

**DISTRIBUTION COMMISSIONING TEST SHEET – VOLTAGE REGULATOR (CLOSED DELTA)**  
**HPC-4DL-07-0032-2014**

This commissioning test sheet covers the checking, testing and commissioning of all replacement or new installations of closed delta connected voltage regulators before energisation.



**NOTE:** Tests must be carried out after the installation, alteration or repair and before putting back to service.  
**SAFETY:** At all times maintain suitable clearance to all other electrical equipment and verify planned escape routes.  
 In preparation for the tests, wherever possible, de-energise, isolate and make the area safe.

<b>DATE:</b>		<b>Project No.</b>		<b>Name of Officer</b>	
<b>Voltage Regulator Location:</b>					

**1. VOLTAGE REGULATOR DESCRIPTION**

System Voltage		kV	Stock code		Label/GIS ID code	
Serial Number R phase			Serial Number W phase		Serial Number B phase	

**2. VISUAL INSPECTION AND SAFETY CHECK**

Structure	1	Check that the installation complies with the distribution construction standards and applicable design drawings.	<input type="checkbox"/>
	2	Check that Public Safety has been considered (e.g. cabinet secured and locked, trip hazards removed where applicable).	<input type="checkbox"/>
	3	Check the supply to the voltage regulator, that it is switched off and isolated as per switching sheet and permit.	<input type="checkbox"/>
	4	Confirm (with approved testing device) that the voltage regulator is de-energised.	<input type="checkbox"/>
	5	Check that the voltage regulator rating matches system voltage.	<input type="checkbox"/>
	6	Check that the earth system is complete, undamaged and bonded to earth points.	<input type="checkbox"/>
	7	Check the regulator for damage, cracks, oil leaks, bushings sound and no excessive dirt.	<input type="checkbox"/>
	8	Check the oil level, must be visible in oil sight gauge.	<input type="checkbox"/>
	9	Check the surge arresters on S, L and between S & L bushings	<input type="checkbox"/>
	10	Ensure that the insulated caps or extension skirts are fitted (if required).	<input type="checkbox"/>
	11	Check that the structure is numbered and labelled correctly with labels and danger signs fitted correctly.	<input type="checkbox"/>



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**3. EARTH RESISTANCE TEST**

1	Test earth resistance using one of the following DCT's and record value in 3.4.	<input type="checkbox"/>
2	New earth stakes, use HPC-4DL-07-0038-2017 DCT- Earth Testing of Distribution Poles, to test the earths.	<input type="checkbox"/>
3	Existing earth stakes, use HPC-4DL-07-0037-2017 DCT- Earth Testing of Altered Systems, to test the earths.	<input type="checkbox"/>
4	Previous test value if known = _____Ω Measured value = _____Ω Value acceptable Yes <input type="checkbox"/> No <input type="checkbox"/>	
	Measured value would be acceptable if <b>below 30 Ohms</b> or a value between 0.8 and 1.2 which is obtained when dividing the Measured value by the Previous test value. <b>Note:</b> If previous test value is not known a value less than or equal to, 30 Ohms is acceptable.	<input type="checkbox"/>
5	Earth stake resistance <b>above 30 Ohms or outside of an acceptable value</b> must be communicated to the formal leader or Asset manager.	<input type="checkbox"/>

**4. INSULATION RESISTANCE TEST**

Using a 5 kV insulation resistance tester for a minimum of 1 minute for a stable reading. Test results are to be greater than 1,000 MΩ.	Short together the S, SL and L bushings using fuse wire or shorting cables. Connect the insulation resistance tester between the shorted bushings and earth. The regulator must be in neutral position. Discharge after each test	Expected Results	Test Results
		>1,000 MΩ	VR 1 _____MΩ
		>1,000 MΩ	VR 2 _____MΩ
Instrument Serial no.	Date last tested	>1,000 MΩ	VR 3 _____MΩ

**5. INSTALLATION CHECK**

Nameplate plug indicator connection	1	Check that the plug indicator is set at the voltage at which the voltage regulator has been connected for each phase						<input type="checkbox"/>
	Example: Cooper							
	Tap in Use	Load Volts	Control Winding Tap (Tank)	Internal PT Ratio	RCT Tap (Control)	Test Terminal Voltage	Overall Potential Ration	
	○	23,000	E1/P1	183.3:1	120	125.5	183.3:1	R
	○	22,000	E1/P1	183.3:1	120	120	183.3:1	<input type="checkbox"/>
	○	20,000	E1/P1	183.3:1	110	119	168:1	
○	19,100	E1/P1	183.3:1	104	120	159.2:1	W	

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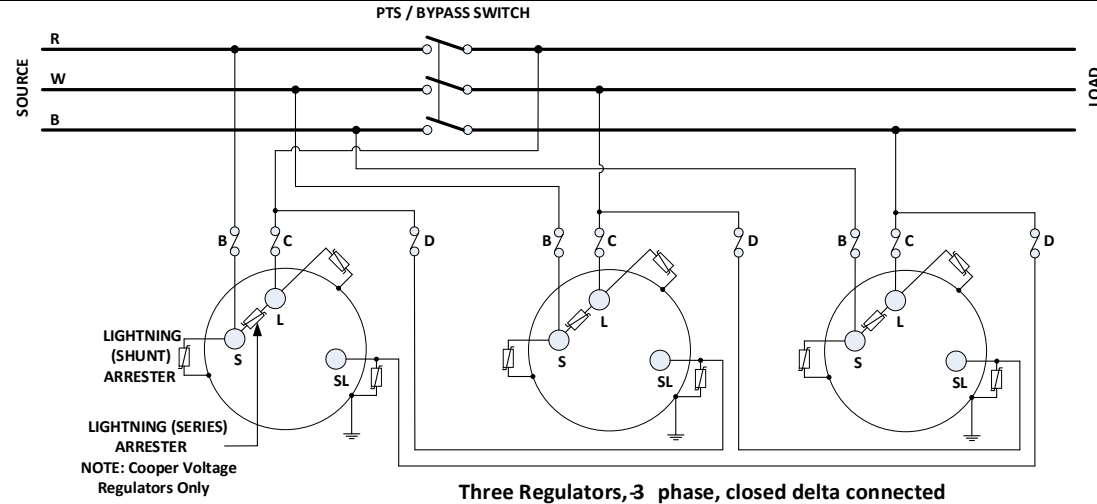


	○	15,000	E2/P2	119.8:1	120	125.5	119.8:1	<input type="checkbox"/>
	○	12,700	E2/P2	119.8:1	104	122.5	103.9:1	<input type="checkbox"/>
	○	11,000	E3/P3	91.6:1	120	120	91.6:1	B
	○	10,000	E3/P3	91.6:1	110	119	84.1:1	<input type="checkbox"/>

Nameplate plug indicator connection	Example: GE							
	POTENTIAL AND CONTROL POWER							
	Load Terminal Volts		Potential Ratio	Control Volts	Connect			R
					NN22 to	NN9 to	F1-2 to	<input type="checkbox"/>
	○	22,000	183.3:1	120	NN21	T4-2	T4-3	W
	○	19,100	159.2:1	120	NN21	T4-2	T4-1	<input type="checkbox"/>
	○	12,700	105.8:1	120	NN20	T4-2	T4-4	B
	○	11,000	91.6:1	120	NN20	T4-2	T4-3	<input type="checkbox"/>
<p><b>Note:</b> For the GE controller, ensure that the connection of the power circuit board, which is located inside the control cabinet in the upper RHS corner, is wired according to the regulator nameplate.          Example: For 22,000 V, the power circuit board is connected NN22 to NN21, NN9 to T4-2 and F1-2 to T4-3.</p>								
2	Confirm that the regulator is connected as per the diagram below.						<input type="checkbox"/>	

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**6. HANDOVER OF RESPONSIBILITY FOR THE COMPLETION OF SECTIONS 1 TO 5**

I hereby certify that sections 1 to 5 have been completed with satisfactory results and transfer responsibility to the network operating authority.

Commissioning Officer: \_\_\_\_\_

Pay Number: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: DD/MM/YY Time: HH:MM

1. **DO NOT ENERGISE THE REGULATOR.** All the high voltage disconnectors connecting the regulator to the high voltage line must be open.
2. The PST/BYPASS/RMU switch position must be set as per the network configuration.
3. Control unit doors must be locked with two (NMK2) Horizon Power approved padlocks.
4. Attach an “**Out of Service (Warning)**” tag to the padlock on the front of the control cabinet.
5. Inform HPCC of the status of the voltage regulator.
6. Ensure the work area is left tidy with no hazards to the public.
7. Hand over responsibility to the commissioning authority



**7. CONTROL SETTING AND TESTING**

Controller power supply setting instructions	1	Select the power switch to OFF and the control switch to OFF.		<input type="checkbox"/>
	2	Cooper <input type="checkbox"/>	GE <input type="checkbox"/>	
		The knife switches on the back panel should be set with V1 (potential switch) and V6 (differential voltage if fitted) closed and C (shorting switch) closed. V6 may be fitted to CL5A on earlier controllers.	The knife switches on the back panel should be set with DS1 (potential switch) closed and DS2 (CT shorting switch) closed.	<input type="checkbox"/>
	3	Close the SL (source load) disconnecter <b>D</b> first and then S (source) disconnecter <b>B</b> – see diagram above.		<input type="checkbox"/>
	4	Set the power switch to INTERNAL and the control switch to MANUAL.		<input type="checkbox"/>
	5	Operate the RAISE/LOWER switch to bring the regulator tap position indicator to the neutral position (zero) if required. The controller neutral lamp/LED is lit while in the neutral position. Check that the tap position indicator and the lamp/LED are synchronized before continuing.		<input type="checkbox"/>
	6	Upload the settings to the control		<input type="checkbox"/>
	7	Cooper <input type="checkbox"/>	GE <input type="checkbox"/>	
		Measure the voltage at the voltmeter terminals to check if the measured voltage closely matches that of the voltage displayed on the panel.	Measure the voltage at the meter out terminals to check if the measured voltage closely matches that of the voltage displayed on the panel.	<input type="checkbox"/>
	8	Cooper <input type="checkbox"/>	GE <input type="checkbox"/>	
	Depress 1, SET VOLTAGE (band centre) keypad	Using the UP, DOWN and ENTER buttons, press buttons until the display indicates the band centre	<input type="checkbox"/>	
9	Set the control switch MANUAL position. Operate the RAISE/LOWER switch to activate raise operation. Allow the tap changer to operate for enough steps to take voltage out of the bandwidth. Set the control switch to AUTO position. After a time delay (30 seconds) the control should cause the regulator to tap down to the top bandwidth edge. <b>Note:</b> If bi-directional (Cooper) is set, it must be disabled (zero) before the AUTO setting can be used. <b>Example:</b> A setting of 120 V (band centre) and 2 V bandwidth = 121 V top bandwidth edge should be shown in the display.		<input type="checkbox"/>	

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Controller power supply setting instructions continued...	10	When the voltage is in band and the tap changing has stopped, set the control switch MANUAL position. Operate the RAISE/LOWER switch to activate lower operation. Allow the tap changer to operate for enough steps to take voltage out of the bandwidth. Set the control switch to AUTO position. After a time delay (30 seconds) the control should cause the regulator to tap up to the lower bandwidth edge. <b>Example:</b> A setting of 120 V (band centre) and 2 V bandwidth = 119 V lower bandwidth edge should be shown in the display.		<input type="checkbox"/>	
	11	When the voltage is in band and the tap changing has stopped, set the control switch MANUAL position. Operate the RAISE/LOWER switch and set the regulator to the neutral position. Reset the drag hands to zero.		<input type="checkbox"/>	
	12	Phase out and then close the L (load) <b>C</b> disconnecter switch – <b>see diagram above</b> .		<input type="checkbox"/>	
	13	Open the BYPASS switch – <b>see diagram above</b> .		<input type="checkbox"/>	
	14	Cooper <input type="checkbox"/>		GE <input type="checkbox"/>	
		Set each regulator configuration to Delta Lead.		Set the current transformer (CT)/voltage transformer (VT) phasing angle setting on each control to +30°	<input type="checkbox"/>
		Open the CT shorting switch C		Open the CT shorting switch DS2	<input type="checkbox"/>
	15	After 30 seconds, check if the power factor reading in each control unit is within the acceptable limits of 0.50 to 0.99; and, if possible, verify with HPCC that the control's power factor reading is similar to the feeder's power factor reading. If yes, set the control switch to the AUTO position and proceed to step 18. If no, proceed to step 16.		<input type="checkbox"/>	
	16	If the power factor reading is not within acceptable limits or not similar to the feeder's power factor as verified with HPCC, set each regulator control to Delta Lag for Cooper or set the CT/VT phasing angle setting to -30° (+330°) for GE units. Recheck the power factor readings after 1 minute and, if the readings are within acceptable limits or are similar to the feeder's power factor readings, set the control switch to the AUTO position and proceed to step 18. If not, proceed to step 17.		<input type="checkbox"/>	
	17	If the power factor reading is still not within acceptable limits or not similar to the feeder reading, ensure that the voltage regulator is in a neutral position. Contact your formal leader or Regional Asset Manager or if possible, Engineering for further investigation. Proceed to step 18.		<input type="checkbox"/>	
18	Voltage Regulator to be returned to neutral position, close the bypass switch, first open the L (load) <b>C</b> disconnecter switch, then S (source) <b>B</b> disconnecter switch and lastly the SL (source load) <b>D</b> disconnecter switch.		<input type="checkbox"/>		
19	IF VOLTAGE REGULATOR IS <b>READY</b> TO BE COMMISSIONED <b>PROCEED TO SECTION 9</b> OTHERWISE GO TO SECTION 8.		<input type="checkbox"/>		

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**8. OUT OF SERVICE**

1	HPCC to be notified that voltage regulator is not ready to be commissioned.	<input type="checkbox"/>
2	Out of service tags to be applied to bypass switch and each voltage regulator. <b>DO NOT PROCEED TO SECTION 9.</b>	<input type="checkbox"/>

**9. OPERATIONAL HANDOVER**

The commissioning officer must ensure that all checks are completed and the test results comply with the minimum standards.

I hereby certify that all sections have been completed with satisfactory results and transfer responsibility to the network operating authority. This equipment is ready to be **SAFELY** energised.

Commissioning Officer: \_\_\_\_\_ Pay Number: \_\_\_\_\_  
 Signature: \_\_\_\_\_ Date: DD/MM/YY Time: HH:MM

1. Ensure the work area is left tidy with no hazards to the public.
2. Hand over responsibility to the operating authority.
3. Return this sheet to the project/working file as a record of commissioning and as a document required for the Handover Certificate.

**Manufacturer Recommends to -**

1. **Energising** Voltage Regulator: Close **First** switches **D**, then close switches **B**, then close switches **C** and **Last** Open Bypass switch.
2. **De-Energising** Voltage Regulator: Close **First** Bypass switch, then open switches **C**, then open switches **B** and **Last** open switches **D**.