SPECIFICATION FOR HIGH VOLTAGE BUSHING FOR WAG-9/WAP-7/WAP-5 ELECTRIC LOCOMOTIVES

Specification No: CLW/ES/3/0052/F

ENCLOSURES :-

1. **CLW/ES/3/SK-1/0052/F**
2. **CLW/ES/3/SK-3/0052/F**

ISSUED BY
DY.CHIEF ELECTRICAL ENGINEER/D-I
CHITTARANJAN LOCOMOTIVE WORKS
CHITTARANJAN – 713331
Dist: BARDHAMAN (WEST)
WEST BENGAL (INDIA)

Prepared By	Checked By	Approved By
JE/Drg	SEE/D-I	Dy.CEE/D-I

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ALTERATION RECORD SHEET

Amendment no.	Date of Amendment	Page no.	Alteration	Descriptions	Authority
1	19/05/1998		A	Deleted Cl. No.7 to 7.7 at Page No.6,7,8,9 & 11 Deleted Previous Drg. No. 1. CLW/ES/3/SK-4/0052 2. CLW/ES/3/SK-5/0052 3. CLW/ES/3/SK-6/0052 4. CLW/ES/3/SK-7/0052 5. CLW/ES/3/SK-8/0052	Sd/-
2	1/04/2006		B	Specification Re-Type and Brass Nut-M20 Added in Scope of supply.	Sd/-
3	06-09-2010		C	Specification thoroughly revised due to inclusion of new drawing no- CLW/ES/3/SK-4/0052 added	Sd/-
4	27-02-2016		D	Nitrile Bonded Cork Gasket included in scope of supply in clause no-5.2 (a) new clause 6.2.	Sd/-
5	29-06-2024		E	i. Specification thoroughly revised and drawing no-CLW/ES/3/SK-4/0052 & CLW/ES/3/SK-2/0052 deleted. ii. General Description included at Page no.4 at Cl.no.1.0 and Level and Marking included at Page no.6 at Cl.no.8.0 iii. Test clause 7.1.8 measurement of weight included (Page no.6). iv. In clause no.4.0 at Page no.4 to 5, EN 45545 or UL94-V0 for fire-retardant properties of all the non-metallic parts is included. v. In clause no.7.1.4 at Page no.6, Wet Power Frequency Withstand Voltage Test at 75 KV (RMS) is condidtion of at least 24 hrs ous rainingafter contini included. vi. In clause no. 5.7 at Page no.5, Creepage Path of Bushing changed from ≥ 806 mm to ≥ 1050 mm. vii. Partial Discharge test is included in Routine Test (for 01 sample from a lot) in In clause no.7.1.6 at Page no.6. viii. In clause no.7.1.1 at Pageno.6, Physical and Dimensional measurement as per approved drawing.is included. ix. Height of the Bushing mentioned in clause no.6.7 at Page no.5 is included. x. Test clause 7.1.9 X-Ray test added.	Sd/-

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6.	xx-xx-2025		F	i. In sub Cl.no. 3.3, Altitude: 1776m above mean sea level against USBRL project conditionis mentioned. ii. In sub Cl.no. 3.4, flood water level of 200 millimeter inplace of 120millimeter above Rail level is mentioned. iii. Cl.no.6.3 is modified. iv. Cl.no. 6.8 Bill of Material & Material composition is included. v. Sub Cl.no.7.2 to Sub Cl.no.7.7 under Cl.no.7 is included. vi. Sub Cl.no. 7.8.1 and Sub Cl.no.7.8.2 is modified vii. X-ray test is elaborated in Sub Cl. no.7.8.9. viii. Verification of fire retardant of non-metallic parts as per latest EN 45545-HL3 or latest is included in Sub Cl.no.7.8.10. ix. Salt fog test is included in Sub Cl.no.7.8.11. x. Material composition of Rod of High Voltage Bushing is CR: 0.3-1.2%, ZR: 0.03 to 0.3%, Rest%:CU (Ref. HZN 400523) (Ref:-DRG.HBTB 416462) **OR** Te: 0.4-0.7%, P: 0.004 – 0.012% ,Rest %: CU (C14500) and is included in Drg. no. CLW/ES/3/SK-1/0052/F. xi. Bill of material is included in Cl.no.6.9.	

Note: Specification has been digitized and all the alteration i.e. addition, deletion, modification etc. has been incorporated in the digitized specification.

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1.0 GENERAL DESCRIPTION

SPECIFICATION FOR HIGH VOLTAGE BUSHING ASSEMBLY FOR WAG-9/WAP-7/WAP-5, 3-PHASE DRIVE 25 KV , 50 Hz AC ELECTRIC LOCOMOTIVE.

2.0 SCOPE:

This specification covers the supply of High Voltage Bushing being used on the roof of the WAG-9/WAP-7/WAP-5 3-Phase Drive 25 KV ,50 HZ AC Electric Locomotive of Indian Railways.

3.0 CLIMATIC AND ENVIRONMENTAL CONDITION

SL.No	Description	Remarks
3.1	Maximum atmospheric temperatures :	• Metallic Surface temperature Under Sun: 75°C Max and in Shade : 55°C • Minimum Temperature -10°C (Also. Snow Fall in certain areas during winter season).
3.2	Maximum Humidity	100% saturation during rainy season
3.3	Reference site conditions	• Ambient Temperature : 50°C • Humidity : 100%. • Altitude : 1776m above mean sea level against USBRL project condition.
3.4	Rainfall	Very heavy in certain areas. The locomotive shall be designed to permit it's running at 10 Km per hour in flood water level of 200 millimeter above Rail level.
3.5	Atmosphere during hot weather	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/m^3. In many iron ore and coal mine areas, the dust concentration is very high affecting the filter and air ventilation system
3.6	Coastal areas	Locomotive and equipment shall be designed to work in coastal areas in humid and salt laden atmosphere with maximum pH value of 8.5. Sulphate of 7 mg per litres, max. concentration of Chlorine 6 mg per liter and maximum conductivity of 130 µ Siemens/cm.
3.7	Vibration	The equipment and subsystem and their mounting arrangement will be designed to withstand vibrations and shocks encountered in service as per IEC 61373 or latest unless otherwise prescribed.
3.8	Electromagnetic Pollution	High Degree of Electromagnetic Pollution is anticipated in Locomotive Machine Room, where part of the equipment will be mounted. Necessary precaution should be taken in this regard.
3.9	Wind Speed	High Wind Speed in certain areas, with Wind Pressure reaching 150 Kg/m^2

4.0 STANDARAD :

Latest IEC-60077 Rules for Electrical Traction Devices.
Latest IEC-61373 for Shock & Vibration.
Latest IEC-60270 for Partial Discharge Measurement
Latest IEC-60137-2017 for Insulated Bushings for Alternating Voltages.

Latest IEC-60060 for Voltage Test under Rainfall.
~~Latest IS-2099 for Insulated Bushings for Alternating Voltages.~~
Latest EN 45545-HL3 or latest for Fire Protection on Railway Vehicles.
IS:13573 part 3:2011 for salt fog test.

5.0 TECHNICAL DATA.

5.1 Rated System Voltage	: 35 KV class
5.2 Nominal Current (Approx.) at 70°*C* Air Temp.	: 630 Amps
5.3 Frequency	: 50HZ ± 3%
5.4 Power Frequency Withstand Voltage (Dry)	: 75KV r.m.s
5.5 Power Frequency Withstand Voltage (Wet)	: 75KV r.m.s
5.6 Impulse Voltage Withstand Voltage (1.2/50 Wave Shape)	: 170KV_P
5.7 Creepage Path of Bushing	: ≥ 1050 mm

6.0 GENERAL FEATURES:

6.1 Outdoor Type High Voltage Bushing with ***Porcelain/Epoxy*** Housing shall be used on the roof of the 3-Phase drive Locomotives. The High Voltage Bushing shall be an integrated unit comprising upper part of Bushing compatible to external connection with mounting base suitable for mounting on 160 mm PCD with 6 nos. holes of 14 mm dia and lower part shall be compatible/have proper interface with T-Type Elastimold connectors Type 755 / 56 BLR, a part of Cable Head Termination (CHT) assembly coming from main transformer.

6.2 To avoid water entry inside the Locomotive through mounting arrangement, provision of '0' ring with groove on the mounting SS flange or any alternate suitable method shall be provided. Suitable Nitrile Bonded Cork Gasket of 5mm ±1mm thick (IS: 4253 part-2-1989) to be supplied by firm.

6.3 Dimensional & assembly details of High Voltage Bushing has been given in in drawing no.- CLW/ES/3/SK-1/ 0052/F of this Specification. However, number of petticoat given in the drawing for reference only. Firms should get approval of their own drawing from CLW/BLW/RDSO complying the overall dimensions, mounting arrangement with the drawing and creepage distance to be maintained ≥ 1050mm.
6.4 Weight of the High Voltage Bushing Assembly shall not be generally more than **22kg.**
6.5 High Voltage Bushing shall be outdoor type application.
6.6 The High Voltage Bushing shall be suitable for continuous duty.
6.7 The mounting compatibility of the Bushing shall be as under:

Mounting SS Plate OD	:	200 mm
PCD	:	160 mm
No. of Holes on PCD	:	6 nos.
Hole Dia	:	14 mm

6.8 Bill of Material

SN	Description	Material grade/Material
1	Petticoats (Outdoor Type High Voltage Bushing)	Porcelain/Epoxy
2	Mounting flange	Stainless steel-304
3	Nut	Brass
4	Rod of High Voltage Bushing	CR: 0.3-1.2%, ZR: 0.03 to 0.3%, Rest%: CU (C18150) (Ref. HZN 400523) (Ref:- DRG. HBTB 416462) OR Te: 0.4-0.7%, P: 0.004 – 0.012%, Rest%: CU (C14500).
5	Gasket	Nitrile Rubber

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NOTE:-

1. Height of the Bushings shall not be more than 540mm from the roof of the locomotives.
2. Collar height to be mentioned in such a way that bushing does not get loosened due to vibration in running operations.

7. TEST

7.1 TYPE TESTS: The Type Tests shall be carried out **once in five years** in the presence of authorized representative of Railways / Production Units /RDSO. The Type Tests once conducted on the complete unit supplied by a particular manufacturer need not be repeated within a period of five years provided its performance is satisfactory during this period. Type tests may be repeated in between this period, if any change in the Manufacturing Process, Construction, Material and Design of High Voltage Bushing assembly or its accessories is introduced.

7.2 Type test and routine test shall be carried out according to relevant Internationals/ Indian standards.

7.3 Type test: All the type tests, mentioned in clause no. 7.8 shall be carried out on prototype unit. The firm manufacturing for the first time shall get prototype approved by CLW/BLW.

7.4 Routine test: Routine test mentioned in clause no. 7.8 shall be carried out on each by the manufacturer at his works to ensure compliance with the specification and drawings.

7.5 Acceptance Test: Acceptance Test mentioned in clause no. 7.8 shall be carried out by authorized representative of Railways at firm's approved premises on sampling basis.

7.6 QAP & Test protocol shall be submitted by firm for approval before proceeding prototype test.

7.7 A copy of the internal test report, conducted by the firm shall be supplied to inspecting authority during type test and acceptance test.

7.8 Table for Tests:

Clause No.	Test Description	Specified standard	Test		
			Type (Proto) 100%	Routine 100%	Acceptance (bulk) 10%
7.8.1	Visual checking, verification of BOM as per drg./test protocol & material composition test reports" etc The authorized letter from OEM & purchase documents of High Voltage Bushing & associated accessories if procured from outside shall be verified by the inspecting agencies of Indian Railways/ PUs /RDSO.	As per drawing.	Y	Y	Y
7.8.2	Dimensional measurement as per specification drawing/ approved drawing of manufacturer Railways/ PUs /RDSO.	-	Y	Y	Y
7.8.3	Dry - Power frequency Withstand Voltage Test at 75 KV (RMS) as per ~~IS:2099-1986~~, IEC-60137-I984	~~IS:2099-1986.~~ IEC 60137-2017 or latest.	Y	Y	Y

7.8.4	Wet Power Frequency Withstand Voltage Test at 75 KV (RMS) after continuous raining condition of at least 24 hrs (Only for ref. ~~IS:2099-1986~~, IEC 60137-2017) or latest.	-	Y	NA	NA
7.8.5	Impulse Voltage Test at 170 KV Peak, as per ~~IS:2099-1986~~, IEC 60137-2017) or latest.	~~IS:2099-1986~~, IEC 60137-2017 or latest.	Y	NA	NA
7.8.6	Partial Discharge Test: PD Test on High Voltage Bushing Unit shall be carried out as per IEC 60270 at 30 KV extinction voltage. The PD value shall be less than 5 PC.	IEC 60270 or latest	Y	Y	Y
7.8.7	Shock and Vibration Test: Shock & Vibration Test shall be carried out as per IEC: 61373 or latest.	IEC: 61373 or latest	Y	NA	NA
7.8.8	Measurement of Weight: Measurement of weight to be done as per clause no-6.4. i.e weight should be not more than 22 kg.	Shall not be generally more than 22 kg.	Y	Y	Y
7.8.9	X-Ray test :- (i) Firm to conduct 100% test on all bushings at two angles i.e. 0º and 90º and submit internal test report to inspecting authority. (ii) During inspection, as per sample size, this test to be conducted by inspector. (iii) Inspection authority will verify the X-ray test reports of 100% offered lot of bushings to ascertain that bushings are free from internal defects.	-	Y	Y	Y
7.8.10	Verification of Fire and Smoke Behavior	As per (EN45545-2)-HL3 or latest	Y	NA	NA
7.8.11	Salt fog test	As per IS :13573 Part 3 :2011	Y	NA	NA

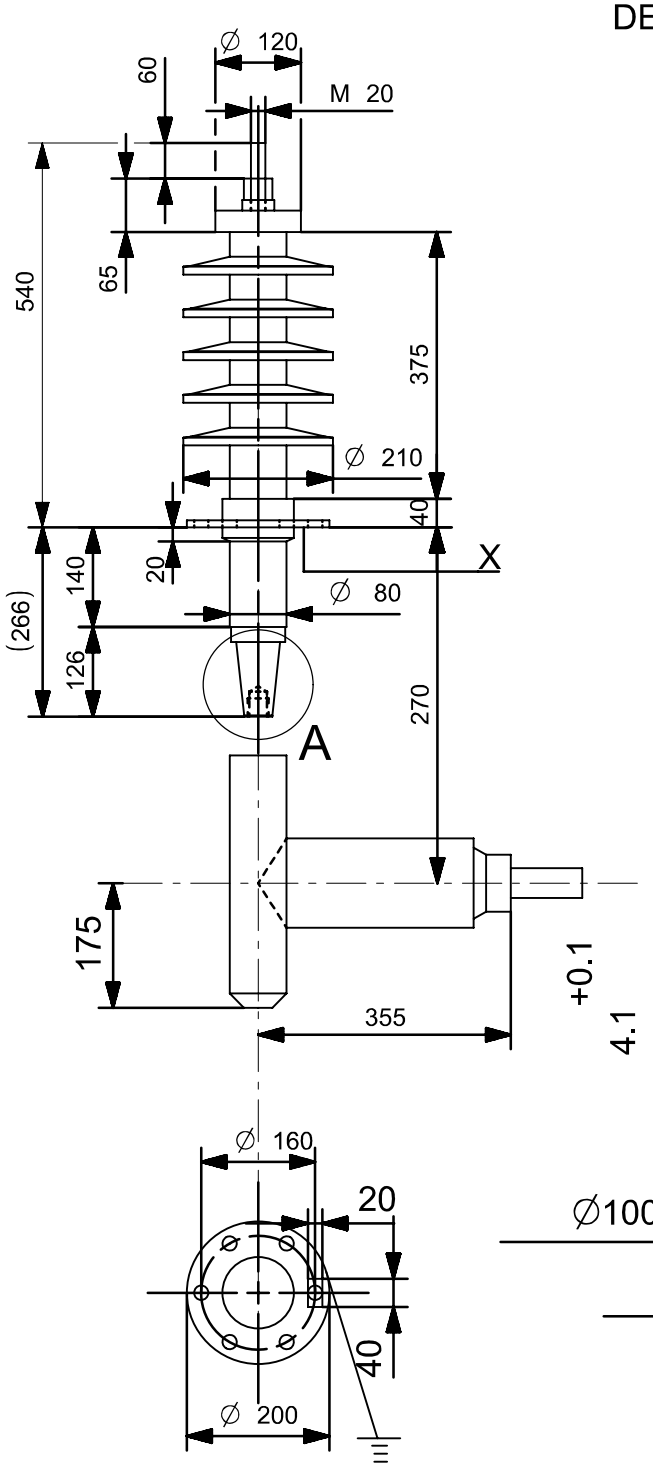
Note: The Type test Certificate approved by **RDSO/CLW/BLW** shall be valid for a period of five years.

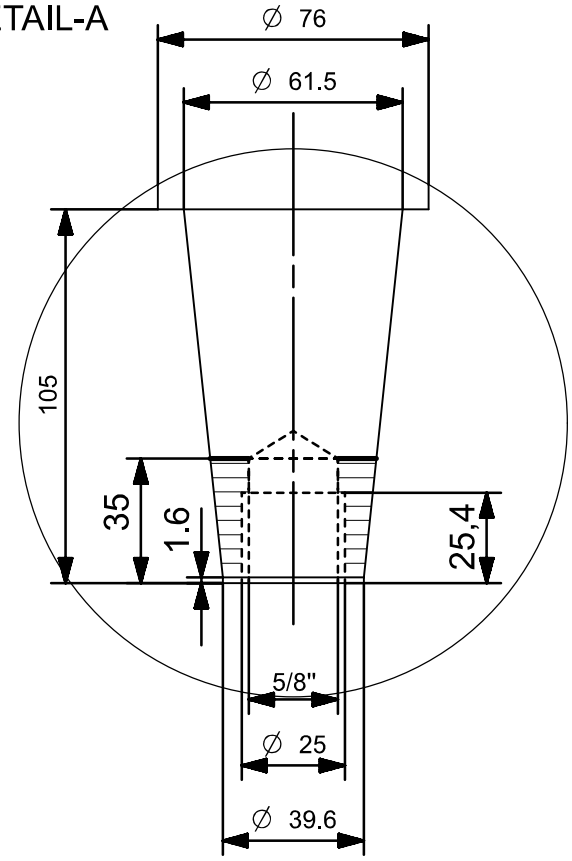
8.0 Label and Marking: Marking details shall be engrave/ embossed on proper location of Bushing which should be clearly visible after mounting of Bushing on loco roof.

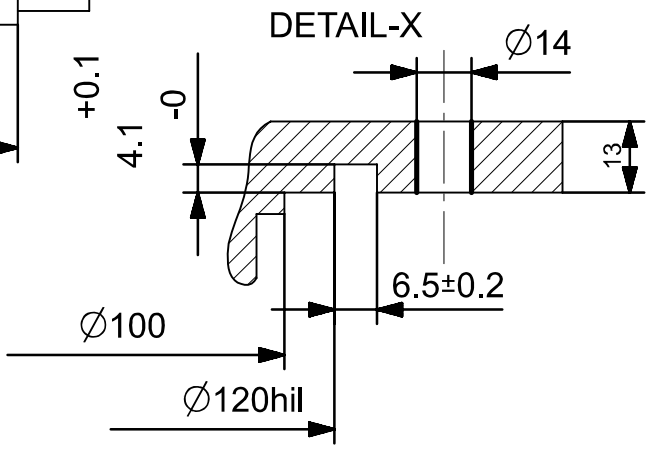
i) Manufacturers name
ii) Year of manufacture
iii) Trade mark if any
iv) Batch No. & Code
v) Serial No of the product

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CLW/ES/3/SK-1/0052/D







1. Dy.CEE /D-I — Material composition of Rod of High Voltage Bushing is CR 0.3-1.2%, ZR 0.03 to 0.3%, CU Rest (Ref.HZN.400523) (Ref:- DRG. HBTB 416462). / Te: 0.4-0.7%, P: 0.004-0.012, % CU: Rest (C14500)

परिवर्तन संख्या ALT.NO.	प्राधिकार AUTHY	वर्णन DESCRIPTION	दिनांकित आद्यक्षर DATED INITIAL

सतह – रूक्षता का मान भा. मा. 3073 / अ. मा. सं. 1302 SURFACE ROUGHNESS VALUE TO IS:3073 / ISO:1302	अनिर्दिष्ट सह्य – सीमा भा. मा. : 2102 / अ. मा. सं. : 2768 UNSPECIFIED TOLERANCE TO IS : 2102 / ISO : 2768	TOL. CLS.
	धातु–वेल्डन चिन्ह भा. मा. : 813 / अ. मा. सं. :2553 WELDING SYMBOLS TO IS:813 / ISO:2553	

पदांक GRADE NO.	सं1 N1	सं2 N2	सं3 N3	सं4 N4	सं5 N5	सं6 N6	सं7 N7	सं8 N8	सं9 N9	सं10 N10	सं11 N11	सं12 N12
Rz	0.16-0.3	0.5-0.7	0.9-1.1	1.5-2.0	2.5-3.8	5.0-6.3	9.0-12	16-25	30-40	50-63	75-100	160-250
Ra μm	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50
चिन्ह SYMBOL												

अभिकल्पित DGN	
जाँचा व.अ.अ. CHD SSE	
समीक्षित स.वि.अ. / व.वि.अ. REVIEWED AEE / SEE	
अनुमोदित उ.मु.वि.अ. APPROVED DYCEE	
दिनांक DATE	
रैखिक अनुपात SCALE	N.T.S
संदर्भ / REF.	
ALT.-	

चितरंजन रेलइंजन कारखाना
CHITTARANJAN LOCOMOTIVE WORKS, INDIA

पदार्थ MATL	प्रति भार कि. ग्रा. WT. EACH IN KG
विशिष्टि SPECN	

वर्णन DESCRIPTION: SPECIFICATION FOR HIGH VOLTAGE BUSHING

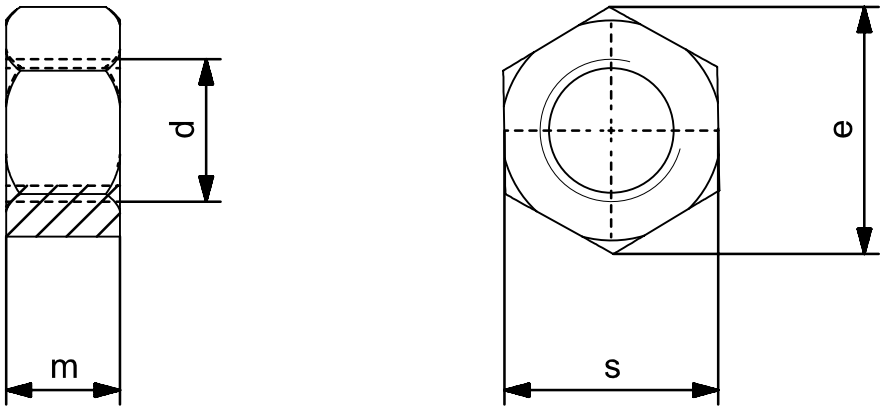
आरेखण संख्या DRAWING NO.: CLW/ES/3/SK-1/0052/E/F

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REDRAWN BY COE

SK-3/0052



d	M20
m	16
e	34.7
s	30

BRASS NUT

परिवर्तन संख्या ALT.NO.	प्राधिकार AUTHY	वर्णन DESCRIPTION	दिनांकित आद्यक्षर DATED INITIAL

सतह – रूक्षता का मान भा. मा. 3073 / अ. मा. सं. 1302
SURFACE ROUGHNESS VALUE TO IS:3073 / ISO:1302

अनिर्दिष्ट सह्य – सीमा भा. मा. : 2102 / अ. मा. सं. : 2768
UNSPECIFIED TOLEARANCE TO IS : 2102 / ISO : 2768

धातु–वेल्डन चिन्ह भा. मा. : 813 / अ. मा. सं. :2553
WELDING SYMBOLS TO IS:813 / ISO:2553

TOL. CLS.

पदांक GRADE NO.	सं1 N1	सं2 N2	सं3 N3	सं4 N4	सं5 N5	सं6 N6	सं7 N7	सं8 N8	सं9 N9	सं10 N10	सं11 N11	सं12 N12
Rz	0.16-0.3	0.5-0.7	0.9-1.1	1.5-2.0	2.5-3.8	5.0-6.3	9.0-12	16-25	30-40	50-63	75-100	160-250
Ra μm	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50
चिन्ह SYMBOL												

अभिकल्पित DGN	
जाँचा व.अ.अ. CHD SSE	
समीक्षित स.वि.अ. / व.वि.अ. REVIEWED AEE / SEE	
अनुमोदित उ.मु.वि.अ. APPROVED DYCEE	
दिनांक DATE	
रैखिक अनुपात SCALE	N.T.S
संदर्भ / REF.	
ALT.-	

चितरंजन रेलइंजन कारखाना
CHITTARANJAN LOCOMOTIVE WORKS, INDIA

पदार्थ MATL	प्रति भार कि. ग्रा. WT. EACH IN KG
विशिष्टि SPECN	

वर्णन DESCRIPTION: SPECIFICATION FOR HIGH VOLTAGE BUSHING

आरेखण संख्या DRAWING NO.: CLW/ES/3/SK-3/0052/E/F

परिवर्तन संख्या ALTERATION. NO. | पर्ण SHEET 8 OF 8 | A4

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