INTER PLANT STANDARD – STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR dc CRANE/MILL DUTY MOTORS** (600 SERIES) (*First Revision*)	**IPSS:1-03-005-03**
	Corresponding IS does not exist	Formerly: IPSS:1-03-005-86

0. FOREWORD

0.1 This Interplant Standard has been prepared by the Standards Committee on Rotating Electrical Machinery, IPSS 1:3 with the active participation of representatives of the steel plants, reputed consulting organizations and established manufacturers of dc Motors; and was adopted in August 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 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.

0.3 In the preparation of this standard assistance has been derived from the following:

a) AISE standard No.1 (Revised, September 1968) on `dc Mill Motor'. Association of Iron and Steel Engineers, USA.

b) Revised draft proposal: Recommendations for dc Mill Type Electric Motors - Doc:IEC 2 (UK) 453.

0.4 The other standard in the series of dc motors is IPSS:1-03-002-82 `Specification for dc mill/crane duty motors (800 series)'.

0.5 This Inter Plant Standard should be read in conjunction with IPSS:1-03-016-92, Standard information for enquiry and order for electric motors (*first revision*).

1. SCOPE

1.1 This standard specifies mechanical and electrical requirements, tests and dimensions of 600 series dc motors with class H insulation for heavy duty service on cranes and other equipment in steel plants and also suitable for reversible duty. It covers series, separately excited shunt, compound and shunt with series stabilization winding motors with rated voltages of 230 V and 460 V.

2. TERMINOLOGY

2.1 For the purpose of this standard, definitions given in IS 1885 (Part 35):1973 `Electrotechnical vocabulary: Part 35 Rotating machinery' shall apply.

3. SITE CONDITIONS

The following shall constitute the normal site conditions for the purpose of this standard.

3.1 **Ambient Temperature** - The ambient temperature of the cooling medium shall not exceed 40°C.

3.2 **Relative Humidity** - The maximum relative humidity shall be 100 percent. However, maximum ambient temperature and 100 percent relative humidity may not occur simultaneously.

3.3 **Ambient Air** - The ambient air may contain fair amount of conductive dust.

3.4 **Altitude** - The altitude shall not exceed 1000 m.

4. TYPE OF ENCLOSURE

4.1 The types of enclosure and the degree of protection to be provided by each type, in accordance with IS 4961:1968 `Degrees of protection provided by enclosures for rotating electrical machinery shall be as follows:

a) TENV type (that is, totally enclosed, non-ventilated type) - degree of protection IP 54, and

b) TEFV type (that is, totally enclosed forced ventilated type) - degree of protection IP 54, except for the ventilation openings which may have IP 23 degree of protection. However for outdoor use, degree of protection may be specified as IP 55.

4.2 The TENV and TEFV type, enclosures shall be mutually convertible by the addition or removal of suitable covers and internal fans, if asked for by the

purchaser. For mutually convertible feature, motors with TEFV enclosures shall be supplied with covers fitted on the ventilation openings, and spare fans and a hood shall be provided with every TENV type motor.

4.3 The motors shall be designed to meet the TEFV ratings when supplied with air volume and air pressure shown in Table 1. Direction of air flow shall be from driving end to commutator end for centrally ventilated motors. For motors with forced ventilation units mounted directly on top of the motor, the air entry may be from commutator end.

5. METHOD OF COOLING

The method of cooling shall be IC 0041 for TENV type motors and IC 17 for TEFV type motors in accordance with IS 6362:1995 `Designation of methods of cooling for rotating electrical machines (first revision).

6. RATINGS

6.1 The ratings for dc mill/crane duty motors (600 series) at an ambient temperature of 40°C shall be as given in Table 1 corresponding to various frame size given in Fig.1, Table 2 and Table 3. These ratings are based on a direct current supply having no appreciable ripple such as that obtained from a generator source.

NOTE: For higher ambient temperatures up to 60 deg C, a derating factor of 1.5 percent per deg C for the temperature above 40 deg C shall be applied to the rated output. The calculated output shall be rounded off to the first decimal place to determine the derated output.

6.2 Two individual motor ratings suitable for voltage supplies of 230 and 460 V shall be available for each frame size. Motor for 230 V ratings shall be suitable for operation on voltages up to 550 V. Maximum operating voltage level of motors for 460 V ratings shall be as agreed to between the manufacturer and the purchaser.

6.3 For motors operating at voltage levels above the nominal rated value, the maximum running torques shown in Table 1 may be reduced.

6.4 Similar motors of 230 V ratings shall permit series connection of two motors across 460 V supply.

7. CONSTRUCTIONAL DETAILS

7.1 **Dimensions and Tolerances** - The mounting dimensions and tolerances shall be as shown in Fig 1 read with Table 2 or Table 3 depending upon the shaft end taper.

7.2 **Mounting** - The position of mounting shall be horizontal foot-mounted IMB3 construction in accordance with IS 2253:1974 `Designations for types of construction and mounting arrangements of rotating electrical machines (first revision)'.

7.3 **Frames** - Frames shall be made of steel and horizontally split, unless otherwise specified in such a manner as to allow removal of armature by a straight vertical lift after the top half of the frame is removed.

NOTE: Inclusion of cylindrical non-split type of construction for the frames is under consideration.

7.4 **Shafts** - The shafts shall be replaceable without disturbing the commutator.

7.4.1 Taper of shaft ends shall be either 1:9.6 with keyway parallel to taper or 1:10 with keyway parallel to axis as specified by the purchaser.

7.4.2 A single-ended shaft may be supplied on specific request from the purchaser.

7.4.3 Shaft dimensions shall be as shown in Table 2 for shaft end taper of 1:9.6. The dimensions for shaft ends with taper 1:10 are given in Table 3.

7.4.4 It is desirable to have a construction of armature which would facilitate repair/replacement of commutator without disturbing/damaging the armature winding.

NOTE: Moulded commutators are not acceptable as these are not amenable to repairs.

7.5 **BEARINGS**

7.5.1 Motors shall be provided with bearings as specified in Table 2. The bearings shall be enclosed in cartridges and provided with suitable tapped lifting holes and with feet to support the armature when it is placed on floor.

7.5.2 Provision shall be made for lubricating the bearings on both sides without dismantling any part through grease nipple size AM 16x1.5 as specified in IS 4009:1967 `Specification for grease nipples for frame sizes 606 and above'. For lower frame sizes, grease nipple size AM 10x1 as specified in IS 4009:1967 shall be provided. Drain plugs shall be provided at the bottom of each bearing housing to remove excess grease.

7.6 **End Play** - The axial end play of the armature shall not exceed 3 mm.

7.7 **Terminals** - Terminal leads shall be made of copper and brought out on the left side viewed from commutator end. The terminals shall be protected by

suitable covers and conduit box shall be provided where specified by the purchaser.

7.7.1 Terminal leads of minimum 300 mm projection from the body of the field shall be provided with copper lugs suitable for connection with aluminium cables of proper size and left free for direct connection. All terminal leads shall be marked in accordance with IS 4728:1975 `Terminal marking and direction of rotation for rotating electrical machinery (first revision)'.

7.7.2 The leads emerging out of the field shall be provided with flexible glands made of suitable material so as to prevent oil and grease entry into the motor. The gland material, should be immune to chemical reaction with oil and grease. The gland should be easily replaceable.

7.8 **Connection Diagram** - A diagram of connections with marking of leads as specified in 7.7.1 shall be clearly and indelibly marked on the inside of the terminal box cover.

7.9 **Brush Gear** - Brushes of standard dimensions as specified in IS 3003 (Part 3):1978 `Specification for carbon brushes for electrical machines: Part 3 Dimensions and requirements (first revision)' shall be used. There shall be free and direct access to all brush-holders for ease of maintenance. The brush holders shall be of constant pressure type.

7.9.1 Neutral position shall be clearly marked on the motor at a suitable location.

8. MOTOR SUPPLIED FROM RECTIFIED POWER SUPPLIED

8.1 Motor shall be suitable for satisfactory operation at the rated outputs listed in Table 1 when supplied from a variable voltage ractified power source, that is, thyristor convertor. The harmonic ripple content of the power source should not exceed that derived under similar circumstances from 3-phase 50 Hz, six phase controlled pulses (300 Hz predominent ripple frequency) and with the phase control of the rectifier not exceeding 15 percent of the free firing condition, that is, 460 V mean dc level from 415 V ac, rms line voltage. This aspect should be kept in mind while designing the motor.

NOTE: When motors are operated from a rectified ac supply, the performance may differ materially from that of similar motors when operated from a generator or battery source having the same effective value of voltage. In case of the former, at the same rated loads the temperature-rise, speed regulation and noise level may increase and commutation could be adversely affected. The degree of difference shall depend upon the level of harmonic currents circulated in the motor circuit and is likely to be more significant when the rectifier pulse number is low (<6) and the amount of phase control is high (>15 percent).

When motors are operated from rectified power supplies, bearing currents may become evident due to high frequency harmonic currents being transmitted through the capacitive coupling between the armature winding and core, and returned through the earth path to the transformer secondary. While these harmonic current levels are normally small in magnitude they may result in long term damage to the bearing surface under certain conditions.

9. TEMPERATURE RISE

9.1 The rated temperature rise of armature and field windings over an ambient temperature of 40°C shall not be greater than 110°C and 125°C respectively as measured by resistance method.

9.2 The rated temperature rise of armature iron core and commutator over an ambient temperature of 40°C shall not be greater than 110 and 110°C respectively as measured by thermometer method.

9.3 The temperature rise of other parts, such as brush holders and pole tips, may attain such values as shall not affect either the operational performance or life expectancy in any respect.

9.4 The one hour and thirty minutes ratings given in Table 1 are based on a load test which shall commence only when the windings and other parts of the machine are within 5°C of the ambient temperature.

10. FIELD VOLTAGE

10.1 For 230 V rated motors, the shunt field voltage shall be 230 V and for 460 V rated motors the shunt field voltage shall be 460 V. On specific request from the purchaser for 460 V rated motors, shunt field winding rated for 460 V may be supplied, having two field coils of 230 V each to be connected in series for 460 V operation and in parallel for 230 V operation.

11. FIELD HEATING AT STANDSTILL

11.1 When supplied at the rated voltage, the separately excited shunt field windings of shunt and compound wound motors shall be capable of full continuous excitation at standstill without exceeding the temperature-rise limits as specified in 9.

12. SPEED

12.1 Speed Regulations for Adjustable Speed Motors - the regulation of adjustable speed motors from no load to the basic one hour rating (for totally enclosed non-ventilated motors) or at the continuous rating (for

totally enclosed forced-ventilated motors) shall not exceed the values given below as appropriate:

Base Speed, Percent	*Regulation, Percent, Max*
100	15
200	20
300	25

NOTE: Base speeds for different frame sizes are given in Table 1.

12.2 **Degree of Compounding** - At the one hour rating (in the case of TENV motors) or at the continuous rating (in the case of TEFV motors) the excitation shall be 50 percent shunt and 50 percent series to within the nearest whole number of series turns.

12.3 **Variation in Speed Due to Heating** - The variation in speed from full load cold to full load hot during a run of rated duration shall not exceed 20 percent of the rated speed for TENV type motors and 15 percent of rated speed for TEFV type motors.

12.4 **Variation from Rated Speed** - At normal operating temperature, rated load and voltage, and at rated field voltage across its terminals the variation above or below the rated full field speed shall not be more than 7.5 percent.

12.5 **Maximum Speeds** - The maximum safe operating speeds shall be as shown in Table 1.

13. MOMENT OF INERTIA

13.1 The maximum value of the moment of inertia of the armature (Wk2) shall be as given in Table 1.

14. EARTHING

14.1 Two earthing terminals of proper size suitable to receive galvanized iron conductors shall be provided on the bottom half of the motor body. In addition to the two outside earthing terminal, provision for one more earthing terminal inside the terminal box is to be kept. Size of earthing terminal shall conform to clause 12.2.2.2 of IS 3043:1987 `Code of practice for earthing (first revision)'.

14A LIMITS OF NOISE LEVEL

14A.1 The noise level shall not exceed the limits specified in IS 12065:1987 `Permissible limits of noise level for rotating electrical machines', if required by the user.

14B LIMITS OF VIBRATION

14B.1 Limits of vibration intensity shall be in accordance with normal class of Table 1 of IS 12075:1986 `Mechanical vibration of rotating electrical machines with shaft heights 56 mm and higher – measurement, evaluation and limits of vibration severity (with 1 amendment) (superseding IS 4729:1968).

NOTE: The manufacturer shall indicate in the test certificate whether the rotor is balanced, with or without the coupling fixing key in the shaft.

15. TESTS

15.1 **Test Certificates** - The manufacturer shall furnish certificates of routine tests for each motor. Type test certificates shall be furnished for each motor whenever asked for.

16. TECHNICAL PARTICULARS

16.1 **Test Certificates** - The manufacturer shall furnish technical particulars for each motor as specified in Appendix A. The manufacturer shall also furnish characteristic curves for torque vs speed in every case and characteristic curves for % time on cersus load whenever asked for by the purchaser.

17. DESIGNATION OF MOTORS

17.1 The designation of motors conforming to the requirements of this standard shall consist of two parts. The first part identifying the application, that is, metallurgical mill/crane duty dc motors and is denoted by `MMDC', and the second part indicating the series and frame size.

Example - A mill/crane duty dc motor of 600 series and of frame size 610 shall be denoted as follows:

MMDC - 610

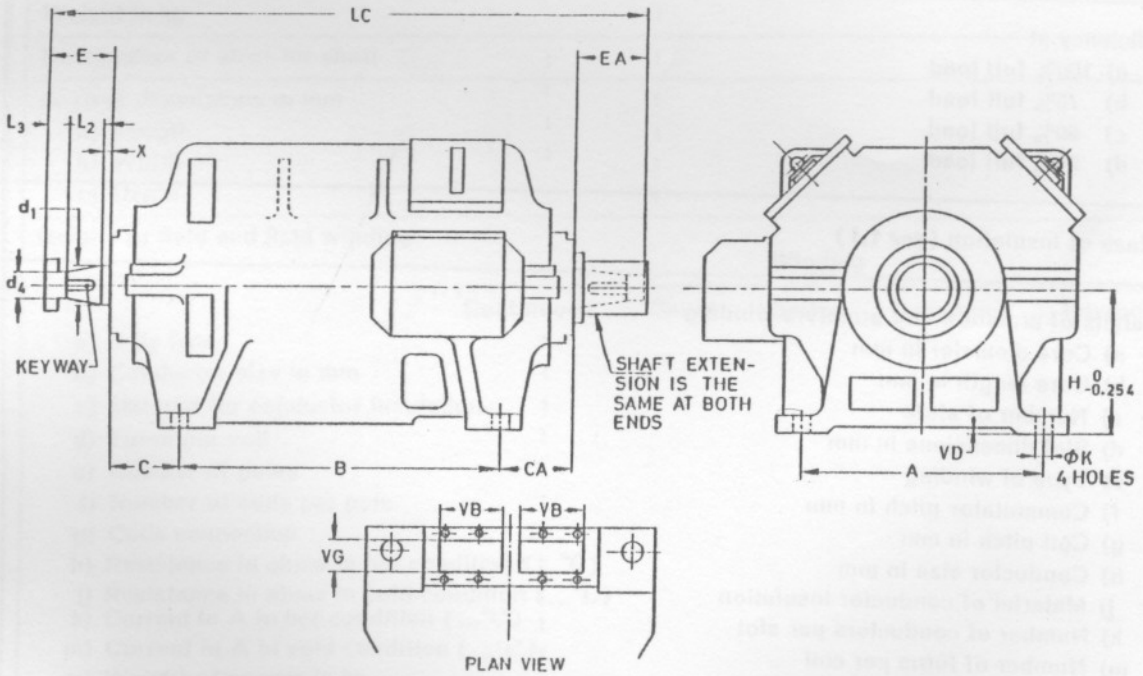
18. RATING PLATE

18.1 A legible and indelibly marked rating plate shall be fixed on the upper half of the motor body and shall give the following minimum information:

a) Manufacturers's name or trade-mark;
b) Manufacturer's type and frame designation;
c) Reference to this standard, that is, IPSS:1-03-005-03
d) Designation of the motor in accordance with this standard (see 17);
e) Rated voltage;

f) Rated output in kW at 40°C;
g) Duty type;
h) Currents at rated outputs at 40°C;
i) Speeds at rated outputs;
j) Excitation voltage and type of excitation, that is, straight shunt, (stabilized shunt, compound or series;
k) Bearing designation and lubrication details;
l) Serial number and year of manufacture; and
m) Weight of motor in kg.
n) Class of insulation.

18.2 Manufacturer's serial number shall be punched on the armature also.



Note—This figure is only illustrative, and does not depict any particular make of motor.

FIG.1 DIMENSIONAL DRAWING OF dc CRANE/MILL DUTY MOTOR (600 SERIES)

APPENDIX A

(*Clause* 16.1)

TECHNICAL PARTICULARS OF dc MILL/CRANE DUTY MOTORS (600 SERIES)

Manufacturer's name	:
Serial number and year of manufacture of the motor	:
Rated output in kW (*see* Table 1) 40°C ambient	: :
Torque in Nm (*see* Table 1)	
a) Full load	:
b) Maximum	:
c) Starting	:
Revolutions per minute (*see* Table 1)	
a) Full load	:
b) No load	:
c) Starting	:
Efficiency at	
a) 100% full load	:
b) 75% full load	:
c) 50% full load	:
d) 25% full load	:
Class of insulation (*see* **1.1**)	:
Details of armature and armature winding	
a) Core diameter in mm	:
b) Core length in mm	:
c) Number of slots	:
d) Slot dimensions in mm	:
e) Type of winding	:
f) Commutator pitch in mm	:
g) Coil pitch in mm	:
h) Conductor size in mm	:
j) Material of conductor insulation	:
k) Number of conductors per slot	:
m) Number of turns per coil	:
n) Length of conductor in mm	:
p) Weight of copper in kg	:
q) Inertia in kg m^2	:
r) Weight of armature in kg	:
s) Resistance in ohms in hot condition (.....°C)	:
t) Resistance in ohms in cold condition (.....°C)	:
Details of commutator	
a) Number of segments	:
b) Length in mm	:
c) Diameter in mm	:
d) Allowable wearing depth in mm	:
e) Width of bar in mm	:
f) Maximum permissible current in A	:

Details of bearings	Drive End :	Commutator End
a) Type		
b) Make	:	
c) Maker's number	:	
Type of grease to be used	:	
Rated voltage (*see* **1.1** and **6.2**)	:	
Rated current in A corresponding to rated output at 40°C	:	
Excitation (Field) (Type/Voltage/Current)	:	
Type of enclosure (*see* **4**)	:	
Method of cooling (*see* **5**)	:	
Duty type	:	
Required air for continuous rating		
a) Quantity	:	
b) Pressures	:	
Frame size	:	
Weight in kg	:	
Designation of steel for shaft	:	
Keyway dimensions in mm	:	
a) Length	:	
b) Width	:	
c) Depth	:	

Details of field and field winding

	Winding				
	Continuous	Shunt	Series	Compound	Interpole
a) Duty type					
b) Conductor size in mm					
c) Material for conductor insulation					
d) Turns per coil					
e) Number of poles					
f) Number of coils per pole					
g) Coils connection					
h) Resistance in ohms in hot condition (...°C)					
j) Resistance in ohms in cold condition (...°C)					
k) Current in A in hot condition (...°C)					
m) Current in A in cold condition (...°C)					
n) Weight of copper in kg					

Air gap between armature and field windings	
a) For main poles in mm	
b) For interpoles in mm	
Details of brushes	
a) Number of arms	:
b) Number of brushes per arms	:
c) Make	:
d) Grade of carbon	:
e) Required pressure	:
f) Length of brush in mm	:
g) Width of brush in mm	:
h) Thickness of brush in mm	:
j) Allowable brush wear in mm	:

TABLE 1 RATINGS OF DC CRANE/MILL DUTY MOTORS (600 SERIES) — 230 V & 460 V

(*Clauses* 4.3, 6.1, 6.3, 8, 9.4, 12.1, 12.5, 13 *and* 15)

Frame Size	Continuous Duty Type S_1 for TEFV or Short Time Duty Type S_2—60 Minutes for TENV					Intermittent Periodic Duty Type S_3—30 percent for TENV (*see* Note 2)						Short Time Duty Type S_2—30 Minutes TENV				Air Requirement Cont. for TEFV Rating Air Inlet from Commutator End		TENV and TEFV							
		Speed at rated voltage, rpm				Series		Compound		Shunt			Speed at rated voltage, rpm					Maximum starting torque Nm			Maximum running torque, Nm				
	Output, kW	Series	Compound	Straight shunt (Base speed)	Shunt or stabilized shunt Adjustable speed (*see* Note 1)	Output, kW	rpm	Output, kW	rpm	Output, kW	rpm	Output, kW	Series	Compound	Shunt	Cubic metres per sec	Static pressure, mm of H_2O	Series	Compound	Shunt	Series	Compound	Shunt	Max Armature Inertia wk^2, kgm^2	Max Safe Speed, rev/min
230 VOLTS																									
602	5·5	800	900	900	900/1 800	6	780	6·5	820	6·5	870	7·5	690	750	850	0·08	13	333	265	211	265	206	177	0·19	3600
603	7·5	725	800	800	800/2 000	8	735	8·5	780	8·5	795	10	630	715	775	0·09	13	490	402	319	392	314	265	0·34	3300
604	11	650	725	725	725/1 800	12	630	12	750	12	715	14	575	700	700	0·12	13	824	667	520	657	515	441	0·55	3000
606	18·5	575	650	650	650/1 950	18·5	575	18·5	650	18·5	650	25	515	615	625	0·16	19	1 540	1 236	990	1 236	961	824	1·10	2600
608	26	525	575	575	575/1 725	24	565	24	600	24	585	34	480	540	585	0·2	19	2 353	1 941	1 549	1 882	1 510	1 294	2·0	2300
610	37	500	550	550	550/1 650	32	545	32	585	32	555	49	455	510	535	0·25	25	3 559	2 912	2 333	2 843	2 265	1 941	3·31	2100
612	56	475	515	515	515/1 300	48	525	48	540	48	555	75	435	480	550	0·35	38	5 627	4 667	3 735	4 510	3 627	3 108	5·60	1900
614	75	460	485	485	485/1 200	64	495	58	515	58	495	100	410	445	485	0·43	38	7 716	6 617	5 294	6 177	5 137	4 392	9·21	1700
616	112	450	460	460	460/1 150	90	495	78	490	78	480	150	415	440	475	0·57	38	11 863	10 332	8 333	9 490	8 118	6 961	16·08	1600
618	150	410	420	420	420/1 050	110	485	100	465	100	440	200	370	390	430	0·76	38	17 353	15 246	11 500	13 500	11 863	9 471	23·83	1500
460 VOLTS																									
602	5·5	935	1 025	1 025	1 025/2 050	6	850	6·5	960	6·5	1 020	7·5	700	900	1 000	0·08	13	226	183	153	196	144	128	0·19	3600
603	7·5	810	885	885	885/1 770	8	800	8·5	855	8·5	870	10	680	800	860	0·09	13	353	289	240	309	226	201	0·34	3300
604	11	725	800	800	800/1 600	12	700	12	800	12	825	14	690	750	820	0·12	13	588	480	397	515	373	333	0·55	3000
606	18·5	635	700	700	700/1 400	18·5	635	18·5	700	18·5	700	25	550	650	665	0·16	19	1 117	912	765	980	711	637	1·10	2600
608	26	585	625	625	625/1 250	24	600	24	650	24	650	34	520	580	635	0·2	19	1 706	1 431	1 196	1 490	1 118	990	2·0	2300
610	37	530	585	585	585/1 170	32	560	32	620	32	620	49	480	530	610	0·25	25	2 686	2 196	1 824	2 353	1 706	1 520	3·31	2100
612	56	510	550	550	550/1 100	48	540	48	580	48	560	75	440	520	570	0·35	38	4 186	3 490	2 912	3 667	2 716	2 428	5·40	1900
614	75	475	500	500	500/1 250	64	520	58	550	58	490	100	420	470	490	0·43	38	6 000	5 118	4 265	5 245	3 990	3 559	9·21	1700
616	112	460	460	460	460/1 380	90	510	78	500	78	470	150	420	440	460	0·57	38	9 275	8 353	6 961	8 118	6 490	5 804	16·08	1600
618	150	415	415	415	415/830	110	480	100	420	100	425	200	380	400	420	0·76	38	13 726	12 352	10 294	12 010	9 608	8 578	23·83	1500

Note 1 — A light stabilizing field may be used to obtain these speed ranges.

Note 2 — Suitable for continuous repeated periodic cycles of 5 minutes duration, with shunt field continuously excited.

Note 3 — Duty types specified herein are in accordance with IS : 4722-1968 'Specification for rotating electrical machines'.

TABLE 2 DIMENSIONS OF D. C. CRANE/MILL DUTY MOTORS (600 SERIES) WITH SHAFT END TAPER 1:9·6

(*Clauses* 6.1, 7.1, 7.4.3 *and* 7.5.1)

Frame Size	Fixing Dimensions						Ventilation Duct Opening (Commutator Side only)			Conical Shaft End 1:9·6 Taper with Keyway Parallel to Taper									Bearing No.
										Shaft Dimensions					Shaft Thread		Keyway		
	A	*B*	*C*/*CA*	*H*	*LC*	*K*	*BV*	*VD*	*VG*	*E*/*EA*	*d*1	*L*2	*X*	*L*3	*d*4	Pitch	Width	Depth at Side	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
602	317·5	419·1	95·25	193·675	835·025	19·84	81	11	64	112·712	44·45	69·85	12·7	30·162	25·4	3·175	12·7	3·95	NJ 310
603	355·6	457·2	114·3	215·9	939·8	23·019	89	13	73	127	50·8	82·55	12·7	31·75	31·75	3·175	12·7	3·95	NJ 311
604	381·0	482·6	127·0	228·6	990·6	23·019	102	13	83	127	50·8	82·55	12·7	31·75	31·75	3·175	12·7	3·95	NJ 313
606	419·1	533·4	127·0	254·0	1 073·15	26·194	120	16	80	142·875	63·5	95·25	12·7	34·925	38·1	3·175	12·7	3·95	NJ 315
608	476·25	628·65	130·175	285·75	1 206·5	30·162	146	16	76	158·75	76·2	107·95	12·7	38·1	50·8	3·175	19·05	6·35	NJ 317
610	520·7	660·4	146·05	311·15	1 276·35	30·162	159	16	82·6	161·925	82·55	107·95	12·7	41·275	57·15	3·175	19·05	6·35	NJ 319
612	571·5	723·9	158·75	339·725	1 397·0	33·338	169	16	82·6	177·8	92·075	120·65	12·7	44·45	63·5	3·175	19·05	6·35	NJ 321
614	635·0	812·8	184·15	374·65	1 543·05	39·688	184	16	98·4	180·975	107·95	120·65	12·7	47·625	76·2	3·175	25·4	10·3	NJ 324
616	685·8	889·0	215·9	406·4	1 714·5	39·688	203	19	108·0	196·85	117·475	133·35	12·7	50·8	82·55	3·175	31·75	11·9	NJ 326
618	762·0	990·6	203·2	450·85	1 793·875	46·038	235	19	108·0	198·438	127	146·05	12·7	39·688	88·9	3·175	31·75	11·9	NJ 328

TABLE 3 DIMENSIONS OF DC CRANE/MILL DUTY MOTORS (600 SERIES) WITH SHAFT END TAPER 1:10

(*Clauses* 6.1, 7.1 *and* 7.4.3)

Frame Size	Fixing Dimensions						Ventilation Duct Opening (Commutator Side only)			Conical Shaft End 1:10 Taper with Keyway Parallel to Axis							Bearing No.
										Shaft Dimensions			Shaft Thread		Key		
	A	*B*	*C*;*CA*+*X*	*H*	*LC*	*K*	*VB*	*VD*	*VG*	*d*1	*L*2	*L*3	*d*4	Pitch	Width	Thickness	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
602	317	419	108·0	193·5	835	20	80	12·5	63	45	72	28	M30	2	10	8	NJ 310
603	356	457	127·5	216	932	23	89	13	73	50	82	28	M36	3	12	8	NJ 311
604	381	483	139·5	228	982	23	102	13	83	55	82	28	M36	3	14	9	NJ 313
606	419	533	140·0	254	1073	27	120	18	82	65	95	35	M42	3	16	10	NJ 315
608	476	628	143·0	286	1194	33	146	18	76	75	105	35	M48	3	18	11	NJ 317
610	520	660	159·0	311	1276	33	158	18	82	85	109	40	M56	4	20	12	NJ 319
612	572	724	171·5	340	1397	33	168	16	82	95	120	45	M64	4	22	14	NJ 321
614	635	813	196·5	374·5	1536	39	185	16	100	110	120	45	M80	4	25	14	NJ 324
616	686	889	228·5	406	1714	39	205	20	108	120	139	45	M90	4	28	16	NJ 326
618	762	990	216·0	451	1792	45	230	20	105	130	140	45	M100	4	28	16	NJ 328

*Dimensions X = 10 mm for every frame size.