Table 9. Performance of each type designation

Type designation	S 60	S 60	S 60	S 60	S 60	S 60	S 60	S 60	S 60	S 60
Items	TX 5 M	TX 5 H	TR 5 M	TR 5 H	TDX 5 M	TDR 5 M	CX 5 M	CX 5 H	CT 5 M	CDX 5 M
No load exciting current (A)	0.3	0.15	0.3	0.15	0.3	0.3	0.15	0.08	0.06	0.15
Transformation ratio V_s/V_p	0.783	0.39	0.783	0.39	1.154	1.154	0.783	0.39	0.735	1.154
Indication error (min)	—	—	±60	±60	—	±60	—	—	—	—
Electrical error (min)	20	20	—	—	20	—	20	20	20	20
Inherent torque ratio (mN · m/degree {gf-cm/degree})	0.29 {3}	0.29 {3}	0.29 {3}	0.29 {3}	0.098 {1}	0.98 {1}	—	—	—	—
Stability (s)	—	—	4	4	—	4	—	—	—	—
Residual voltage (mV)	Total value	—	—	—	—	—	125	125	125	150
	Fundamental component value	—	—	—	—	—	80	80	80	100
Friction torque (mN · m {gf-cm})	1.96 {20}	1.96 {20}	—	—	1.96 {20}	—	1.96 {20}	1.96 {20}	1.96 {20}	2.45 {25}
Temperature rise (°C)	60	60	60	60	60	60	40	40	40	40