Government of India
Ministry of Railways
Research, Designs & Standards Organisation
Manak Nagar, Lucknow - 226 011

No.EL/3.2.61 Dated 17.1.91

SPECIAL MAINTENANCE INSTRUCTION NO. RDSO/ELRS/SMI-136.

Instructions for testing the Vacuum Circuit Breaker Type 20CB for Travel Records.

1. OBJECT.

1.1 Railways have reported a few cases of ET2 flash-over during of Vacuum Circuit Breaker. It has been observed during investigation that these flashover were mainly due to slow closing speed of the breaker.

1.2 It is necessary to check up the closing speed of the breaker whenever sucha fault is observed. Also after repairs/overhaul, the following parameters of the breakers should be adjusted and kept within limits.

Closing speed	:	0.1m/s to 0.4m/s
Time between first to final make of each interrupter.	:	Not to exceed 10 m. s.

1.3 In addition. certain other aspects of the travel graph during closing and opening are to be checked up.

1.4 Accordingly, these instructions have been framed for obtaining the travel graph and making necessary adjustment in the breaker to ensure that the above parameters are within the limits.

2. INSTRUCTIONS

2.1 The following gadgets are required to be procured for contact travel tests:-

2.1.1

Displacement Transducer (LVDT) type 501-01300 AC linear variable displacement transducer of range ±0.3” working from 6V (RMS) excita- tion supply at 2.5 kHZ for use in harsh industrial environments.	Manufacturer- M/s Schaevitzem Ltd., 543, 9P Switch RD., slough, Berkshire SLI4 EG, England (0753) 37622-9.

2.1.2

Signal conditioner Type ATA-101-200 Analogue line powered signal conditioning unit providing +/-10 V DC	Manufacturer- M/s Schaevitzem Ltd., 543, 9p Switch Rd., slough, Berkshire, SL14EG England

	output from a 220 volts excitation supply.	(0753) 37622-9
2.1.3	Storage oscilloscope with probos (1:1, 1:10, 1:100) L&T GOULD MODEL 1421- Digital storage, Dual beam Fretrigger, Post storage- Expansion, etc.	Manufacturer- M/s. L&T Gould Ltd., Post Box 13, Mysore-571 186.
2.1.4	Mounting gudget (Block) (SK. EL. 4004)	M/s. G.E.C., Naini works, Naini. Allahabad.
2.1.5	Adapter Fork (SK. EL. 4005)	-do-
2.1.6	X-Y RECORDER TYPE OMNI GRAPHIC SERIES 2000 X-Y Recording at variable speeds	Manufacturer- M/s. Digital Electronics Ltd. Ltd., Bombay.

2.2 **<u>Mounting of LVDT to VCB</u>**

2.2.1 Remove flexible connection (Pt. No. 11) between two bottles after opening the cradle cover.

2.2.2 Assembly adapter fork with LVDT plunger. Place this assembly (consisting of LVDT plunger with adapter fork and LVDT core) in 22 mm dia. hole of mounting block.

2.2.3 Mount this assembly on the cradle channel of VCB. Fix adapter fork with actuating nut (Pt.13). Lock mounting block in position by 2 numbers of M5 screw and LVDT core by 2 numbers of M3 nylon screws as shown in SK. EL.4006 and photographs as per Annexure-4.

2.3 **<u>Connection between LVDT and signal conditioner.</u>**

2.3.1 Short blue and green wire of the LVDT.

2.3.2 Connect rest of the wires to 9 pin connector of signal conditioner. Care is to be taken to ensure that double colour wires/ are input signal wires for

LVDT and red and black wires are output from LVDT.

2.3.3 Connect wires to 15 pin connector of signal conditioner for taking its output to CRO.

<u>NOTE</u> : Refer manual of signal conditioner before connections.

2.4 **<u>Connections for contacts (For CRO only)</u>**

2.4.1 Make a resistance box as per circuit diagram (1) enclosed as per Annexure-1.

2.4.2 Make connection to the VCB terminals as shown on the diagram (1).

2.5 **<u>Connections to oscilloscope (SK. EL. 4003)</u>**

2.5.1 Connect output of signal conditioner to the input of channel 2 of CRO.

2.5.2 Connect output of resistance box (see diagram 1) to input of channel 1 of CRO.

2.6 <u>Calibration/setting of CRO/LVDT</u>

2.6.1 Switch on the mains supply (230V-AC) to signal conditioner and CRO.

2.6.2 Adjust length of core inside the LVDT to give full travel record between ON/ OFF position of breaker. (Output saturates, i.e., remain constant above the travel limit).

2.6.3 Set time scale to 20 m/s per div. and select Y scale of Ch. 1 and 2 suitability. Channel 2 should have voltage scale in such a way as to give about 10 mm (1 Div.) shift for 2 mm travel of LVDT core.

2.6.4 Set other CRO knobs as below:

(a) ch. 1 and 2 both DC:,

(b) Channel selector mode-Dual.,

(c) Push buttons to be pressed -Auto to normal, CH2, DC, Store 25%.

2.6.5 Adjust channel (Beam) locations, trigger level, X shift suitably.

2.6.6 Operate VCB, see that both channel (beams) remain on screen and shift properly. If not check for power to signal conditioner and battery of resistance box.

2.6.7 Press ARM, a red light should glow intermittently. Operated VCB, travel record and contact status should come on the screen. If not, adjust, trigger level, trigger polarity, etc. For fresh recording again press 'ARM' before operating VCB.

<u>NOTE</u> **:** Typical closing and tripping traces are shown in annexure-2.

2.7 CRO-X-Y Recorder connections (SK. EL. 4003).

2.7.1 Connect output of CRO to printer as per their respective pamphlet.

2.7.2 CRO output to X-Y recorder terminals are provided on the rear side of it.

2.7.3 Whenever recording is required, connect the recorder as per the instruction of oscilloscope and XY recorder.

2.7.4 In case of any doubt regarding the use of said equipments, the dealing staff can be deputed to M/s GEC, Naini works. They will demonstrate the use of equipments by taking traces of VCB interrupters.

2.8 Check points on recording.

2.8.1 Closing sequence.

- All test traces should look similar to the diagram shown in Annexure-2
- The time difference between initial closure and final closure of interrupter must not exceed 10 m/s (i.e., horizontal step duration should not be more than 10 m/s).
- The moving contact must not stop during any part of its travel between fully open and fully closed. Thus the slope at point (b) must never be horizontal.
- Slope (a) should always be similar to slope (c). Both slopes should be straight and never decrease below 01 m/s except at transition.

EXAMPLE : Take a straight portion of line (upper/lower) of typical trace to find out the distance on Y axis and time on x axis after considering the setting scale as shown in Annexure-3. then calculate the closing speed = distance/time m/s.

A typical calculation is at Annexure-3.

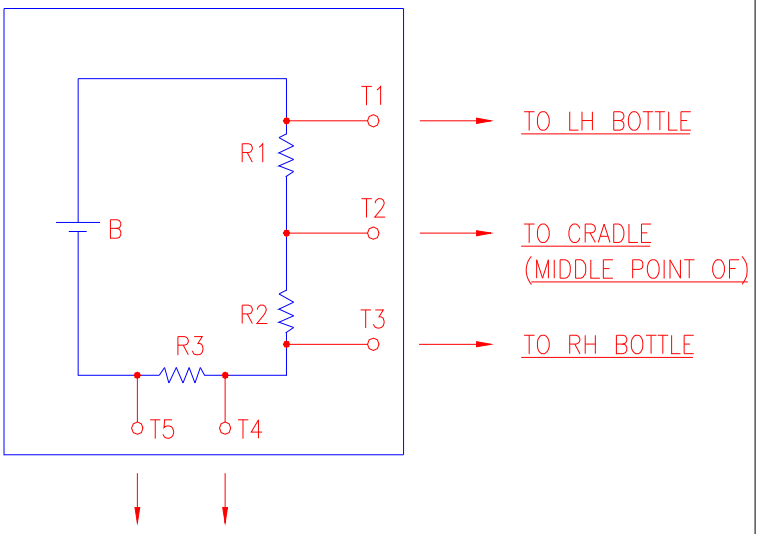
- At transaction point(d), the curve should blend smoothly into the closed condition.

2.8.2 Adjustment, If any.

In case closing is slow, i.e. speed is less than 0.1 m/s, retuning will be needed.

ANNEXURE–1

RESISTANCE BOX

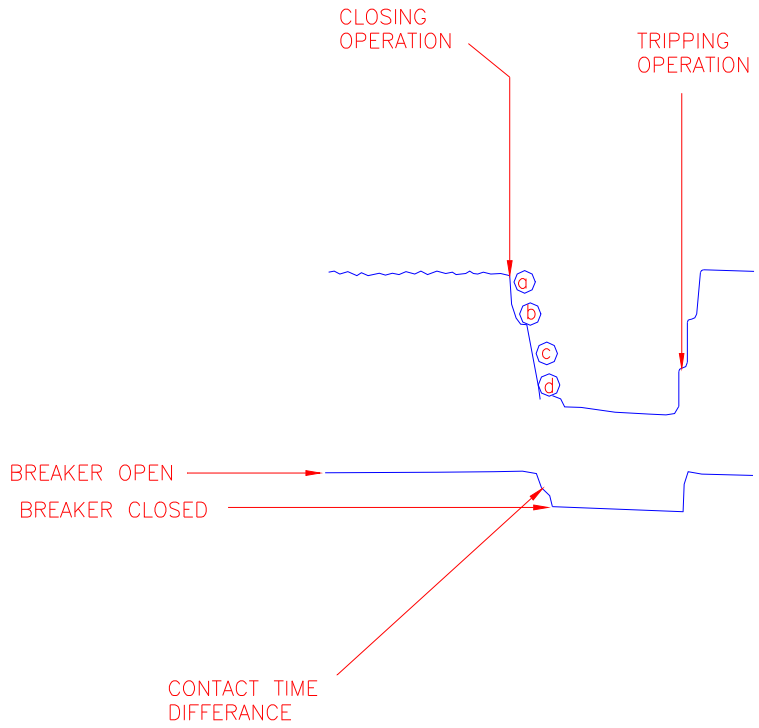


TO CRO
CHANNEL – 1

R1 — 2 K Ω, 1 WATT
R2 — — DO ——
R3 — — DO ——
B — BATTERY 1.5V TO 6V (ANY VALUE)
T1, T2 ETC. — TERMINAL

CIRCUIT DIAGRAM 1

ANNEXURE–2

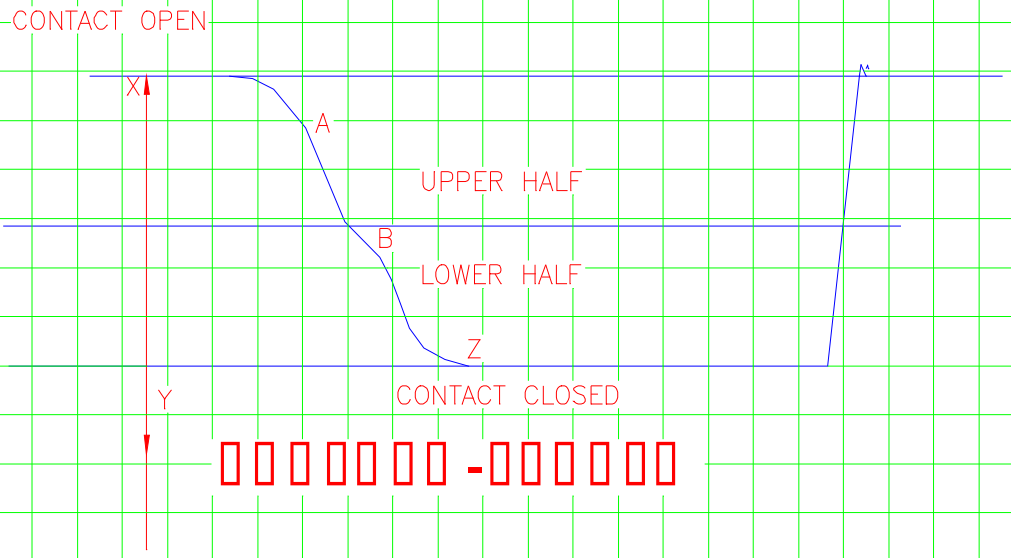


UPPER :– TRAVEL OF VACCUUM INT

LOWER :– CONTACT STATUS

TYPICAL CLOSING & TRIPPING TRACES

Dt	12.90
D	AJAI
T	
C	



[redacted]

HORIZONTAL SCALE :- 10mmX20m sec
VERTICAL SCALE :- 10mm.= 2 mm.

XY : Contact Travel
YZ : Time taken by contacts to close from open position.
XZ : Contact travel V/sTime curve.

In contact travel V/s Time curve, XZ, only the straight line portion in the upper half is to be considered for calculating the speed of the contacts. Inthe above curve AB is the straight line portion.

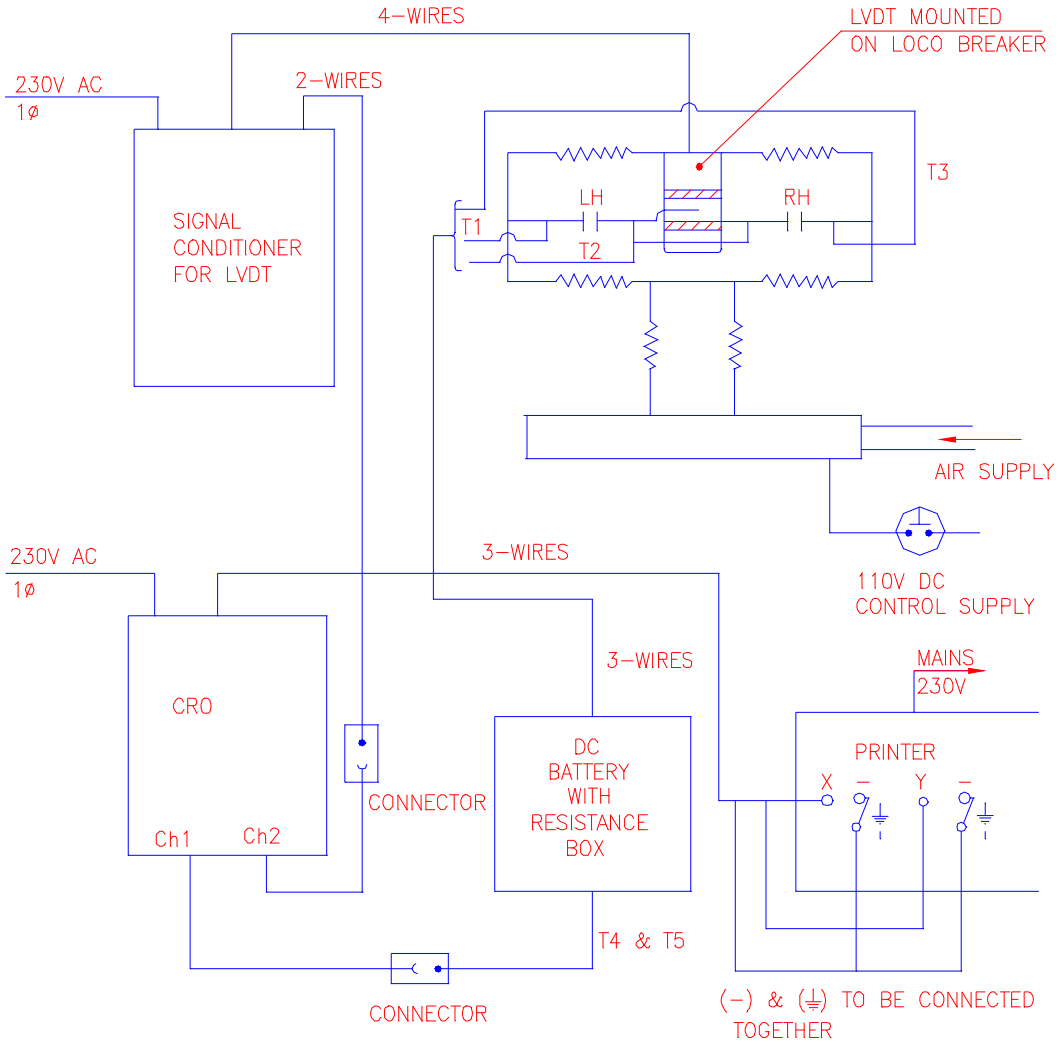
For the travel portion AB, the distance covered is AC and the taken to cover distance AC in CB

Distance AC = 10 mm. : On graph
Actual distance : 2 mm.
Time CB : 5 mm. on graph.

The actual time taken for the travel $= \frac{5 \text{ mm.}}{10 \text{ mm.}} \times 20 \text{ ms} = 10 \text{ ms}$

Closing speed of contact. : $= \frac{2 \text{ mm.}}{10 \text{ ms}} = 0/2 \text{ m/s}$

= 0.2 miters /second,



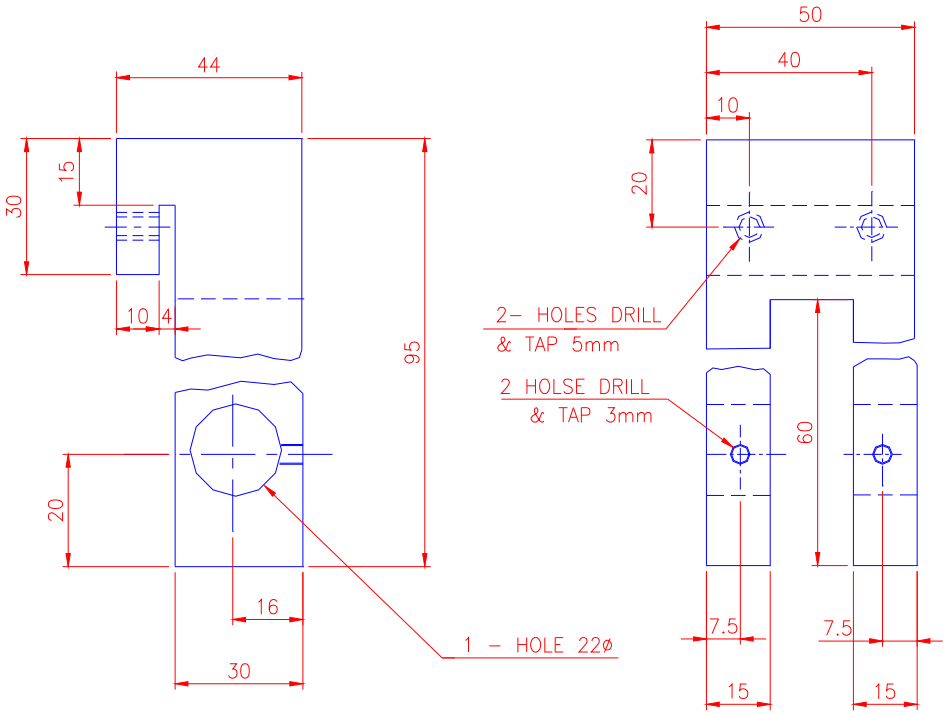
REF:–	SCALE:–	APPROVED BY:– Sd. FOR D.G.

SCHEMATIC BLOCK DIAGRAM FOR USE OF CRO WITH CVDT

RDSO.ELEC.DTE.	SKEL–4003

Dt.	16.12.90
D	AJAI
T	
C	

SK.EL-4004



3– NON FEROUS MOUNTING BLOCK

REF:– SEC DRG NO ISD : 173	SCALE:–	APPROVED BY:– FOR D.G.

MOUNTING GADGET (BLOCK) FOR LVDT CORE

RDSO.ELEC.DTE.	SKEL – 4004

Dt.	16.2.79
D	AJAI
T	
C	

SK.EL-4005

DRILL & TAP 6-40 UNF BRAZE TO ROD AFTER CHECKING ASSEMBLY

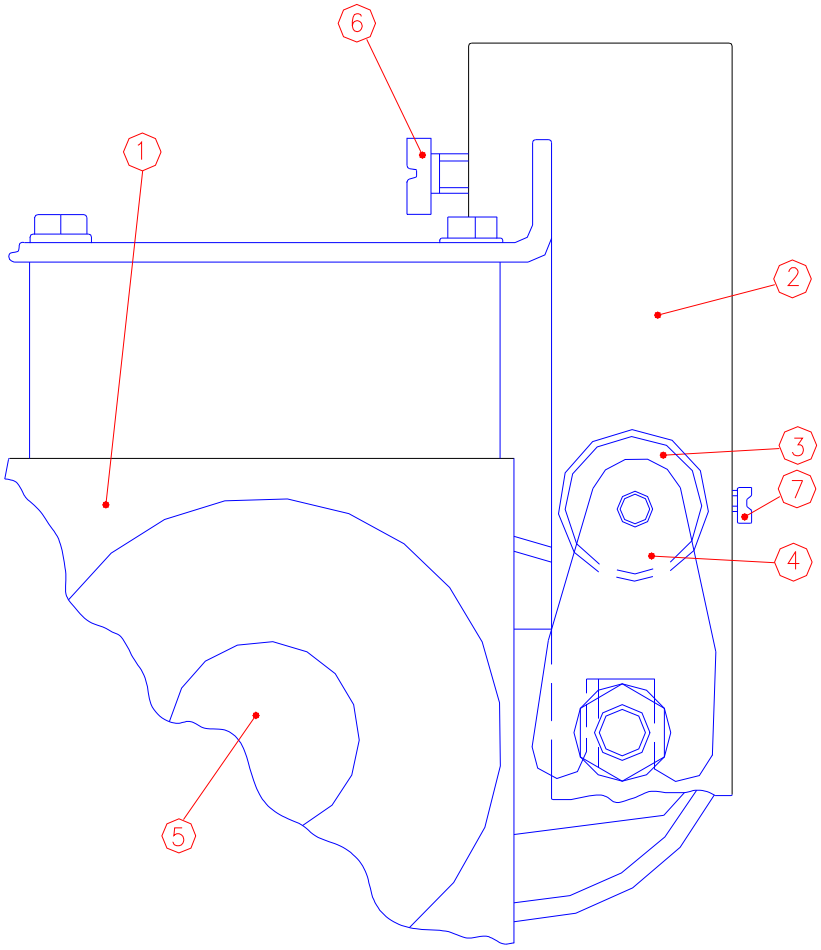
PART NO.	DESCREPTION	QTY	MTL/SPEC
2	ADAPTER FORKS	1	STEEL
1	RODS 40mm lg	1	PHOSPHOR BRONZE

REF:- GEC DRG NO- LSD 172 | SCALE:- | APPROVED BY:- FOR D.G.

ADAPTER FORK FOR MOUNTING LVDT PLUNGER

RDSO.ELEC.DTE. | SKEL-4005

Dt.	6.12.90
D	AJAI
T	
C	



PART NO.	DESCRIPTION	QTY.	MTL./SPEC
7	SCREWS M3X8mmLq	2	NYLON
6	MS.HEX.HD SCREWS M5 X 15mm Lq	2	M.S.
5	PISTON	2	
4	ADAPTOR FORK	1	
3	TRANSDUCER(LVDT)	1	
2	MOUNTING BLOCK	1	
1	CYLINDER	1	

REF:– DRG. NO. LSD: 174 | SCALE:– | APPROVED BY:– Sd

MOUNTING ARRANGEMENT FOR LVDT IN VCB

RDSO.ELEC.DTE. SKEL– 4006

Dt.	12.90
D	AJAI
T	
C	