INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR CONTACTORS FOR VOLTAGES NOT EXCEEDING 1000 V ac OR 1500 V dc** *(Second Revision)*	**IPSS:1-04-001-03**
	BASED ON IS 13947 (Part 4/Sec 1):1993	Formerly : IPSS:1-04-001-83

0. FOREWORD

0.1 This Interplant Standard has been prepared by the Standards Committee on electrical components, IPSS 1:4, with the active participation of the representatives of the steel plants, reputed consultancy organizations and established manufacturers of contactors and was adopted in June 2003.

0.2 Interplant Standards for steel industry primarily aim at achieving rationalization and unification of parts and sub-assemblies used in steel plant equipment and accessories and provide guidance in indenting stores or equipment for existing or new installations by individual steel plants. For exercising effective control on inventories, it is advisable to select a fewer number of sizes (or types) from those mentioned in this standard for the purpose of company standards of individual steel plants. It is not desirable to make deviations in the technical requirements.

1. SCOPE

This Interplant Standard, which covers the requirements of electro magnetically operated air-break type contactors for voltages not exceeding 1000 V ac and 1500 V dc used in steel industry for making and breaking electric circuits, is generally based on IS 13947 ,1993 : Part IV.

1.1 This Interplant Standard does not apply to oil-immersed and pneumatic-operation type contactors.

1.2 Mounting and overall dimensions of contactors are not covered in this standard.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS 1885 :1979 `Electrotechnical vocabulary: Part 27(17) and Part (57) Switchgear and controlgear (*first revision*)' shall apply. However, some important definitions have been reproduced in **Appendix A** for ready reference.

3. **SITE CONDITIONS -** The following shall constitute normal site conditions for the purpose of this standard:

a) The reference ambient temperature shall be 40°C.

b) Altitude shall not exceed 1000 m,

c) The ambient air may contain fair amount of conductive dust, and

d) The maximum relative humidity shall be 100%. Maximum temperature and 100% relative humidity may not occur simultaneously.

3.1 For applications where corrosive gases are prevalent, necessary care shall be taken in the design.

3.2 The contactor shall be suitable for use on mobile equipment and cranes with normal vibrations.

NOTE : Under consideration.

4. DESIGNATION

Contactors shall be designated by the following:

a) Rated operational voltage, ac or dc;

b) Rated thermal current;

c) Rated operational current with corresponding utilization category, class of intermittent duty and on-load factor (see 5.4.2.2);

d) Rated coil voltage, ac or dc; and

e) Reference to this standard, that is, IPSS:1-04-001-03(F)

Example : Contactor for operation at 415 V ac and rated for 630 A thermal current and 315 A operational current at Class 6 of intermittent duty (that is, 600 operating cycles per hour) under AC-3 utilization category and 40% on-load factor and having a rated coil voltage of 230 V dc conforming to this standard shall be designated as:

415 V ac 630 AI_{th} - 315 AI_e Coil 230 V dc IPSS : 1-04-001-03(F)

5. RATINGS

5.1 Preferred Rated Operational Voltages for the Main Circuit

a) ac 240 and 415 V; and
b) dc 230, 460 and 600 V.

5.2 Preferred Rated Coil Voltages

a) ac 110, 220, 240 and 415 V; and
b) dc 24 (considering P L C ' use,) 110, 230 and 460 V.

5.3 Preferred Rated Current

5.3.1 Thermal

a) ac contactors: 10, 16,25, 63, 100, 160, 200, 315, 400, 630 and 800 A; and
b) dc contactors: 20, 80, 160, 315, 630, 1250 and 2000 A.

5.3.2 Operational (under duty conditions specified in 5.4.2.2)

a) ac contactors: 6, 10, 16, 25, 63, 100, 160, 200, 315, 400, 630 and 800 A; and
b) dc contactors: 16, 20, 63, 80, 160, 315, 630 1250 and 2000 A.

5.4 **Rated Duty -** The rated duties of the contactors shall be as follows.

5.4.1 Eight-hour duty - Duty in which the main contacts of the contactor remain closed while carrying a steady current long enough to reach thermal equilibrium but not for more than 8 hours without interruption.

NOTE 1 : This is the basic duty on which the thermal current rating of the apparatus is determined.

NOTE 2 : Interruption means breaking of the current by operation of the contactor.

5.4.2 Intermittent duty - Duty in which the main contacts of a contactor remain closed for periods bearing a definite relation to the no load periods, both periods being too short to allow the contactor to reach thermal equilibrium. Intermittent duty is characterized by the value of the current, the duration of current flow and by the on-load factor which is the ratio of the in-service period to the entire period, often expressed as a percentage. Standard values of on-load factors recognized are 40 and 60%.

5.4.2.1 *Classes of intermittent duty* - According to the number of operating cycles which they shall be capable of carrying out per hour, contactors are divided into the following classes:

Operating Cycles per hour	*Class*
30	0.3
120	1
300	3
600	6
1200	10

5.4.2.2 Unless otherwise specified, the manufacturers shall state the rated operational current at the rated operational voltage for the intermittent duty class of 6 at 40% on-load factor under utilization category AC-3 or DC-5 as the case may be.

5.4.2.3 In order to facilitate proper selection of the contactor to suit the different duty conditions other than those specified in 5.4.2.2, the manufacturers shall specify values of operational currents under different class of intermittent duty (5.4.2.1), on-load factors (5.4.2) and various utilization categories (5.5.) as per **Table 1**.

5.5 **Rated Utilization Category** - Only contactors of AC-2, AC-3, AC-4, DC-3 and DC-5 utilization categories as per IS 13947 (part 4/Sec-1):1993 shall apply for steel industry. For easy reference the information is reproduced in Appendix B.

5.5.1 *Rated making and breaking capacities* - The rated making and breaking capacities of the contactors for the utilization categories specified in 5.5 shall be in accordance with IS 13947 (part 4/Sec-1):1993.

5.5.2 **Electrical Endurance** - With respect to its resistance to electrical wear, a contactor is characterized by the number of on-load operating cycles, corresponding to the service conditions as per IS 13947 (part 4/Sec-1):1993 , which may be made without repair or replacement.

5.5.2.1 For the utilization categories AC-3 the number of on-load operating cycles shall not be less than one-twentieth of the number of no-load operating cycles corresponding to the mechanical endurance of the contactor.

5.5.2.2 For the utilization categories AC-2, AC-4, DC-3 and DC-5, the number of on-load operating cycles shall not be less than $1/50^{th}$ of the number of no-load operating cycles corresponding to the mechanical endurance of the contactor.

5.6 **Mechanical Endurance (Number of No-load Operating Cycles)** - The contactor shall be capable of withstanding 10 million numbers of no-load operating cycles (namely, without current on the main contacts) before it becomes necessary to service or replace any mechanical part. However, normal maintenance including replacement of contacts as specified in IS 13947 (part 4/Sec-1):1993, is permitted.

5.7 Auxiliary Circuit

a) *Contactors for ac* - Contacts shall be rated for not less than 4 A, 415 V for a rated duty of AC-15 [see IS 13947 Part 2 & Part 5] and

b) *Contactors for dc* - Contacts shall be rated for not less than 1 A, 230 V for a rated duty of DC-14 [see IS 13947 Part 2 & Part 5].

5.8 **Auxiliary Contacts** - All contactors should be provided with minimum 2 numbers of normally closed and 2 numbers of normally open auxiliary contacts. For the contactors of 100 A and above, provision for interchanging normally open to normally closed and vice-versa or add-on block to serve the purpose should be provided and for the contactors below 100 A this provision of interchangeability may be provided, if required.

5.8.1 Clapper type contactors may have provision for extra auxiliary contacts if so desired by the purchaser.

6. SPECIAL DESIGN AND CONSTRUCTIONAL FEATURES

6.1 In addition to the general features of design and construction specified as per IS 13947 Part 4/Sec-1.

6.2 If specified by the purchaser, the contacts shall be provided with silver alloy tips brazed on them for contactors remaining on for eight hours or more.

6.3 There shall be a provision for fitting mechanical interlocks for contactors. The mechanical interlock attachment shall be supplied along with the contactor, whenever so specified by the purchaser.

6.4 The dc contactors which are provided with blow-out coil that need to be connected at site, the polarity of the leads of the blow-out coil shall be properly indicated to facilitate connection.

7. LIMITS OF OPERATION

7.1 Unless otherwise stated, the contactors shall close with any control supply voltage between 85 and 110% of the rated coil voltage with the ambient air temperature between 5 and 40°C. These limits apply to dc or ac as appropriate.

NOTE : 1 For latched contactors, the operating limits shall be agreed upon between the manufacturer and the purchaser.

7.2 The drop-out voltage shall not be higher than 75 percent, nor (with worn out contacts) lower than 10 percent of the rated coil voltage.

7.3 The pick-up and drop-out voltage specified above are applicable after the coils have reached a stable temperature corresponding to indefinite application of 100 percent rated coil voltage. In the case of ac coils, the voltage limits apply at rated frequency.

8. LIMITS OF TEMPERATURE-RISE

8.1 The temperature-rise of several parts of the contactor measured during a test carried out under the conditions specified in IS 13947 Part 4/sec-1:1993 shall not exceed the limiting values stated in **Table 2** These temperature-rise limits are applicable for the site conditions given in 3 over a reference ambient temperature of 40°C.

NOTE : When the contactors are enclosed the rating for the test shall be reduced to the 90 percent of their rating in order to allow for temperature-rise of air in the enclosure.

9. MARKING

9.1 Each contactor shall be provided with a name-plate containing the following data marked in a durable manner and so placed that the marking is visible when the contactor is installed:

a) Designation of the contactor,
b) Manufacturer's name and/or trade-mark,
c) Manufacturer's type reference and serial number, and
d) Country of origin.

9.1 All the relevant technical details of the contactor according to IS 13947, Part 4/Sec-1:1993 shall be given in the separate leaflet, which shall include the following details:

a) Overall dimensions and mounting details (Front/back connection);

b) Number of main poles and their arrangement (NO/NC);

c) Number of auxiliary contacts and their arrangement (NO/NC);

d) Values of the operational currents for different utilization categories, classes of intermittent duty and on-load factors as given in **Table 1**.

e) Type and VA ratings;

f) List of all components with parts numbered;

g) Ratings of the auxiliary contacts; and

h) Mass of the contactor.

10. TESTS - The tests shall be carried out in accordance with IS 13947 Part 4/ sec-1:1993.

TABLE 1

VALUES OF OPERATIONAL CURRENT FOR DIFFERENT UTILIZATION CATEGORIES, CLASSES OF INTERMITTENT DUTIES AND ON-LOAD FACTORS

Utilization Category	On-Load Factor Percent	Operational Currents in A				
		Classes of Intermittent Duty (No. of Operating Cycles Per Hour)				
		0.3 (30)	1 (120)	3 (300)	6 (600)	10 (1200)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
AC-2	40 60					
AC-3	40 60					
AC-4	40 60					
DC-3	40 60					
DC-5	40 60					

TABLE 2

Temperature-rise limits for terminals and accessible parts

Description of part*	Temperature-rise limits (K)**
– Terminals for external insulated connections	80
– Manual operating means: metallic non-metallic	 25 35
– Parts intended to be touched but not hand-held: metallic non-metallic	 40 50
– Parts which need not be touched for normal operation: metallic non-metallic	 50 60

* No value is specified for parts other than those listed but no damage should be caused to adjacent parts of insulating materials.

** The temperature-rise limits specified are not intended to apply to a new sample, but are those applicable to the temperature-rise verifications during the appropriate test sequences specified in Clause 8.

APPENDIX - A

(Clause 2)

TERMINOLOGY

A-1. Rated Operational Voltage - The value of voltage which combined with a rated operational current determines the application of the contactor and to which are referred to the making and breaking capacities, the types of duty and the utilization category. For polyphase circuits it is stated as a voltage between phase.

A-2. Rated Operational Current - It is the value of current which determines the conditions of use of the contactor. It is stated by the manufacturer and takes into account the rated operational voltage, frequency, rated duty, the utilization category and the type of protective enclosure specified by the user.

The rated making and breaking capacities of a contactor are generally expressed in relation to the rated operational current. In the case of contactors of motors, the indication of operational current may be replaced by a statement of the power rating of the motor corresponding to the rated operational voltage considered. The manufacturer shall be prepared to indicate the assured relation between the current and the power.

A-3. Rated Making Capacity - The value of r.m.s current that a switching device is capable of making at a stated voltage under prescribed conditions.

A-4. Rated Breaking Capacity - The rms value of breaking current that the switching device shall be able to break at a stated voltage under prescribed conditions.

For those switching devices which operate so rapidly that the current cannot properly be measured and/or which inherently reduce the breaking current, the breaking capacity is the prospective breaking current at a stated voltage under prescribed conditions.

NOTE : For all switching devices, other than those which operate so rapidly that the current cannot properly be measured and/or which inherently reduce the breaking current, the breaking capacity is expressed in terms of the symmetrical and asymmetrical breaking capacities.

A-5. Recovery Voltage - The voltage which appears across the terminals of a switching device after the breaking of the current.

This voltage may be considered in two successive intervals of time, one during which a transient voltage exists, followed by a second one during which the power frequency recovery voltage alone exists.

A-5.1 Recovery voltage power frequency - The recovery voltage after the transient voltage phenomena have subsided.

NOTE 1 : The power frequency recovery voltage may be referred to as a percentage of the rated voltage.

NOTE 2 : This definition applies also to the case of dc, the frequency then being considered zero.

A-5.2 Recovery voltage, transient (restriking voltage) - The recovery voltage during the time in which it has a significant transient character.

NOTE :1 The transient voltage may be oscillatory or non-oscillatory or a combination of these depending on the characteristics of the circuit and the switching device. It includes the voltages shift of the neutral of a polyphase circuit.

NOTE : 2 The transient recovery voltage in three-phase circuits is, unless otherwise stated, across the first pole to clear because this voltage is generally higher than that which appears across each of the other two poles.

APPENDIX- B

(Clause 5.5)

UTILIZATION CATEGORIES

Category	Typical Applications
AC-2	Slip-ring motors : Starting, plugging*
AC-3	Squirrel-cage motors ; Starting, switching off motors during running
AC-4	Squirrel-cage motors : Starting plugging*, inching**
DC-3	Shunt-motors : Starting, plugging*, inching**
DC-5	Series-motors : Starting, plugging*, inching**

NOTE: The application of contactors to the switching of rotor circuits, capacitors or tungsten filament lamps shall be subject to special agreement between the manufacturer and the purchaser.

* By plugging, is understood stopping or reversing the motor rapidly by reversing motor primary connections while the motor is running.

** By inching (jogging), is understood energizing a motor once or repeatedly for short periods to obtain small movements of the driven mechanism.