INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR GEARED TYPE LIMIT SWITCHES**	**IPSS:1-04-036-08**
	Based on IS 13947:1993	

0. FOREWORD

0.1 This Inter Plant Standard has been prepared by the Standards Committee on Switchgear and Controlgear, IPSS 1:4 with the active participation of the representatives of the steel plants, reputed consultancy organizations and established manufacturers of limit switches and was adopted in March 2008.

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

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1. SCOPE

1.1 This Inter Plant Standard covers the requirements of the following types of geared limit switches for voltages upto and including 1000 V ac and 1200 V dc used in steel industry and intended to be used in control circuits of cranes, hoists, wireless and other drive mechanisms where two way travel of the mechanisms is to be limited within certain well defined predetermined positions.

These are suitable for coupling directly on the motors, reduction gear shafts, rope drums etc:

a) Cam operated rotary geared limit switches

b) Spindle type rotary geared limit switches

1.2 This Inter Plant Standard does not cover the limit switches meant for direct interruption of main power circuits and micro switches. Mounting and overall dimensions are also not covered in this standard in view of the diversity of usage.

1.3 The service conditions as applicable are as follows:

1.3.1 The reference ambient temperature shall be 55^{o}C.

1.3.2 Maximum humidity shall be 100% occurring simultaneously with maximum ambient temperature.

1.3.3 Altitude shall not exceed 1000 m .

1.3.4 For application in areas where corrosion and inflammable gases are prevalent, the limit switches shall be specially designed as per the needs.

1.3.5 Limit switches shall be suitable for withstanding vibrations and jerks in EOT cranes, transfer cars and such other mobile equipment (2g in vertical direction and 1g in horizontal direction).

2. TERMINOLOGY - For the purpose of this standard; the definitions given in IS 1885 (Part XVII):1963 Electrotechnical vocabulary, (Part XVII) Switchgear and controlgear; and IS 13947 (Part 1 and 2):1993 shall apply. Some important definitions however, have been reproduced below for ready reference:

2.1 Actuating Force - The force (or moment) applied to an actuator necessary to complete the intended operations.

2.2 Double Break Contact Element - A contact element which opens the conducting path of its circuit in two locations in series [*see clause 2.3.3.2 of IS 13947 (Part 5)/Sec. 1:1993*].

2.3 Changeover Contact Elements - A contact element combination which includes one make-contact element and one break - contact element [*see clause 2.3.3.5 of IS 13947 (Part 5)/Sec. 1:1993*].

2.4 Electrically Separated Contact Elements - Contact elements belonging to the same control limit switch but adequately insulated from each other so that they can be connected into electrically separated circuits.

2.5 Snap Action Contact Element - A contact element in which the velocity of contact motion is substantially independent of the velocity of actuating system [see clause 2.3.3.8 of IS 13947 (Part 5)/Sec. 1:1993].

2.6 Rated Thermal Current - The value I of current assigned by the manufacturers and limited by the temperature-rise [see clause 4.3.2.1 of IS 13947 (Part 1):1993].

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NOTE: It is the maximum value of current which a control switch installed under standard condition of service, can carry continuously without damage.

2.7 Rated Operational Current - A value Ie of current which determines the application of the contact elements. It is stated by the manufacturers and takes into account the rated operational voltage, the rated supply frequency, the utilization category and the electrical endurance (*wherever applicable*).

2.8 Rated Operational Voltage - A value Ve of voltage assigned by the manufacturers which, in combination with a rated operational current, determines the application of the contact element and to which the utilization categories are referred.

NOTE: A contact element may be assigned a number of combinations of rated operational voltage and rated operational current. [*See also clause 4.3.1.1 of IS 13947 (Part 1):1993*].

2.9 Pre-travel of the Actuator - The maximum travel of the actuator which causes no relative motion of the contact element.

2.10 Over-travel of the Actuator - The travel of the actuator after all the contacts have reached their closed (open) position.

2.11 Pre-travel of the Contact Element - The maximum travel of the contact element which causes no relative motion of the contacts.

2.12 Over-travel of the Contact Element - The travel of the contact element after the contacts have reached their closed (open) position.

2.13 Differential Travel - It is the distance travelled in reverse direction in millimeters or degrees at the time of resetting beyond the point where the switch operated at the time of forward travel.

3. DESIGNATION

3.1 A control limit switch shall be designed by the following:

a) Type, depending on the operating mechanism
b) Rated operational voltage
c) ac or dc
d) Rated thermal current
e) Rated operational current
f) No. of contacts
g) Reduction ratio
h) Shaft extension
i) Contact opening - closing sequence for each of the contact
j) Optional extras (*to specify*)
k) Number of the standard i.e. IPSS:1-04-036-08

4. REQUIREMENT

4.1 Preferred Rated Operational Voltages

a) *ac* - 240 V
b) *dc* - 24, 220 V

4.2 Preferred Rated Currents

a) *Thermal* - 10, 16 & 25 A for ac; and 6 & 10A for dc and;

b) *Operational* - 3, 6 & 10 A for ac; and 0.254, 0.5, 1 & 2.5 A for dc

4.3 Rated Frequency - Shall be 50 Hz

4.4 Rated Duty - The rated duty for limit switches shall be 600 operations per hour carrying operational current and at operational voltage under conditions [see Table C1 of IS 13947 (Part 5)/Sec 1:1993].

4.5 Utilization Category

a) *For ac* - Contacts shall be suitable for utilization category of AC 11 [see IS 13947 (Part 5)/Sec 1:1993], and

b) *For dc* - Contacts shall be suitable for utilization category of DC 11 [see IS 13947 (Part 5)/Sec 1:1993]

4.5.1 Load operation and rated making and breaking capacities of the switches for utilization categories specified in 4.5(a) & (b) shall be in accordance with Table-IV of IS 13947 (Part 5)/Sec 1:1993]

4.6 Electrical Endurance - With respect to this resistance to electrical wear, a limit switch shall be characterized by the number of on-load operating cycles, which shall not be less than 1/10th of the number of no-load operating cycles specified for mechanical endurance of the limit switches.

4.7 Mechanical Endurance (*number of no-load operating cycles*) - This limit switch shall be capable of withstanding 15 million number of no-load operating cycles before it becomes necessary to service or replace any mechanical part.

4.8 Contacts

a) Limit switch shall have electrically separated contact element.

b) All contacts shall be snap acting and double break type

c) Spindle type limit switches will have minimum 2 N.C. or 4 N.C. contacts and cam operated limit switches will have 2, 4, 5, 6 or 8, 16 and 24 Cams for different

types and the Cam details shall be mutually agreed upon between the purchaser and the manufacturers.

4.9 Mounting - Foot Mounting

4.10 Material

a) The enclosures shall be made of cast iron, cast steel or as specified by the purchaser.

b) Lever roller shall be made of steel and shall be protected against corrosion (*should be hardened*).

c) Insulating materials used in limit switches shall have good electrical and mechanical properties and shall conform to relevant Indian Standard.

4.11 Enclosure - The type of enclosure shall be as prescribed in IS 13947 (Part 1) :1993 `Specifications for low voltage switchgear and controlgear' : General Rules (superseding IS 2147 & IS 4237).

4.12 Earthing - Earthing arrangements shall be as prescribed in IS 13947(Part 5)/sec 1) :1993.

5. CONSTRUCTION

5.1 Cam Operated Rotary Geared Limit Switches

5.1.1 These limit switches consist essentially of the following parts

a) Reduction gear unit with single or twin operated shafts of square section on which number of Cam segments are fitted e.g. 2, 4, 5, 6, 8.....

b) Sets of making and breaking Cams (maximum 3 sets) bolted on the Cam segment corresponding to each circuit. Due to provision of slotted and not-through holes in the Cams, these can be displaced by 10 to 30 degree with respect to the fixing bolt in better direction, thereby ensuring accurate positioning of opening and closing of contacts at any desired angle.

c) Contact arm with spring loaded moving contact bridge
d) Fixed contact studs mounted on insulating board
e) Latching arrangement and disengaging arm

5.1.2 Operation - When the shaft rotates, the making Cam presses against the contact arm through a roller. The contact arm turns and the circuit is closed through the moving contact bridge. The disengaging arm enters the slot provided in the contact arm and holds the latter in the switched position.

When the shaft further rotates, the breaking Cam approaches the roller of the disengaging arm. On being pressed, the disengaging arm retracts from the slot in the contact arm and it trips thereby permitting the contact arm to turn around its axis and open the contacts.

5.1.3 Gear Ratios

a) Horizontal Configuration, Foot Mounted, Single Shaft Extension with Reduction Gear:

SL NO.	NUMBER OF CKTS PER DRUM	NUMBER OF DRUM	GEAR RATIO
1	4	2	1:16.65
2	4	2	1:1, 1:2, 1:20, 1:36
3	8	2	1:16.65, 1:248
4	8	2	1:1, 1:2, 1:20, 1:36
5	12	2	1:16.65
6	12	2	1:1, 1:2, 1:20, 1:36
7			1:248

b) Vertical Configuration, Fastened to Horizontal Base, with Reduction Gear:

SL NO.	NO. OF CONTACTS	GEAR RATIO	SHAFT
1	2	1:1, 1:5, 1:15, 1:30	Both single & double shaft
2	4	- do -	- do -
3	6	- do -	- do -

5.2 Spindle Type Rotary Geared Limit Switches

5.2.1 The limit switch consists of two main parts housed in a common casing with a contact system with 2 N.C. (or 4 N.C.) double break contacts on one side of cast iron casing and a reduction gear unit on the other side.

The switches have one drive shaft (spindle) with key for mounting of the coupling. A worm gear is fixed on the spindle which drives a gear mounted on the operating shaft carrying two nos of adjustable operating Cams for contact operations.

5.2.2 Operation - When the spindle rotates and reaches extreme position, the corresponding operating Cam presses against its contact assembly opening the contact. Similarly when the direction of the spindle rotation is reversed, the other Cam opens the second set of contacts in the other extreme position.

The switch is fully adjustable as regards to contact opening and closing within 42 revolutions of the spindle in cases of switches having gear ratio 1:50. After operation, the switch is reset by the drive shaft turning through maximum 0.5 revolutions in the reverse direction.

When the limit switches are used with unidirectional mechanisms, the contacts can be made to close or open at any fixed point of the mechanism travel.

5.2.3 Gear Ratios - 1:50, 1:75

6. TESTS - The following tests shall be carried out in accordance with IS 13947 (Part 5)/Sec 1:1993 :

6.1 Type Tests

a) General inspection

b) Temperature rise test (*as per Table 2*)

c) Test for making and breaking capacities, and

d) High voltage test

6.2 Routine Tests

a) General inspection, and

b) High voltage test

6.3 Special Tests

a) Load operation test, and

b) Verification of mechanical duty class

7. MARKING

7.1 Each limit switch shall be provided with a name plate carrying the following information marked in durable manner and so placed that marking is legible when the limit switch is in installed position:

a) Manufacturer's name or trade-mark,
b) Serial number,
c) Designation,
d) Gear ratio, and
e) No. of contacts

7.1.1 Number of positions and contacts with diagram showing the arrangements shall be marked on the inside face of the cover.

7.2 The information contained in clause 7.1.1 may be given in separate leaflet which shall include the following additional details as well:

a) Number of revolutions and reduction ratio

b) Mounting dimensions

c) Pre-travel, over-travel and differential travel of contact element

d) Mass of limit switch in kgs, and

e) Any other relevant information as required by the purchaser.