

# **SPECIFICATION FOR HIGH VOLTAGE CABLE WITH PLUG FOR WAG-9/WAP-7/WAP-5 ELECTRIC LOCOMOTIVES**

Specification No : CLW/ES/3/0251 (Rev1~~2~~ December-06)

Enclosures :-

- i) Drawing no. CLW/ES/3/SK-1/0251 REV.01 ~~02~~(DEC-06)
- ii) Drawing no. CLW/ES/3/SK-2/0251 REV.01 ~~02~~ (DEC-06)
- iii) Drawing no. CLW/ES/3/SK-3/0251 REV.01 ~~02~~ (DEC-06)

**ISSUED BY**

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

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**ALTERATION RECORD SHEET**

Amendment Number	Date of Amendment	Page number	Alteration/ Revision	Description	Authority
1.	XX-XX-2025		2	<p>i) Specification has been digitized.</p> <p>ii) In Cl.no.3.0, Sr.no.5 Altitude and Sr.no.6 Rainfall have been modified.</p> <p>iii) In Cl.no.4.0 Standard, IS:2089 has been corrected to IS:2099.</p> <p>iv) Drawing no in scope of supply in Cl.no.5.0 has been modified.</p> <p>v) In Cl.no.-6.5, Technical details are referred to specification of High voltage Bushing.</p> <p>vi) "or equivalent/ higher rating as approved by CLW/BLW/RDSO" is included in Cl.no.-6.7.1, sl.no.1</p> <p>vii) Cl.no.6.7 is included.</p> <p>viii) In Cl.no.6.7.1, sl.no. 12 for Rated Impulse voltage has been added.</p> <p>ix) In Cl.no.-7.0, Wet power frequency withstand voltage test at 75KV (RMS) has been deleted in sr.no.-7.3, IEC60502 corrected to IEC60270 in sr.no.-7.5, temperature rise test modified in sr.no.-7.7.</p> <p>x) In Cl.no.-7.0 Test, Nominal rated current 800A, Over current carrying ability 900A&amp; Rated Impulse current &gt;125KA and Short time current test 50kA for 1 sec is included in sr. no. 7.8, 7.9 and 7.10 respectively.</p> <p>xi) Cl.no.8 Test condition has been deleted.</p> <p>xii) Test connection under Cl.no.8 is deleted and included in CLW/ES/3/SK-1/0251 Rev-4 2, Dec-06</p> <p>xiii) In Sub Cl.no. 9.3, Material composition of thread of FAL-PLUGS 755 LR and material composition of Stud is mentioned.</p> <p>xiv) Cl.no.10 Reference type and Cl.no.11 General Condition have been deleted.</p>	

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				xv) Cl.no.12.0 have been modified. xvi) NOTE is included in drawing no. CLW/ES/3/ SK-2/0251 Rev-2. xvii)Drawing of STUD is included in drawing no. CLW/ES/3/SK- 3/0251 Rev-2.	
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**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 CABLE WITH PLUG FOR THREE PHASE 6000 HP WAG-9 / WAP-7 & WAP-5 CLASS 50 Hz AC LOCOMOTIVE.

## 2.0 SCOPE

This specification applies to high voltage cable with plug being used in the 3-phase 6000 HP, WAG-9/WAP-7/WAP-5 Class 50 Hz AC Locomotive with its accessories.

## 3.0 CLIMATIC AND ENVIRONMENTAL CONDITION

Sr.no.	Description	Remarks
1.	Maximum atmospheric temperatures	Under Sun : +70°C. In shade : +50°C.
2.	Ambient Temperature	Max.55°C, Min.-0°C.
3.	Normal Humidity	60%.
4.	Maximum Humidity	100% saturation during rainy season.
5.	Altitude	<del>160 m above mean sea level</del> 1776 m above mean sea level against USBRL project condition.
6.	Rainfall	Very heavy in certain areas. The locomotive will be designed to permit it's running at 10 kilometer per hour in flood water level of <del>102 mm</del> 200 millimeter above rail level.
7.	Atmosphere during hot weather	Extremely dusty and desert terrain in certain areas.
8.	Coastal areas	Locomotive and equipment will be designed to work in coastal areas in humid and salt laden atmosphere.
9.	Vibration	The equipment, subsystem and their mounting arrangement will be designed to withstand vibrations and shocks encountered in service as specified in corresponding IEC: 61373 or latest publications unless otherwise prescribed.

## 4.0 STANDARAD

IEC-60077 or latest  
~~IEC-60502 or latest~~  
 IS-13573, 20 or latest  
 IS-2089 2099 -1986 or latest  
 IEC-60137-11984 or latest  
 IEC-61373 or latest  
 IEC-60270 or latest.

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## 5.0 SCOPE OF SUPPLY

The scope of supply will be high voltage cable with plug as per drawing No. **CLW/ES/3/SK-2/0251 Rev-4 2, Dec-2006**.

## 6.0 TECHNICAL DATA

### 6.1 HIGH VOLTAGE CABLE GKT, 45/26 KV :-

This cable has the following general properties:

- Flexible
- Conductor and screen made of copper.

### 6.2 MECHANICAL DATA OF HIGH VOLTAGE CABLE :-

Cl.No.	Description	Data
6.2.1	Diameter of Cable: 185 sq.mm, for cross-linked polyethylene insulated cable (XLPE cable). <b>OR</b> 185/240 sq.mm, for ethylene propylene cable (EPR cable).	-
6.2.2	Min. bending radius at pulling (mm)	710
6.2.3	Min. Bending Radius when laid (mm)	475
6.2.4	Max. Pulling force (daN)	1110

### 6.3 ELECTRICAL AND THERMAL DATA OF HV CABLE :-

Cl.No.	Description	Data
6.3.1	Max. Service Voltage [kV] (Uo Phase/Phase)	52
6.3.2	Test Voltage/Dielectric [kV]	75
6.3.3	Rated impulse withstand voltage [kV]	250
6.3.4	Max. Operate Temperature of conductor [ °C] (continuously)	90
6.3.5	Max. Operate Temperature of conductor [ °C] (short circuit max. 3 sec.)	250
6.3.6	Max. Operate Temperature of screen [ °C] (short circuit max. 3 sec.)	350

### 6.4 TECHNICAL DATA OF EARTHLING CABLE :-

Cl.No.	Description	Data
6.4.1	Earthling Cable	Earthling cable of nominal cross section of 16 sq.mm.
6.4.2	Total length	(250+450)=700 mm.
6.4.3	Cable sleeve	SD Sleeve yellow/green.
6.4.4	Conductor	Standard tin-plated copper.
6.4.5	Insulation	Electron beam cross-linked.
6.4.6	Sheath	Electron beam cross-linked copolymer, color- black.
6.4.7	General Properties	Limited fire hazard electrical installation cable dual wall insulation, low smoke, halogen free, flame retardant, excellent resistance to high and low temperature, oil, ozone, weathering and abrasion, easily strippable.

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6.5 The cable shall be compatible with High voltage bushing (Not in the scope of supply) of following technical parameters:-

**TECHNICAL DATA OF HIGH VOLTAGE BUSHING [MICAFIL] (Not in the scope of supply)**

Salient technical details of High Voltage Bushing (Not in scope of supply) as follows:-

Sr. no.	Description	Data
1	Rated voltage	30 KV
2	Max. Operating voltage	30 KV
3	Test Voltage 50 Hz 1 min Dry/Wet	75 KV
4	Shock Voltage- 1, 2/ 50 $\mu$ s full wave	170 KV
5	Nominal current at 70°C air temperature	630 A
7	Short time current	50kA
8	Lf	400 mm
9	Creepage path hk	>806 mm <b>1050mm</b>

**6.6 ELBOW Connector-** ELBOW connector of 30 kV 630 Amp of ABB Identification No. 3EHW470090R1185 plug type 755 LR or equivalent/ higher rating as approved by CLW/BLW/RDSO shall be mounted ~~as per manufacturer recommendation~~ on to the bushing. The bushing shall be tightening 30 kV basic insulating plug Elbow and other details has been shown as per sketch No. CLW/ES/3/SK-3/0251 Rev-1 2, Dec-06.

**6.7 ELBOW Connectors Technical Data** It has been shown on the Sketch No. CLW/ES/3/SK-2/0251 Rev-12, Dec-06.

**6.7.1 Dimensions as per Sketch No. CLW/ES/3/SK-3/0251 Rev-1 2, Dec-06.**

**6.7 ELBOW Connector assembly & dimensional details:** Complete assembly with ELBOW Connector has been shown in the drg. no. CLW/ES/3/SK-3/0251 Rev-2 and dimensions as per drg.no. CLW/ES/3/SK-3/0251 Rev-2.

**6.7.1 ELECTRICAL DATA :**

Sr. no.	Description	Data
1	Connector type	755 LR or equivalent/ higher rating as approved by CLW/BLW/RDSO
2	Voltage	40 kV
3	Max. Line voltage	36 kV
4	Partial discharge	< 5PC
5	Nominal withstand voltage	170 kV
7	Nominal withstand AC volt	75kV 50 Hz
8	1 min - DC Voltage	144 kV
9	Nominal rated current	800A
10	Over current carrying ability	900A
11	Nominal short-time current (1 sec)	>50KA

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12	Rated impulse Current	>125 kA
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7.0 **TEST:-** The following tests shall be carried out in the presence of authorized representative of Railways/ Production Units/RDSO.

Sr. No.	Test Description	Test			Remark
		Routine* (100%)	Acceptance (bulk) 10%	Type (100%)	
		Inspected by as per PO			
7.1	Preliminary Checks of the Complete CHT System: Check the technical particulars, details of rating plate and all dimensional details as per approved drawing of CLW for the following assemblies. a) HV cable & other supplementary part as per CLW Drg. No. CLW/ES/3/SK-2/0251 Rev-12, Dec-06. b) Elbow type connector along with its accessories as per CLW Drg. Nos. CLW/ES/3/SK-3/0251 Rev-12, Dec-06.	Y	Y	Y	For complete assembled cable
7.2	Dry power frequency withstand voltage test at 75KV (RMS) as per IS: 2099-1986, IEC-60137-1984.	Y To be done at 60KV	Y To be done at 60KV	Y	
7.3	<del>Wet power frequency withstand voltage test at 75KV (RMS) as per IS:2099-1986, IEC-60137-11984 Exempted for prototype sample: refer para2 of this office letter No. EL 3.2.21 dated 18.04.2006.</del>	NA	NA	NA	
7.4	Impulse voltage test at 170KV peak, as per CLW specification No. CLW/ES/3/0251 and IS:2099-1986 (10 positive & 10 negative).	NA	NA	Y	For complete assembled cable
7.5	Partial discharge test: PD test on CHT shall be carried out at 30KV as per IEC-60502 60270, the PD values shall be less than 5 PC.	Y	Y	Y	
7.6	Vibration and Shock Test: Vibration and shock test as per IEC: 61373 or latest shall be conducted on the complete CHT system.	NA	NA	Y	
7.7	<del>Temperature Rise Test</del> AC Voltage Life with Cyclic Current Loading:- maximum operating temperature of 90°C for the conductor, and test is performed at 10°C above the operating voltage, reaching 100°C At 100°C - 3 cycles (5 hours heating & 3 hours cooling) as per procedure given in IS: 13573.	NA	NA	Y	
7.8	Verification of Nominal rated current of Elbow connector for 800A Testing standard : As per IEC:60502.	NA	NA	Y	For connector
7.9	Verification of Over current carrying capacity for 900A & Rated Impulse current >125KA Testing standard : As per IEC 60502.	NA	NA	Y	
7.10	Verification of Short time current test: >50KA for 1 sec.	NA	NA	Y	

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- \* Routine test to be treated as firm's internal inspection which is to be submitted by firm during acceptance test (bulk/regular inspection as per sample size) as well as type test (prototype).

**8.0 TEST CONDITION:-**

- ~~-Bushing complete, lower part submersed in oil.~~
- ~~-Bushing complete, including HV Plug and 1.8 m HV Cable including cable and cap, air exposed.~~

**MEASUREMENT OF PARTIAL DISCHARGE:**

- Measurement of circuit according IEC 60270
- Capacity Impedance: 60 n / Back ground distortion 2 pc.

**TEST CONNECTION:**

~~For shock voltage and switch on shock test as per Sketch No. CLW/ES/3/SK-1/0251.~~

~~Cs = Pulse capacitor~~

~~F = Switch on path~~

~~Rb = load resistance~~

~~Rd = Damping resistance~~

~~C1 C2 = Voltage divider~~

~~KV = Volt meter~~

~~OSC = Oscilloscope~~

~~Control of the ratio of the voltage divides is done by means of Volt Meter. All equipments used during testing shall be calibrated.~~

**9.0 DRAWING :**

9.1 Connection diagram CLW/ES/3/SK-1/0251, Rev-1 ~~2, Dec-06.~~

9.2 Dimensional drawing of HV cable and other supplementary part Drawing No.CLW/ES/3/SK-2/0251 Rev-4 ~~2, Dec-06.~~

9.3 (i) Material composition of thread of item no.-13 shall be CR:0.3-1.2%, ZR: 0.03-0.3%, CU: Rest is mentioned in drg. no. CLW/ES/3/SK-2/0251 Rev-2.

(ii) Material composition of Stud shall be CR:0.3-1.2%, ZR: 0.03-0.3%, CU: Rest is mentioned in drg. no. CLW/ES/3/SK-3/0251 Rev-2.

9.4 L-PLUG dimensional drawing No. CLW/ES/3/SK-3/0251 Rev-1 ~~2, Dec-06.~~

**10.0 REFERENCE TYPE :**

~~RMF 30Y/630 SL~~

~~Identification No. HBTB 416462 Bushing ABB Drg. No. HUM126284 supplied by ABB manufacturer MICAFIL.~~

**11.0 GENERAL CONDITION :**

~~The tenderer should confirm that the high voltage cable with plug used as similar to three phase electric locomotive WAG-9 class manufacturer by M/s. ABB for Indian Railways.~~

**12.0 LABEL AND MARKING :**

~~i) Manufacturers name~~

~~ii) Year of manufacture~~

~~iii) Trade mark if any~~

~~iv) Batch No. & Code~~

~~v) Serial No of the Product.~~

Following details to be mark/tagged on proper location of High Voltage Cable with Plug which should be clearly visible after laying of item in loco.

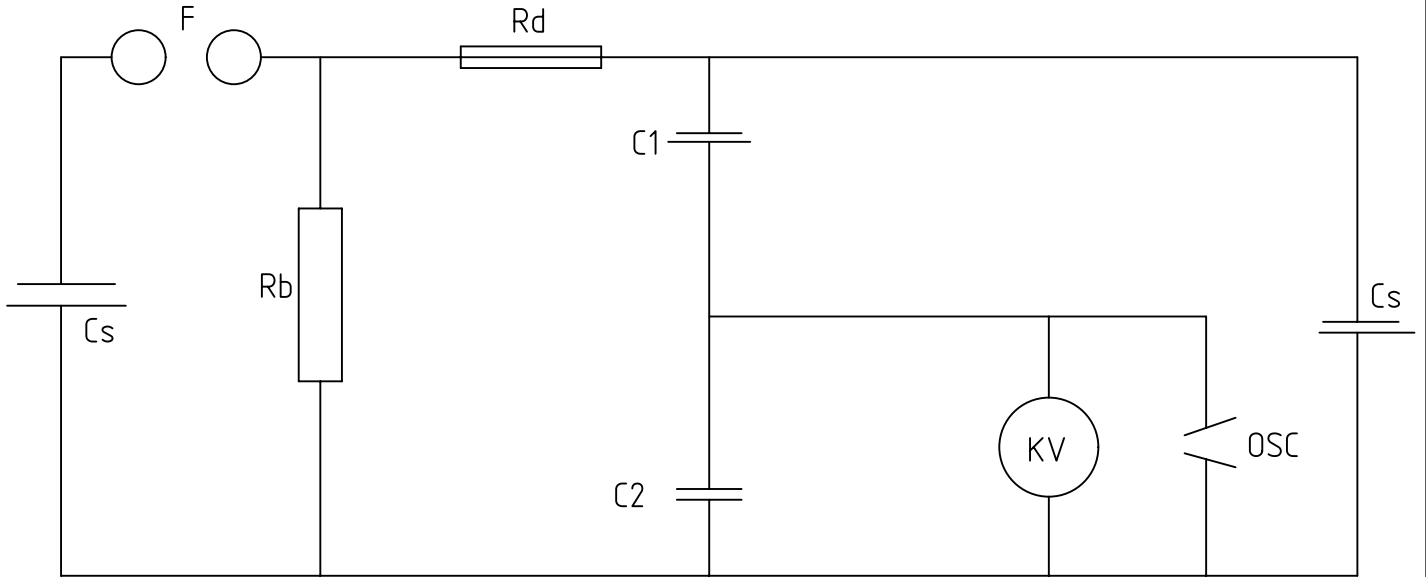
(i) Manufacturer name/Trade mark if any

(ii) Month & Year of manufacture

(iii) Batch No. & code

(iv) Serial No. of the Product.

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Cs = Pulse capacitor

F = Switch on path

Rb = load resistance

Rd = Damping resistance








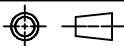
C1, C2 = Voltage divider

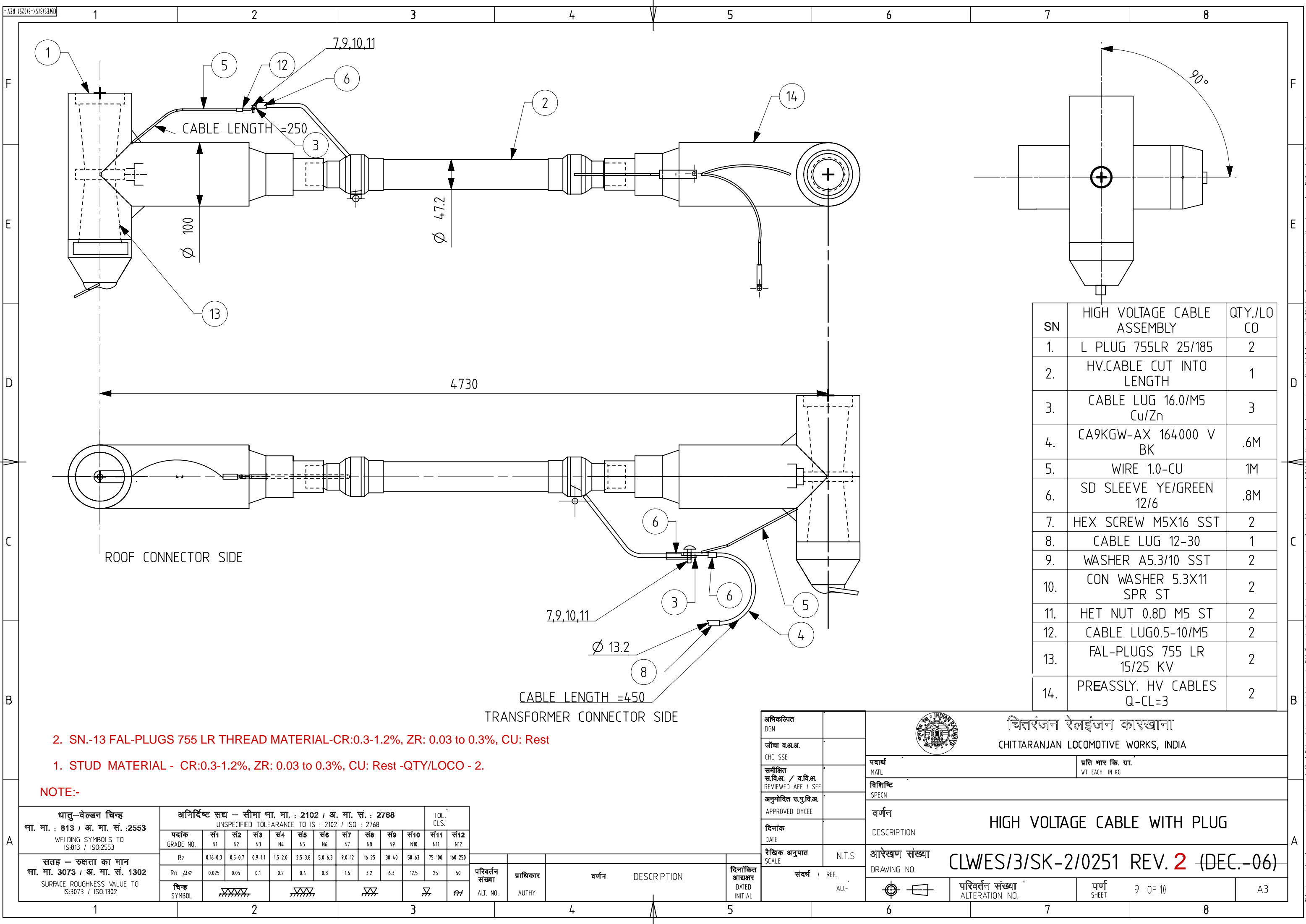
KV = Voltmeter

OSC = Oscilloscope

Control of the ratio of the voltage divides is done by means of Voltmeter.

All equipment's used during testing shall be calibrated.

													अधिकृत DGN		 चितरंजन रेलइंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA					
													जॉचा व.अ.अ. CHD SSE							
परिवर्तन संख्या ALT.NO.	प्राधिकार AUTHY		वर्णन DESCRIPTION						दिनांकित आधार DATED INITIAL		समीक्षित स.वि.अ. / व.वि.अ. REVIEWED AEE / SEE		पदार्थ MATL		प्रति भार कि. ग्रा. WT. EACH IN KG					
सतह — रूखाता का मान मा. 3073 / अ. मा. सं. 1302 SURFACE ROUGHNESS VALUE TO IS:3073 / ISO:1302			अनिर्दिष्ट सद्य — सीमा मा. मा. : 2102 / अ. मा. सं. : 2768 UNSPECIFIED TOLERANCE TO IS : 2102 / ISO : 2768						TOL. CLS.		अनुमोदित उ.मु.वि.अ. APPROVED DYCEE		विशिष्ट SPECN		वर्णन HIGH VOLTAGE CABLE WITH PLUG DESCRIPTION					
			धातु-वेल्डन चिन्ह मा. मा. : 813 / अ. मा. सं. : 2553 WELDING SYMBOLS TO IS:813 / ISO:2553								दिनांक DATE									
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	रैखिक अनुपात SCALE	N.T.S		आरेखण संख्या DRAWING NO.				
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				CLW/ES/3/SK-1/0251 REV. 2 (DEC.06)				
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													संदर्भ / REF.		ALT. -					
															परिवर्तन संख्या ALTERATION. NO.		पर्ण SHEET 8 OF 10		A4	



SN	HIGH VOLTAGE CABLE ASSEMBLY	QTY./LO CO
1.	L PLUG 755LR 25/185	2
2.	HV.CABLE CUT INTO LENGTH	1
3.	CABLE LUG 16.0/M5 Cu/Zn	3
4.	CA9KGW-AX 164-000 V BK	.6M
5.	WIRE 1.0-CU	1M
6.	SD SLEEVE YE/GREEN 12/6	.8M
7.	HEX SCREW M5X16 SST	2
8.	CABLE LUG 12-30	1
9.	WASHER A5.3/10 SST	2
10.	CON WASHER 5.3X11 SPR ST	2
11.	HET NUT 0.8D M5 ST	2
12.	CABLE LUG0.5-10/M5	2
13.	FAL-PLUGS 755 LR 15/25 KV	2
14.	PREASSLY. HV CABLES Q-CL=3	2

2. SN.-13 FAL-PLUGS 755 LR THREAD MATERIAL-CR:0.3-1.2%, ZR: 0.03 to 0.3%, CU: Rest

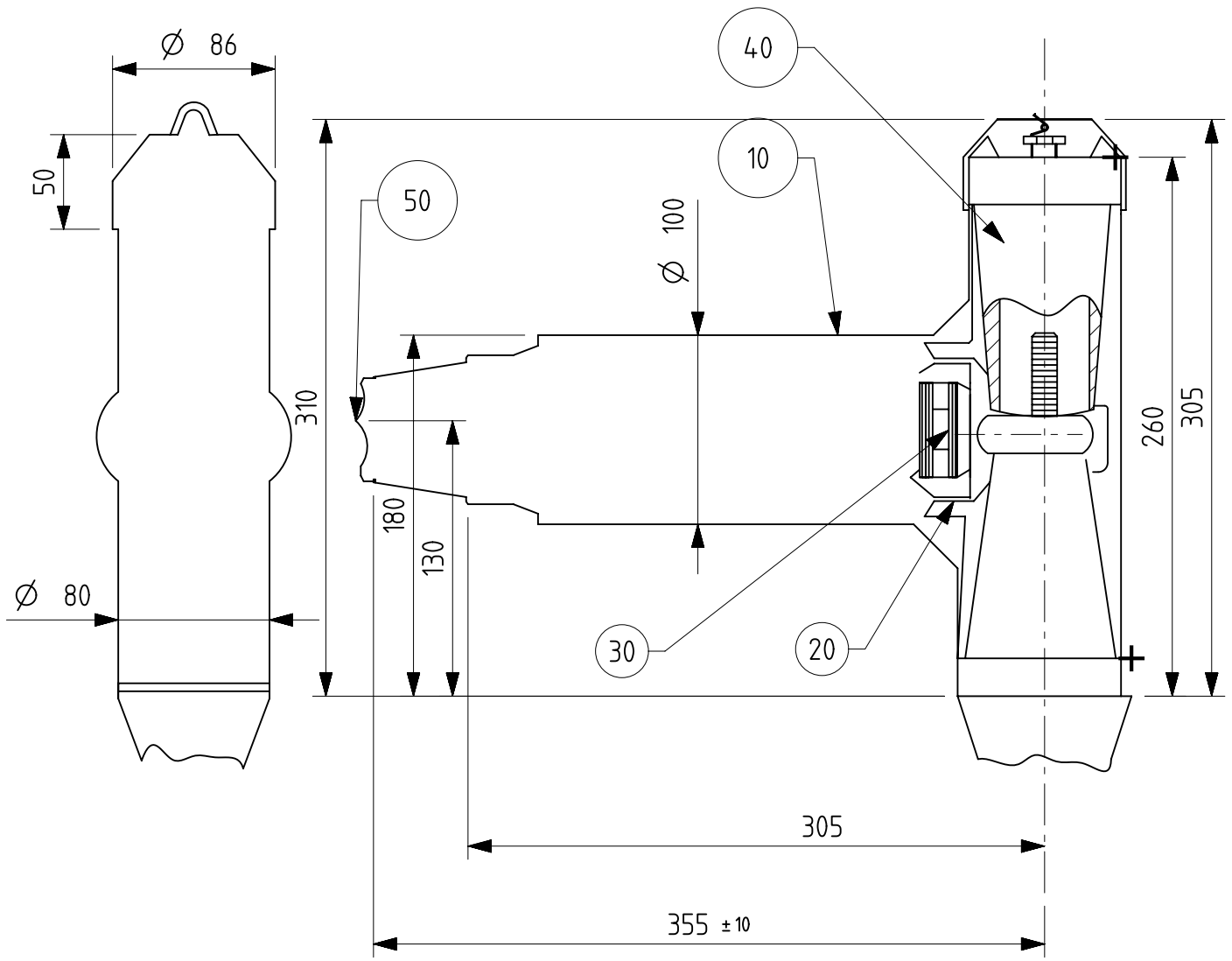
1. STUD MATERIAL - CR:0.3-1.2%, ZR: 0.03 to 0.3%, CU: Rest -QTY/LOCO - 2.

NOTE:-

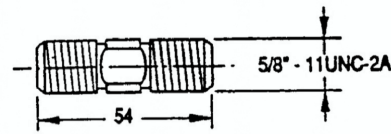
धातु-वेल्डन चिन्ह भा. मा. : 813 / अ. मा. सं.:2553 WELDING SYMBOLS TO IS:813 / ISO:2553	अनिर्दिष्ट सद्य – सीमा भा. मा. : 2102 / अ. मा. सं. : 2768 UNSPECIFIED TOLERANCE TO IS : 2102 / ISO : 2768											TOL. CLS.	
	पदांक GRADE NO.	सं1 N1	सं2 N2	सं3 N3	सं4 N4	सं5 N5	सं6 N6	सं7 N7	सं8 N8	सं9 N9	सं10 N10	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 $\mu$ m	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50
सतह – रुक्षता का मान भा. मा. 3073 / अ. मा. सं. 1302 SURFACE ROUGHNESS VALUE TO IS:3073 / ISO:1302	चिन्ह SYMBOL												

परिवर्तन संख्या ALT. NO.	प्राधिकार AUTHY	वर्णन DESCRIPTION	दिनांकित आधार DATED INITIAL
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अधिकृत DGN		 चितरंजन रेलइंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA	
जोचा व.अ.अ. CHD SSE			
समीक्षित स.वि.अ. / व.वि.अ. REVIEWED AEE / SEE		पदार्थ MATERIAL	प्रति भार कि. ग्रा. WT. EACH IN KG
अनुमोदित च.यु.वि.अ. APPROVED DYCEE		विशिष्ट SPECN	
दिनांक DATE		वर्णन DESCRIPTION	
रैखिक अनुपात SCALE	N.T.S	आरेखण संख्या DRAWING NO.	CLW/ES/3/SK-2/0251 REV. 2 (DEC.-06)
संदर्भ / REF. ALT.-		परिवर्तन संख्या ALTERATION NO.	पूर्ण SHEET
			9 OF 10
			A3








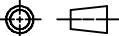


L-PLUG 755 LR 25/185



STUD

- 10 CONNECTOR SHELL  
 20 CONNECTOR INSERT  
 30 CABLE LUG  
 40 INSERT FOR SCREW  
 50 OUT DOOR ADAPTER 20 MA-JB

													अभिलेखित DGN		 चित्तरंजन रेलइंजन कारखाना CHITTARANJAN LOCOMOTIVE WORKS, INDIA					
													जॉचा व.अ.अ. CHD SSE							
परिवर्तन संख्या ALT.NO.	प्राधिकार AUTHY		वर्णन DESCRIPTION							दिनांकित शीतल DATED INITIAL	समीक्षित स.वि.अ. / व.वि.अ. REVIEWED AEE / SEE		पदार्थ MATL		प्रति भार कि. ग्रा. WT. EACH IN KG					
सतह — रूक्षता का मान मा. मा. 3073 / अ. मा. सं. 1302 SURFACE ROUGHNESS VALUE TO IS:3073 / ISO:1302		अनिर्दिष्ट सद्य — सीमा मा. मा. : 2102 / अ. मा. सं. : 2768 UNSPECIFIED TOLERANCE TO IS : 2102 / ISO : 2768							TOL. CLS.		अनुमोदित उ.मु.वि.अ. APPROVED DYCEE		वर्णन HIGH VOLTAGE CABLE WITH PLUG DESCRIPTION							
		धातु-वेल्डन चिन्ह मा. मा. : 813 / अ. मा. सं. : 2553 WELDING SYMBOLS TO IS:813 / ISO:2553									दिनांक DATE									
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	रैखिक अनुपात SCALE	N.T.S		आरेखण संख्या DRAWING NO.				
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			CLWES/3/SK-3/0251 REV.2(DEC.06)					
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													संदर्भ / REF.		परिवर्तन संख्या ALTERATION. NO.					
													ALT. -				पृष्ठ SHEET 10 OF 10		A4	