#### 2-IM-RT

### INSTRUCTION MANUAL MULTI-AMP® PROTECTIVE RELAY TEST SETS

for testing all types of protective relays



ILLUSTRATED: MODEL SR-51A, ONE-PIECE UNIT

The MULTI-AMP<sup>®</sup> test instrument described in this manual contributes to the more convenient and accurate field testing of protective relays.

Set-up time, accuracy, safety and a forward step in standardization of testing procedures are among the many benefits.

The following sections describing the use of the MULTI-AMP<sup>®</sup> relay test instrument will enable the user to utilize it to its fullest extent. Refer to manufacturer's instruction book for the details of the specific device to be tested.

It is recommended that this instruction manual be read thoroughly before proceeding with testing.

NOTE: If the relay test set is not equipped with optional Current Actuator "C.A.", the "Curr. Act" position of the "Timer Operation Selector" switch is not operable.

MODEL NO. SR-51 A SERIAL NO.

Please refer to the above serial number when making inquiries regarding this equipment.

nulti-amp

4271 Bronze Way Dallas, Texas 75237 U.S.A. Telephone (214) 333-3201 TWX 910-861-9052

PART NO. 3260 PRINTED IN U.S.A.

#### APPRECIATION

We are indebted to the manufacturers of protective relays, who have given their time and advice in the preparation of this instruction book.

And, we also express our gratitude to engineers all over the country for their counsel and encouragement.

#### water fan Bellenen en yn de de de ferene ferste ferste ferene en de ferene i

till a fer het sollt i eine en en<mark>nere</mark>enen here ander is de enternet operation en heren en Der refekterenet er deerenge her bei en die er die er die enternet

úr Beren Seren ar 1993 a 1997, ar 1997 a carra a carra a bhair a reach Shati a teac an car a ga carra a 1110 a bheite an t-1997 a cart Su

. Mit o servers sporte tradition tradition assessed of the first of the Constant of the Constant Research Terms of the Site ender the tradition of the Constant of the Constant of the Constant of the Constant Research of the Research of the Constant of the Research of the Research of the Research of the Constant of the

ar goor e gaya a sa a a cala sa cala sa caga manang kanang kaning kanang kanang kanang kanang kanang sa sa sa Baba kanang sa

n. 1997 – La Martin Latines, Kalender en la Meser Meller en Meser, and a faith and an instrument of the Addition Meller and Meller Schemeling matched and Meller instruments and a structure faith in the Meller.

#### IMPORTANT

The information and data contained within this instruction manual are proprietary with MULTI-AMP Corporation. The equipment described herein may be protected by one or more U.S. letters patent. MULTI-AMP specifically reserves to itself all rights to such proprietary information as well as all rights under any such patent, none of which is waived by the submission of this instruction manual to anyone.

The recipient, if a Government Agency, acknowledges that this instruction book and the equipment described were procured with "Limited Rights" to technical data as described in ASPR 9-203(b).

Copyright @ MTILTI-AMP Corporation, 1980

1

#### FOREWORD

The MULTI-AMP test instrument described in this manual contributes to the more convenient and accurate testing of current and voltage actuated devices.

Setup time, accuracy, safety, and a forward step in standardization of relay testing are among the many benefits.

This manual presents detailed test procedures for the common types of protective relays. As additional test procedures are developed, they will be added to the manual. Copies of these new procedures will be available upon request.

It is suggested that the relay engineer or technician using the MULTI-AMP test equipment, refer to the relay manufacturer's instruction book for details concerning the characteristics or adjustments for the particular relay under test.

The following publications may be consulted for theory of relay operation and application:

- "Applied Protective Relaying" (Silent Sentinal) Westinghouse Electric Corporation Relay-Instrument Division Newark, New Jersey
- "The Art and Science of Protective Relaying" by C. Russell Mason, General Electric Company published by John Wiley and Sons, Inc., New York, N.Y.
- 3. "Protective Relays Their Theory and Practice" by A. R. Van C. Warrington, The English Electric Co. Ltd., Stafford, published by John Wiley & Sons, Inc. New York, N.Y.
- 4. "Electric Power Distribution for Industrial Plants IEEE No. 141
- 5. MULTI-AMP "The Electrical Tester", Vol. 2, No. 1 "duPont Coordinates, Tests Protective Relays" by T. L. Bourbonnais II, E. I. duPont de Nemours & Co. Inc.
- 6. MULTI-AMP "The Electrical Tester", Vol. 7, No. 2 "Effect of Changing Short Circuit Duty on Relay Settings" by F. P. Brightman
- 7. MULTI-AMP INSTITUTE Curriculum "Principles of Coordination for Industrial and Commercial Power Systems".

and the second states in the second

### TABLE OF CONTENTS

• • •

.

5

\$

•

Foreword	ection	Page
Foreword SPECIFICATIONS Cables - Input and Output		
THEORY OF OPERATION General Description. Control Device Function. Current Metering Circuit. Short Time Rating. Use of Phase Shifter & Phase Angle Meter	2	1 2 12 14 16
TESTING PROCEDURES - (Protective Relays)Principle of OperationPreparation for Relay TestingRelay InspectionOvercurrent Relays	33	1 4 7
Overcurrent Relays         Current Phase Balance - West. CM, GE IJC         Overcurrent - West. CO, GE IAC         Overcurrent - Complete Test         Voltage Controlled Overcurrent - West. COV         Voltage Restraint Overcurrent - GE IJCV	3 3 3 3	20 12 16 29 26
Voltage Relays Undervoltage - West. CV, GE IAV Instantaneous Undervoltage - West. SV, SV-1, GE PJV Phase Sequence & Undervoltage GE ICR Reverse Phase - West. CP	3	34 37 39 39
Differential Relays Percentage - West. CA, GE IJD. Percentage - West. CA-5. Percentage - West. CA-6. Voltage - GE PVD. Pilot Wire - GE CPD. Pilot Wire - West. HCB. Transformer Differential with Percentage and Harmonic Restraint - GE Type BDD.	3 3 3 3 3 3 3 3 3 3 3 3 3 3	438 5582 64

.

#### TABLE OF CONTENTS (CONT'D)

•

Page 2

	)vercu	nal Relays rrent - West. CR, GE IBC - West. CW, GE ICW	<u>Section</u> . 3 . 3	<u>Page</u> 68 73
	Loss o Distan	e - Reactance Relays f Excitation - GE CEH-11 ce - Reactance - GE GCX ce - Reactance MHO - GE GCY ce - Impedance - West. HZ	↓ * * 3** * *	77 84 98 103
	11 C	<u>s</u> iliary OCEDURES - (Other Devices)		_ <b>111</b>
I	DC Tar Insula Motor Heat Ther Rowa Circui	get and Seal-In Units tion Resistance Overload Relays er Type Thermal (Typical Tests) mal Overload - West. BL-1, GE TMC n Magnetic Overload t Breakers i-Pole Molded Case Circuit Breakers le-Pole Molded Case Circuit Breakers		1 3 4 6 9 10 12
SERV		The second se Second second se Second second sec		1
SCHE	MATIC	· • • • • • • • • • • • • • • • • • • •	• 5	•••• ••
ADDE	NDUM.			
			na an a	· · ·
р. 1.				
	• 42	(1,1) = (1,1) + (1,1		
			an aan e	

			el de verden. Se de services
	Constant and Const		
-1	i.	TABLE OF CONTENTS - RELAY TYPES	the second

This table lists alphabetically by type designation, relays covered by test procedures in this instruction manual.

Type	Application or Description Section	n <u>Page</u>
BDD	GE-Harmonic Restrained Transformer Differential	б4
CA	WestGenerator/2 winding Transformer Differential 3	43
CA-5	WestGenerator/2 winding Transformer Differential 3	48
CA-6	WestMulti-restraint Bus/Transformer Differential 3	51
CEH-11	GE-Loss of Excitation (Loss of Field)	7.7
CM	West-Current Phase Balance	20
CO	WestInduction Disc. Overcurrent	12
cov	WestVoltage Controlled Overcurrent	29
CP	WestReverse Phase (Three Phase Undervoltage) 3	39
CPD	GE-Pilot Wire 3	59
CR	WestDirectional Time Overcurrent 3	68
cv	WestInduction Disc Time Voltage 3	34
CW	WestPower Directional 3	73
GCX	GE-Directional Distance (Reactance) Phase 3	84
GCY	GE-Directional Distance (Mho) Phase 3	98
HCB	WestPilot Wire 3	62
HZ	West3 Zone Directional Impedance 3	103

TABLE OF CONTENTS - RELAY TYPES (CONT'D) Page 2.

Type	Application or Description Se	ction	Page
IAC	GE-Induction Disc Overcurrent	3	12
IAV	GE-Induction Disc Voltage	3	34
IBC	GE-Directional Overcurrent	3	68
ICR	GE-Phase Sequence and 3 Phase Undervoltage	3	39
ICW	GE-Power Directional	3	73
IJC	GE-Current Phase Balance	3	20
JCV	GE-Voltage Restraint Time Overcurrent	3	26
IJD	GE-Percentage Differential	. <b>3</b>	43
PJV	GE-Instantaneous Solenoid Voltage	3	⊜/ <b>.37.</b>
PVD	GE-High Impedance Voltage Operated Bus Differentia	1 3 <sub>11</sub>	55
SV,	WestInstantaneous Solenoid Voltage	• 3	37
SV-1	1 - Alexandra - Alexandra and an ann an		
  	Na na kana na	2	
	an a	:	ACT A GAQ
2 - 2 - 4 	an. An an an ann an Araban an Arab		
 	an a		
		:	la di National
an an An an An	2 - Construction and a state of the state of	d. A	
	2		
	<sup>2</sup> A second s second second seco	-	n Ballana Marina
···			
	na an a		

# Universal Protective Relay Test Set Model SR-51A

and a second and a second seco



Model SR-51A-2PC



Model SR-51A



4271 Bronze Way Dallas, Texas 75237-1088 U.S.A. Ph. (214) 333-3201 Telex 163548 MULAM DL Fax (214) 333-3533 Multi-Amp Canada, 445 Finchdene Square, Scarborough, Ontario, M1X 1B7 Ph. (416) 298-6770 Telex 065-25453 Fax (416) 298-7214

## Model SR-51A

#### **General Description**

Designed to reduce equipment set-up time, simplify test procedures, and eliminate wiring errors introduced when interconnecting individual components, Multi-Amp Model SR-51A is a self-contained, portable test set incorporating the necessary outputs, control circuitry and instrumentation for testing the "basic" single-phase, single-frequency protective relays. Designed for either field or shop use, this rugged test set is constructed to withstand the rigors of transporation as well as daily field activity.

Among its many outputs are two ac current sources, two ac voltage sources, a dc voltage source, a dc current source and a high voltage source for insulation tests. Of the two (2) dc outputs which are provided, one is used primarily for testing dc auxiliary relays and the other for testing dc targets, operations indicators and seal-in units. Two (2) ac current sources are provided for applications such as testing current unbalance relays or the slope of differential relays. Facilities are provided to utilize and independently adjust two outputs simultaneously; and the test set includes several special test circuits which greatly simplify test procedures and increase efficiency.

Built-in overload relay and fuses protect the test set from damage due to overloads or short-circuits. The input line cord and test leads supplied with each test set are all that is needed for testing essentially all the "basic" protective relays.



### **Common Test Applications**

**Relays:** Overcurrent, percentage differential, current unbalance, directional overcurrent, thermal, overload, over/under voltage, timing, and ac and dc auxiliary relays. When used in conjunction with a phase shifter such as Multi-Amp Model CS-7B, the Model SR-51A would also be used in testing distance, impedance, mho, reverse power, loss of excitation, and other relays which require control of the phase angle relationship.

Other Applications: Circuit breakers rated up to 50 amperes, current and potential transformer ratios, ammeters, voltmeters.

#### **Specifications**

Rating: 1.0 kVA Input Voltage (specify one): 120 volts, 1¢ OR 240 volts, 1¢ Input Frequency (specify one): 60 hertz OR 50 hertz Outputs:

No. 1: Continuously adjustable through 4 ranges to meet a wide variety of test circuit impedances.

- o 0-10 volts at 100 amperes
- o 0-20 volts at 50 amperes

o 0-40 volts at 25 amperes

o 0-80 volts at 12.5 amperes

- Overload (Intermittent) Capabilities of Output No. 1:
- When the output voltage is sufficient to "push" higher than rated current through the impedance of the load circuit, the test set may be overloaded for short durations as shown below. The overload capabilities are approximate since output values will vary with regulation.

Per Cent Rated Current

100% 200% 300% Maximum Time-On 30 minutes 3 minutes 20 seconds Minimum Time-Off 30 minutes 8 minutes 4 minutes

- No. 2: 0-140 volts at 3 amperes ac
- No. 3: 0-150/300 volts at 0.5/0.25 amperes ac
- No. 4: 0-8 volts at 5 amperes dc for dc current source in testing targets, operations indicators and seal-in units.
- No. 5: 0-150/300 volts at 0.3/0.15 amperes dc
- No. 6: 1200 volts, current limited to 5 milliamperes ac for insulation resistance tests.
- No. 7: 0-24 volts at 10 amperes ac for second current source when testing dual current coil relays.
- No. 8: "Directional Element Test" (DET) A special test circuit to apply a current and voltage which are exactly in phase to determine minimum pick-up of wattmeter elements of complex relays. Four calibrated values are provided as well as five extra positions for special ranges.
- No. 9: "Voltage Relay Test" (V. RLY.) A special circuit for testing over or under or over/under voltage relays. Provides a "normal" voltage holding circuit where the "normal" voltage is adjusted and held while the fault voltage is properly set. Switching to the "Test" position applies the fault voltage and starts the timer simultaneously. Timer stops and voltage is de-energized when relay contacts close.

#### Instrumentation

- 1. Main AC Ammeter: A 4-inch square moving iron vane instrument with non-reflective glass, mirrored scale, knife edge pointer and pointer pre-set mechanism.
  - Scales: 5/10/25 amperes

Ranges: (switch selected): 0-2.5/5/10/25/50/100/250/500 amperes ac Accuracy: 1% of full scale

2. Secondary AC Ammeter: A 4-inch square moving iron vane instrument with non-reflective glass, mirrored scale and knife edge pointer.

Scales: 5/10 amperes Ranges (switch selected): 0-5/10 amperes ac Accuracy: 1% of full scale

3. DC Ammeter: A 4-inch square D'Arsonval movement instrument with non-reflective glass, mirrored scale and knife edge pointer.

Scales: 0.5/5.0 amperes Ranges (switch selected): 0-0.5/5.0 amperes dc Accuracy: 1% of full scale

4. Multi-function AC/DC Meter: A 4-inch square rectifier type instrument with non-reflective glass, mirrored scale and knife edge pointer.

Scales: 15/30/75 volts ac or dc; 10 megohms Ranges (switch selected): 0-1.5/7.5/15/30/75/150/300 volts ac or dc; 10 megohms Accuracy: 1% of full scale

5. Solid-State Digital Timer: A specially designed Multi-Amp® solid-state digital timer is incorporated to measure the elapsed time of the test in either seconds or cycles. It has extensive shielding and noise suppression circuitry to ensure accurate and reliable operation under the most demanding field conditions. Incorporating a crystal-controlled oscillator, accuracy of the timer is independent of the power line frequency. The readout display appears as continuous, solid, unbroken digits with no gaps between the segments to impair readibility. The high brightness to contrast ratio of the display ensures excellent readability even in high ambient light conditions, including direct sunlight. The flat, planar design of the display allows a full 130° viewing angle without distortion.

Display: .375-inch (9.53 mm) flat, planar characters using high intensity, gas-discharge technology.

Ranges (switch-selected):

- (a) 0-9999.99 seconds
- (b) 0-999999 cycles

Accuracy: Seconds Mode: ± least significant digit or 0.0025% of reading, whichever is greater. Cycles Mode: ± 1 Cycle



#### Housing:

Test set is housed in a tough, heavy-duty formica enclosure with carrying handles on both top and ends and has a removable, hinged protective cover. Available in either a one-piece enclosure, or for increased portability, in a two-piece enclosure with a single, multi-conductor interconnecting cable with appropriate plugs.

One-piece enclosure Model SR-51A Dimensions: 16½"H, 22"W, 11"D Net Weight: 86 lbs. (39 kg.)

Two-piece enclosure Model SR-51A-2PC Dimensions: 16%"H, 14"W, 11"D Each Net Weight: 43 lbs. (19.5kg.) and 48 lbs. (21.8 kg.)



#### Test Leads:

- One (1) pair No. 6 welding cables with insulated alligator clips and spaded lug Part No. 1285
- Two (2) pair No. 18 utility leads Part No. 1282
- One (1) pair continuity test leads Part No. 1283
- One (1) set of high-voltage test leads Part No. 1125
- One (1) 10-foot 3-conductor input lead Part No. 2708
- One (1) pair #10, 20 feet long output leads Part No. 2040

#### **Standard Features:**

- Provided with two instruction manuals, each containing approximately 150 pages of detailed, step-by-step
  procedures for testing protective relays as well as operating instructions for the test set. Manuals also include
  maintenance instructions, schematic diagram and parts list.
- High current outputs of the test set are obtained using standard 120-volt convenience outlet for input power. No special high current power source required.
- Output control circuit permits momentary, "pulsed" application of output to avoid damage or overheating of relay when setting test current. Also, output is automatically de-energized when relay under test stops timer.
- Built-in overload and short circuit protection.
- · Facilities to initiate the test set from a remote location.

Model 1-3PH

- Facilities to utilize the test set's voltmeter to measure external AC or DC voltages.
- Continuity test circuit to indicate contact action.
- An auxiliary channel, completely independent of the main output channel is incorporated and may be fed from the common primary source or from an external phase shifter or frequency generator.
- Facilities are provided for efficient use of Multi-Amp accessory units such as the Model 1-3PH three-phase synthesizer (shown below), as well as a phase shifter or frequency generator. For additional information on these accessory models, please contact the factory.



For additional information request bulletins, DS-FG, DS-3PH, DS-CS.

Copyright Multi-Amp Corporation, 1988 Printed in USA

MA-5944

#### GENERAL DESCRIPTION

MULTI-AMP relay test sets are portable, variable current and/or variable voltage units suitable for testing and calibrating electrical protective or indicating devices. They are capable of testing all single phase protective relays that do not require a change in frequency or a specified phase angle relationship between a voltage and a current or between two currents or two voltages. They may also be used to test any three phase protective relay that may be tested one phase at a time. The test sets are dual channeled; each channel controlled independent of the other. The main channel provides test facilities for AC current actuated or AC voltage actuated devices with a continuously variable output.

The second or Auxiliary channel supplies continuously variable outputs of AC or DC for current actuated or voltage actuated devices; provides special circuitry for testing undervoltage relays, directional units, and, in addition, for performing an insulation resistance test on all protective relays.

Accessories are available to be used in conjunction with the MULTI-AMP relay test sets when special facilities are required:

a - change of frequency

b - a specified phase angle relationship between two circuits

c - three phase voltage

Detailed descriptions of the controls are given in the following pages. The numbers() refer to those shown on Figure 1.

#### GENERAL DESCRIPTION

MULTI-AMP relay test sets are portable, variable current and/or variable voltage units suitable for testing and calibrating electrical protective or indicating devices. They are capable of testing all single phase protective relays that do not require a change in frequency or a specified phase angle relationship between a voltage and a current or between two currents or two voltages. They may also be used to test any three phase protective relay that may be tested one phase at a time. The test sets are dual channeled; each channel controlled independent of the other. The main channel provides test facilities for AC current actuated or AC voltage actuated devices with a continuously variable output.

The second or Auxiliary channel supplies continuously variable outputs of AC or DC for current actuated or voltage actuated devices; provides special circuitry for testing undervoltage relays, directional units, and, in addition, for performing an insulation resistance test on all protective relays.

Accessories are available to be used in conjunction with the MULTI-AMP relay test sets when special facilities are required:

a - change of frequency

b - a specified phase angle relationship between two circuits

c - three phase voltage

Detailed descriptions of the controls are given in the following pages. The numbers() refer to those shown on Figure 1.



Sector and the second control device functions

INITIATING SWITCH (1)

SYNCH

FUSE NO

TERMINALS

2 - 3

This switch serves to start operation of the test set.

120 volts is present on these terminals whenever the unit is initiated. This voltage may be used as a control source to initiate an external unit such as MULTI-AMP Model 1010/RB Reactor Booster. Closing a circuit plugged into this jack will allow the test set to be initiated from a remote position. This fuse protects the entire unit.

"RELAY CONTACTS" BINDING POSTS (5) as dealers of the trip circuit contacts of the device and the second sec

"POWER ON" LIGHT (6) and This light indicates that the main switch is closed.

<u>CONTINUITY JACK (7)</u> A 6.3 volt circuit is wired in series <u>CONTINUITY LIGHT (8)</u> action of relay under test or circuit continuity can be checked.

POWER SWITCH (9) souther this is the main input switch controllcare freedom of sectors between sping all power except to the "120V"

120V OUTLET (10) This convenience outlet is wired directly across the line cord so that power for auxiliaries such as trouble lights, etc. is available whenever the test unit is plugged in. Sector and the second control device functions

INITIATING SWITCH (1)

SYNCH

FUSE NO

TERMINALS

2 - 3

This switch serves to start operation of the test set.

120 volts is present on these terminals whenever the unit is initiated. This voltage may be used as a control source to initiate an external unit such as MULTI-AMP Model 1010/RB Reactor Booster. Closing a circuit plugged into this jack will allow the test set to be initiated from a remote position. This fuse protects the entire unit.

"RELAY CONTACTS" BINDING POSTS (5) as dealers of the trip circuit contacts of the device and the second sec

"POWER ON" LIGHT (6) and This light indicates that the main switch is closed.

<u>CONTINUITY JACK (7)</u> A 6.3 volt circuit is wired in series <u>CONTINUITY LIGHT (8)</u> action of relay under test or circuit continuity can be checked.

POWER SWITCH (9) souther this is the main input switch controllcare freedom of sectors between sping all power except to the "120V"

120V OUTLET (10) This convenience outlet is wired directly across the line cord so that power for auxiliaries such as trouble lights, etc. is available whenever the test unit is plugged in.

FUSE NO. 2 (11) This fuse protects the control transformer. さしょうさい ちょうねつ This knob controls the setting of the MAIN CONTROL KNOB ( main variable autotransformer. AUX. POWER INT-EXT Selects energizing of second channel SWITCH (12) of test set from internal or external source. These terminals are for connecting a AUXILIARY POWER INPUT TERMINALS (14) second source of power (not over 120 volts) from a phase shifter or frequency 学校 メモールメナート 見た あわし みいもしたい generator so that relays requiring control of phase relationship or frequency may be tested. This switch selects the output to be AUXILIARY SELECTOR SWITCH (15) adjusted by the auxiliary control (16). In the "VERNIER" Position, the Auxiliary. assessment should be added to a control acts as a fine adjustment for a Dushe have address the Main Control (12). AUXILIARY .CONTROL KNOB (16) This knob controls the setting of the auxiliary autotransformer to change Mersia as the estimate places by see the magnitude of the output selected by and set assumptions dathe "Auxiliary Selector" Switch. AC OUTPUT #3 TERMINALS ( 17) Binding posts where AC output associated with second channel of MULTI-AMP test is provident is picked up. DC RANGE SWITCH (18) White This switch selects the range of the DC Ammeter (0.5A or 5A). DC OUTPUT TERMINALS (19) Binding posts where DC outputs of MULTI-AMP test set are picked up.

2 - 4

"PRESS TO TRIP DC" SWITCH This switch (NC Momentary Contact) (20) opens the DC supply. This switch is used when running timing VOLTAGE RELAY TEST D.E.T. (Directional tests on voltage relays or minimum Element) TEST SWITCH (21)pickup of directional units on direct-A part of the second of the property of the ional overcurrent relays. and a the and an arrest the test of the "SET NORM" Position - When used with an ménangkan pangkan ketalak k "Voltage Relay Test" circuitry, this いがは えわららし ちょうかん たいし しちいろ マライ position connects AC Output #3 terminals 医口腔 的复数形式 网络小学 法政府保护 化过滤器 化丙烯酸 (17) to output of Channel 1 of the test set. a service a second s Second "SET FAULT" Position - Switches voltn na an an an an thar a shail sana Saca meter to output of second channel of test set while allowing AC Output #3 terminals of test set to remain conu shanan ilinek Le Tagana affinitation and the needed to output of Channel 1 of the en ut (ageneration of annant of (annantest set.<sup>1999</sup>) and the set "TEST" Position - Connects AC Output #3 passe to a serie validate series and the subsector terminals to soutput, of Channel, 2 of ACTR when the designed as free privatest set and starts timer. Position #1 through 4 are factory wired with resistors to provide specific values of voltage and current at zero phase angle to test pickup of directional element. Position #5 through 9 are left unwired to permit addition of resistors to produce values common to the user's system.

2 - 5

OUTPUT #1 TERMINALS 22 and 24 ACCESSORY SOCKET (23)

EXTERNAL VOLTMETER TERMINALS (25)

PAM JACK (26) PAM JA

SWITCH (27)

OUTPUT #2 TERMINALS (28)

INSULATION RESISTANCE JACKS (29)

MAIN AMMETER RANGE SWITCH (30) AC RANGE SWITCH (31)

This switch is an ammeter range switch. (5 or 10 amperes)

AC Output #1 is available from these terminals and is adjusted by the Main Control in four (4) ranges. This socket is connected to the 0 to 140 volt, 3 amp output of the autotransformer and can be used to supply a soldering iron or similar accessory. These terminals enable the voltmeter to be used for external voltage measurements.

This jack enables a phase angle meter current coil or external 5-ampere ammeter to be inserted in series with the main ammeter.

This switch makes available Output #1 (Current) or Output #2 (Voltage) from

Channel 1 of the test set.

AC Output #2 is available from these terminals and is adjusted by the Main Control.

These jacks accept the high voltage test leads provided with the unit.

This switch selects the range of the main ammeter. The ammeter range must correspond to the appropriate Common of Output #1. VOLTMETER SELECTOR SWITCH (32)

VOLTMETER RANGE SWITCH (33)

FUSE NO. 3 (34)

<u>FUSE NO. 4 (35)</u>

TIMER (36)

TIMER RESET BUTTON (37) TIMER OPERATION SELECTOR SWITCH (38 & 39)

garelt gelgi egi e en litere i i committe de la maca e especte e constant d'altre estatores en escatajor este estato e i portat mata gelgi e constante este e tato de la fi estatore e actores e set to

a seconda da como da como de la seconda da s Este de seconda da secon By means of this switch, the voltmeter can be connected to any one of several output circuits.

This switch selects the voltage range for the voltmeter.

This fuse protects the main autotransformer.

This fuse protects the auxiliary (VERNIER) autotransformer.

Measures elapsed time of test in cycles or seconds. Ranges (switch-selected): (a) 0-999.99 seconds (b) 0-999999 cycles

This push-button resets timer to zero. The timer operation selector switch (38 and 39) mounted immediately below the timer on the panel of the MULTI-AMP relay tester is a dual section switch. Each section is controlled by a separate operating device. The first section of the switch reads against the nomenclature below the switch. It has five positions and is referred to below as the "LOWER" switch (39). The second section is controlled by a knob. It also has five positions and reads against the nomenclature above the switch. This switch is referred to below as the "UPPER" switch (38). By proper selection of positions, many varieties of tests can be run with the MULTI-AMP relay tester.

2 - 7

ويحمد الأراب والمتعاور المحفقات

In order to best explain the operation of this dual switch, its function, as most commonly used in relay testing, is first described.

1946 - Andrew College (1999 - 1995) - 1995 - **2. – 8** 

With the "LOWER" switch (39) set at "TIMER", the "UPPER" switch (38) may be set at any one of its five positions and operation of the test set will be as follows:

A. "N.O. MOM" (Normally Open Momentary) - When the relay under test has normally open contacts which are connected to the "Relay Contact" terminals (5), the test unit may be initiated by depressing the Initiating Switch (1). The selected output of the MULTI-AMP will remain energized as long as the initiating switch is held depressed or until the contacts of the device under test close. If the Initiating Switch is held depressed after the contacts of the device under test close, the cycle will repeat itself.

B. "N.O. MAINT" (Normally Open Maintained) - The function of this position is exactly the same as above except that the Initiating Switch need be depressed only momentarily to lock in the internal control relay. The timer will stop and the output of the MULTI-AMP relay test set de-energized upon contact closure of the device under test.

C. "C.A." (Current Actuated) - A third type of timer operation may be provided as an optional feature. The center position marked "CA" on the timer operation selector switch is inoperative unless a Current Actuator is supplied. The operation of the Current Actuator is as follows:

(1) A second state of the second property of the second se Second secon second sec

The output current of the test set passes through a current transformer(s) on the output common bus(es). The secondary of the current transformer(s) is rated 5 amperes and is connected to a series circuit containing the operating coil of the indicating ammeter the primary coil of a second current transformer. The secondary circuit of this second current transformer is used to energize the grid of a 2D21 Thyratron when a minimum pre-determined amount of current passes through the output terminals of the test unit, the Thyratron tube "fires", locking the test unit's and the main contactor closed until current flow ceases. "CA" Position is used when the device to be tested has no contacts other than those involved in the passing of test current (such as single pole circuit breakers). In this position, the timer will run from the initiation a search of the test unit until current flow from the output of

. The second of the test unit is interrupted. The mean of the ad

D. "N.C.MAINT." (Normally Closed Maintained) - In this position, the unit may be initiated by depressing the Initiating Switch (1) momentarily, provided the contacts of the device under test are in closed position and are connected to the "Relay Contact" terminals (5). The selected output will be energized and the timer will run until the contacts of the device under test open, at which time the output will be deenergized and the timer will stop.

- 「京都に開始の時代の「「海豚」」という。 - 「海」の「白い」の「小山」の「白い」の「白い」の「白い」の「白い」の「白い」の「 教 - 「「「」」

2 – 9

E. <u>"N.C. MOM" (Normally Closed Momentary)</u> - The operation in this position is exactly the same as in "D" above except that the output will be energized and the timer will run only as

long as the initiating switch is held depressed.
The selection of other positions on the "LOWER" switch(39) will
affect the operation of the relay tester in the following manner:
F. DC - In this position, the "Relay Contacts" (5) binding posts
are connected to the "DC 8" output of the test set for convenience in testing target and seal-in units on relays. (Note
that the Auxiliary Selector Switch (15) must be in "DC-8"
position.)

The timer will not run and closure of the contacts of the device under test will not de-energize the test set. Only the positions "N.O. MOM" and "N.O.MAINT" of the UPPER Switch (38) may be used for this position of the "LOWER" Switch (39).

- G. <u>"CONT"</u> (Continuity) In this position the "Relay Contacts" binding posts (5) are connected to the 6.3 volts continuity circuit of the test unit. Therefore, contact operations of a relay under test may be observed by watching the continuity light.
- H. "TIMER" This operation has been described above.
  - I. "OFF" With the "LOWER" switch (39) set to the OFF position, the timer motor and clutch are de-energized.
  - J. "FAST TRIP" In this position of the "LOWER" switch (39), the operation of the timer selector and initiating circuits are as follows:

MUST BE USED WITH "UPPER" SWITCH IN "N.O. MOM" POSITION.

With the Normally Open Contacts of the device under test connected to the "Relay Contacts" (5) binding posts, the unit may be initiated by depressing and holding the Initiating Switch (1). The closing of the contacts of the device under test will stop the Timer (36) upon their first closure. The output of the MULTI-AMP test unit will continue as long as the Initiating Switch is held depressed. In this way, devices may be tested whose contact closure occurs faster than the Initiating Switch

The second be released. At the property was a second to the second

#### - Andre Anderson de WARNING !!!

esentres - les subtrais antis de secolaritadas deliveradas de literador de la secolaritadas. Antis de la secondas

and the second second

一门,后山门门,门门,山口的"金田"的道道,第5年了他们自己的复数,总如果是这些金属。

化合理机 化合理性 化合理性 化合理性

, sjebile – k na sanskedar udvijek komenska svereda dve oregi of komenska of en revenska sveren de sekarska filosom sa kompilska skonstala CURRENT METERING CIRCUIT (AMMETER)

le de la fair de la décide de la construction de la service de la service de la service de la service de la se

na Millingan Proking industry and industry and set of the set of the

The main ammeter on the MULTI-AMP test set is equipped with an adjustable Pointer Stop or "Pointer Pre-Set", by means of which the ammeter pointer may be preset to any position on the scale and held there with no current flowing through the meter. This is a purely mechanical operation, easily accomplished by means of an insulated knob on the meter front. It is used to overcome the inertia of the moving system of the meter so that currents of short duration can be read or set accurately.

In use, the pointer is mechanically set approximately 1/2 scale division below the desired current reading. The load is connected, the timer operation selector switch is placed in either "N.O. MOM" or "N.C. MOM" position, and the main power control is slowly rotated clockwise while the initiating switch is periodically pulsed.\* Some quivering of the pointer will be seen as the output current approaches the pre-set value. In continuing to advance the Main Power Control, the meter pointer will lift off the "Pointer Pre-Set" to desired current.

\*NOTE: DO NOT MOVE THE CONTROL WHILE CURRENT IN EXCESS OF THE TAP RATING IS FLOWING.

I-M-P-O-R-T-A-N-T

ALWAYS MAKE CERTAIN THAT THE AMMETER IS SET ON A RANGE HIGH ENOUGH SO THE OUTPUT CURRENT WILL NOT DRIVE THE POINTER OFF SCALE.

NOTE: The ammeter position selected must be within the range of the "Common for Ammeter" tap selected.

#### SELECTION OF OUTPUT TAPS

The MULTI-AMP test set may be operated most advantageously by using the tap with the <u>Lowest Voltage</u><sup>\*</sup> rating consistent with being able to obtain the desired current. In this way, finer adjustment can be obtained by making maximum use of the autotransformer range. With a low impedance load, even small currents may be obtained from the <u>Low Voltage</u>, <u>High Current</u> tap. When the impedance of the load is too high to obtain the desired test current with the low voltage tap, it becomes necessary to use a higher voltage tap.

> IT SHOULD BE NOTED THAT THERE IS NO RELATION BETWEEN THE AMMETER RANGES AND THE CURRENT TAPS. ANY AMMETER RANGE CAN BE USED ON ANY TAP.

Current taps are provided to adapt the test set output to a wide range of load impedances.

Ammeter ranges are provided to facilitate more accurate read-

a second and the second se

\*When making a timing test on an overcurrent relay, it is suggested that the 80 volt tap be used. Its use will tend to nullify the effect of relay core saturation. When the relay is in good

adjustment, test time obtained will match the relay manufacturer's published curves within allowable tolerances.

(a) A set of the se

#### 2 - 13

#### 1822 AND 0 20-014-080 AND

SHORT TIME RATING The MULTI-AMP equipment is rated at a certain kva output and is equipped with one or more output taps each capable of supplying the rated kva. The total load kva rating of the unit may be exceeded as noted below. The continuous rating in kva is based on a 50% load factor of 1/2 hour FULL LOAD followed by 1/2 hour at NO LOAD. The MULTI-AMP test set can also be used for continuous duty of 100% ON provided the load current is limited to 70.0% of the output

tap value. A second of a second second second second second second second second

For Example:

	ating		n fast och Astra		) kva	- 1. t 11	esta fi		
	-		Ang shiri		1787 E		100		
0	utput	Taps:						amperes	
				40	volts	at	25	amperes amperes	or
		5 g. 2	1.21.2.2.2.2.2	80	volts	at	12.	.5 ampere	38

- (a) Consider the 10 volt tap. 100 amperes may be drawn at any voltage from 0 to 10 volts for 1/2 hour provided a 1/2 hour NO LOAD condition persists before load is re-applied.
  - (b) The 100 ampere tap may be used to supply a continuous (100% duty factor) load current of 70.7 amperes (70.7% of tap value) at any voltage from 0 to 10 volts.
- (c) The 100 ampere tap may be used to supply the following load currents for the time ON indicated, followed by the indicated OFF period and at any voltage from 0 to maximum. The maximum output voltage available when the rated current is exceeded (overload), will be less than the rated value due to the regulation of the transformers in the test set. For example, when drawing 200 amperes from the 100 ampere tap, the maximum voltage available is approximately 8.0 volts.

2 **- 15** 

Current	Time ON	<u>Time OF</u> F

100 A 200 A 300 A 20 seconds 4 minutes

the star we to it is a start start for a straight of

化加热试验检测试器 化化化试验 化乙酸 建冷却 医外外的 化化化合物 化化合物 化合金管理 计分子 化合金 化合金

- \*Continuous duty is defined as 30 minutes ON and 30 minutes OFF
- وال المراجع من عليك المعقولة، ما يعمر بالله والعام الله الله الله الله الله الله المالية. المحرف المعلمان العالية عليه المالية المعالية المحرف المحلة الله والله المحلة المحلة المحلة المحلة المحلة الم المحاصلية المحلة المحلة المحلة المحلة المحلة المحلولة المحلولة المحلة المحلة المحلة المحلة المحلة المحلة المحلة المحلة المحلولة المحلة المحلة المحلة المحلولة المحلولة المحلولة المحلة المحلة المحلة المحلة المحلة المحلة المحل
  - (\*\*\*\*) \* or state state galanting on the State \* or state to gate the state of t
  - 는 정말 (1997), 2019년 1월 2019년 2019년 1월 2018년 2019년 1월 2019년 2019년 2019년 2017년 2019년 2019년 2019년 2019년 2019년 2019년 1999년 - 11월 2019년 1월 2019년 2019년 3월 2019년 2019
  - → Burrow Barray, Ether (Allaberg), Connect Connect Campa Connect Connect, Connect Conference, Connect Conference, Connect Connect

1. 使命的 通過過速度 计方向中心的 注意。

a en en l'altra de Barra e recht a de la transfer a sector de la companya de la companya de la companya de la c

#### 2 - 16

#### USE OF PHASE SHIFTER AND PHASE ANGLE METER

#### WITH MULTI-AMP Models SR-21 and SR-51

The complete testing of certain relays requires control of the phase relationship between the two sources of energy utilized in the test. To facilitate testing of these relays, provisions have been made for connecting a Phase Shifter and Phase Angle Meter to the MULTI-AMP relay test sets.

PROCEDURE (Models CS-5 or CS-6)

- 1. Connect Phase Shifter to a suitable input power source.
- 2. Connect Phase Shifter terminals marked "Phase Shifter Output" to the "Aux. Power" input terminals on relay test set. Observe polarity. Connect terminals marked "±" together.
- 3. Plug in the telephone type plug into the "P.A.M." jack on relay test set. Connect the leads from the plug to the Phase Shifter terminals marked "Current Coil Input". Observe polarity. Connect black lead to terminal marked "±".
- 4. Turn "Aux. Pwr." Switch on relay test set to "EXT".
- 5. Turn "AUX." Selector Switch on relay test set to "AC3-24", "AC3-150" or AC3-300.
- 6. Depending on voltage level required for test, set voltmeter selector switch to "AC3".
- 7. The Phase Angle Meter will now read the angle between "Output #1" and "AC Output #3" of the relay test set. The Phase Shifter may be used to change this angle to any desired value. "Output #1" is varied in magnitude by the "Main Control" and read on the "Main Ammeter". "AC Output #3" is varied in magnitude by the "Aux. Control" and read on the voltmeter.
  - NOTE: If two (2) current sources are desired with variable phase relationship and magnitude, the above procedure may be used with the "Aux."Selector Switch set at "AC3-24". The second current is read on the 5/10 ammeter.

PROCEDURE (Model CS-7)

See Instruction Manual for MODEL CS-7.

#### PROTECTIVE RELAYS Principle of Operation

Protective relays are used as sensing devices in a power circuit. Their operation activates a control circuit to effect operation of a circuit breaker(s) located in the power circuit. For their operation, practically all protective relays employ either one or a combination of two basic principles:

a. Electromagnetic attraction and a state of a state of the state

b. Electromagnetic induction of the set of the second second

When the electromagnetic attraction principle is employed, the protective relay consists of an iron core surrounded by a coil of wire, an armature or plunger to which is attached a contact (known as the moving contact since it moves as the armature or plunger moves), and a fixed contact attached to the body of the relay. These two contacts are connected into the circuit breaker trip coil circuit. The contacts are maintained in their de-energized position by action of a spring or gravity. When the magnetic field is sufficiently strong, the armature or plunger moves and causes a relay operation. This, in turn, energizes a circuit through the trip coil of the breaker and opens the breaker. Normally, the operation of this relay has <u>no intentional time delay</u>. The principle of electromagnetic attraction may be used equally well on either AC or DC and it is responsive to DC transient offset.

When the electromagnetic induction principle is employed, the protective relay is essentially a small induction motor and, therefore, this relay may only be used on AC circuits. This type relay consists of a flat disc, cylinder or cup which is free to rotate, an iron core surrounded by a coil of wire, a moving contact attached

3 - 1

to the shaft of the rotating element, and a fixed contact located in the body of the relay. The rotating disc (cylinder or cup) is suspended between the pole pieces of the electromagnet and employs a spiral spring to return the moving contact to its de-energized position. As voltage is applied or current is passed through the electromagnet coil, a magnetic field is produced which develops a torque on the disc. When the magnetic field and resultant torque becomes strong enough to overcome friction in the bearings and tension in the spiral spring, the disc rotates moving a contact. Eventually, the moving and fixed contacts will make and energize the trip coil of the circuit breaker. When this is a single phase relay, some means of splitting the phase must be employed so that a rotating magnetic field is produced. These relays employ shading coils, polarized coils, wattmetric principles or tuned circuits. In some electromagnetic induction relays, the distance the moving contact travels may be controlled; these relays provide a time delayed operation. A provide the second state and the state that the state of the state of the second state of the state of the second state of th

Protective relays may be constructed so that they respond to faults in a specified section of a circuit (percentage differential), changes in current flow (overcurrent), fluctuations in applied voltage (over or under voltage), frequency changes (over or under frequency). More sophisticated protective relays may distinguish between allowable overloads and faults on a circuit or they may be employed to sectionalize a system. Since the protective relay is a sensing device connected to the power circuit through either current transformer or

n franske senten skale graaf af en en en fan franske skrake en en en kalender te en en en en en de skrake skra

3 - 2

potential transformers, it may be used to protect circuits of any known voltage level or current capacity. Circuit breakers that are operated by protective relays may be built with interrupting ratings measured in millions of <u>volt-amperes</u>.

Types of Relays

Although there are many models of relays, most fall within three (3) types:

1. Overcurrent and Voltage Relays

a. Greatest number in use

b. Involve a single coil which is either voltage or current actuated.

2. Bus, Generator or Transformer Differential and Current Balance Relays

a. Have two (2) or more circuits which act jointly upon an electromagnetic structure to provide contact action.

3. Distance, Directional and Impedance Relays

- a. These are "Complex Type" relays
- b. Have several components any one of which may require definite voltage, current and phase angle relationship for operation.

With the exception of the instantaneous relays, most of the above devices work on the induction principle.

(Sprite and Sprite in the set of a structure brack to a construct of the structure in the set of the set of

#### PREPARATION FOR RELAY TESTING

Relay testing should be kept to a minimum. It should be remembered that the purpose of testing is to prove that the relay will work and not to unnecessarily check all the details. Relay testing should be streamlined to as nearly approach actual conditions as possible in a minimum of time and effort. The following are some of the points to be considered:

#### 1. PLAN

- a. Set up program to fit system's needs.
- b. The technician should confer with operating personnel to work out procedures to be followed should a circuit be inadvertently tripped.

If the relay technician makes a mistake and trips a circuit, he should admit it immediately. This admission may save many hours of work trouble shooting the control circuit looking for non-existent problems. It should be remembered that one of the reasons for planned maintenance and testing is to build confidence in the protective system.

「いたいとない」 おちのからがち しろいえた ひょう

#### 2. SCHEDULING

a. Test program should be set up on a regular schedule.

- b. Test periods vary with system requirements. Annual inspection and test schedules are common practice.
- c. Operating personnel should be fully informed of the maintenance schedule and the work to be performed. Operating personnel should be notified in advance, and, if possible, operations should be shifted so that the circuits may be de-energized. However, if circuits cannot be de-energized, the technician should proceed with caution, bearing in mind that all the time a relay is out of the circuit, some of that circuit's protection is removed. Therefore, a relay job should never be started unless it can be finished before leaving the work area. It is imperative that any relay work be done in a very thorough manner. A job should not be rushed or left half-done.

#### 3. SAFETY

Safe work habits and use of good common sense cannot be overemphasized. Metal ladders or step stools should never be used around switchgear. If safety helmets are required, a fiber or plastic helmet should be worn. Loose key chains, tool pouches, or pieces of wire should never be allowed to hang from the body. Rings and metal watchbands should be removed.

usa wa sir di guna penakat

Whenever possible, power circuits should be de-energized and properly tagged to conform with approved procedures. It must not be assumed that circuits are de-energized.

Test personnel should be familiar with the "shock hazard". Since MULTI-AMP test units are all designed with output isolated from input, the "shock hazard" is at an absolute minimum. However, certain outputs of high value should be handled with proper caution. Voltages present in testing contribute to the very dangerous hazard of ventricular fibrillation.

#### 4. KNOW CONTROL CIRCUIT

It is important to know the pecularities of the control circuit associated with the relay being maintained; such as the trip circuit being interlocked with a cubicle door; or that removal of potential from the relay operating coil before opening the trip circuit results in tripping the power circuit breaker.

#### Identification of Circuits

Double-check the identification of the relays on the panel. This can be complicated when work on relay terminals must be done behind the board and there are a large number of similar boards.

#### 5. CURRENT TRANSFORMERS

The current transformer is a vital part of the electrical protective system. It is this device that reduces the current in the power circuit to a value that can be handled by the protective relay, and insulates the relay from the power circuit. There is <u>danger</u> associated with a current transformer. <u>Under no circumstances</u> should the secondary of a current transformer be opened while the primary is carrying current.

6. TARGET OR OPERATIONS INDICATOR

When a breaker trips under fault, this device indicates the type of fault and the phase which faulted. This information is important and, therefore, a target should never be reset without the supervisor's knowledge and permission.

7. READ AND UNDERSTAND MANUFACTURER'S INSTRUCTION LITERATURE

Many relays have been damaged in testing by incorrect procedures, unfamiliarity with the relay, or improper connections. The engineer in charge should specify test values and conditions. Served (1999) A server and that the control of the 3 control of the server, the server of the server

- a. Good records are very important. b. An individual card for each device is recommended.
- c. Using the information recorded during "As Found" and "As Left" inspections and tests, can result in an economic schedule for performing protective relay maintenance.

Suggested record forms are shown below.



معامل المراقعين فرائعة حركة بعض التربية بحملة الأراث المعلي المرأة المراقع من الكار المحكوم في المعامل المحكاة من كان المراجع المكافة المحمل المراجع الكامر والكراك في محمل المركز المحكوم في المحكوم في ويوم المحكومين في يؤدر المهام المعام في المحمل في محمد المحكوم المحمل المحكوم في المحكوم في المحكوم في المحكوم

#### RELAY INSPECTION

#### Tools and Equipment

#### je – dijudje stela od 2000 seda 2000 seda Pratovno statikuju

Before the job is started, the technician should have the required test data, settings, record cards, test equipment, leads and relay tools on hand.

The following tools are necessary to inspect and adjust protective relays:

1 regular blade straight tweezer state ender the later of	
1 heavy duty straight tweezer	
3 thin open-end wrenches, 3/16", 11/32", 3/8" 1 screw holding screwdriver	
1 thin blade screwdriver (6" shank 3/16")	
l Phillips screwdriver l Optician's screwdriver	
l pair needle nose pliers ou la sasse de la transference de la transference	
1 burnishing tool	
1 magnet cleaner 4 spintite wrenches, 3/16", 5/16", 11/32", 3/8"	N 1975
1 dental mirror	
1 small bulb syringe 1 soft 1" flat paint brush (insulated ferrule)	
l bullseye spirit level	
l offset boxwrench 5/16" l offset screwdriver	
e se en la completa de la completa d	

#### VISUAL INSPECTION CONTRACTOR STATES AND DEVELOPMENT OF THE STATES OF THE

A. Remove cover from relay case a state and a state as a state of the

WARNING The trip circuit is a live circuit and, on some relays, it is possible to cause an instantaneous trip while removing the relay cover.

1. Inspect the cover gasket. The same same same

2. Check glass for tightness in the frame, cracks, etc.

3. Clean glass inside and outside. Depicts of the second o

B. Remove relay from case and the second contract of the second cont

- 1. To eliminate uncertainties, short the CT secondary by jumpering the CT terminals on the back of the relay case. This jumper should be clipped on with square jaw clips such as crocodile clips.
- 2. Open trip circuit by opening the <u>Red</u> handled switch in the Westinghouse relay or removing the connection block in the General Electric relay.
- 3. Open the rest of the black handled switches on the Westinghouse relay.
- 4. Open the latches that hold the relay in the case and <u>carefully</u> remove relay from case. Remember that the switch blades attached to the case in the Westinghouse relay as well as the bars in the bottom of both the Westinghouse and the General Electric case are still "hot". If extreme care is not exercised, the breaker may be tripped. With capacitor trip, high voltages are present in the trip circuit; these voltages may be as high as several hundred volts.
- C. Foreign material such as dust or metal particles should be removed from the relay case and relay. This foreign material can cause trouble, particularly in the air gaps between the disc and magnet.
- D. Dust can be removed by blowing air from a small hand syringe.
- E. Remove any rust or metal particles from disc or magnet poles with a magnet cleaner or brush.
- F. Hold relay up to the light to make sure disc does not rub and has good clearance between magnet poles.
- G. Inspect relay for the presence of moisture. If free moisture is present or rust spots are noted, report this condition to supervisor. This condition may indicate that the relay is in the improper atmosphere and presents a design problem.
- H. Connections, especially taps, should be checked for tightness. Tighten all screws, nuts and bolts that are <u>not</u> pivotal joints.
- I. Sluggish bearings may be detected by noting smoothness of relay reset. Rotate the disc manually to close the contacts and observe that operation is smooth. Allow the action of the spiral spring to return the disc to its normal de-energized position. If the bearings appear bad or operation of the relay is questionable, this condition should be reported to the supervisor. It may be that the relay should be returned to the manufacturer for overhaul. On an instantaneous plunger type relay, occasionally a burr or groove may develop on the plunger which would cause the relay to "hang-up".

J. Check mechanical operation of targets by lifting the armature and observe showing of target.

ない。 は彼があいたかがら、彼氏で、彼氏を話していたがない。 たちが、天、氏、白色の「しょう」である。 こうしん しいないないなみになるから、そのかが、この人がない、かかであるがです。 こうない マン・ロート・ロート かい、 からくためになるかない。 ようなないのであったが、ない

- K. Observe that the relay coils have not been subjected to high currents for a prolonged period by smelling or squeezing between thumb and fingers.
- L. Components of the relay that touch when the relay is in a "normal" position and part as the relay "operates", should be cleaned. These parts may become dirty and prevent the relay from operating properly on relatively low overloads.
- M. Pitted or burned contacts should be cleaned with a contact burnisher. Never use a solvent on these contacts or touch with fingers as the residue left on the contacts may cause improper operation.

#### 化乙酰基苯基 化乙酸乙酯 医白喉 医坏死 网络海豚 人名法法 医颈外腹部分的

# ELECTRICAL TESTING

# The Test Equipment

The purpose of relay test equipment is to provide the relay with a load that will simulate operating conditions, and to meter electrical quantities with accuracy and simplicity. The test tools for common relays include time and current measuring instruments and loading devices as provided by the MULTI-AMP relay testers. For more complex relays, a phase shifter and phase angle meter are required for complete results. (See MULTI-AMP specifications for Models CS-5, CS-6 and CS-7 Phase Shifter and Phase Angle Meter units.

#### Proper Setup

Careless setups can use valuable time and often result in erroneous data. Attention should be given to proper setup of controls as given in MULTI-AMP test procedures, and proper connections to devices under test as given in manufacturer's literature.

#### A. Test Methods

1. Testing with the relay disconnected from the power and trip circuits.

2. Testing across the secondary of the current transformer with primary de-energized (secondary injection).

- a. This method may be used whenever it is possible to de-energize power circuit being tested.
- b. This test includes checking the operation of circuit breaker, presence of energy to trip breaker, etc.

c. Testing is done by introducing the test current at the secondary terminals of the instrument transformer (s). This test checks the relay connections as well as the relay.

- ta se transferencia e la construction de la construction de la construction de la construction de la constructio 3. Primary Circuit Test - high current, low voltage (Primary Injection)
- a. Complete system is checked including the current transformers.
- b. This method requires that caution and safety practices be closely observed, as test connections are made on the primary conductors.
  - c. This test simultaneously checks current transformer ratio, secondary wiring, polarity, relay operation and identity of each phase on the switchboard.
- This test is valuable for initially checking bus d. differentials where many current transformers are paralleled at the relay.

1. Relays with draw-out construction

Whenever possible and practical, the relay should be tested in place, disconnected from the power а. and trip circuits. The use of the proper test plug is convenient.

b. If the relay cannot be tested in place, carefully remove it from case and proceed to set up at a convenient location. Care should be exercised to ascertain that the relay is level. If possible, a spare case should be procured and used to hold the relay during the test.

2. Relays permanently fixed to panel.

a. Usually these relays have test facilities installed to disconnect the relay from the power and trip circuits and to permit access to the relay circuits from the front of the board.

b. If such facilities do not exist, it is necessary to test from rear of panel.

### C. Types of Tests

- Insulation resistance 1.
- state 2. sZero, checksa state szerezette att de a au
- 3. Pickup (induction disc and/or instantaneous unit)

Time characteristics (when applicable) 4.

# 

## 1025. . . Target and Seal-in operation for exercise terms in

6. Special tests that are peculiar to the specific type of relay such as through fault, reach, drop-out, etc.

## Insulation Resistance

A test that may be run on all types of relays to determine the condition of the insulation. In this test, 1200 volts AC is applied between the relay connections that are brought to the outside of the relay and the frame of the relay. If a finite quantity is read on the megohmmeter, look for trouble.

## Zero Check

A test conducted on any relay that has a time dial. The purpose is to determine the time dial reading when the relay's fixed and moving contacts are closed by the manual rotation of the time dial towards zero.

#### Pickup

A test conducted on relays to determine the minimum or maximum current, voltage, power, or frequency that will allow relay operation and closure of the relay contacts.

## Time Characteristics

A test run to determine the elapsed time for relay operation with a specific abnormal quantity of current, voltage, power or frequency.

#### Target and Seal-In Operation

A test to determine minimum current required in the trip circuit for an operation of the target and/or seal-in unit.

م المدار الجنور

i si kuto danka meneral desili

# INDUCTION DISC OVERCURRENT RELAYS

(Westinghouse Type CO) (General Electric Type IAC)

# GENERAL ( Contract and the contract provided between the second of the

The overcurrent relay is designed to detect abnormal conditions of current in a circuit. If the abnormal condition is an overload, usually there will be a time delay operation. Time current characteristics are inverse. A short circuit or fault will cause an instantaneous operation of the relay providing the relay is equipped with such a unit.

The time delay overcurrent relay is an induction disc relay. The action of the spiral spring is to keep the relay trip circuit contacts open. The spiral spring action is opposed by torque produced as current is passed through the relay's current actuated operating coil. Thus, the higher the current, the faster the disc rotates.

The following procedures describe the use of the MULTI-AMP units in testing time overcurrent relays. There are many variations within this type. However, they all operate on similar principles. It is recommended that details of relay circuits be obtained from the manufacturer's instruction book as well as other pertinent data concerning procedures.

These test procedures are designed so that a specific test can be made without performing all tests on the relay. See following test procedure for "Complete Test of an Overcurrent Relay" which outlines the most efficient manner to consecutively perform all tests.

TEST PROCEDURES

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

Type of Tests

Pickup

Time Current Characteristics

Instantaneous Trip

SETUP OF CONTROLS BEFORE TEST

. . . . . . . . . . .

CONTROL	POSITION
"Power ON"	•••• <b>OFF</b>
'Timer Operation Selector" Switch	UPPER-"N.O.MOM" LOWER-"CONT."
Main Control"	wise)
Aux. Power" Switch	
'Voltmeter Range" Switch	and the second
"Voltmeter Selector" Switch	"EXT. A.C."
"Aux. Selector" Switch	<ul> <li>A state of the sta</li></ul>
"Aux. Control"	Zero (counter- clockwise) 10A (not SR-21)
DC Range" Switch	••• <b>5A</b>
"Main Ammeter Range" Switchtest cur upper 1/ "Voltage Relay Test"("Direct. Element Test")S	rent will be read on 3 of meter scale.
"Output #1-#2" Switch	Output #1
Lesting Pickup	<ul> <li>Mile State Constraints (Pro- physical State Sta</li></ul>
1. Connect the MULTI-AMP relay tester to a s power as indicated on the nameplate and g MAIN SWITCH IS OFF. CHECK THE "POWER ON"	round. BE SURE THE
<ol> <li>Connect induction unit operating coil to 80 volt tap of "Output #1".</li> </ol>	right-hand Common and
3. Connect light leads from binding posts ma to induction disc unit trip circuit conta relay.	rked "Relay Contacts" act terminals of the
4. Select proper Main Ammeter range. Expect should be read in upper 1/3 of ammeter sc	ed value of pickup ale.

5. Adjust "Timer Operation Selector" Switch -- UPPER to "N.O. MAINT", LOWER to "CONT".

a de la compositiona de la compositiona de la compositione de la compositional de la compositione de la composi La compositione de la compositione La compositione de la compositione La compositione de la compositione d

- 6. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 7. Initiate unit by pressing "Initiate" Switch.
- 8. Rotate "Main Control" (clockwise) to increase output until relay induction unit trip circuit contacts close and the Continuity light flickers. The "Aux. Control" may be used as a fine adjustment for "Main Control".
- 9. Read current on Ammeter. Record.

# Testing Time Current Characteristics

- 1. Connect the SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect relay induction unit operating coil to right-hand Common and 80 volt tap of "Output #1". (Note: Test current should not exceed 25 amperes. If relay tap exceeds 8, move tap to 4 or 5 position for this test)
- 3. Select ammeter range so that test current will be read in UPPER 1/3 of meter scale. Preset ammeter needle using "Pointer PreSet". Set to 1/2 division below desired current value.
- 4. Adjust "Timer Operation Selector" Switch, UPPER to "N.O. MOM", LOWER to "CONT.".
- 5. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 6. Initiate unit by pressing "Initiate" Switch.
- 7. Set test current desired by jogging unit with "Initiate" Switch and rotating "Main Control" (clockwise) to increase output until the ammeter needle quivers. Hold in "Initiate" Switch and rotate "Aux. Control" as a fine adjustment to the "Main Control" until test current is read on ammeter.
- 8. Connect light leads from binding posts marked "Relay Contacts" on the SR-51 to trip circuit contact terminals on relay induction unit.
- 9. Set "Timer Operation Selector" Switch, UPPER to "N.O.MAINT." (or "N.C.MAINT." if relay is of circuit opening type), LOWER to "TIMER".
- 10. Reset timer to zero with "Timer Reset" button.
- 11. Initiate unit by pressing "Initiate" Switch. Timer will run and test current will flow. The relay tester will automatically cut off, and the timer will stop when relay contacts make (or break).

- 13. If desired, reset "Timer Operation Selector" Switch -- UPPER to "N.O. MOM", LOWER to "CONT.". Proceed from Step 6 to obtain another point on relay curve.
- 14. When test is concluded, return "Main Control" knob to zero setting. Replace relay tap in proper position.
- NOTE: Check Ammeter while test is on for accurate reading. Minor adjustment may be made with "Aux. Control".

#### Testing Instantaneous Trip

ie S

- 1. Connect the MULTI-AMP relay tester to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect relay instantaneous unit operating coil (with heavy leads) to "Output #1" of the relay tester. Connect to appropriate Common for ammeter range to be utilized and "10V-100Amp" tap.
- 3. Select Ammeter Range so that desired test current will be read in upper 1/3 of meter scale.
- 4. Connect light leads from binding posts marked "Relay Contacts" on the relay unit to trip circuit contact terminals on the relay instantaneous unit.
- 5. Set "Timer Operation Selector" Switch -- UPPER to "N.O. MOM", LOWER to "FAST TRIP".
- 6. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 7. Initiate unit and hold in "Initiate" Switch.
- 8. Rotate "Main Control" (clockwise) to increase current until timer stops. Make sure this is minimum setting on "Main Control" where instantaneous unit of relay will consistently pick up as the "Initiate" Switch on the test set is alternately opened and closed.
- 9. Rapidly read this value of current and release "Initiate" Switch.

WARNING!!!	CURRENT IS	FLOWING	THROUGH I	HE RELAY	COIL UNTIL
	"INITIATE"	SWITCH	IS RELEASE	ED. There	fore, it is
	important t	O READ	THE VALUE	OF CURREN	IT RAPIDLY.

10. Record ammeter reading.

#### COMPLETE TEST OF AN OVERCURRENT RELAY

The following procedure outlines the most efficient manner to consecutively perform all tests on an overcurrent relay. This procedure involves the least possible number of changes in the connecting test leads and test set controls. n en en martin de la destruction de la clara esta constructiones de la clara de la clara de la clara de la clar TYPES OF TESTS Zero Check Pickup-Induction Unit Timing- Induction Unit D.C. Target & Seal-In - Pickup Instantaneous Pickup des de sa destruction de la Meles indice en la second SET UP OF CONTROLS BEFORE TEST POSITION CONTROL "Power On" .....OFF "Timer Operation Selector" Switch..... UPPER - "N.O. MOM" LOWER - "CONT" "Main Control.....Zero (counterclockwise) "Aux. Power" Switch....."INT" "Aux. Selector" Switch..... "Aux. Control".....Zero ( counterclockwise) "AC Range" Switch..... SR-21) "MAIN Ammeter Range" Switch......To read test current on upper 1/3 meter scale "Voltage Relay Test" ("Direct. Element Test"-SR-51) SET NORM Switch and a second 

searchean de geber tre setter t

#### ZERO CHECK

This test is to determine that the relay contacts close when the dial is set to zero. For this test, the continuity light of the MULTI-AMP relay tester is used. Consult manufacturer's instruction leaflet to identify current terminals and contact terminals.

### Procedure

- Connect the MULTI-AMP test set to a suitable source of power as 1. indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- Connect light leads from binding posts marked "Relay Contacts" 2. to trip circuit contact terminals of the relay induction unit.
- Turn "Power ON" Switch ON. "Power ON" light should glow. 3.
- Manually rotate time dial on the relay toward zero until the 4. continuity light glows. Record reading on time dial.
- Reset time dial as specified, adjust for any irregularities 5. and a state of the second s A second uncovered in the Zero Check test.
- Turn "Power ON" Switch OFF. Official of a late of a late of the second o б.

# PICKUP - INDUCTION UNIT

This test is to determine the minimum operating current of the relay; that is, the minimum current needed to close the relay contacts for any particular tap setting. Pickup value should be equal to tap value = 5%.

- Connect relay induction unit operating coil to right-hand Common 7. and 80 volt tap of "Output #1".
- Select Main Ammeter range so that relay tap value of current may 8. be read on upper 1/3 of ammeter scale.
- Adjust "Timer Operation Selector" Switch UPPER to "N.O. Maint", 9. LOWER to "CONT.".
- 10. Turn "Power ON" Switch ON.

المتحاد المراجع والمراجع

- 11. Initiate unit by pressing "Initiate" Switch.
- 12. Rotate "Main Control" (clockwise) to increase output until relay picks up and Continuity light flickers. "AUX. Control" may be used for fine adjustment.
- 13. Read current on ammeter. Record.
- 14. Turn "Power ON" Switch OFF. na ana ao amin' na mana ao amin' na mana mana mana amin' na mana ao amin' ao amin' ao amin' ao amin' ao amin' a

计同步问题者 网络小学校 网络小学校 网络教教教师 网络教教教师 化

a destruction de la constant de la c La constant de la cons

a ha a shekara marana a she shekara shekara

•

	: If relay tap exceeds 8, move to 4 or 5 tap for this test.
IOTE	This should prevent test current from exceeding 25 amperes.
.5. 1	Return both "Main Control" and "Aux. Control" to zero.
.6.	Adjust "Timer Operation Selector" Switch, UPPER - "N.O.MOM.", LOWER - "CONT.".
. 4	Select main ammeter range so that test current will be read in upper 1/3 of meter scale. Use ammeter Pre-Set so that ammeter needle is approximately 1/2 division below desired current.
18. 9	Turn "Power ON" Switch ON. "Power ON" light should glow.
19.	Initiate unit by pressing "Initiate" switch.
	Set test current desired by jogging unit with "Initiate" Switch and rotating "Main Control" (clockwise) to increase output until ammeter needle quivers. Hold in "Initiate" Switch and rotate "Aux. Control" to make final current adjustment.
<b>?</b> 1.	Set "Timer Operation Selector" Switch, UPPER - "N.O. MAINT." (or "N.C.MAINT." if relay is of circuit opening type), LOWER - "TIMER".
22.	Reset timer to zero with "Timer Reset" button.
	Initiate unit by pressing "Initiate" Switch. Timer will run and test current will flow. The relay tester will automatically cut off and the timer will stop when relay contacts make (or break).
24.	Read timer. Time shown is total time of test. Record time.
	If desired, reset "Timer Operation Selector" Switch, UPPER - "N.O.MOM", LOWER - "CONT.". Proceed from Step 15 to obtain another point on relay curve.
26.	When test is concluded, return "Main Control" knob to zero setting.
NOTE	: Check ammeter while test is on for accurate reading. Minor adjustment may be made with "Aux. Control".
Test	ing DC Target and Seal-In
27.	Adjust "Timer Operation Selector" Switch UPPER - "N.O.MAINT.", LOWER - "DC".
28.	Adjust "Aux. Selector" to "DC-8" the selector of the selector
29.	Adjust Main Ammeter range switch so that a current value approximate ly 150% of relay tap value may be read in UPPER 1/3 of meter scale.
30.	Choose proper range for DC Ammeter.

ì

- 32. Initiate test unit by pressing "Initiate" Switch.
- 33. Rotate "Main Control" clockwise to energize relay induction unit operating coil with a value of current equal to approximately 150% relay tap value.
- 34. When relay induction unit trip circuit contacts close, rotate "Aux. Control" clockwise to energize relay target coil with DC. When target drops, read and record DC amperes.
- 35. Rotate "Main Control" counterclockwise to zero. If DC circuit is energized when relay induction unit trip circuit contacts open. the Seal-In unit is working properly.

36. Return "Aux. Control" to zero and turn test set OFF.

Testing Instantaneous Pickup

- 37. Connect relay instantaneous unit operating coil to right-hand Common and 10 volt tap of test set "Output #1".
- 38. Connect relay instantaneous unit trip circuit contacts to "Relay Contacts" binding posts of test set.
- 39. Select Main Ammeter range so that desired test current will be read in UPPER 1/3 of meter scale.
- 40. Adjust "Aux. Selector" to "VERN.".

•\*\*

- 41. Set "Timer Operation Selector" Switch, UPPER "N.O. MOM.", LOWER - "FAST TRIP".
- 42. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 43. Initiate unit by holding in "Initiate" Switch.
- 44. Rotate "Main Control" (clockwise) to increase current until timer stops. Make sure this is minimum setting on "Main Control" where instantaneous unit of relay will consistently pick up as the "Initiate" Switch is alternately opened and closed:
- 45. Rapidly read this value of current and release "Initiate" Switch.

WARNING!!! COURRENT								
			IS RELEAS					
IMPORTAN	TV TV	ro read	THE VALU	EOF	CURRENT	RAPI	DLY.	

46. Record ammeter reading.
47. Turn test set OFF: A second ammeter reading.
47. Turn test set OFF: A second ammeter reading.
47. Turn test set OFF: A second ammeter reading.
47. Turn test set OFF: A second ammeter reading.
47. Turn test set OFF: A second ammeter reading.
48. A second ammeter reading.
48. A second ammeter reading.
49. A second ammeter reading.
40. A second ammeter readi

# CURRENT PHASE BALANCE RELAYS (General Electric IJC) (Westinghouse CM)

The Current Phase Balance Relay operates to trip a circuit breaker when the phase currents in a circuit become unbalanced by some predetermined amount. This relay compares the three phase currents of a line.

# General Electric Type IJC

The General Electric IJC relay is composed of three individual induction discs with two coils per disc. One coil produces a contact closing torque on the disc and is called an operating coil. The second coil produces a contact opening torque on the disc and is called a restraint coil. These two coils see currents from different phases of the circuit and the relay will operate when the phase currents become sufficiently unbalanced. The trip circuit contacts associated with all three induction discs are connected in parallel.

and a second second second state of the second s

## Testing

Always refer to manufacturer's literature before testing.

#### Types of Tests

- and a start of the second s A second secon

  - 3.
  - 4. Target and Seal-In

# SETUP OF CONTROLS BEFORE TEST

CONTROL

POSITION

· 建立的运行。 "这些学校你们是这些教师,它们就是一些发展的时候,我们

"Power ON" Switch..... OFF "Timer Operation Selector" Switch......UPPER-"N.O. MAINT." LOWER-"CONT."

"Aux. Power" Switch.....

"Aux. Selector" Switch..... "VERN."

"Main Ammeter Range" Switch..... be test current may be read in upper 1/3 of scale

"Voltage Relay Test" (DET) Switch......Set "NORM"

Testing Pickup

ge .

- 1. Connect SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect current operating coil for one unit of the relay to "Output #1" of the SR-51.
- 3. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 4. Initiate unit by pressing "Initiate" Switch.
- 5. Slowly increase current by rotating "Main" and "Aux." controls clockwise until disc moves and contacts are almost closed. Then decrease current until disc remains stationary at this point.

St. St. Berger

- 6. Record this value of current as Pickup.
- 7. Repeat for operating coils of the other two relay units.
- Testing Timing A toblication where a transformed to writer and a first material of
- 1. Repeat Steps 1 and 2 under "Pickup".
- 2. Set Main Ammeter Pointer Pre-Set to 1/2 division below desired test current.
- 3. Adjust "Timer Operation Selector" Switch, UPPER-"N.O.MOM", LOWER-"CONT.".
- 4. Set test current desired by jogging with "Initiate" Switch and rotating Main Control clockwise. Fine adjustment may be made by rotating "Aux." Control clockwise.
- 5. Using a pair of light leads, connect relay trip circuit contact terminals to "Relay Contacts" binding posts on the SR-51.
- 6. Adjust "Timer Operation Selector" Switch to UPPER-"N.O. MAINT.", LOWER-"Timer".
- 7. Reset Timer to zero. Make sure relay trip circuit contacts are fully open.
- 8. Initiate test unit by pushing "Initiate" Switch.
- 9. Observe and record time for relay trip circuit contacts to close.
- 10. Repeat Steps 1-9 for operating coils of the other two relay units.

#### Testing Slope

- 1. Repeat Steps 1 and 2 under "Pickup" test.
- 2. Connect restraint coil for same relay unit that was used in Step 2 under "Pickup Test" to "AC Output #3".

- 3. Adjust "Timer Operation Selector" Switch to UPPER-"N.O.MAINT.", LOWER-"CONT.".
  - 4. Turn "Aux. Selector" Switch to "AC3-24".
- 5. Turn "Power ON" Switch ON. "Power ON' light should glow.
- 6. Initiate unit by pressing "Initiate" Switch.
- 7. Rotate "Main Control" clockwise to energize operating coil of
- se grelay unit under test.
- 8. Rotate "Aux. Control" clockwise to energize restraint coil of relay unit under test.
- 9. Regulate the two currents until the disc of the relay under test is stopped with that unit's trip circuit contacts. (About halfway between full open position and trip position.)
- 10. Record both values of current and calculate slope.
- 11. Repeat Steps 1-10 for the other relay units.

# Westinghouse Type CM Relay

The Westinghouse Type CM relay has two individual induction discs. Each disc has two current coils. One coil produces torque to move the disc to the left and the other coil produces torque to move the disc to the right. As long as the currents energizing the two coils are equal, the torques cancel and the disc remains stationary. In connecting the relay in the circuit, the coil producing rotation to the right on one disc is in "A" Phase, while the coil producing rotation to the left on the same disc is in "B" Phase. The other disc is connected left rotation "B" Phase, right rotation "C" Phase. Each unit of the relay has a moving contact attached to the disc shaft and two stationary contacts, one on the right and one on the left. When the relay is energized with balanced 3-phase currents, the moving contacts of both relay units should be midway between the left and right stationary contacts. An unbalance of the phase currents will cause either or both of the discs to rotate with subsequent closing of the relay trip circuit contacts. The relay trip circuit contacts are connected in parallel.

#### Types of Tests

- 1. Electrical Balance
- 2. Minimum Trip Setting
- 3. Operating Curve
- 4. Time Curve

#### Testing

Always refer to Manufacturer's literature before testing.

.

# SETUP OF CONTROLS BEFORE TEST

CONTROL		POSITION POSITION	× 1
		••••••••••••••••••••••••••••••••••••••	2
"Timer Operation	Selector" Switch.	UPPER-"N.O.MOM" LOWER-"CONT."	. <sup>14</sup>
"Main Control"		Zero (counterclockwise	<b>)</b>
"Aux. Power" Swit	<pre>M</pre>	······································	
"Voltmeter Range"	"Switch	•••••••••••• <b>300</b>	
"Voltmeter Select	tor" Switch	"EXT. AC"	an thi
"Aux. Selector"	Switch	••••••"VERN."	ale sule i l
"Aux. Control"	•	Zero (counterclockwise	)
"AC Range" Switch			
"DC Range" Switc	анда болай с Панан с Конед <b>h</b>	en andere en la serie de la ••••••••••••••••••••••••••••••••••••	*
Main Ammeter Ra	nge <sup>n</sup> Switch	So that desired test c will be read in UPPER meter scale	urren
"Voltage Relay T	est"(DET) Switch	Set "NORM"	e (*
"Output #1-#2" S	witch	•••••••Output #1	
Testing Electric	al Balance	a na shi waqaala baqaya dhar bar daalada	1
1. Connect Mode the nameplat THE "POWER O	e and ground. BE	ble source of power as indicat SURE THE MAIN SWITCH IS OFF.	ed on CHECK
2. Connect fron Output #1 te	t operating coil o rminals of the SR-	f one induction disc unit to 51.	
3. Connect rear "AC Output #	operating coil of 3" terminals of th	the same induction disc unit le test set.	to
4. Adjust "Aux.	Selector" Switch	to "AC-3 24".	· .
5. Adjust "Time	r Operation Select	or" Switch to UPPER-"N.O.MAIN	• ",
LOWER-CONT.			

- 7. Initiate unit by pressing "Initiate" Switch.
- 8. Rotate "Main Control" clockwise to obtain a reading of 6 amperes on Main Ammeter.
- 9. Rotate "Aux. Control" clockwise to obtain a reading of 6 amperes on the second AC Ammeter on test set.
- 10. The moving contact of the induction disc unit under test should be in a balanced position as described in relay manufacturer's literature.
- 11. Turn "Power ON" Switch OFF.

## Minimum Trip Setting

- 1. Repeat Steps 1 through 7 under testing "Electrical Balance".
- 2. Connect light leads from "Relay Contacts" binding posts on test set to the trip circuit contacts of the relay.
- 3. Rotate "Main Control" clockwise to obtain a reading of one ampere on "Main Ammeter".
- 4. Adjust left stationary contact until it just makes with the moving contact as indicated by glowing of the Continuity light.
- 5. Return "Main Control" to zero.
- 6. Rotate "Aux. Control" clockwise to obtain a reading of one ampere on second AC Ammeter of test set.
- 7. Adjust right stationary contact until it just makes with moving contact, as indicated by glowing of Continuity light.

#### Operating Curve

- 1. Connect light leads from "Relay Contacts" binding posts on the test set to the trip circuit contacts of the relay.
- 2. Repeat Steps 1-8 under "Testing Electrical Balance".
- 3. Rotate the "Aux. Control" clockwise until the moving contact and the right stationary contact just make, as indicated by flickering of the Continuity light. Record readings of both ammeters.
- 4. Slowly decrease current output of "AC Output #3" by rotating the "Aux. Control" counterclockwise until the moving contact and lefthand stationary contact just makes, as indicated by flickering of Continuity light. Record readings of both ammeters.

Time Curve

- 1. Repeat Steps 1-6 under "Testing Electrical Balance".
- 2. Connect a pair of light leads from "Relay Contacts" binding posts of the test set to trip circuit contact terminals of the relay.
- 3. Jog "Initiate" Switch and rotate "Main Control" to obtain a reading of 10 amperes on main ammeter.
- 4. Manually set moving contact to "Balance" position.
- 5. Adjust "Timer Operation Selector" Switch, UPPER-"N.O.MAINT.", LOWER-"TIMER".

6. Initiate test set by pressing "Initiate" Switch.

- 7. Read and record time for closure of moving contact and left stationary contact.
- 8. Adjust "Timer Operation Selector" Switch UPPER-"N.O.MOM", LOWER-"CONT.".
- 9. Return "Main Control" to zero.
- 10. Jog "Initiate" Switch and rotate "Aux. Control" to obtain a reading of 10 amperes on second AC Ammeter.
- 11. Manually set moving contact to "Balance" position.
- 12. Adjust "Timer Operation Selector" Switch to UPPER-"N.O.MAINT.", LOWER-"TIMER".
- 13. Initiate test set by pushing "Initiate" Switch.
- 14. Read and record time for closure of moving contact and right stationary contact.

물리가 그 전철에서 동생님은 것들을 지말 가까? 성장

and the second secon

Repeat all four tests, i.e. Electrical Balance, Minimum Trip Setting, Operating Curve and Time Curve for the other induction disc unit.

n e ten en el la companya de la comp Este en la companya de la companya de la

a de destanos de estanos en entre en entre en entre en entre en entre en entre en el entre en entre de la cons Mariante en Mariante de la constante en entre a constante en entre en entre en entre entre entre entre entre en

99. Several de la company de la company de la company de la several de la several de la company de la company e La majoria de la company de

a de la companya de l

٠ .

# VOLTAGE RESTRAINT OVERCURRENT RELAY

A TARABA AND AND AND A SAME (GENERAL ELECTRIC TYPE IJCV) and a same and

## GENERAL

The IJCV contains an induction disc which is influenced by the magnetic fields of two electromagnets. The current actuated electromagnet produces torque on the disc to close the relay trip circuit contacts and is known as the operating coil. The potential actuated electromagnet produces torque on the disc to open the relay trip circuit contacts and is known as the restraint coil. When the voltage applied to the restraint coil decreases, a smaller amount of current is required to operate the relay and close the trip circuit contacts. This relay may operate to close trip circuit contacts even though the voltage applied to the restraint coil may remain at full system voltage.

The IJCV relay is normally used to protect a generator against bus faults.

#### Testing

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

Type of Tests

Pickup of overcurrent unit, zero voltage restraint Pickup of overcurrent unit, system voltage restraint Timing of overcurrent unit, zero voltage restraint Timing of overcurrent unit system, voltage restraint

SETUP OF CONTROLS BEFORE TEST

"Aux. Selector" Switch....."AC-3-150"

••

.

CONTR	POSITION
"Aux.	Control"Zero (counterclockwise)
"A.C.	Range" Switch
"D.C.	coRange" Switch
"Mair	Ammeter Range" SwitchSo that desired test current may be read on upper 1/3 of meter scale.
"Volt	age Relay Test" (DET) SwitchSet "NORM"
"Outr	put #1 - #2" Switch
Testi	Ing for Pickup - Zero Volts Restraint
1.	Connect the Test set to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
2.	Connect relay voltage restraint coil terminals to test set binding posts marked "A.C. Output #3".
3.	Connect the relay current operating coil terminals to the test set "Output #1" right-hand Common on 80 volt tap.
4.	Connect test set binding posts marked "Relay Contacts" to the relay trip circuit contacts terminals.
5.	Turn "Power On" Switch ON. "Power ON" light should glow.
6.	Initiate unit by pressing "Initiate" Switch.
7.	Increase current through operating coil of relay to a value 50% above relay tap by rotating "Main Control" clockwise.
8.	When relay contacts close, Continuity light will glow.
9.	Slowly decrease current by rotating "Main Control" counter- clockwise until Continuity light flickers. Record this value of current as "Pickup - zero volts restraint".
10.	Return "Main Control" to zero and turn "Power ON" switch off.
Test	ing for Pickup - System Volts Restraint
Repe	at steps 1 - 6 above.
7.	Apply system voltage to voltage restraint coil of relay by rotating "Aux. Control" clockwise.
8.	Repeat steps 7 - 10 above.

.\*

.

. A. Ma<sup>\*</sup>

:

•

# Testing Timing - Overcurrent Unit - Zero Volts Restraint

- Connect the test set to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. 1. CHECK THE "POWER ON" LIGHT.
- Connect relay voltage restraint coil terminals to "AC Output #3" 2. binding posts of the test set.
- Connect the relay current operating coil terminals to the test set "Output #1" right-hand Common and 80 volt tap. 3.
- Connect the test set "Relay Contacts" binding posts to the relay 4. trip circuit contact terminals.
- Pre-set Main Ammeter needle 1/2 division below desired test 5. current.
- 6. Adjust "Timer Operation Selector" Switch UPPER to "N.O. MOM", LOWER to "CONT.".
- Turn "Power ON" Switch ON. "Power ON" light should glow. 7.
- Initiate unit by pressing and holding "Initiate" Switch. 8.
- Set test current to desired value by rotating "Main Control (clockwise) while jogging "Initiate" Switch. 9.
- 10. Set "Timer Operation Selector" Switch UPPER to "N.O. MAINT.", LOWER to "TIMER". ng• bblachter

11. Reset timer to zero with "Timer Reset" button.

12. Initiate unit by pressing "Initiate" Switch. Timer will run and test current will flow until the relay trip circuit contacts close.

13. Read timer. Time shown is total time of test. Record time.

14. Turn "Power ON" Switch OFF.

٠.

٠.

đ

۰.

Testing Timing Overcurrent Unit - System Voltage Restraint

- Repeat Steps 1 8 above "Timing Test". 1.
- Rotate "Aux. Control" clockwise to increase applied voltage to a 2. value equal to system voltage.
- Repeat Steps 9 14 above "Timing Test".

3.

# VOLTAGE CONTROLLED OVERCURRENT RELAY

## (WESTINGHOUSE TYPE COV)

3 - 29

#### GENERAL

The COV relay contains an induction disc overcurrent unit and an instantaneous undervoltage unit. The undervoltage unit supervises the operation of the overcurrent unit. Regardless of the amount of current passing through the operating coil of the overcurrent unit, no operation takes place unless the undervoltage unit has "dropped out". This means that the overcurrent unit may be set to operate on less than full load current when the voltage falls below a predetermined value. Conversely, the overcurrent unit will not operate as long as the voltage is above the predetermined value.

This relay is normally used to protect a generator against a bus fault. an an tha the second second

# Testing and the second second

ical Tests		
	ndervoltage unit	
Voltage c	ntrol of overcurrent unit	1
Pickup - Time curr	vercurrent unit nt characteristics - overcurrent unit.	Î.

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SETUP OF CONTROLS BEFORE TEST

CONTROL

#### POSITION

"Power On".....OFF

"Timer Operation Selector" Switch.... UPPER -"N.O. Maint." en en la contra de l Loure de la contra d

"Main Control"..... .....Zero (counterclockwise)

"Aux. Power" Switch....."INT."

be read in upper 1/3 of scale

"Voltmeter Selector" Switch....."AC-3"

"Aux. Selector" Switch......"AC-3 150"

"Aux. Control"......Zero (counterclockwise)

CONTROL	
"DC Range" Switch	
"Main Ammeter Range" Switch	
"Voltage Relay Test" (DET) SwitchSet "NORM"	
"Output #1-#2" Switch	
化化学学校 化化学学校 化化学学校 化化学校 化化学学 化化学学 网络新闻教师 网络新闻教师 网络古罗马拉 计分析 化分析 法法法 法法律 法法 医结核结核 化化合物	
Testing Pickup and Dropout of Undervoltage Unit	
1. Connect the test set to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.	
2. Connect the "AC Output #3" binding posts of the test set to the undervoltage unit operating coil terminals.	
3. Connect a pair of light leads from the "Relay Contacts" binding posts of the test set to the relay so that operation of the undervoltage unit contacts may be observed.	
4. Turn "Power ON" Switch ON. "Power ON" and "Continuity" lights should glow.	
5. Initiate test set by pushing "Initiate" switch.	
6. Rotate "Aux. Control" (clockwise) to increase voltage applied to undervoltage unit operating coil until the Continuity light just goes out. Read and record this value of voltage as "pick-up of undervoltage unit."	
7. Continue to rotate "Aux. Control" clockwise to increase applied voltage until relay rated voltage is read on test set voltmeter.	
8. Rotate "Aux. Control" counterclockwise to decrease applied voltage until the Continuity light just lights. Read and record this value of voltage as "drop out of the undervoltage unit."	•
9. Return "Aux. Control" to zero and turn test set "Power ON" switc OFF.	h
Testing Voltage Control of Overcurrent Relay	
1. Connect the test set to a suitable source of power as indicated on the nameplate and ground. BE SURE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.	* *
2. Connect the "AC Output #3" binding posts of the test set to the undervoltage unit operating coil terminals.	

3. Connect "Output #1" terminals of the test set to the overcurrent unit operating coil terminals.

÷.,

	<b>4</b> .	Adjust "Main Ammeter Range" switch so that the desired to current may be read on the upper 1/3 of the meter scale.	est
	5.	Connect light leads from the test set binding posts marke "Relay Contacts" to the relay trip circuit contacts term	ed Lnals.
	6.	Adjust "Timer Operation Selector Switch" - UPPER to"N.O. LOWER to "TIMER".	MAINT."
	7.	Initiate test set by pushing "Initiate" switch.	
	8.	Rotate "Aux. Control" clockwise until relay rated voltage read on voltmeter.	
	9.	Rotate "Main Control" clockwise until the value of current on the main ammeter is approximately 4 times tap value of overcurrent unit.	f the
	10.	. The overcurrent unit should <u>not</u> operate to close the relative contacts.	
i.		. Rotate "Aux. Control" counterclockwise to reduce voltage undervoltage unit "drops out".	
	12.	. The overcurrent unit should operate to close the relay to circuit contacts. This stops timer and de-energizes the	rip relay.
	Test	sting Pickup of Overcurrent Unit Made Lowerst Base rouged rea	
		sting Pickup of Overcurrent Unit Made Liberted Reserved and the sec	
	SET	TUP OF CONTROLS BEFORE TEST	an a
	SETU CON	TUP OF CONTROLS BEFORE TEST AN HAR TO BE LAND TO THE AND THE AS A DETERMINED	an a
	SETI CON	TUP OF CONTROLS BEFORE TEST NTROL POSITION	an a
	SETI CON' "Pot "Til	TUP OF CONTROLS BEFORE TEST NTROL Dower On"OFF imer Operation Selector" SwitchUPPER - "N.O. MOM"	28 - 29 - 29 - 29 - 20 - 20 - 20 - 20 - 20
	SETI CON' "Pot "Til "Ma. "Au	TUP OF CONTROLS BEFORE TEST         NTROL       POSITION         ower On"OFF         imer Operation Selector" SwitchOFF         imer Operation Selector" SwitchOFF         ain Control"Zero (counterclockwise         ux. Power" Switch"INT."	ила <u>2010 — 19 — 19 — 19 — 19 — 19 — 19 — 19 —</u>
	SETI CON' "Pot "Til "Ma. "Au	TUP OF CONTROLS BEFORE TEST         NTROL       POSITION         ower On"OFF         imer Operation Selector" SwitchUPPER - "N.O. MOM"         LOWER - "CONT."         ain Control"Zero (counterclockwise	ила <u>2010 — 19 — 19 — 19 — 19 — 19 — 19 — 19 —</u>
	SETI CON' "Por "Til "Ma. "Au "Vo	TUP OF CONTROLS BEFORE TEST         NTROL       POSITION         ower On"OFF         imer Operation Selector" SwitchOFF         imer Operation Selector" SwitchOFF         ain Control"	23 - 21 - 22 - 22     
	SETU CON "Pou "Til "Ma "Au "Vo "Vo "Au	TUP OF CONTROLS BEFORE TEST         NTROL       POSITION         ower On"OFF         Imer Operation Selector" SwitchOFF         ain Control"Zero (counterclockwise         ux. Power" Switch	
	SETU CON' "Pot "Til "Ma: "Au "Vo "Vo "Au "Au	TUP OF CONTROLS BEFORE TEST         NTROL       POSITION         ower On"OFF         Imer Operation Selector" SwitchOFF         Imer Operation Selector" SwitchOFF         ain Control"	
	SETU CON "Pot "Til "Ma "Au "Vo "Au "Au "Au "Au	TUP OF CONTROLS BEFORE TEST         NTROL       POSITION         ower On"OFF         Imer Operation Selector" SwitchOFF         ain Control"Zero (counterclockwise         ux. Power" Switch	

• .

..

.

1998. 1

<u>C01</u>	TROL POSITION
'nΨ	in Ammeter Range" SwitchSo that desired test current will be read in upper 1/3 of meter scale. Itage Relay Test" (DET) SwitchSet " <u>NORM</u> "
"01	tput #1 - #2" SwitchOutput #120200000 and electron
Te	, det 1942 medete Alex modele providence providence providence ( ting Pick-Up
<b>1.</b>	n na servera da se
	Connect overcurrent unit operating coil to righthand Common and 80 volt tap of "Output #1". Connect light leads from binding posts marked "Relay Contacts"
<b>3</b> •	to trip circuit contact terminals of the relay.
4.	Adjust "Timer Operation Selector" Switch - UPPER to "N.O. MAINT." LOWER to "CONT.".
5.	The undervoltage unit contacts must remain closed.
6.	Turn "Power ON" Switch "ON". "Power ON" light should glow.
7.	Initiate unit by pressing "Initiate" switch.
8.	Rotate "Main Control" (clockwise) to increase output until relay picks up and Continuity light flickers. The "Aux. Control" may be used as a fine adjustment for "Main Control".
9.	Read current on Ammeter and record. The second state of the second
Te	sting Time Current Characteristics - Overcurrent Unit
1.	Connect the test set to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECH THE "POWER ON" LIGHT.
2.	Connect relay overcurrent unit operating coil to righthand Common and 80 volt tap of "Output #1". (NOTE: Test current should not exceed 40 amps. If relay tap exceeds 8, move tap to 4 or 5 position for this test.)
3.	Select ammeter range so that test current will be read in upper 1/3 of meter scale. Pre-set ammeter needle using "Pointer Pre-set". Set to 1/2 division below desired current value.

- 4. Adjust "Timer Operation Selector" Switch UPPER to "N.O. MOM", LOWER to "CONT.".
- 5. Turn "Power ON" switch "ON". Power "ON" light should glow.
- 6. Initiate unit by pressing "Initiate" switch
- 7. Set test current desired by jogging unit with "Initiate" switch and rotating "Main Control" (clockwise) to increase output until required test current is reached. "Aux. Control" may be used for fine adjustment.
- 8. The undervoltage unit contacts must remain closed.
- 9. Connect light leads from binding posts marked "Relay Contacts" on the test set to trip circuit contact terminals on relay overcurrent unit.
- 10. Set "Timer Operation Selector" Switch UPPER to "N O. MAINT", LOWER to "TIMER".
- 11. Reset timer to zero with "Timer Reset" button.
- 12. Initiate unit by pressing "Initiate Switch. Timer will run and test current will flow. The test set will automatically cut off, and the timer will stop when relay contacts make.
- 13. Read timer. Time shown is total time of test. Record time.

a series and the series of t The series of t

and and a second se In the second second

na se en la serie de la se Altre de la serie de la serie

м	and the second second second	, etc. As epo	edita de la stra-	i ta jiya	
	and the strength of the				
and Contractory Sala	an e se gran gran gran gran gran gran gran gran	to the second second	·	• North States of the states o	a tinneg in

3 - 34 INDUCTION DISC OVER, UNDER OR OVER/UNDER <u>VOLTAGE RELAYS</u> (Westinghouse Type CV) (General Electric Type IAV)

n sed i desta séra

#### GENERAL

The voltage relay is a load balancing relay and is not intended to clear a fault in the power system. In most applications it is used as an undervoltage device and is designed to de-energize the power circuit whenever voltage falls below a predetermined value. Time of operation may be instantaneous or delayed.

The time delay undervoltage relay is also an induction disc relay. The action of the spiral spring is to keep the relay contacts trip circuit closed. The torque produced when voltage is applied to the relay's voltage actuated coil opposes the spring action. Thus, as the applied voltage decreases, the disc rotates to close the relay trip circuit contacts.

The overvoltage relay has the opposite operation. The spring action keeps the relay trip circuit contacts open whenever voltage in the circuit is normal or below normal. A higher than normal voltage produces operating torque on the relay disc.

TES	ST	P	RO	CE	DU	RE	<u>S</u>	-		
			Тy	pe	0	f	Te	:S	ţ,	9
1.0	$(1,1) \in \mathcal{A}$		70-1	10	-11 **					

Timing

# ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SETUP OF CONTROLS BEFORE TEST

CONTROL	POSITION
"Power ON" Switch	OFF
"Timer Operation Selector" Switch	
"Main Control" "Aux. Power" Switch	
The second se	So that desired test voltage will be read in UPPER 1/3 of scale
"Voltmeter Selector" Switch	
"Aux. Selector" Switch	"V.RLY".
"Aux. Control"	Zero (counterclock-
"AC Range" Switch	w130)

~	~	ът	<b>m</b>	n	n	τ
U	U	£	T	n	U	L

					***
	たいてん ふいたたい	111 (j. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	and the spectrum of	1.198 1.19	- 1 · · · · ·
"DC Range"	Switch		 5A		

POSITION

"Voltage Relay Test" (DET) Switch....Set "NORM"

"Output #1-#2" Switch....."Output #2"

### Testing for Pickup

- 1. Connect the relay test set to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect relay operating coil to terminals marked "AC Output #3" on relay tester.

3. Connect light leads from binding posts marked "Relay Contacts" to trip circuit contact terminals of the relay.

4. Turn "Power ON" Switch ON. "Power ON" light should glow. 5. Initiate unit by pressing "Initiate" Switch.

- 6. Rotate "Main Control" (clockwise) to increase voltage until Continuity light flickers.
- 7. Record this value of voltage as pickup of the relay.

# Testing Timing

- 1. Connect the relay tester to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect relay operating coil to terminals marked "AC Output #3" of the relay tester.
- 3. Turn "Power ON" Switch to ON. "Power ON" light should glow.
- 4. Initiate unit by pressing "Initiate" Switch.
- 5. Set normal relay voltage (see relay nameplate) by rotating "Main Control" (clockwise) to increase output. Read voltage on voltmeter.
- 6. Connect light leads from binding posts marked "Relay Contacts" to trip circuit contact terminals on the relay.
- 7. Adjust "Timer Operation Selector" Switch, UPPER to "N.O.MAINT", LOWER to "TIMER".

8. Turn "Voltage Relay Test" Switch to "Set Fault" position.

- 9. Set fault relay voltage (over or under normal) by rotating "Aux. Control" (clockwise) to increase output. Read voltage on Voltmeter. (NOTE: Rotate "Aux. Control" until voltage read on Voltmeter is approximately 2 volts higher than desired test voltage.
- 10. Reset timer to zero.
- 11. Turn "Voltage Relay Test" Switch to "Test" position.

NOTE: The fault voltage (over or under normal) as set in Step 9, will be impressed on the relay operating coil instantaneously. The timer will automatically start.

- 12. When relay trip circuit contacts make, the timer will stop. Read timer. Time shown indicates time in which the relay contacts closed after impressing fault voltage. Record this time.
- 13. If desired, turn "Voltage Relay Test" Switch back to "NORMAL". Remove one lead from "Relay Contacts" binding post. Initiate unit by pressing "Initiate" Switch. Replace lead in "Relay Contacts" binding post. Repeat Steps 8 through 12 for other values of fault voltage.

e di per agli e da se e cugare da case da casa di Cale de Cartare da casa de reserve de la case de case de cas

- · (2011) 이상 수가 가지 않는 한가에 가지 가지가 가지 않으면 것이 가지 않는 것이 가지 않는 것이 같다. 가지 않는 것이 안정한 것이 있었는 것이 가지 않는 것이 못 같다. 것이 아닌 것이 있는 것이 같은 것이 같다. 아직 '한국권' '한국권' '한 것이 안 가지 않는 것이 같다. '한 '한국''
- de la servicie de la servicie de persona d'un de la servicie de la composition de la servicie d'al mener de la El la marte de la servicie de la servicie d
  - "你们,你们是我们的你?"你说,你说道:"你说你?""你们,你们就是你们的你?""你们,你们就是你?""你……""你……""你……""你……""你……""你……"
- الان المراجع بين المركز بين المحارك بين المراجع المحاري المراجع المراجع المراجع المراجع المراجع المراجع المراجع المحقية: الأكان المراجع بين المراجع المحاجة المحاجة المحاجة المحاجة المحاجة المحقية المحاجة المحقية المحاجة الم المراجع المحقة المحتج
- elis siderraente magina das ser entralas elaveia de entre el la serie de la serie de la serie el serie el seri elemente de la composition de encontron harvelare de entre traje anello el la serie de la serie de la serie de s
- 우리는 나라는 것 같은 가지는 일부는 것이라는 것을 가을 수 있는 것이라. 이 가지는 것이 가지는 것이 있는 것이다. 이 가지는 것이 같이 있는 것이다. 이 가지 않았는 것은 것을 것이다.

TYPICAL TESTS FOR INSTANTANEOUS VOLTAGE RELAYS (Westinghouse Type SV, SV-1) (General Electric Type PJV) ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING Type of Tests Pickup na na kana shekara ka markara shekara ka ka ka ka Dropout 化学的财产性 动口干的人 一分对于自己 预定计 SETUP OF CONTROLS BEFORE TEST POSITION A CARL POSITION CONTROL "Power ON" Switch.....OFF "Timer Operation Selector" Switch.....UPPER-"N.O.MAINT." LOWER-"CONT." "Main Control"..... .....Zero (counterclockwise) "Aux. Power" Switch....."INT." "Voltmeter Range" Switch.....So that desired test voltage may be read in upper 1/3 of scale "Voltmeter Selector" Switch......"A.C. 2" "Aux. Selector" Switch....."VERN." "Aux. Control".....Zero (counterclockwise) "Voltage Relay Test" (DET) Switch......Set "NORM" "Output #1-#2" Switch....."Output #2"

Testing for Pickup

- Connect SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS <u>OFF</u>. CHECK THE "POWER ON" LIGHT.
- Connect relay operating coil terminals to "AC Output #2" binding posts of the test set.
- 3. Connect light leads from test set binding posts marked "Relay Contacts" to the relay trip circuit contact terminals.

<ul> <li>4. Turn "Power ON" Switch ON. "Power ON" light and continuit: light should glow.</li> <li>5. Initiate test set by pressing "Initiate" Switch.</li> </ul>	
	linn for
5. Initiate test set by pressing "initiate" Switch.	
6. Rotate "Main Control" clockwise until continuity light is extinguished. The "Aux. Control" may be used for fine adj	just ustment.
7. Read pickup voltage on voltmeter. Record.	it lat
8. Continue to rotate "Main Control" clockwise until relay no voltage (on relay nameplate) is read on voltmeter.	rmal
9. Rotate "Main Control" counterclockwise to decrease voltage until the continuity light just glows. The "Aux. Control" be used as a fine adjustment.	may
10. Read and record this value of voltage as dropout.	5 <sup>1</sup>
11. Turn test set OFF.	1998) 1997 - 1999
n 1999 - Bradin Brazer and Antonia and an anna an an an an an an Albert (1997). B' a bha Raingeacht an th	
i na sina na sa	
n an the second second state of the second secon	s · · · · ·
en e	2 A
	4 <sup>11</sup>
Maria da anticipada da serie da anticipada da presenta terrativa da serie da serie da serie da serie da serie d	
n. De state en state de la section de la sec	
	·
्रास्त्र हो ते क्रिस्ट्रांट देखता हो जिल्हा के स्थापक तो है। इन तो तो तो के विद्यार देख है विद्यार हो स्था तात्र स्थाप्त के साथ स्थाप्त का स्थापन जीवर के दिसा के तो की सिंह तो के साथ से स्थाप के तो है। स्थापत के तान्य के साथ के साथ के साथ के सिंह	
ne. 1995 - De la seguerar de la construction de la sola de la seguerar de la seguerar de la seguerar de la constru 1997 - De la construction de la construction de la construction de la seguerar de la seguerar de la constructio	
ter sedet Arres i andras filmer (att eller eller) eller a secondation eller (all'eller). Recenter sefende andras antras attentionen eller in antres i filmationelle.	4.

.

# TESTS FOR GENERAL ELECTRIC PHASE SEQUENCE AND UNDERVOLTAGE RELAY (TYPE ICR) OR WESTINGHOUSE REVERSE PHASE RELAY (TYPE CP)

#### GENERAL

Westinghouse Type CP and General Electric Type ICR relays are threephase voltage induction disc relays used to protect for undervoltage or phase reversal in AC systems.

The CP and ICR relay electromagnets contain three (3) coils. When the three (3) coils are energized, out-of-phase fluxes are produced causing the disc to rotate toward closure of the high voltage contact. The out-of-phase fluxes produced when a phase is reversed, cause the disc to rotate to close the low voltage contacts. Low voltage with proper phase rotation may not produce enough torque on the disc to overcome mechanical tension in a spring and the low voltage contacts will close. Pickup, Dropout and Operating Time of the relay may be varied by adjustments.

#### TYPE OF TESTS

Pickup - Minimum voltage to close Normally Open contact Dropout - Maximum voltage at which Normally Closed contacts will close Loss of One Phase Phase Sequence Timing

# EQUIPMENT REQUIRED

Model SR-51 Relay Tester 1-3PH Synthesizer Accessory NOTE: If Model CS-7 Phase Shifter and Phase Angle Meter unit is supplied, 1-3PH Synthesizer is not required. Refer to instructions on testing of these relays in CS-7 instruction manual.

# ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

9. Classical real formers is for severy remains a serie of the severic second s second s second s second seco

ارد المحتري (1996) بالاحتراب بالمحققة والمحتمة الاحتراب ألمان الألمان الاحتراب المتأمة المان المتأمة ال المحتوي بالمحتولة الإحتراب بالمحتر المحتر المحتر

ال المحافظة مع يعنيه بعن المحافظة عليه معلم وإن عن عن يكون الرئيس المثلث المعالية المحافظ المحافظ الم العالم المحافظ المحافظ المعالية العلمان في معطول المحافظ مع في المحافظ المحافظ المحافظ المحافظ المحافظ المحافظ ا المحافظ المحافظ

3	 40

SETUP OF CONTROLS BEFORE TEST

CONT	rrol	POSITION
SR-5	(Stall filt) – tuska vynaks casarsaid (g. 11	i e Mire di Nerre de
"Pov	ver ON" Switch	•OFF
<b>"Tin</b> "T <b>in</b>	mer Operation Selector" Switch	.UPPER-"N.O.MAINT." LOWER-"CONT."
"Mai	in Control"	.Zero (counterclockwise)
"Au:	k. Power" Switch	INT See State and a line in the second
"Vo	ltmeter Range" Switch	•150
"Vo	ltmeter Selector" Switch	<b></b>
"Au	x. Control"	.Zero (counterclockwise)
"Au	x. Selector" Switch	AC Output #3 150V
"AC	Range" Switch	.loa
"DC	Range" Switch	S <b>•5A</b> r <sup>abS</sup> − en locationen Arten est i en locationen et de
"Ma	in Ammeter Range" Switch	
"Vo	ltage Relay Test" (DET) Switch	Set <sup>wa</sup> "NORM <sup>"</sup> (set 1 to ) Mark 2 st s
"Ou	tput #1-#2" Switch	.Output #1
<u>1-3</u>	PH Accessory	n an an ann an an ann an an an an an an
"Ba	lance"	Red Dot
Tes	ting Pickup	en de la companya de Nome de la companya d
1.	Connect the SR-51 to a suitable source the nameplate and ground. BE SURE THE THE "POWER ON" LIGHT.	ce of power as indicated on HE MAIN SWITCH IS OFF. CHECH
2.	Connect "AC Output #3" (yellow) term marked "Input" on 1-3PH accessory un	inals to yellow terminals it.
3.	Connect white terminals "EXT.VM." on marked "EXT. VOLTMETER 0-150" on 1-3	SR-51 to white terminals PH accessory unit.
4.	Using #18 flexible leads, make the f the 1-3PH accessory and the relay un	ollowing connections between der test:
	a - red terminal "A" to relay termin b - yellow terminal "B" to relay ter c - blue terminal "C" to relay termi	minals for mase 2 of b

- 5. Connect two #18 flexible leads from white terminals on SR-51 marked "Relay Contacts" to relay terminals which will permit observation of operation of relay Normally Open contacts.
- 6. Turn "Power ON" Switch to ON. Amber pilot light should glow.
- 7. Initiate SR-51 test set. Press red "Initiate" Switch. Red light in switch should glow.
- 8. Rotate "Aux. Control" clockwise until continuity light flickers.
- 9. Check AB-AC-BC switch positions for balance of voltage. Readjust Balance of 1-3PH as necessary to get the three voltages as close as possible.
- 10. Record the average of the three voltages (AB-AC-BC) as pickup.
- 11. Turn "Power ON" Switch OFF. Return "Aux. Control" to zero.

#### Testing Dropout

- 1. Repeat Steps 1-4 above
- 2. Connect two #18 flexible leads from white terminals on SR-51 marked "Relay Contacts" to relay terminals which will permit observation of operation of relay Normally Closed contacts.
- 3. Throw "Power ON" Switch ON. Amber pilot light and green continuity light should glow.
- 4. Press "Initiate" Switch. Red light in switch should glow.
- 5. Rotate "Aux. Control" clockwise until continuity light extinguishes
- 6. Check AB-AC-BC switch positions for balance of voltages. Readjust balance of 1-3PH as necessary to get the three voltages as close as possible.
- 7. Record the average of the three voltages as dropout.

#### Testing Loss of One Phase

- 1. Repeat Steps 1-4 under "Testing Dropout".
- 2. Rotate "Aux. Control" clockwise until rated voltage has been applied to relay coils. Continuity light should be extinguished.
- 3. Check AB-AC-BC switch positions for balance. Adjust as necessary.
- 4. Carefully remove lead from red terminal "A" on 1-3PH accessory. After a few seconds, the green continuity light should glow.
- 5. Turn "Power ON" Switch OFF. Return "Aux. Control" to zero.

•

.

٠

•

•

	Sources and the second s Second second s Second second
	L. Repeat Steps 1-3 under "Testing Loss of One Phase".
	2. Carefully interchange the connections on the 1-3PH accessory. Lead connected to red terminal "A" should be moved to yellow terminal "B" and lead on yellow terminal "B" moved to red terminal "A".
1 - 2 <sup>4</sup> 1 - 1 - 1	3. The movable contact on the relay should make the low voltage contact. The green continuity light should glow.
	4. Replace "A" and "B" test leads in proper sequence.
	5. Turn "Power ON" Switch OFF. Return "Aux. Control" to zero. Testing Timing
	1. Repeat Steps 1-4 under testing "Dropout".
ર્ગજેલના સાર્ગ	2. Adjust "Aux. Selector" switch on test set to "V.Rly" position.
	3. Change "Output #1-#2" toggle switch to "Output #2" position.
1	4. Turn "Aux. Control" fully counterclockwise to zero.
	5. Turn "Power ON" Switch ON. Amber light should glow. Green continuity light should glow.
· · · ,	6. Initiate unit by pressing red "Initiate" switch. Red light should glow in switch.
· · ·	7. Rotate "Main Control" clockwise until rated voltage is impressed across relay. Check balance and readjust if necessary. Green light will be extinguished.
	8. Reset timerato zero with reset button.
•	9. Adjust "Timer Operation Selector" Switch LOWER to "Timer" position.
	10. Turn "Voltage Relay Test" switch to "Test" position.
	11. When timer stops, test is complete. Read timing value on timer and record.
e e de la composición de la composición Composición de la composición de la comp	12. Turn "Power ON" switch to OFF.
	13. Remove all test leads.
	第14日、「「」」の1943年、1943年代「「」、1943年、1943年代の日本市内部に「1953年によります。 1943年代の「「」」の1943年の「1943年代」、1943年代の日本市内部に、1953年代の日本市内部に、1943年代の日本市内部により、1945 1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により 1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により、1945年代の日本市内部により 1945年代の日本市内部により、1945年代の日本市内本市内内部により本市内本市内市内部により、1945年代の日本市内本市内本市内本市内本市内本市内本市内本市内本市内本市内本市内本市内本市内本

ţ

.

# PERCENTAGE DIFFERENTIAL RELAYS

(Westinghouse Type CA) (General Electric Type IJD) en anna e anna anna anna 1988. A

# GENERAL

This relay compares two similar currents in a circuit, i.e. primary and secondary current of a transformer. Since the relay compares two currents, it is connected to two current transformers. That portion of the circuit between the two CT primaries is referred to as the relay's "zone of protection". The percentage differential relay operates to close its trip circuit contacts and trip a circuit breaker(s) whenever it senses an abnormal condition within the "zone of protection". The degree of unbalance or abnormality the relay may tolerate is a function of the relay's design. (i.e. 5%, 10%, 25% or 50% differential)

The simple percentage differential relay has two restraint coils and one operating coil. The operating coil is common to the two restraining coil circuits. Under normal conditions, the currents in the operating coil produce torques that are equal in magnitude but opposite in direction and thus cancel.

Under fault conditions, these currents in the operating coil become unequal and produce an operating torque on the disc. When the differential current reaches a predetermined amount, as governed by relay design, the relay trip circuit contacts close.

and the state of the

# TEST PROCEDURES

# ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

Type of Tests

Pickup

Time Current Characteristics

Through Fault

Slope (Cannot be performed with SR-21)

SETUP OF CONTROLS BEFORE TEST

CONTROL

POSITION

"Power ON" Switch.....OFF

LOWER-"CONT"

The freedom region weather the second second state of the line of clockwise)

"Aux. Power" Switch....."INT."
. 3 - 44

	" Switch	
"Aux. Selector" Swit	tch	"VERN."
		3* · · · · · · · · · · · · · · · · · · ·
"A.C. Range" Switch		10A (Not on SR-21)
"Main Ammeter Range	" Switch current 1 1/3 of me	So that desired test may be read in UPPER

"Voltage Relay Test" ("Direct. Element) Switch...Set "NORM" "Output #1-#2" Switch.....Output #1

#### Testing Pickup

- 1. Connect the MULTI-AMP relay tester to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- Connect operating coil and one restraint coil of relay to "Output #1" of the test unit. Connect to right-hand Common and 10 volt tap.
- 3. Connect light leads from binding posts marked "Relay Contacts" to trip circuit contact terminals of the relay. NOTE: This relay usually has one moving contact and two fixed contacts. Use terminals for moving contact and one of the fixed contacts.
- 4. Select proper ammeter range so that expected pickup current will be read in UPPER 1/3 of Main Ammeter scale.
- 5. Set "Timer Operation Selector" Switch UPPER to "N.O. MAINT.", LOWER to "CONT.".
- 6. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 7. Initiate unit by pressing "Initiate" Switch.
  - 8. Rotate "Main Control" (clockwise) to increase output until relay picks up and Continuity light flickers. "Aux. Control" may be used for fine adjustment. Read and record current.
  - 9. Move one light lead to relay terminal for other fixed contact of the relay and repeat Steps 4 through 8.

Testing Time Current Characteristics

<u>\*</u>

- Connect the MULTI-AMP relay tester to a suitable source of power 1. as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- Connect operating coil and one restraint coil of relay to 2. "Output #1" of the tester. Connect to right-hand Common and 10 volt tap.
- Select proper ammeter range. Set ammeter Pre-Set mechanism 3. 1/2 division below desired test current. (See "Current Metering Circuit")
- Turn "Power ON" Switch ON. "Power ON" light should glow. 4
- 5. Set test current desired by jogging unit with "Initiate" Switch and rotating "Main Control" (clockwise) to increase output. Use "Aux. Control" for fine adjustment. (See "Current Metering Circuit")
- 6. Connect light leads from binding posts market "Relay Contacts" to trip circuit contact terminals of the relay (terminals for moving contact and one of the fixed contacts).
  - 7. Set "Timer Operation Selector" Switch UPPER-to "N.O.MOM", LOWER-"FAST TRIP".
  - 8. Reset timer to zero with "Timer Reset" button.
  - Initiate unit by pressing and holding "Initiate" Switch. As soon as timer stops, release "Initiate" Switch. 9.
  - Time shown is total time of test. 10. Read timer.
  - 11. Disconnect lead from the restraint coil of relay and connect to the other restraint coil. a da esta en esta en entre en Esta esta entre Esta esta esta esta entre en

12. Repeat Steps 7. through 10.

Testing "Through Fault"

- Connect the MULTI-AMP relay tester to a suitable source of power 1. as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- Connect "Output #1" of relay tester to restraint coil terminals 2. so that current flows through the coils in series. Connect to right-hand Common and 10 volt tap.
- Select proper Ammeter Range on Main Ammeter. 3.

4. Set "Timer Operation Selector" Switch UPPER to "N.O. MAINT.", LOWER to "CONT.".

5. Turn "Power ON" Switch ON. "Power ON" light should glow.

3 - 46

- 6. Initiate unit by pressing "Initiate" Switch.
- 7. Rotate "Main Control" (clockwise) to increase output to desired value. Read current on ammeter (approximately 20 amperes).
- 8. Manually turn relay disc for evidence of restraint. Turn "Power ON" Switch OFF.

Testing Slope (Cannot be performed with Model SR-21)

- 1. Connect the MULTI-AMP relay tester to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect "Output #1" of the relay tester to restraint coil terminals so current flows through them in series. Use righthand Common and 10 volt tap of "Output #1".
  - 3. Connect light leads from binding posts marked "Relay Contacts" to trip circuit contact terminal of the relay. (terminals for moving contact and one of the fixed contacts)
  - 4. Select proper Ammeter Range on "Main Ammeter" for larger currents desired. ( 20 to 30 amperes depending on percent differential of relay)
  - 5. Turn "Aux. Selector" Switch to "24-AC-3" position.
  - 6. Connect operating coil and one restraint coil of relay to terminals marked "AC Output #3". Instantaneous ± of "Output #1" and "AC Output #3" of the relay tester should be connected to same relay terminal. NOTE: On Westinghouse Type CA relay "AC Output #3" must be connected to operating coil and <u>untapped</u> restraint coil of the relay.
  - 7. Set "Timer Operation Selector" Switch UPPER to "N.O. MAINT.", LOWER to "CONT".
  - 8. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 9. Initiate unit by pressing "Initiate" Switch.
  - 10. Rotate "Main Control" (clockwise) to increase output from "Output #1" to desired value of larger current. Read current on Main Ammeter.

#### en el contra de la contra de transferencia de la contra de la constance de la constance de la constance de la c 12. If desired, test may be repeated for opposite restraint coil by disconnecting test leads from operating coil terminal and first restraint coil terminal and reconnecting test leads to opposite restraint coil terminal and operating coil terminal.

م کی ایس به را در بیش به در به ایران از این این در در بیشه افران می این در بیشه در در به این در در در در در در همچنین افراد در می به در می این این این این مینها افراد در این آنها از مین در معرف این می در می این در این این مربق در می این این این این این می می افراد این می دان از آن در معرف میرد و این این افراد از آمان در این می and see the

a tanàn 1990. Ny INSEE dia mampika mampika mandritra mandritra dia kaominina mandritra dia kaominina minina mandritra dia kaominina dia kaomini	a an an Anna an Anna Anna Anna Anna Ann
a statistica e a statistica e a statistica e a statistica. Reference e a statistica e a statist	kare of south and the constant
	en viel en en skielige en en steringelige
a provinsi marka Marka in transmissi na	a an
and the second	and the standard states and the
	tan babab <mark>a</mark> keacant (offi
	a na da navana kala o <u>m</u> asya
lan da kan sang pang tersiti sa sa sa sa sa	
	an an 1999 - Charles Alexandra an San An

## PERCENTAGE DIFFERENTIAL RELAY (WESTINGHOUSE TYPE CA-5)

#### GENERAL

The CA-5 Percentage Differential Relay consists of one restraining element with two windings, and one operating element. The operating element is energized through an external auxiliary current transformer. Taps to control the sensitivity of the relay are located in this external transformer.

The unit operates on the induction disc principle with both electromagnets operating on the same disc. The front electromagnet is the restraining element and the rear electromagnet is the operating element.

#### Testing

NOTE: This test procedure specifically applies to the Westinghouse Type CA-5 relay used for transformer or generator differential. Refer to Westinghouse Bulletin I.L. 41-339.1B for details. This relay is used in conjunction with an auxiliary current transformer. This same auxiliary current transformer <u>must</u> be in the test circuit.

#### Type of Tests

Pickup - Operating Coil Percent Slope Characteristics

SETUP OF CONTROLS BEFORE TEST

CONTROL	POSITION
"Power On" Switch	.OFF
"Timer Operation" Switch	.UPPER -"N.O. MAINT." LOWER -"CONT."
"Main Control"	.Zero (counterclockwise)
"Aux. Power" Switch	."INT"
"Voltmeter Range" Switch	.300
"Voltmeter Selector" Switch	."EXT. A.C."
"Aux. Selector Switch	."A.C. #3 - 24 V"
"Aux. Control"	.Zero (counterclockwise)
"A.C. Range" Switch	.10A

3	-	49
---	---	----

		3 - 49	
	CON	NTROL POSITION	
8	"D.	.C. Range" Switch	
	"Ma	ain Ammeter Range" Switch500A	
	"Vo	oltage Relay Test"(DET) SwitchSet "NORM"	
×	"Ou	utput: #1-#2"# Switch	
	Tes	sting Pickup a find that the test state of the first state of the stat	a da series no tra series no tra series
; ·	1.	Connect the SR-51 to a suitable source of power as indicate the nameplate and ground. BE SURE THE MAIN SWITCH IS OF THE "POWER ON" LIGHT.	ated on F. CHECK
	<b>2.</b>	Connect the operating coil of the relay to the "R" termin the auxiliary current transformer.	nal of
	3.	Connect the primary winding of auxiliary current transfor Terminals) in series with one of the relay restraint col Connect this series circuit to "AC Output #3" binding po the test set. An external milliammeter capable of readin between 0.145 and 1.0 ampere must be in this circuit.	ls. sts of
•	<b>4</b> .	Connect test set "Relay Contacts" binding posts to relay circuit contacts terminals.	trip trip
•	5.	. Set tap on auxiliary current transformer to 19.	en Maria de Carlos de Carlos Maria de Carlos de Carlos Maria
	б.		OW.
	7.	. Initiate test set by pressing "Initiate" switch.	
•	8.	. Rotate "Aux. Control" clockwise until continuity light f	lickers.
	9.	. Read and record the value of current indicated on the ex milliammeter as pickup.	ternal
	10	D. Turn test set off.	
•	Te	esting Slope Characteristics	
	1.	. Connect the SR-51 to a suitable source of power as indic the nameplate and ground. BE SURE THE MAIN SWITCH IS <u>OF</u> THE "POWER ON" LIGHT.	ated on F. CHECK
	2.	. Connect the operating coil of the relay to the "R" termi of the Auxiliary Current Transformer. (NOTE: The Auxili former should be positioned so that the "R" terminals ar top. The <u>right-hand</u> "R" terminal should be connected to numbered terminal of the relay operating coil.)	ary Trans e at the

A state of a state o

- 3. Connect the primary winding of Auxiliary Current Transformer (Io Terminals) in series with one of the relay restraint coils. This series circuit should be connected to "AC Output #3" binding posts of the test set.
- 4. Connect the relay two restraint coils in series to "AC Output #1" of the test set. NOTE: Polarity (±) terminals from both outputs of the test set should be connected to the <u>same</u> relay restraint coil terminal.
- 5. Connect test set "Relay Contacts" binding posts to relay trip circuit contacts terminals.
- 6. Set "Main Ammeter Range" switch so that test current through the relay's two restraint coils may be read in upper 1/3 of scale.
- 7. Turn "Power On" Switch "ON". Power "On" light should glow.
- 8. Initiate unit by pressing "Initiate" switch.
- 9. Rotate "Main Control" clockwise until desired test current is read on main ammeter (suggested 20 amps.)
- 10. Rotate "Aux. Control" clockwise until continuity light flickers.
- 11. Read and record currents indicated on both ammeters. Compare to relay manufacturer's specifications.

(a) the state of the second s second seco

- 12. Turn test set off.
- na infilite d'Angeland Angeland de la construction de la substance de la substance de la substance de la subst La defensiva de la classica de la defensa de la construction de la calence de la construction de la construction
  - - o v eleta e altro dosta o standito velo.
  - an an tha an that that the standard of the standard of the
- (c) Statement and Withold Date A sum of a fight of a set of a subject of a subject of a set of subsubject of sets (as in the subject of a subject of subject of a subject of a subject of subject of states (subject of as in a subject).

#### PERCENTAGE DIFFERENTIAL RELAY (Westinghouse Type CA-6)

The CA-6 Percentage Differential relay is usually applied for the protection of multi-circuit buses. The relay operates on the induction disc principle and consists of four (4) electromagnets operating on two discs which are fastened to the same shaft. Three of the electromagnets are restraining elements, each of which has two separate windings connected to receive secondary currents from the various current transformers. The fourth electromagnet is the operating element with its winding connected to receive the differential or unbalance current through an auxiliary current transformer. The sensitivity of the relay is controlled by taps on the auxiliary current transformer.

#### TEST PROCEDURE

NOTE: This test procedure specifically applies to the Westinghouse Type CA-6 relay used for transformer or bus differential. Refer to Westinghouse Bulletin I.L. 41-337.1 for details. This relay is used in conjunction with an auxiliary current transformer. This same auxiliary current transformer <u>must</u> be in the test circuit.

Type of Tests

Pickup - Operating Coil Restraint Characteristics

SETUP OF CONTROLS BEFORE TEST

CONTROL

POSITION

"Power ON" Switch.....OFF

"Timer Operation Selector" Switch....UPPER - "N.O.MAINT." LOWER - "CONT."

"Main Control".....Zero (counterclockwise)

"Aux. Power" Switch....."INT."

"Voltmeter Selector" Switch.....EXT. AC

"Aux. Selector" Switch....."AC 3-24"

"Aux. Control".....Zero (counterclockwise)

"AC Range" Switch.....10A

"DC Range" Switch......5A

and the second second

CO	MT	יסי	١Τ.
$\mathbf{v}\mathbf{v}$	7A 🕇	.n.	

"Voltage Relay Test" (DET) Switch.....Set "NORM"

"Output #1-#2" Switch.....Output #1

#### Testing Pickup

1. Connect Model SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.

- NOTE: This is a polarized relay and polarities must be observed. The relay even numbered terminals on the restraint coils are polarity (±). Facing the auxiliary current transformer, the "R" terminals are the secondary winding and the I terminals are the primary winding. The right-hand terminals of both "R" and "I " are polarity (±). The odd numbered terminal of the relay operating coil is connected to the right-hand terminal of "R" auxiliary current transformer.
  - 2. Connect operating coil of relay to "R" terminals of the auxiliary current transformer. (Observe polarity. See NOTE)
  - 3. Connect the I terminals of the auxiliary current transformer to the "AC Output #3" binding posts of the test set. (Observe polarity. See NOTE.). An external milliammeter, capable of reading as low as 0.145 amperes or as high as 1.0 amperes, must be in this circuit.
  - 4. Set tap on auxiliary current transformer to 19.
  - 5.. Connect test set "Relay Contacts" binding posts to "Relay Trip Circuit" contacts terminals.
  - 6. Turn "Power ON" Switch ON. "Power ON" light should glow.
  - 7. Initiate unit by pressing "Initiate" Switch.
  - 8. Rotate "Aux. Control" clockwise until continuity light flickers. Read this value of current on milliammeter and record as pickup.
  - 9. Return all controls to zero and de-energize test set. Remove external ammeter. Do not disconnect any other leads.

Testing Restraint Characteristics

1

а. у. SETUP OF CONTROLS BEFORE TEST.

CONTROL POSITION

"Power ON" Switch.....OFF

"Timer Operation Selector" Switch.....UPPER - "N.O. MAINT." LOWER - "CONT."

- "Main Control".....Zero (counterclockwise)

"Voltmeter Selector" Switch....."EXT. AC"

"Aux. Selector" Switch....."AC #3-24V"

"AC Range" Switch.....lOA

"Main Ammeter Range" Switch.....So that desired test current may be read on upper 1/3 of scale.

"Voltage Relay Test" (DET) Switch.....Set "NORM" "Output #1-#2"Switch.....Output #1

- 1. Connect SR-51 to a suitable source of power and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect all six relay restraint coils in series. Observe polarity. (See NOTE above)
- 3. Connect the series circuit of the six relay restraint coils to "AC Output #1" of the test set. "AC Output #1" common terminal (±) to polarity terminal of relay.
- 4. Connect operating coil of relay to "R" terminals of the auxiliary current transformer. (Observe polarity. See NOTE)
- 5. Connect the "Io" terminals of the auxiliary current transformer to "AC Output #3" binding posts of the test set. (Observe polarity. See NOTE.)

3 - 53

		3 - 54 3 - 54	•
	6.	Set auxiliary current transformer tap to 19.	
	7.	Connect test set "Relay Contacts" binding posts to relay circuit contacts terminals.	
	8.	Turn "Power ON" Switch ON. "Power ON" light should glow	•
	9.	Initiate test set by pressing "Initiate" Switch.	
	10.	Rotate "Aux. Control" clockwise to energize relay operat circuit with a value of current equal to 1/2 tap setting auxiliary current transformer. Continuity light should (	OT .
	11.	Rotate "Main Control" clockwise to energize the relay recoil circuit until the continuity light flickers. Read record this value of current.	straint and
. 1	. ≳§	a de rederador en la derectada de la construcción en la construcción de la construcción de la defensación activ Construcción	1
		an ta	
		y a commensation of the state of the second of the second of the second of the second second second of the seco second second second second second	24) W
	ć	to 100 montanta di sua contrata di substanta Malazza di substant	
	•	<ul> <li>Market in the second s second second sec second second sec</li></ul>	• •
		an an an an anna an an an an an an an an	5 
	 1	a destination de la seconda de la constante de la seconda de la seconda de la seconda de la seconda de la secon La desta destinationes de la desta de la seconda de la s La desta desta de la seconda de la second	
		an anna ann amhrach a' chuiseachan an ann an	· · · · ·
		- Han der eine Steppen 122 och gaven der den gavensteren som ender 6. og 1. – Marcaleg Stradselvin, – markalander er selvendar og så bisker,	an an A
	1.42	الاستعادية الحوافر المراجعة المستقل وملائد المحال الذات المعرفة المعادية المعادية المحالة المحالة المحال المحا المعطولات المعاد المعاد المحال الم المعل مصحف المحالة المحال المحافظ المحال	а I.,
		•	

DIFFERENTIAL VOLTAGE RELAY General Electric Type PVD

#### GENERAL

This relay is a high speed bus differential relay which contains two operating units connected in parallel. One of the units (known as 87L) is an instantaneous voltage unit having a high impedance operating coil connected across the dc terminals of a full wave rectifier. The rectifier is connected in series with a reactorcapacitor combination tuned for resonance at rated frequency. The other unit (known as 87H) is an instantaneous overcurrent unit with a low impedance operating coil which is connected in series with Thyrite resistor stacks. Both of these units are connected in parallel with the secondaries of all current transformers on all the circuits associated with the bus to be protected. The current transformers should all have the same ratios.

The purpose of the 87L unit is to allow designation of the minimum internal fault that will operate the relay to trip all circuit breakers associated with the protected bus. The purpose of the 87H unit is to provide instantaneous operation for extremely severe internal faults.

## Testing General Electric Type PVD11C Relays

Note: Set both the 87L and 87H units in low range. ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

Tests

2. Pickup of 87H element and and the bud bud be been being a

· "你们的你们,我们们的我们不会有了。"

3. Testing leakage of Thyrite

Testing Pickup of 87L Element

SETUP OF CONTROLS BEFORE TEST

CONTROL

POSITION

"Power ON" Switch.....OFF

"Timer Operation Selector" Switch. UPPER-"N.O.MOM", LOWER-"CONT"

"Main Control.....Zero (counterclockwise)

"Aux. Power" Switch....."INT."

"Voltmeter Range" Switch.....150

"Voltmeter Selector" Switch.....AC-3

"Aux. Selector"Switch.....AC-3-150

÷ .		-	_	
	3	-	56	
100	•	S.		١.
			1997 - 19	

CO	NΤ	R	ÖĽ

ふた からす

## POSITION

"Aux. Control".....Zero (counterclockwise)
"AC Range" Switch......10A
"DC Range" Switch......5A
"Main Ammeter Range" Switch......500A

"Voltage Relay Test" (DET) Switch....Set "NORM"

"Output #1-#2" Switch.....Output #1

- 1. Connect test set to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect "AC Output #3" binding posts of the test set to the relay terminals so that the relay 87L unit operating coil circuit may be energized.
- 3. Jumper the relay terminals so that the relay 87H operating coil circuit is connected in parallel with the 87L operating coil circuit.
- 4. Connect the "Relay Contacts" binding posts of the test set to the trip circuit contact terminals of the relay.
- 5. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 6. Initiate unit by pressing and holding "Initiate" Switch.
  - 7. Rapidly rotate the "Aux. Control" clockwise until the voltmeter indicates an applied voltage approximately 25 volts higher than setting of the relay 87L unit. The Continuity light should glow. Release the "Initiate" Switch.
  - 8. Jog "Initiate" Switch while reducing applied voltage by rotating the "Aux. Control" counterclockwise. Determine minimum voltage which closes the relay 87L trip circuit contacts as indicated by the Continuity light.

and the second secon

9. Record this value of voltage as pickup of 87L element.

	SETUP OF CONTRO	LS BEFORE TEST		
	CONTROL -	ate da se filoso de	POSITION	
	"Power ON" Swit	ch	OFF	sin 8 million en la Ref.
·	"Timer Operatio	on Selector" Swite	h UPPER-"N.O.MAINT	", LOWER-"CONT"
	"Main Control		Zero (counterclo	ckwise)
	"Aux. Power" Sw	vitch	·····"INT"	de ser e transfer
	"Voltmeter Rang	ge" Switch		eesti <u>163 e</u> steed
	"Voltmeter Sele	ector" Switch	"EXT. AC"	
	"Aux. Selector	Switch	VERN	Nacional de Constantes de C
	"Aux. Control"		Zero (counterclo	ckwise)
•		,		
	"DC Range" Swit	tch	••••• <b>5</b> A waa waa ka maala ma	an ing marking t
	"Main Ammeter	Range" Switch	So that test cur in upper 1/3 of	rent will be rea ammeter scale
	"Voltage Relay	Test"(DET) Switch	hSet "NORM"	formal de la company de la La company de la company de
		Switch	こうにははいた ひとう気感 したたみがた	Name (Maring) in a star (Marine) Anna Anna Anna Anna Anna Anna Anna Anna
	on the name	e test set to a s eplate and ground "POWER ON" LIGHT.	uitable source of pow . BE SURE THE MAIN S	ver as indicated SWITCH IS OFF.
	tonminals	so that the opera	t #1" binding posts t ting coil of the rel hyrite resistor disks	Lay of II all a
	3. Connect th trip circu	e "Relay Contacts it contacts termi	" binding posts of the nals of the relay.	ne test set to th
	4. Turn "Powe	r ON" Switch ON.	"Power ON" light sho	ould glow.
	5. Initiate u	nit by pressing "	Initiate" Switch.	<ul> <li>Reported to 1</li> <li>Reported to 1</li> </ul>
	6. Slowly inc "Main Cont light glow	rol" and "Aux. Co	the relay operating on trol" clockwise unt	coil by rotating il Continuity
	7. Record thi	s value of curren	t as "Pickup" of the	87H unit.

•

3 - 57

. . .

3 – 58	
Testing Thyrite Leakage	
SETUP OF CONTROLS BEFORE TEST	
CONTROL	POSITION
"Power ON" Switch	••••OFF
"Timer Operation Selector" Switch	UPPER-"N.O.MAINT", LOWER-"CONT"
"Main Control"	Zero (counterclockwise)
"Aux. Power" Switch	
"Voltmeter Range" Switch	••••• <b>•150</b> .000/00000000000000000000000000000000
"Voltmeter Selector" Switch	••••• • DC grade and an extension of the statement
"Aux. Selector" Switch	••••150 DC T Late Constructions and the system
"Aux. Control"	Zero (counterclockwise)
"AC Range" Switch	anning an an an an an 1945. ( • • • • 10A king an an an an fradainn aig saga fradainn an a
"DC Range" Switch	
"Output #1-#2 Switch	
"Main Ammeter Range" Switch	
"Voltage Relay Test" (DET) Switch	····Set "NORM"
1. Connect the test set to a suitable on the nameplate and ground. BE	le source of power as indicated
2. Connect the "DC Output" binding relay terminals so that the Thyr independently energized. A 0-15 be connected in series with this	rite resistor disks may be 5 milliampere DC meter should
3. Turn "Power ON" Switch ON. "Pow	ver ON" light should glow.
4. Initiate unit by pressing "Init:	iate" Switch.
n en	

- 5. Rotate "Aux. Control" (clockwise) to increase output to 120 volts dc.
- 6. Read current on milliammeter. Compare with relay manufacturer's specifications.

## 3 – 59 -

## PILOT WIRE RELAY

#### (General Electric Type CPD)

#### GENERAL

The CPD relay is a single element pilot wire relay. Two (2) of these relays, one at each end of a power line, and a two-wire pilot wire circuit between the relays, provides protection for both phase to phase and phase to ground faults over the entire length of the power line. The basic components of the relay are the relay unit, a tapped autotransformer and an input transformer.

The relay unit is of the induction cylinder classification. This unit has directional qualities.

The tapped autotransformer transforms three-phase and ground currents into a single phase current which energizes the primary of the input transformer. The secondary voltage of the input transformer is polarized and is applied to the relay unit restraining coils. Any pilot wire current must pass through the relay unit operating coil.

The pilot wire scheme operates on the opposed voltage principle and on normal operation or with a through-fault, no current flows through the pilot wire. For a fault on the power line within the protected section, the voltages at the opposite ends of the pilot wire become additive and relatively large currents pass through the pilot wire relay operating coils to close the relay trip circuit contacts.

#### Test Procedure

ALWAYS CONSULT MANUFACTURER'S INSTRUCTION LEAFLET FOR PROPER CIRCUIT CONNECTIONS AND INFORMATION ON CHARACTERISTICS BEFORE TESTING.

Type of Tests

Pickup Phase A to Neutral Pickup Phase A to C Pickup Phase A to B	a Baran Baran Baran an an Anna Anna Anna Anna Anna Anna Anna
Pickup Target and Seal-In	alan da tazh i popola an provincia.
SETUP OF CONTROLS BEFORE TESTS	$\int_{\mathbb{R}^{n}}    _{L^{\infty}(\mathbb{R}^{n})} = \int_{\mathbb{R}^{n}}    _{L^{\infty}(\mathbb{R}^{n})}    _{L^{\infty}(\mathbb{R}^{n})} = \int_{\mathbb{R}^{n}}    _{L^{\infty}(\mathbb{R}^{n})}    _{L^{\infty}(\mathbb{R}^{n})} = \int_{\mathbb{R}^{n}}     _{L^{\infty}(\mathbb{R}^{n})} = \int_{\mathbb{R}^{n}}                                    $

CONTROL	POSITION WEATER IN CONTRACTOR
"Power ON" Switch	•••OFF
"Timer Operation Selector" Switch	
"Main Control	Zero (counterclockwise)
"Aux. Power" Switch	• "INT."
"Voltmeter Range" Switch	

3 - 60

CONTROL
"Voltmeter Selector" Switch"EXT. AC"
"Aux. Selector" Switch
"Aux. Control"
"AC Range" Switch
"DC Range" Switch
"Main Ammeter Range" SwitchSo that test current may be read in UPPER 1/3 of scale
"Voltage Relay Test" (DET) SwitchSet "NORM"
"Output #1-#2" Switch"Output #1"
Testing Pickup Phase A to Neutral
1. Connect Model SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS <u>OFF</u> . CHECK THE "POWER ON" LIGHT.
2. Connect "Output #1" of SR-51 to relay terminals so as to pass curren "Phase A" to "Neutral".
3. Connect Continuity light so as to observe action of <u>front</u> relay trip circuit contacts.
4. Turn "Power ON" Switch ON. "Power ON" light should glow.
5. Initiate unit by pressing "Initiate" Switch.
6. Slowly increase current by rotating "Main Control" and "Aux. Control" clockwise until Continuity light glows. Record this value of current as pickup.
7. Open Continuity light circuit to de-energize relay trip circuit contact holding coil.
8. Adjust "Timer Operation Selector" Switch to UPPER-"N.O.MOM.".
9. Set test current to <u>125</u> % of value recorded in Step 6 by jogging "Initiate" Switch.
10. Adjust "Timer Operation Selector" Switch to UPPER-"N.O. MAINT.".
ll. Reconnect Continuity light to observe closure of relay back trip circuit contacts.
12. Initiate unit. Continuity light should glow.
and the second

## 

#### Pickup Phase A to Phase C

20

1 14

1. Follow Steps 1 through 12 above except "Output #1" of relay test set is connected to relay terminals so as to pass current Phase A to Phase C.

alle and a state of a state of a

#### Pickup Phase A to Phase B

1. Follow Steps 1 through 12 above except "Output #1" of relay test set is connected to relay terminals so as to pass current Phase A to Phase B.

And the week of the stand of the

#### Pickup Target & Seal-In

wire.

1. Block relay trip circuit contacts closed and follow normal procedure for DC Target pickup.

# IMPORTANT NOTE

In testing this relay, it is necessary that the relay terminals connected to the pilot wire isolating transformer should be shorted through a suitable

resistor. The value of the resistance should be approximately equal to the resistance of the pilot

> server and the server of th Server of the server of the

je gogo na star so Startan 1949 - Star Startan (Startage 1944 - Startan Startan (Startage

## 

> an an an an taon ann an taonach ann an taonach ann an taoinn an taoinn an taoinn an taoinn an taoinn. Ann an ta Taoinn ann an taoinn an taoinn. An taoinn

A CAR BRIDE AND A COMPANY

#### PILOT WIRE RELAY

## (Westinghouse Type HCB) and a complete state

a the second second

GENERAL

The HCB relay is a three-phase high speed pilot wire relay designed for simultaneous tripping at the terminals of a power line. The power line three-phase currents energize the relay operating circuits through current transformers and are converted by a combination posi-

tive and zero sequence filter into a single phase output voltage. The single-phase output voltages from the HCB relays which are located at each power line terminal, normally have polarity to cause a circulating current through the pilot wire. When a fault occurs between the terminals of the power line, polarity of the single-phase output voltage from one of the relays will reverse, causing the two single-phase output voltages to oppose each other in the pilot wire. Therefore, the output voltage of each relay is bypassed through the relay operating coil causing relay trip circuit contact closure.

The relay moving contact is attached to a pivoted armature on a magnetic frame which contains both an electro-magnet and a permanent magnet. The electro-magnet has two (2) concentric coils connected in opposition, so that one is used as a restraining winding and the other an operating winding. The restraining winding sets up a magnetic field, which in conjunction with the field from the permanent magnet, holds the contact in the Normal Open position. The operating winding produces a magnetic field which acts to move the armature in the relay trip circuit contact closing direction.

#### TEST PROCEDURE

ALWAYS CONSULT MANUFACTURER'S INSTRUCTION LEAFLET FOR PROPER CONNECTION: AND INFORMATION ON RELAY CHARACTERISTICS BEFORE TESTING.

Type of Tests

Phase to Neutral Pickup Phase to Phase Pickup Target and Seal-In Pickup

SETUP OF CONTROLS BEFORE TEST

CONTROL	POSITION
"Power ON" Switch	OFF
"Timer Operation Selector" Switch	LOWER-"CONT."
"Main Control"	Zero (counterclockwise)
"Aux. Power" Switch	••••••"INT."
"Voltmeter Range" Switch	

-		ROL POSITION
17	'Vol	tmeter Selector" Switch"AC EXT."
11	Aux	. Selector" Switch "VERN."
		. Control"Zero (counterclockwise)
11		Range" Switch
11	DC	Range" Switch
tt	Out	put #1-2" Switch
		n Ammeter Range" SwitchSo that test current may read in UPPER 1/3 of sca
11		tage Relay Test" (DET) SwitchSet "NORM"
Ĩ	lest	ing Phase to Neutral Pickup as the second state of the second stat
1	L.	Connect Model SR-51 to a suitable source of power as indicate on the nameplate and ground. BE SURE THE MAIN SWITCH IS <u>OFF</u> . CHECK THE "POWER ON" LIGHT.
2	2	Connect "Output #1" of SR-51 to relay terminals so as to pass current "Phase A" to "Neutral".
3	3.	Connect Continuity light to observe action of relay trip circ contacts.
4	<b>+.</b>	Turn "Power ON" Switch ON. "Power ON" light should glow.
5	5.	Initiate unit by pressing "Initiate" Switch.
6	5.	Slowly increase current by rotating "Main Control" and "Aux. Control" clockwise until Continuity light glows.
7	7.	Record this value of current as pickup.
8	8.	Repeat for "B" to Neutral and "C" to Neutral.
]	rest	ing Phase to Phase Pickup and a second
Ċ	conr	eat Steps 1 through 7 above except that "Output #1" of SR-51 in nected to relay terminals so as to pass current Phase B to Phase series.
8	8. (	Increase current until neon light glows. Record value.
9	9.	Repeat for Phase "C" - "A" and Phase "A" - "B".
		ing Target and Seal-In Pickup
۳. E	Bloc	ok relay trip circuit contacts closed and follow test procedur testing DC Target and Seal-In.

### TRANSFORMER DIFFERENTIAL RELAY WITH PERCENTAGE AND HARMONIC RESTRAINT (General Electric Type BDD)

#### GENERAL

The Type BDD relay is a single-phase transformer differential relay provided with the features of percentage and harmonic restraint and has a sensitive polarized relay as the operating element. Percentage restraint permits accurate determination between internal and external faults at high currents. Harmonic restraint enables the relay to distinguish, by the difference in waveform, between the differential current caused by an internal fault and that caused by transformer magnetizing inrush.

The Type BDD 15 relay is designed to be used for the protection of two-winding power transformers and has two (2) through-current restraint circuits and one (1) differential current circuit.

The Type BDD 16 relay is designed to be used with three-winding power transformers and has three (3) through-current restraint circuits and one (1) differential current circuit.

Type of Tests Pickup of DHR Unit	Harmonic Restraint Pickup of Instantaneous Unit
ALWAYS REFER TO MANUFACTURER'S LITERA	
SETUP OF CONTROLS BEFORE TEST	
CONTROL	POSITION de la calacteria de la calacter
"Power ON" Switch	
"Timer Operation Selector" Switch	LOWER-"CONT."
"Main Control"	Zero (counterclockwise)
"Aux. Power" Switch	
"Voltmeter Range" Switch	• • • • • <b>• 150</b> Karalan dari bertekan dari dari b
"Voltmeter Selector" Switch	••••••• <b>DC</b> C and the second second second
"Aux. Selector" Switch	•••••• <b>150 DC</b>
"Aux. Control"	
"AC Range" Switch	
"DC Range" Switch	

Note: The harmonic restraint and slope tests are written based on testing the relay with all restraint windings set in the 5 tap. If the relay is to be tested with any other tap settings, please refer to the G.E. instruction book under "Periodic Testing".

•

al ga S	CONT	TROL	POSITION
	"Vol	ltage Relay Test (DET) Switch.	
	"Out	tput #1-#2" Switch	Standard (1997) (1997) (1997) (1997) (1997) (1997) Output #1" (1997) (1997) (1997)
	Test	ting Pickup (Relay rated 125 v	olts aDC) en agentation a le station de la service de la s
		E: If the BDD relay is rated "Aux. Selector" to "DC 300 clockwise for a reading of	for 250 volts DC circuit, adjust ". In Step 7, rotate "Aux. Control" 250 volts on the voltmeter.
	1.	Connect the relay tester to a on the nameplate and ground. CHECK THE "POWER ON" LIGHT.	suitable source of power as indicated BE SURE THE MAIN SWITCH IS <u>OFF</u> .
, , ,	2.	Connect "AC Output #1" termin so that differential current coil may be energized.	als of the test set to relay terminals coil and one through current restraint
14	3.	Connect leads from "DC" bindf terminals across DHR unit Nor	ng posts of the test set to relay mally Open contacts.
a shi a shi t	4.	Connect leads from "Relay Con to relay trip circuit contact	tacts" binding posts of test set terminals.
	5.	Turn "Power ON" Switch ON.	Power ON" light should glow.
	6.	Initiate unit by pressing "Ir	itiate" Switch.
	7.	voltmeter.	se for reading of 125 volts DC on
	8.	Rotate "Main Control" clockwi	se to increase output until relay glows. Read current on ammeter.
<i></i>	9.	Return "Aux." and "Main" cont Switch to OFF.	rols to zero. Turn "Power ON"
	10.	Repeat test with "AC Output	"1" terminals of the test set connected he differential current coil and each ht coils may be energized.
	Test	ting Through Current Restraint	en an Arailean air an Stairean ann an th S <b>(Slope)</b> ann an Stairean Ann an Stairean
et d		Connect the SR-51 to a suitable the nameplate and ground. BE THE "POWER ON" LIGHT.	le source of power as indicated on SURE THE MAIN SWITCH IS <u>OFF</u> . CHECK
,		Connect the 10 volt tap and "AC Output #1" to terminals 4 "AC Output #1" is connected to	the right hand common terminals of and 6 of the relay. The common of terminal 6 of the relay.
		and a contract of the second	n en

- 3. Connect "AC Output #3" terminals of the test set to terminals #5 and #6 of the relay. Connect the polarity (+) terminal of "AC Output #3" to terminal #6 of the relay.
- 4. Connect leads from test set "Relay Contacts" binding posts to relay terminals across DHR unit Normally Open contacts.
- 5. Adjust "Timer Operation Selector" switch, UPPER "N.O. MOM.", LOWER - "FAST TRIP".
- 6. Adjust "Aux. Selector" switch to "AC3-24", "Voltmeter Range" switch to "300", "Voltmeter Selector" Switch to "Ext. A.C."
  - 7. Turn "Power ON" switch ON. "Power ON" light should glow.

#### WARNING

- The relay coils are energized as long as the test set is initiated. Therefore, this test should be conducted as rapidly as possible to prevent damage to relay coils.
  - 8. Initiate unit by pressing and holding "Initiate" Switch.
    - 9. Rotate "Main Control" clockwise until desired current is read on Main Ammeter, as indicated by relay manufacturer's instruction book.
    - 10. Rotate "Aux. Control" clockwise until relay DHR unit Normally Open contacts close. At this point, readjustment of "Main Control" may be necessary to maintain current set in Step 9 and test set timer may restart. Readjust "Aux. Control" until timer stops. Read current values and release "Initiate" switch.
    - 11. For BDD 16, repeat procedure from Step 4. In Step 4, re-connect 10 volt tap of "AC Output #1" to relay terminal #3.
    - 12. Turn test set off.

### Testing Harmonic Restraint

- 1. Connect the SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect the 10 volt tap of "AC Output #1" to the external test rectifier. Connect the other side of the test rectifier to terminal #5 of the relay. Connect the right hand common of "AC Output #1" to terminal #6 of the relay.
- 3. Short the external test rectifier by placing a jumper across its terminals.
- 4. Adjust "Aux. Selector" switch to "AC3-24" "Voltmeter Range" switch to "300", and "Voltmeter Selector" Switch to "Ext. A.C."
  - 5. Turn "Power ON" switch ON. "Power ON" light should glow.

- 6. Initiate unit by pressing "Initiate" switch.
- 7. Rotate "Main Control" clockwise to increase current output until 9 amperes is read on the Main Ammeter.
- 8. Turn test set off.
- 9. Remove jumper from external test rectifier.
- 10. Connect "AC Output #3" terminals of the test set to terminals #5 and #6 of the relay. Connect the polarity terminal (+) of "AC Output #3" to terminal #6 of the relay. NOTE: "AC Output #3 must not be connected to relay while 9 amperes is being set in Step #7.
- 11. Adjust "Timer Operation Selector" switch, UPPER "N.O. MOM.", LOWER - "FAST TRIP".
- 12. Turn "Power ON" switch ON. "Power ON" light should glow.
- 13. Initiate unit by pressing and holding "Initiate" switch.
- 14. Rotate "Aux. Control" clockwise until timer stops. Read value of current required to operate Harmonic Restraint on the Auxiliary Ammeter and release "Initiate" switch.

15. Turn test set off.

## Testing Instantaneous Unit

- 1. Connect the SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Adjust "Voltmeter Range" Switch to "300", "Voltmeter Selector" Switch to "Ext. A.C.", and "Aux. Selector" Switch to "Vern."
- 3. Connect "AC Output #1" terminals of the test set to relay terminals to energize the differential current coil and one through current restraing coil, i.e.: relay terminals 5 and 6.
- 4. Connect leads from "Relay Contacts" binding posts of test set to relay trip circuit contact terminals.
  - 5. Turn "Power ON" switch ON. "Power ON" light should glow.

This test should be conducted as rapidly as possible to avoid damage to the relay coil.

- 6. Initiate unit by pressing "Initiate" switch.
- 7. Rotate "Main Control" clockwise until the continuity light glows. Read and record current value on main ammeter.
- 8. Turn test set OFF.

#### DIRECTIONAL OVERCURRENT RELAY

(Westinghouse Type CR) (General Electric Type IBC)

#### GENERAL

A Directional Overcurrent Relay trips a circuit when it senses two abnormal conditions in the following sequence:

Current flow must be reversed 1.

2.

The reversed current flow must be higher than a prescribed amount, and the flow must continue for a predetermined time.

This relay is composed of two units, a directional unit and an overcurrent unit. The directional unit is similar to a single phase wattmeter. It contains a voltage actuated and a current actuated coil. When these two coils are energized, a torque is produced on the unit's disc. A 180° shift in phase relationship between the voltage and current produces a reverse torque on the disc. Normally, the torque produced holds the directional unit contacts open. When the current flow in the circuit reverses, the unit's disc will rotate to close the directional unit contacts.

The overcurrent unit of the relay is similar to the time delay overcurrent relay. In modern designs, the directional unit contacts must be closed before operating torque will be produced on the induction disc of the overcurrent unit. Thus, the directional overcurrent relay requires reversal as well as a minimum quantity of current flow before it may operate to trip a breaker.

Test Procedures

Type of Tests

Directional Unit Minimum Pickup

<u>Overcurrent Unit</u> ann a' geann a' tha a' leannaith gu cheal bh Time Current Characteristics

The test procedure is arranged to test each element of the relay individually. The directional element contacts must be blocked closed or bypassed to permit complete testing of the overcurrent element.

- "我们还是你们不可能了,你们还不能了。""我我们是你这些人的人的,你不能是我也找到了。"唐叔说,说道:"

Alternational Constraints
 Alternational Constratints
 Alternational Constratints
 Alt

(a) Strangenergy and set of the set of the set of general company of the set of the s

2.2%

1000

	TESTING DIRECTIONAL ELEMENT FOR MINIMUM IN MULTI-AMP MODEL SR-51 RELAY TESTER. (	PICKUP USING D.E.T. CIRCUIT CURRENT AND VOLTAGE IN PHASE)
Sar L	ALWAYS REFER TO MANUFACTURER'S LITERATUR	
	SETUP OF CONTROLS BEFORE TEST	
	CONTROL	POSITION
	"Power ON" Switch	OFF
A.A.	"Timer Operation Selector" Switch	UPPER-"N.O.MAINT." LOWER-"CONT."
	"Main Control	Zero (counterclockwise)
t sa at t ta sa	"Aux. Power" Switch	
	"Voltmeter Range" Switch	To read voltage in upper 1/3 of scale
1998 	"Voltmeter Selector" Switch	••••••••"D.E.T."
A	"Aux. Selector" Switch	••••••"D.E.T."
	"Aux. Control"	Zero (counterclockwise)
	"AC Range" Switch	••••••10A
	"DC Range" Switch	••••••••••• <b>5</b> A
	"Main Ammeter Range" Switch	
	"Voltage Relay-D.E.T." Switch	
	"Output #1-#2" Switch	"Output #1"
	<ol> <li>Connect the MULTI-AMP relay tester to as indicated on the nameplate and gr SWITCH IS OFF. CHECK THE "POWER ON"</li> </ol>	round. BE SURE THE MAIN
	2. Connect Polarity terminal <sup>+</sup> of relay operating coil to the Polarity termi (right-hand binding post). The othe terminal should be connected to the	inal of "AC Output #3" (=) er relay operating coil

3. Connect the relay voltage polarizing coil to "AC Output #3" terminals. The polarity terminal "±" of the relay voltage polarizing coil should be connected to <u>Non-Polarity</u> terminal of "AC Output #3". (left-hand binding post)

(10 volt)

e en la seconda de la compositiva de la La compositiva de la c

4. Turn "D.E.T." (Direct. Element Test) Switch to desired position. <u>NOTE</u>: Positions 1, 2, 3, and 4 are factory wired to produce values given below:

POSITION	<u>VOLTS</u>
î.	n en en en en en en en en en alter de la presentation de la pre
1 <b>2</b>	

Positions 5 through 9 are left unwired to permit their use for any particular values common to the user's system. The installation of a resistor in these unwired positions may produce any reasonable values of current and voltage.

- 5. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 6. Initiate unit by pressing "Initiate" Switch.

いたいないのなどのないという

- 7. Rotate "Main Control" clockwise to increase output until the relay directional unit contacts close. Read and record the values of voltage and current on the respective meters.
  - 8. Reverse leads from test set to potential coil of relay. Relay directional unit contacts should resist closure.
  - TESTING PICKUP AND TIME CURRENT CHARACTERISTICS OF OVERCURRENT UNIT
  - 1. Block Directional Unit contacts closed and follow procedure for "Induction Disc Overcurrent Relay".

## NOTE: AT END OF TEST BE SURE TO REMOVE ALL BLOCKING FROM RELAY

- - Conserve Marco Structures (2010)
     Conserve
    - الان المالية المركز المكلمة الحقائي المركز المر المركز المركز

TESTING DIRECTIONAL ELEMENT FOR MINIMUM PICKUP USING EXTERNAL PHASE SHIFTER AND PHASE ANGLE METER (MULTI-AMP MODELS CS-5 or CS-6) SETUP OF CONTROLS BEFORE TEST - Model SR-51 POSITION CONTROL "Power ON" Switch.....OFF "Timer Operation Selector" Switch......UPPER-N.O.MAINT." Contraction of the second of the second of LOWER-"CONT." .....Zero (counter-"Main Control"..... clockwise) "Aux." Power" Switch....."ExT." mand the same age may be read in upper 1/3 of scale "Aux. Selector" Switch....."AC-3 -24" "Aux. Control".....Zero (counter-Leader of gradient of the second clockwise) "DC Range" Switch..... 5A "Main Ammeter Range" Switch..... Souther that with Alexandre and Alexandre a sattest current may be read in upper 1/3 of scale "Voltage Relay Test" (Direct. Element) Switch ..... SET NORM "State and the second sec "Output #1-#2" Switch..... SETUP OF CONTROLS BEFORE TESTS (Models CS-5 or CS-6) "Power ON" Switch.....OFF "Input Voltage" Selector" Switch.....As required "Phase Shift Adjust Coarse".....Any position Switch (Upper Right).....Phase Shift Output Model CS-7 Phase Shifter and Phase Angle Meter may be NOTE: used for this test. Please refer to Instruction Book covering tests using MULTI-AMP CS-7.

i .

3 - 71

 Connect Model CS-5 to a suitable source of 3-phase power or Model CS-6 to a suitable single phase source. Check "Power ON" light. BE SURE THE MAIN SWITCH IS OFF.

, bi de l'est∰e de l'Adés **3.,−. 72**,57 de déción de la sectembre de la sectembre de la sectembre de la sectembre

- 2. Connect Model SR-51 relay tester to a suitable source of power as indicated on the nameplate and ground. Check the "Power ON" light. BE SURE THE MAIN SWITCH IS OFF.
- 3. Using Continuity leads, connect the "P.A.M." jack on the SR-51 to "Current Coil Input" terminals on Model CS-5 or CS-6. Connect black lead to polarity (±) on CS-5 or CS-6.
- 4. Using light leads, connect the "Phase Shifter Output" terminals to the "Aux. Power Input" terminals on the SR-51..."#" terminals should be connected together.
- 5. Using light leads, connect the voltage polarizing coil of the relay directional unit to "AC Output #3" terminals of the SR-51; relay polarity terminal "±" to "AC Output #3" polarity terminal "±".
  - 6. Using regular leads, connect current operating coil of the relay directional unit to "Output #1"; relay polarity terminal "±" to "Output #1" polarity terminal "±".
  - 7. Rotate "Main Control" knob clockwise to desired current value as read on Main Ammeter.
  - 8. Adjust "Coarse" and "Fine" Controls on Model CS-5 or CS-6 to desired phase angle as read on phase angle meter. (This should be angle of maximum torque as determined from manufacturer's instruction bulletin.)
  - 9. Rotate "Aux. Control" clockwise until the relay directional unit contacts close. Read value of voltage on voltmeter.
  - 10. Record values of current, voltage and phase angle at which directional unit contacts close.

(1) Bits was with a subscription of the subscription of the subscription of the subscription of the subscription.

## POWER DIRECTIONAL RELAYS (General Electric Type ICW) - (Westinghouse Type CW)

#### GENERAL

2

 $\sum_{i=1}^{n}$ 

The General Electric Type ICW or Westinghouse Type CW relay is an induction disc relay containing current and voltage operating coils. It is a single-phase wattmeter element equipped with a tap block so that minimum operating watts may be varied. The operation of these relays depends upon both phase angle and the magnitude of the applied voltage and current. Either the ICW or CW relay is available as a 3-phase or 1-phase unit.

The 3-phase relay measures 3-phase watts, and the relay current coil is connected to the secondary winding of a current transformer in one phase. The relay potential coil is connected to the secondary winding of a potential transformer providing line to line voltage. The tap block of this relay is calibrated in 3-phase watts. W=1.73 EI (Power Factor).

The single-phase relay measures single-phase watts. This relay's current and potential coils are connected to the secondaries of current and potential transformers in the same phase. The tap block of this relay is calibrated in single-phase watts.

Testing GE Type ICW 51A Relay (calibrated in 3-phase watts).

#### Type of Tests

1. Minimum Pickup 2. Timing

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE PROCEEDING WITH TESTS.

SETUP OF CONTROLS BEFORE TEST - MODEL SR-51

CONTROL

"Power ON" Switch.....OFF

"Timer Operation Selector" Sw... UPPER - "N.O.MOM" LOWER-"CONT"

"Main Control".....Zero (counterclockwise)

"Aux. Power" Switch....."EXT"

"Voltmeter Range" Switch.....So that test voltage may be read on upper 1/3 of meter scale "Voltmeter Selector" Switch...."AC Output #3"

"Aux. Selector" Switch..... "AC Output #3 150V"

"Aux. Control".....Zero (counterclockwise)

## 3 - 73

		Range" Switch10A
		Range" Switch
		in Ammeter Range" Switch
	"Ma	est read on upper 1/3 of meter
	"Vo	ltage Relay Test" (DET) SwitchSet "NORM"
	"Ou	tput #1-#2" Switch"Output #1"
	1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	TUP OF CONTROLS BEFORE TESTS-MODEL CS-5 or CS-6
		wer ON-OFF" SwitchOFF
in traisi	🤟 🐼 Inp	out Voltage Selector As required (Not on CS-6)
	Dha	se Shift Adjust Coarse Any Position
	Pha	ase Shift Adjust FineCounterclockwise
		tch (upper right)Phase Shift Output
•		sting Minimum Pickup
	1.	Connect SR-51 and CS-5 or CS-6 together as described under "Use of Phase Shifter and Phase Angle Meter", Section II.
	2.	Connect Model SR-51 and CS-5 or CS-6 to suitable sources of power as indicated on test set nameplate. BE SURE "POWER ON" SWITCHES ARE OFF. CHECK THE "POWER ON" LIGHTS.
•		Connect SR-51 "Output #1" binding posts to relay terminals so that the relay current coil may be energized. Observe polarity.
	· 4•	Connect SR-51 "AC Output #3" binding posts to relay terminals so that the relay potential coil may be energized. Observe. polarity.
	<b>5.</b>	Connect a pair of light leads from the SR-51 binding posts marked "Relay Contacts" to the relay trip circuit contacts terminals.
	6.	Turn the SR-51 and CS-5 or CS-6 "Power ON" Switches ON. "Power ON" lights should glow.
	7.	Adjust "Timer Operation Selector" Switch, UPPER to "N.O. MAINT", LOWER to "CONT".
	8.	Initiate SR-51 by pressing the "Initiate" Switch.

- 9. Rotate the SR-51 "Main Control" clockwise to energize the relay current coil, until the Main Ammeter indicates 5 amperes.
- 10. Adjust the "Coarse" and "Fine" controls on CS-5 or CS-6 until the Phase Angle Meter indicates 90° current lead voltage (270°I lag.)
- 11. Rotate the SR-51 "Aux. Control" clockwise until the Continuity light flickers. Observe this value of voltage.
- 12. If the relay is in perfect adjustment, the value of voltage observed in Step 2 should be:

13. Turn both test sets OFF.

Testing Timing

- 1. Repeat Steps 1-10 above ("Testing Minimum Pickup").
- 2. Rotate SR-51 "Aux. Control" clockwise until the voltmeter indicates a value of voltage equivalent to:

$$E= \frac{(4) (Relay Tap Setting)}{(1.73) (5)} = Volts$$

If this value of voltage exceeds the relay voltage rating, rotate SR-51 "Main Control" clockwise to increase current input to relay. Calculate a new voltage corresponding to the new value of current.

- 3. Turn SR-51 "Power ON" Switch OFF.
- 4. Adjust "Timer Operation Selector" Switch, UPPER to "N.O.MAINT", LOWER to "TIMER".
- 5. Reset timer to zero.
- 6. Turn SR-51 "Power ON" Switch ON.
- 7. Initiate SR-51 by pressing "Initiate" Switch.
- 8. When relay trip circuit contacts make, the timer will stop and the relay will be de-energized. Read and record this value of time.
- 9. Turn both test sets OFF.

Testing Westinghouse Type CW Relay 30° Characteristic (Calibrated in 3-Phase Watts)

Follow exactly same procedure as for General Electric Type ICW51A except as noted below:

 The Phase Shifter (CS-5 or CS-6) controls should be adjusted until the Phase Angle Meter reads current lead voltage by 30° (330° current lag). Testing General Electric Type ICW51B or Westinghouse CW Zero Degree Characteristic. (Calibrated in Single-Phase Watts)

anal o na kutoata aka san shi ku ku su 191<mark>3 ila 176</mark>94 saƙasti Rolagi anti kata kutoa sa si sa sa si si si si s Su anti waka si Sukasi tan Alaba si ni si sukasi si sa tan tangan si tan si si sa sa si si sa sa si si si si si

Follow exactly same procedure as for Type ICW51A except as noted below:

- 1. The Phase Shifter (CS-5 or CS-6) controls should be adjusted until the phase angle meter reads zero (voltage and current in phase).
- 2. In calculating the test voltages, use the formula:

Watts = (Voltage) (Current)

Where watts = tap value or multiple thereof

Current = Reading of Main Ammeter or magnitude of current energizing relay current coil from "Output #1" of SR-51.

Strength, Area (18) (1) (2) strengthe § 7, and strength (1,2) (2,2) (2,3)
 Area (2,3) (2,3) (2,3) (2,3) (2,3) (2,3) (2,3) (2,3) (2,3) (2,3) (2,3) (2,3)

ال المادي والما في حالي من المائية والمعالية والمعالم من من المادي المائي المؤلف مؤلم المعائل من الم المائية مع مالي المائية المائية الموضيع ومعاقاً من المحاجة والعجاج المراجع والمعاد والمائية المعادية والمائية المراجع المحاج والمائية المائية والمحاجة المائية المائية المعاد في المعاد المعاد المعاد والمحاجة والمحاجة المحا المراجع المحاج والمائية المحاجة والمحاجة الم

- ものです。1565年代的人は大学会会をおうない。その目前は15月にあったとし、15月1日の日本に「19月1日」。 15月1日を19月1日開始時間

an e ar an la casa

in the second the second of the second second

(a) A set of the se

n menten na al construir de la construir de travar en construir de la construir de la construir de la construir La construir de la construir de

小原原 をすいた げんしい 身のかれ かいしい 一般

Social equide comprehension ("come the end of end of "Come of "Come of a sub-Come of the social efficiency of the social sub-

a dibara ang se se sa garan manara se sa karana ang sa karang ang sa karang ang sa di 1991. Ang se sa sa sa sa sa sa

is a born termen of the set of the Start is set as if the set of the start of the set of the Start is set of the set

#### LOSS OF EXCITATION RELAY (General Electric Type CEH)

#### GENERAL

. . The Type CEH relay is a single-phase offset MHO type relay which operates on the induction cylinder principle. This relay is designed to detect the loss of excitation of synchronous generators with a sufficient selectivity so as not to function during system short circuits.

A HENRY ROOM & MAN

The relay contains current operating and voltage polarizing coils and will operate to close its trip circuit contacts whenever the voltage and current "seen by the relay" result in an impedance value within the relay manufacturer's operating characteristics curve. The operating characteristics curve may be changed in size or shifted through relay tap changes or relay adjustments.

#### TEST PROCEDURES - General Electric Type CEH-11A

PLEASE REFER TO MANUFACTURER'S BULLETIN BEFORE PROCEEDING WITH TEST.

#### Equipment Required

1. MULTI-AMP Model SR-51 relay tester

2. MULTI-AMP Model CS-5 or CS-6 Phase Shifter and Phase Angle Meter. (Note: See MULTI-AMP CS-7 Instruction Book for procedures using Model CS-7.

All for a set of the set of the

#### Power Required

Input: 3-phase at approximately 200 VA for Model CS-5

120 volts, 60 hertz, 1-phase at approximatly 1.0 kva for Models SR-51 and CS-6

#### Type of Tests

1. Characteristics of Induction Cylinder Unit

a. Offset and diameter of circle (Total Ohmic Reach)

b. Angle of maximum torque

2. Pickup of auxiliary relay ("A")

3. Pickup of target and seal-in unit

#### Pre-Test Requirements

- 1. All mechanical maintenance and adjustments should be performed prior to the electrical tests. Follow recommended procedures as outlined in the manufacturer's instruction bulletin (except when "As Found" tests are required).
- 2. Relay must be level for tests.
- 3. The MHO unit spiral spring should hold the contact definitely ope

## SETUP OF EQUIPMENT BEFORE TEST

1. Place Model CS-5 or CS-6 to the left of Model SR-51.

- 78

2. Place the relay at a convenient location so that easy connections can be made to all terminals, or

Place Model CS-5 or CS-6 and Model SR-51 close to the relay at the switchboard so that the test lead length is kept to a minimum and the relay operation can be observed during testing.

3. If the relay is to be tested on the switchboard, remove connection plug from the bottom of the unit and replace with test plug.

<u>WARNING</u>!!! During removal of cover and plugs, be careful not to activate the target and seal-in unit contacts as this can cause tripping of the circuit breaker.

- 4. Make sure that the Main Switch on Models CS-5 or CS-6 and SR-51 are OFF.
- 5. Connect Model CS-5 to a suitable source of 3-phase power, or Model CS-6 to a suitable 120 volt, single-phase source.
- 6. Connect Model SR-51 to a suitable source of single-phase power as indicated on the nameplate.

SETUP OF CONTROLS BEFORE TEST - MODEL SR-51

CONTROL	POSITION
"Power ON" Switch	
"Timer Operation Selector" Switch	UPPER-"N.O.MOM." LOWER-"CONT."
"Main Control"	Zero (counterclockwise)
"Aux. Power" Switch	"EXT."
"Voltmeter Range" Switch	upper 1/3 of scale
"Voltmeter Selector" Switch	#AC Output #3"
"Aux. Selector" Switch	"AC Output #3" 150V
"AC Range" Switch	
"Main Ammeter Range" Switch	
	ter el constante delle en el

いたい かいたい 見合いたい たい 教育の部分 なんしかがく

不可能な パード みぶく シュアージャル しゃたい 支付 んかくそうわれてはない 登場し続け しょけ

CONTROL	28	POSITION	
"Voltage Relay Test	("Direct. Element	")SwitchSET NORM	
"Output #1-#2" Switc	рания и служи карал различи и служи карали на служи и служи	"Output #1"	
SETUP OF CONTROLS BE		이 같은 것 같은	
CONTROL		POSITION	
"Power ON" Switch		(*************************************	
"Input Voltage Selec	tor"	As required	
		Any position	×
"Phase Shift Adjust	Fine"		
Switch (Upper Right)	) • • • • • • • • • • • • • • • • • • •		Output"
<u>NOTE</u> : For testi	ng with Model CS-	-7, please refer to CS-7	

instruction book.

## Induction Cylinder Unit

ş

The induction cylinder unit belongs to the general classification of MHO units. That is, the unit is composed of a wound field with both current and voltage coils and an armature shaped like a cylinder and acts like a single-phase induction motor. The design is such that the torque may rotate the armature either clockwise or counterclockwise, dependent upon the value of the impressed voltage and current. For certain phase angle relationships, there are no values of voltage and current that will produce a torque on the armature to close the unit's trip circuit contacts. This characteristic gives the relay directional qualities.

Testing Induction Cylinder Unit

A. Offset and Diameter of Circle - (Ohmic Reach)

1. Connect the MULTI-AMP test units to a suitable source of power and ground. BE SURE THE "MAIN SWITCH" IS OFF. CHECK "POWER ON" LIGHTS.

2. Connect Model CS-5 or CS-6 output terminals marked "Phase Shifter Output" to the "Aux. Power" input terminals on Model SR-51. Observe polarity. Connect terminals marked "±" together.

3. Connect "AC Output #3" terminals on SR-51 to relay voltage polarizing coil terminals. Relay polarity terminals(±) should be connected to "AC Output #3" polarity terminal (±).

4. Connect "AC Output #1" of the SR-51 to the relay current operating coil terminals. The relay contains two current coils. A jumper must be used so that the current will
flow through these coils in series. "AC Output #1" polarity terminal ( $\pm$ ) must be connected to polarity terminal ( $\pm$ ) of one of the operating coils. <u>Non-polarity terminal</u> of that coil is jumpered to polarity terminal ( $\pm$ ) of relay second operating coil. <u>Non-polarity terminal</u> of relay second operating coil is connected to <u>non-polarity terminal</u> of "AC Output #1".

- 5. Insert the telephone type plug into the "P.A.M." jack on Model SR-51. Connect the leads from the plug to the CS-5 or CS-6 terminals marked "Current Coil Input". Observe polarity. Connect black lead from plug to terminal marked (±).
- 6. Connect the SR-51 continuity light across the relay terminals so as to observe operation of the relay main trip circuit contacts.
- 7. Block the auxiliary relay (A) trip circuit contacts closed.
  - 8. Select proper Voltmeter and Main Ammeter ranges on the Model SR-51 so that meter readings will be in upper 1/3 of meter scale.

Turn "Power ON" in both SR-51 and CS-5 or CS-6. "Power ON" lights should glow.

10. Adjust "Timer Operation Selector" Switch to UPPER-"N.O.MAINT."

11. Initiate Model SR-51 by pressing "Initiate" Switch.

- 12. Rotate "Main Control" to energize relay current operating coils. (Suggested 5 amps.)
- 13. Adjust phase angle by means of "Coarse" and "Fine" Phase Shifter adjustment to 270°. (e.g. 90° current lead voltage or any other specified angle of maximum torque.)
- 14. Rotate "Aux. Control" (clockwise) to increase voltage until the continuity light lights.
  - 15. Continue to rotate "Aux. Control" (clockwise) to increase voltage until continuity light is extinguished. Continue to rotate "Aux. Control" to increase voltage approximately 10 or 20 volts above point where continuity light was extinguished.
- 16. Decrease voltage by rotating "Aux. Control" (counterclockwise) until continuity light glows. Record this value of voltage for Maximum Reach Voltage. Continue to decrease voltage until continuity light extinguishes. Record this value of voltage as offset voltage. During this operation, maintain current and phase angle as specified in Steps 12 & 13.

17. Remove blocking from relay.

9.

### B. Testing for Angle of Maximum Torque

 Repeat Steps 1 through 16 above for phase angles of 255° (current lead voltage by 75°) and 285° (current lead voltage by 105°). (15° on either side of angle of maximum torque) Other angles may be used depending upon offset tap setting.

2. Remove all blocking from relay.

# Auxiliary or "A" Unit

÷.1

This unit is an electromagnetic attraction type unit actuated by a DC coil. The purpose of this unit is to prevent false tripping due to vibration should that relay voltage go to zero as the result of a blown fuse in the potential transformer circuit.

### Pickup of Auxiliary Relay ("A")

SETUP OF CONTROLS - MODEL SR-51 (CS-5 or CS-6 not required) The state of the second st CONTROL "Power ON" Switch.....OFF "Timer Operation Selector" Switch......UPPER-"N.O.MAINT." LOWER-"CONT." "Main Control".....Zero (counterclockwise) "Aux. Power" Switch...."INT." "Voltmeter Range" Switch......So that test voltage may be read in UPPER 1/3 of scale. the second states of the second s "Voltmeter Selector" Switch.....DC "Aux. Selector" Switch.....DC 150 "Aux. Control".....Zero(counterclockwise) "Main Ammeter Range" Switch..... "Voltage Relay Test" ("Direct. Element") Switch..Set "NORM" "Output #1-#2" Switch....."Output #1"

> n nei sen el sen el servicio de la companya de la c El sen el sen

	3 - 82			
1.	Connect SR-51 to a suitable source of power and ground. BE SURE THE "MAIN SWITCH" IS OFF. CHECK "POWER ON" LIGHT.			
2.	Connect a pair of light leads to relay terminals which will permit energizing auxiliary (A) coil of relay when relay main trip circuit contacts are closed. Connect other end of these leads to SR-51 "D.C. Output".			
3.	Connect continuity light across relay terminals to observe operation of relay ("A") trip circuit contacts.			
4,•	4. Block relay main trip circuit contacts closed.			
5.	Turn "Power ON" Switch ON. "Power ON" light should glow.			
6.	Push "Initiate" Switch.			
7.	Rotate "Aux. Control" until continuity light glows.			
	Record these values of DC voltage and current.			
Te	st of Target and Seal-In (Model CS-5 or CS-6 not required)			
	SETUP OF CONTROLS - MODEL SR-51			
co	NTROL			
	ower ON" SwitchOFF			
"T	ower ON" SwitchOFF imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C."			
"P "T	imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C."			
"P "T "M	imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C."			
"P "T "M "A "V	<pre>imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C." ain Control"Zero (counterclockwise) ux. Power" Switch"INT" oltmeter Range" Switch</pre>			
"P "T "M "A "V	<pre>imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C." ain Control"Zero (counterclockwise) ux. Power" Switch</pre>			
"P "T "M "A "V "V	<pre>imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C." ain Control"Zero (counterclockwise) ux. Power" Switch"INT" oltmeter Range" Switch</pre>			
"P "T "M "A "V "V "A	<pre>imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C." ain Control"Zero (counterclockwise) ux. Power" Switch"INT" oltmeter Range" Switch</pre>			
"P "T "A "A "V "V "A "A	<pre>imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C." ain Control"Zero (counterclockwise) ux. Power" Switch</pre>			
"P "T "A "A "V "V "A "A	<pre>imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C." ain Control"Zero (counterclockwise) ux. Power" Switch"INT" oltmeter Range" Switch</pre>			
Υ "T" M" A" V" V" V" A" A" A" Δ" Δ" Δ" Δ"	<pre>imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C." ain Control"Zero (counterclockwise) ux. Power" Switch"INT" oltmeter Range" Switch</pre>			
"P "T "A "A "V "V "A "A "A "I	<pre>imer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"D.C." ain Control"Zero (counterclockwise) ux. Power" Switch"INT" oltmeter Range" Switch</pre>			

Que 20 19 19

- 1. Connect SR-51 to a suitable source of power and ground. BE SURE MAIN SWITCH IS OFF. CHECK "POWER ON" LIGHT.
- 2. Connect a pair of light leads to relay terminals which will allow energizing the target and seal-in coil; connect other end of these leads to SR-51 "Relay Contacts" binding posts.
- 3. Block relay main unit and "A" unit trip circuit contacts closed.
- 4. Turn "Power ON" Switch CN. "Power ON" light should glow.
- 5. Initiate unit by pressing "Initiate" Switch.

5.

14.

6. Rotate "Aux. Control" (clockwise) to increase current to target and seal-in coil until target shows. Remove blocking from "A" unit trip circuit contacts. If DC circuit remains energized, the seal-in unit is operating properly.

7. Record this value of current. 8. Remove all blocking from relay.

Bada and all a characteristics of the set of t the set of t set of the set the set of the set set of the set set of the set set of the set of t

# 

ಸತ್ತುದು. ಸೇರೆ ತನ್ನ ನಡುವಲಿಯಿ ಸಂದಿನ್ನುಗಳಿಗೆ ಗುಂದಿನ ಗಾರಿಕಿ ನಿರ್ದಾರಿ ಕೊನ್ನವರು ನಿರ್ದೇಶದಿಂದ ಗುಂದಿ ಸೇರೆಯಲ್ಲಿ ತಿಂದಿ ಸಿ ಸರಿ ಪ್ರಧಾನಿಸುವ ಸಂಭಾಗಿಸಿಕೊಂಡಿಗೆ ಸೇರೆ ಪ್ರತಿಕೊನ್ನ ಸೇರೆ ಸಂಶೇಷ ಸಂಪರ್ಧ ಸಂಪರ್ಧಿಸಿ ಮಾನದಿ ಸರ್ಕಿಂಗ ಸೇರೆಯಲ್ಲಿ ತಿಂದಿ ಸಿದೆ ಪೂರ್ಣ ತೆಡಿಗಿ ಮತ್ತು ಸಂಪರ್ಧಿತಿಯ ಸ್ಥಾನಿಗೆ ಸಂಪರ್ಧಿತಿಯ ವರ್ಷಗೊಂಡಿ ಸಂಪರ್ಧ ಸಂಘ ಗಾರಿ ಸರ್ಕಾರಿ ಸಂಪರ್ಧಿಸಿ ಸಂಪರ್ಧಿಸಿ ಸೇರೆಯ ಸಂಪರ್ಧಿಕಿಯಿಂದ ಮಾನವಾದಿ ಕಾರ್ಣಿಯಲ್ಲಿ ಮಾನ ಕ್ರಾಮಿದ್ದಾನೆ. ಇದು ವಿರೇಶಿ ಸಂಪರ್ಧಿಕ ಸಂಪರ್ಧಿಸಿ ಸಂಪರ್ಧಿಸಿ ಸಂಪರ್ಧಿಸಿ ಸೇರೆಯಲ್ಲಿ ಸಿದೆಯಿಂದ ಸೇರೆಯಲ್ಲಿ ಕಾರ್ಣಿಕಿ ಸಾಧಾನ್ಯ ಮಾನ ಕ್ರಾಮಿದ್ದಾನೆ. ಇದು ವಿರೇಶಿ ಸರ್ಕಾರಿ ಸಂಪರ್ಧಿಸಿ ಸರ್ಕರ್ ಸಿದೆಯಲ್ಲಿ ಸಿದೆಯಲ್ಲಿ ಸ ಸಿದೆಯಲ್ಲಿ ಸಿದೆಯಲ್ಲಿ

# • 2000 and 2

ಮೇಲ್ಯಾಂಗ್ರಿಸ್ ಪ್ರಾಯಾಗಿದ್ದ ಮಾಡಿದ ಮುಂದಿ ಮೇಲ್ಯೆ ಸಂಪಾರಿಯನ್ನು ಮೇಲ್ಯಾಂಗ್ರಿಯಿಂಗ್ ಮಾಡಿದ್ದಾರೆ. ಇದು ಹಿಲ್ಲಿದ್ದಿ ಮೇಲ್ಯಿ ಮೆಲ ಡಿಪ್ರಾಂಗ್ರಾಮ್ ಕೇಲ್ಯಾಡಿ ಸ್ವಾಮ್ ಸ್ವಾಮ್ ಸಿಕ್ರಾಂಗ್ ಸಿಕ್ರಾರ್ ಗಳು ಮಾಡಿಗೆ ಗಳಿಗೆ ಸಿಕ್ಕಾರ್ ಮಾಡಿ ಮೇಲ್ ಸಮಿಪ ಗ್ರಿಕಿಸ್ ಸಂಪ್ರ ಹಿತ್ತು ಸಂಪ್ರದಿಂಗ್ರಾಮ್ ಸೇರ್ ಸ್ವಾಮ್ ಸ್ವಾಮಿ ಮಾಡಿ ಸೇರ್ ಸಾಲ್ ಸಿಕ್ಕಾರ್ ಡಿಕ್ಕಾರ್ ಸ್ವಾಮಿಗೆ ಸಿಕ್ಕಾರ್ ಸಿಕ್ಕಾರ್ ಸಿಕ್ಕಾರ್ ಸ

ntegen om en skære på den var terna de enderer fære. Er trederer for en som talen er erer for en efter som skær Koreje om egener stære fordet en forste av forste konstanter og en skære fædge. Nære en forste forste en en en Her forsjære for av de de skære en stredet en jokalister for en er er krætter forste en er er en er er er er er

## DIRECTIONAL DISTANCE (REACTANCE) RELAY (General Electric Type GCX)

3 - 84

#### s - use distribution of the state of

#### GENERAL

The GCX relay is a high-speed directional-distance relay intended for the protection of transmission lines. The relay contains two (2) basic units - MHO and OHM, and may contain some or all of several accessory units, each of which is explained below:

#### MHO UNIT

The MHO unit belongs to the general classification of induction cup units. That is, the unit is composed of a wound field with both current and voltage coils and an armature shaped like a cup. The unit operates like a single-phase induction motor. The design of this motor is such that the torque may rotate the armature either clockwise or counterclockwise dependent upon value of the impressed voltage, current, and phase angle between the current and voltage. There are certain phase angle relationships where it is <u>impossible</u> to find values of voltage and current that will produce a torque on the armature to close the MHO unit trip circuit contacts. Therefore, the MHO unit has directional qualities.

#### OHM UNIT

This is also an induction cup unit with both current and voltage coils acting like a single-phase induction motor. However, in this case, regardless of phase angle relationships, values of voltage and current can be found that will produce torque on the armature to close the OHM unit trip circuit contacts. Torque is a function of impressed voltage, current, and phase angle between the current and voltage.

### INSTANTANEOUS OVERCURRENT UNIT

This is an electromagnetic attraction type of unit actuated by an AC current coil. The coil of this unit is in series with the MHO and OHM unit current operating coils. The overcurrent unit trip circuit contacts must be closed before this relay can trip a circuit breaker.

#### "OX" UNIT

This is an electromagnetic attraction type unit actuated by a DC coil. This unit changes potential taps on the "OHM" unit so that the "OHM" unit will respond for either Zone 1 or Zone 2 values of OHMIC reach.

#### "S" UNIT

This is an electromagnetic attraction type of unit actuated by a DC coil. For certain faults, the MHO unit reset is relatively slow. The "S" unit prevents a false trip signal under these conditions.

#### Equipment Required

- MULTI-AMP Model SR-51 Relay Tester and and second 1.
- MULTI-AMP Model CS-5, CS-6 or CS-7 Phase Shifter & Phase Angle Meter NOTE: For testing with Model CS-7, please refer to CS-7 instruction 2. book.

#### Power Required

3-phase at approximately 200 VA for Model CS-5 1 - 152 KE 11 Input: 120 volts, 60 hertz, 1-phase at approximately 1.0 kva for Model SR-51 or CS-6

### Types of Tests

- OHM unit tests First (#1) zone reach and maximum torque angle 1. OHM unit tests - Second (#2) zone reach
- 2. MHO or starting unit tests - Third (#3) zone reach and maximum

- 3. torque angle Pickup of "OX" relay Pickup of "S" relay
- 4.
- 5.
- Pickup of overcurrent unit (where applicable) 6.
- Pickup of target and seal-in unit 7+
- 8. Overall test

12

#### Pre-Test Requirements

All mechanical maintenance and adjustments should be performed prior to the electrical tests. Follow recommended procedures as outlined in the manufacturer's instruction bulletin (except when "As Found" tests are required).

Relay must be level for tests.

The OHM unit (upper) lead-in spring should barely hold the contact and the second against the backstop.

The MHO unit (lower) lead-in spring should hold the contact definitely open.

### Set-up of Equipment Before Test

- Place Model CS-5 or CS-6 to the left of Model SR-51. 1.
- Place the relay at a convenient location so that easy connections 2. can be made to all terminals, or

Place Model CS-5 or CS-6 and Model SR-51 close to the relay at the switchboard so that the test lead length is kept to a minimum and the relay operation can be observed during testing.

2、每次工作,多时,每多一个提出了,不可能是有可能是重要要不

If the relay is to be tested on the switchboard, remove plugs from the top and bottom of the unit and replace them with test plugs. 3. Remove bottom plug first.

3 - 86
WARNING: During removal of cover and plugs, be careful not to activate the Target and Seal-In unit contacts as this can cause tripping of the circuit breaker.
4. Make sure that the "Main Switch" on CS-5 or CS-6 and SR-51 are OFF.
5. Connect Model CS-5 to a suitable source of three-phase power.
6. Connect Model SR-51 and CS-6 to a suitable source of single-phase power as indicated on the nameplate.
Test Procedures
SETUP OF CONTROLS BEFORE TESTS - MODEL SR-51 CONTROL POSITION
"Power ON" Switch
"Timer Operation Selector" SwitchUPPER-"N.O.MOM." LOWER-"CONT."
"Main Control"Zero (counterclockwise)
"Aux. Power" Switch
"Voltmeter Range" Switch be read in upper 1/3 of scale
"Voltmeter Selector" Switch
"Aux. Control"Zero (counterclockwise)
"AC Range" Switch
"DC Range" Switch
"Main Ammeter Range" Switch be read in upper 1/3 of scale
"Voltage Relay Test" (DET) SwitchSet "NORM"
"Output #1-#2" Switch"Output #1"
SETUP OF CONTROLS BEFORE TEST - Model CS-5 or CS-6
CONTROL POSITION
"Power ON-OFF" SwitchOFF
Input Voltage Selector
"Phase Shift Adjust CoarseAny position
"Phase Shift Adjust Fine"
"Switch" (upper right)"Phase Shift Output"

Testing OHM Unit (Zone 1) for Reach and Phase Angle

Connect Model CS-5 or CS-6 output terminals marked "Phase Shifter Output" to the "Aux. Power" input terminals on Model SR-51. Observe polarity. Connect terminals marked "±" together. 1. Connect Model SR-51 "AC Output #3" to the relay potential coil 2. terminals. Observe polarity. Connect SR-51 "AC Output #1" to relay current coil terminals. 3. The relay current coils should be connected in series. Observe polarity. Plug in the telephone type plug into the "P.A.M." jack on SR-51. 4. Connect the leads from the plug to the CS-5 or CS-6 terminals marked "Current Coil Input". Observe polarity. Connect black lead to terminal marked "±". 5. Connect a pair of light leads from terminals marked "Relay Contacts" to terminals on relay so as to observe operation of OHM unit trip circuit contacts through the "OX" unit NC contacts. Bypass or block the overcurrent unit contacts (if present) and 6. the MHO unit contacts. Select proper AC range on the "Aux. Selector" Switch of the SR-51. 7. 8. Turn Power ON in the Models SR-51 and CS-5 or CS-6. "Power ON" lights should glow. 9. Turn "Timer Selector" Switch to UPPER - "N.O. MAINT.", LOWER-"CONT". 10. Initiate Model SR-51 by pressing the "Initiate" Switch. 11. Adjust current through the current coils of the relay to the desired value by turning the "Main Control" on SR-51 slowly clockwise. (The value of current will be calculated from the impedance settings of the relay and will be provided to the personnel performing the test (suggested value 5 amps.). The continuity\_light\_will\_glow. 12. Adjust the phase angle by means of the "Coarse" and "Fine" phase shifter adjustment on the CS-5 or CS-6. The phase angle utilized will be either the angle of maximum torque of the relay (e.g. 90° current lag voltage) or value as determined from actual operating conditions. 13. Adjust "Aux. Control" on SR-51 until the continuity light extinguishes. Continue to increase voltage for another 10-15 volts. 14. Reduce voltage slowly by rotating "Aux. Control" counterclockwise until the contacts of the OHM unit just close (as shown by the flickering of continuity light).

- 15. Record the values of current, voltage and phase angle. Compare with values computed and/or calibration data on the relay.
  - 16. Return "Main" and "Aux." controls on SR-51 to zero (maximum counterclockwise).
  - 17. To determine the angle of maximum torque, repeat Steps 11-16 for two other values of phase angle equi-distant from 90° current lag. (e.g. 60° current lag and 120° current lag)
  - 18. Turn "Power ON" Switches on SR-51 and CS-5 or CS-6 to OFF.

Testing OHM Unit - (Zone 2) - For Reach

- 1. Connect a pair of light leads from binding posts marked "Relay Contacts" to relay terminals to observe closure of OHM unit and "OX" unit Normally Open contacts.
- 2. Close the "OX" relay contacts by blocking its armature in the closed position. (This is the relay mounted behind the nameplate).
- 3. Turn Models SR-51 and CS-5 or CS-6 "Power ON" Switches to ON.
- 4. Initiate SR-51 by pressing "Initiate" Switch.
- 5. Adjust current through the current coils of the relay to desired value by turning the "Main Control" on SR-51 slowly clockwise. (The value of current will be calculated from the impedance settings of the relay and be provided to the personnel performing the test. (Suggested value 5 amps.)
- 6. Adjust the phase angle by means of the "Coarse" and "Fine" phase shifter adjustment on the CS-5 or CS-6 to the angle of maximum torque of the relay (e.g. 90° current lag voltage), or value as determined from actual operating conditions. Continuity light should glow.
- 7. Adjust "Aux. Control" on SR-51 until the continuity light extinguishes. Continue to increase voltage another 10-15 volts.
- 8. Reduce voltage slowly with "Aux. Control" until the contacts of the OHM unit just close as shown by the flickering of the continuity light.
- 9. Record the values of current, voltage and phase angle. Compare with values computed and/or calibration data on the relay.
- 10. Return "Main" and "Aux. Control" on SR-51 to zero (maximum counterclockwise).
  - 11. If desired, Steps 4 through 10 may be repeated at other phase angles.

- 12. Turn Models SR-51 and CS-5 or CS-6 OFF.
- 13. Remove blocking of MHO and OX units. Retain blocking on instantaneous overcurrent unit (if present).

<u>Testing MHO Unit - (Starting Unit) - (Zone 3) for Reach and</u> Angle of Maximum Torque

- 1. Block OHM unit and overcurrent unit (if present) closed.
- 2. Connect a pair of light leads from "Relay Contacts" binding posts to relay terminals to observe closure of MHO unit terminals.
- 3. Turn "Power ON" in Models SR-51 and CS-5 or CS-6. "Power ON" lights should glow.
- 4. Initiate Model SR-51 by pressing the "Initiate" Switch.
- 5. Adjust current through the current coil of the relay to desired value by turning the "Main Control" on SR-51 slowly clockwise. (The value of current will be calculated from the impedance settings of the relay and will be provided to the personnel performing the test (suggested value 5 amps.).
- 6. Adjust the phase angle by means of the "Coarse" and "Fine" phase shifter adjustment on CS-5 or CS-6 to the angle of maximum torque of the relay (e.g. 60° current lag) or values as determined from actual operating conditions. Continuity light may be extinguished. If so, follow with first part of Step 7.
- 7. Rotate "Aux. Control" clockwise on SR-51 until the continuity light glows. Continue to rotate "Aux. Control" until continuity light extinguishes. Continue to increase voltage for another 10-15 volts.
- 8. Reduce voltage slowly by rotating "Aux. Control" counterclockwise until the contacts of the MHO unit just close (as shown by flickering of the continuity light).
- 9. Record the values of current, voltage and phase angle.
- 10. Return "Main" and "Aux." Controls on SR-51 to zero (maximum counterclockwise).
  - 11. To determine angle of maximum torque, repeat Steps 4 10 for two (2) other phase angles, equi-distant from 60° current lag. (e.g. 30° current lag and 90° current lag)
  - 12. Turn Models SR-51 and CS-5 or CS-6 OFF.
  - 13. Remove all blocking from the relay.

en en de la seconda de la Esta de la seconda de la se Esta de la seconda de la se

ć

.

y s

	ing "OX" Unit (Phase Shifter not requir	그는 것 같은 것 같
SETU	P OF CONTROLS BEFORE TEST - Model SR-51	n in an the second device of a fair of the state of the second second second second second second second second References and the second se
CONT	ROL	POSITION
"Pow	er ON" Switch	
	er Operation Selector" Switch	.UPPER-"N.O. MAINT." LOWER-"CONT."
"Mai	n Control"	.Zero (counterclockwise)
"Aux	. Power" Switch	
and the	n na stran a brinn an tara ann an tart ann an tart ann a' chuir ann a' chuir an Air ann an tart an tart ann an An tart ann an tart ann an tart an tart ann an tart ann an tart ann an tart an tart an tart an tart an tart an t	in upper 1/3 of scale
"Vol	tmeter Selector" Switch	LDC And Adding a Adding a and a contract and a sector a
"Auz	. Selector" Switch	DC of desired voltage
"Aux	Control"	Zero (counterclockwise)
"AC	Range" Switch	•.10A
"DC	Range" Switch	•• <b>5.0A</b>
"Maj	n Ammeter Range" Switch	••500 Eligentation
"Vo]	tage Relay Test" (DET) Switch	Set "NORM"
"Out	put #1-#2" Switch	"Output #1"
1.	Block MHO, OHM and overcurrent unit con	ntacts closed.
2.	Connect a pair of light leads to relay "OX" unit operating coil.	··· · ·
3.	Connect the other end of the leads to to on SR-51.	terminals marked "DC Output"
÷ *,	Connect a pair of light leads from term to terminals of relay to observe opening circuit contacts.	minals marked "Relay Contact ng of "OX" unit trip
5.	Turn "Power ON" Switch to ON. "Power of light should glow.	ON" light and Continuity
6.	Initiate unit by pressing "Initiate" S	
7.	Advance "Aux. Control" slowly clockwishight is extinguished. Observe the vo This is the pickup voltage of the "OX"	ltage on the voltmeter.

· .

• • •

8. Return "Aux. Control" to zero (max	ximum counterclockwise).
9. Reconnect the continuity light to <u>closure</u> of "OX" unit contacts. Co	relay terminals to observe ontinuity light is extinguished.
10. Advance "Aux. Control" slowly close light glows. Observe the pickup the voltmeter.	ckwise until the continuity voltage of the "OX" relay on
11. Turn "Aux. Control" slowly counter light is extinguished. Observe the	rclockwise until continuity
12. Return the "Aux. Control" to zero	(maximum counterclockwise):
13. Turn Model SR-51 OFF.	erande en el composition de la composition (1830)
14. Remove all blocking from the rela	y construction of the second state of the
Testing "S" Relay - (Phase Shifter and	
SETUP OF CONTROLS BEFORE TEST - MODEL	SR-51
(a) A set of the se	POSITION
"Power ON" Switch	
•	
"Timer Operation Selector" Switch	UPPER-"N.O.MAINT." LOWER-"CONT."
"Timer Operation Selector" Switch "Main Control"	LOWER-"CONT." - Cont. C
an and an substant and the second statistics of	LOWER-"CONT." Zero ( counterclockwise)
"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch	LOWER-"CONT." Zero ( counterclockwise) 
"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch "Voltmeter Selector" Switch	LOWER-"CONT." Zero(counterclockwise) So that test voltage will be read in upper 1/3 of scale DC
"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch "Voltmeter Selector" Switch	LOWER-"CONT." Zero(counterclockwise) So that test voltage will be read in upper 1/3 of scale TDC
"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch "Voltmeter Selector" Switch	LOWER-"CONT." Zero(counterclockwise) INT." So that test voltage will be read in upper 1/3 of scale DC desired voltage
"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch "Voltmeter Selector" Switch "Aux. Selector" Switch	LOWER-"CONT." Zero(counterclockwise) So that test voltage will be read in upper 1/3 of scale DC DC desired voltage Zero (counterclockwise)
"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch "Voltmeter Selector" Switch "Aux. Selector" Switch "Aux. Control" Switch	LOWER-"CONT." Zero(counterclockwise) So that test voltage will be read in upper 1/3 of scale DC DC desired voltage Zero (counterclockwise) 10A
<pre>"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch "Voltmeter Selector" Switch "Aux. Selector" Switch "Aux. Control" Switch "AC Range" Switch "DC Range" Switch</pre>	LOWER-"CONT." Zero ( counterclockwise) So that test voltage will be read in upper 1/3 of scale DC DC desired voltage Zero (counterclockwise) 10A
<pre>"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch "Voltmeter Selector" Switch "Aux. Selector" Switch "Aux. Control" Switch "AC Range" Switch "DC Range" Switch "Main Ammeter Range" Switch</pre>	LOWER-"CONT." Zero ( counterclockwise) So that test voltage will be read in upper 1/3 of scale DC DC desired voltage Zero (counterclockwise) 10A 5.0A
<pre>"Main Control" "Aux. Power" Switch "Voltmeter Range" Switch "Voltmeter Selector" Switch "Aux. Selector" Switch "Aux. Control" Switch "AC Range" Switch "DC Range" Switch</pre>	LOWER-"CONT." Zero ( counterclockwise) So that test voltage will be read in upper 1/3 of scale DC DC desired voltage Zero (counterclockwise) 10A 5.0A 5.0A

1

3 - 91

		·
	e forte de d'entre of d'autre de oudd <b>a31 −1892</b> (alve oudda)	$\mathcal{H} = \mathcal{H} \mathcal{H} \mathcal{H} \mathcal{H} \mathcal{H} = \mathcal{H} \mathcal{H} \mathcal{H} \mathcal{H} \mathcal{H} \mathcal{H} \mathcal{H} \mathcal{H}$
1.	Connect a pair of light leads to relay to with "S" unit operating coil.	erminals associated
2.	Connect the other end of the leads to ter on Model SR-51.	
3.	Connect a pair of light leads from termin to relay terminals so as to observe opera	nals marked "Relay Contacts" ation of "S" unit contacts.
4.	Turn the "Power ON" Switch ON. "Power O	N" light should glow.
5.	Initiate unit by pressing "Initiate" Swi	tch. State Property Strategy - 15
6.	Observe the Continuity light. Light sho	uld be extinguished.
	Advance "Aux. Control" slowly clockwise light glows. Observe the pickup voltage	of the "S" relay on
1.81	withe voltmeter. Class and the second the	
		en the continuity light
9.	Return the "Aux. Control" to zero (maxim	um counterclockwise).
10	. Turn Model SR-51 OFF.	and a set of the second se
Te	sting Overcurrent Unit - Phase Shifter and is not required	Phase Angle Meter
	TUP OF CONTROLS - MODEL SR-51	
		POSITION
	ower ON" Switch	
"T	imer Operation Selector" Switch	.UPPER-"N.O.MAINT." LOWER-"CONT."
им	ain Control	
	ux. Power" Switch	
	"oltmeter Range" Switch	
	'oltmeter Selector" Switch	
•	ux. Selector" Switch	
<b>"</b> A	ux. Control"	
	Aux. Control"	Zero (counterclockwise)

•

.

	CONTROL	
	"DC Range" Switch	
	"Output #1-#2" Switch	
	"Main Ammeter Range" SwitchSo that test current may be read in UPPER 1/3 of scale	
	"Voltage Relay Test" (DET) SwitchSet "NORM."	
	1. Block the OHM and MHO unit trip circuit contacts closed.	
	2. Connect a set of heavy leads to relay terminals associated with the overcurrent unit operating coil.	
Ę.	3. Connect the other end of these leads to the "Output #1" terminals of SR-51. Use suitable Common for the mammeter range to be utilized and desired output taps. (See "Selection of Output Taps	
	4. Connect a pair of light leads from terminals marked "Relay Contact to relay trip circuit terminals so as to observe operation of overcurrent unit contacts.	ts
• • •	5. Turn "Power ON" Switch ON. "Power ON" light should glow.	
	6. Initiate unit by pressing "Initiate" Switch.	
	7. Turn "Main Control" and "Aux. Control" slowly clockwise until instantaneous element picks up. Continuity light should glow.	
	8. Read current on ammeter. This is the pickup current of the instantaneous overcurrent element.	
	9. Return "Main Control" to zero (maximum counterclockwise).	
	10. Turn the SR-51 OFF.	
	11. Remove all blocking from the relay.	
• • •	Testing of Target and Seal-In Unit - Phase Shifter and Phase Angle Meter not required.	
2 15 1 - 2	SETUP OF CONTROLS - MODEL SR-51	
	CONTROL	•
1.	"Power ON" Switch	
	"Timer Operation Selector" SwitchUPPER-"N.O.MAINT." LOWER-"CONT."	
	"Main Control"Zero (counterclockwise)	

÷.,

CONTROL	
"Aux. Power" Switch"INT."	
"Voltmeter Range" Switch	an a
"Voltmeter Selector" Switch "EXT. AC"	an an Coll
"Aux. Selector" Switch	
"Aux. Control"Zero (counterclo	ckwise)
"AC Range" Switch10A	ez jugirri
"DC Range" Switch be read in UPPER 1/3 of sc	are
"Main Ammeter Range" Switch	
"Voltage Relay Test" (DET) SwitchSet "NORM"	
"Output #1-#2 Switch"Output #1"	
1. Block the OHM, MHO and Instantaneous Overcurrent Element supplied) trip circuit contacts closed.	(when
2. Connect a pair of light leads from terminals marked "Rel tacts" to relay trip circuit terminals so as to observe of seal-in contacts.	operation
3. Connect a set of light leads to relay terminals associat target and seal-in operating coil.	ed with
4. Connect other end of the leads to terminals marked "DC C	utput".
5. Turn "Power ON" Switch ON. "Power ON" light should glow	<b>T 4</b>
6. Initiate unit by pressing "Initiate" Switch.	
7. Rotate "Aux. Control" slowly (clockwise) to increase out	put.
8. Observe Target operation. When Seal-In contacts close, Continuity light will glow.	
9. Read pickup current on DC ammeter.	
NOTE: Target and Seal-In operation can be observed by a pressing and holding the "Press to Trip DC" Switc SR-51 with one hand and resetting the target with other hand and then releasing the switch.	sn on
10. Return the "Aux. Control" to zero (maximum counterclocky	vise).
11. Turn SR-51 OFF.	
12. Remove all blocking from the relay.	

### OVER-ALL TEST OF GCX RELAY

÷...

The following tests provide over-all operational tests of the GCX relay. They verify the integrity of internal connections in the relay, correct polarization between the OHM and the MHO units, and the operation of the "OX" relay. SETUP OF CONTROLS BEFORE TEST - MODEL SR-51 POSITION CONTROL "Power ON" Switch..... ....OFF "Timer Operation Selector" Switch.....UPPER-"N.O.MAINT." LOWER-"CONT." .....Zero (counterclockwise) "Main Control"..... "INT." "Aux. Power" Switch..... be read in UPPER 1/3 of scale "Voltmeter Selector" Switch...... "EXT." AC "Aux. Selector" Switch..... DC "AC Range" Switch.....10A "DC Range" Switch..... 5A be read in UPPER 1/3 of scale. "Voltage Relay Test" (DET) Switch......Set "NORM" .....#Output #1" "Output #1-#2" Switch..... SETUP OF CONTROLS BEFORE TEST - MODELS CS-5 or CS-6 POSITION CONTROL : "Power ON-OFF" Switch..... ...OFF "Input Voltage" Selector.....As required (Not on CS-6) "Phase Shift Adjust Coarse".....Any position "Phase Shift Adjust Fine".....Counterclockwise Switch (upper right).....Phase Shift Output and a second star was a second with the first second second second second second second second second second s

- 1. Connect Model CS-5 or CS-6 output terminals marked "Phase Shifter Output" to relay potential coil terminals. Observe polarity. ± to ±.
- 2. Connect one set of light leads from terminals marked "DC Output" to relay terminals associated with "OX" unit operating coil.
- 3. Connect SR-51 "AC Output #1" to the relay current operating coil terminals. Current coils are connected in series. Observe polarity.
- 4. Plug in the telephone type plug into the "P.A.M." jack on SR-51. Connect the leads from the plug to the CS-5 or CS-6 terminals marked "Current Coil Input". Observe polarity. Connect black lead to terminal marked "±".
- 5. Connect a pair of light leads from terminals marked "Relay Contacts" to relay trip circuit terminals to observe closure of overcurrent, OHM and MHO unit contacts through circuit with "OX" unit Normally Closed contacts.
- 6. Select 150V range on the "Voltmeter Range" Switch.
- 7. Hook up external voltmeter terminals on SR-51 to output terminals of phase shifter.
- 8. Connect CS-5 or CS-6 to a suitable source of power and SR-51 to 120 volts, single-phase power.
- 9. Turn "Power ON" Switches in Model SR-51 and CS-5 or CS-6. "Power ON" lights should glow.
- 10. Initiate Model SR-51 by pressing "Initiate" Switch.
- 11. Select proper ammeter range on Main Ammeter. The range should be high enough to register the current sufficient to pick up the OHM unit (Zone 1) when phase shifter output voltage is applied to potential coils of relay.
- 12. Rotate "Main Control" on SR-51 clockwise to pass about 5 amperes through relay current coils. Rotate "Coarse" and "Fine" controls on CS-5 or CS-6 until desired phase angle is read on phase angle meter. (e.g. 90° current lag). Continue to rotate "Main Control" on SR-51 until Continuity light glows. Rapidly read current, voltage and phase angle.
- 13. Reduce the current to zero by turning "Main Control" to its maximum counterclockwise position.
- 14. Record the value of current, voltage and phase angle observed in Step 12.
- 15. Repeat Steps 12 through 14 for another phase angle, if desired.

- Increase the DC output voltage by turning the "Aux. Control" 16. on the SR-51 slowly clockwise until the "OX" relay picks up as indicated by a clicking noise. This will set up the relay for the second zone operation.
- Hook Continuity light across relay trip circuit terminals to 17. observe closure of Overcurrent, OHM and MHO unit contacts through circuit with "OX" unit Normally Open contacts.
- Repeat Steps 12 through 15. The second state of the second state o 18.

. Nga salah sa 112 - sala sanah na na barang karang karang karang karang karang karang karang karang karang kara n Bernen an an an an Salar an Salar an an Anna an Anna an Anna an Anna an an an an an Anna an Anna an Anna an A

, men ander som en som en brukken er som en skriverer och som er som en beser 19 mar for och som er som er som er som er brukken skriver att ander som som er brukken som er som er som er 19 mar for ender som er sjärnage for som er som e

and shall a the formulation of the second to be appendiced at the part of the part an en anter e comerciario de **compo**nse con a consector e a consectador e anter a comerciario de anter A de esta deseña a de consector de consector e consector de consectador e a consectador de a consectador e a GAR deseña e esta de consectador e a deseña de consectador e esta año año a consectador e a consectador e Referencia de sector e a deseña de consectador e a consectador e esta año a consectador e a consectador e a Referencia de sector e a deseña de consectador e a consectador e esta año a consectador e a consectador e a Referencia de sector e a deseña de consectador e a consectador e a consectador e a consectador e a consectador e Referencia de sector e a de consectador e a consectador e

· 陈紫秋云道:"这个人就是是这些你们,我们是这些问题,你们是这些是不是不是我们是不是我们是

는 이 물람들이 나오는 것 같은 것이 가 있으시다. 이 가 그는 이 가 가 있다. 것이 아는 아이가 무엇을 넘쳐졌는 것이 같은 것이 아닌 아가 주는 것이 하는 것이 안 가 있다. 이 아는 것이 같이 같이 같

- angeach a' Cheannach a' a anns an shreach an 2000. 'S Colonnach a' Chean Carl an Stadaichtean Bac Cheannach anns anns an Stadaichtean Stadaichtean Anns Cheannachtean
- ು ಮಾಲಕ್ಷೆಯಾಗುವುದು ಸಂಗ್ಲಿತೆಯಲ್ಲಿ ಎಂದು ಸಾಹಾಕ್ಷೆಯಲ್ಲಿರುವ ಸಂಕಾರ್ಣವರು ಮಾಡಿದ್ದಾರೆ. ಇದು ಸೋತ್ರಮದ ಸಂಕಾರ್ಣವು ಸಂಕ್ರೆಸ್ ಸ್ಟೇಟ್ ಸಂಕಾರಣೆ ಮಾಡಿದ್ದಾರೆ ಸಂಕಾರಣ ಸಂಕ್ರಣ ಸಾಹಿತಿಯಲ್ಲಿ ಸಾಹಿತಿಯಲ್ಲಿ ಸಾಹಿತಿಯಾಗಿದೆ. ಇದು ಸಂಕಾರಣ ಸಂಕರ್ಷನ್ ಸಂಕರ್ಣವು ಸಂಕರ ಸ್ಟೇಟ್ ಸ್ಟೇಟ್ ಸ್ಟೇಟ್ ಸ್ಟೇಟ್ ಸ್ಟೇಟ್ ಸಾಹಿತಿಯಲ್ಲಿ ಸಾಹಾಕ್ಷ್ಯಾಗೆ ಸಾಹಿತ್ಯ ಸಾಹಿತಿ ಸಂಕರ್ಣವು ಸಾಹಿತ್ಯ ಸಹಕ್ಷೆಗಳು ಸಂಕರ್ಣವು a Maria a provinské provinské stala v Maria Provinské stala se stala se stala se stala se stala se stala se st

#### DISTANCE RELAY (MHO) GENERAL ELECTRIC TYPE GCY

The Type GCY relay is a high speed directional distance relay containing three (3) MHO units known as the M1 unit, the M2 unit and the OM3 unit. Each of these units contains a wound field with both current and voltage coils and an armature shaped like a cup. The units operate like single-phase induction motors. Generally speaking, the voltage coils produce torque to hold the relay trip circuit contacts open while the current coils produce torque to close the trip circuit contacts.

The M1 unit is used for first zone protection. This unit is an instantaneous unit, has directional qualities and operates independent of any other relay.

The M2 unit is used for second zone protection. This unit has directional qualities and operates in conjunction with a timing relay. Therefore, a time delayed trip is obtained.

The OM3 unit may be used for zone 3 protection. This unit has directional qualities; however, its circular impedance characteristics may be offset so as to encompass the origin of the impedance diagram. Thus, this unit may "Reach" backwards. The OM3 unit is also used in conjunction with a timing relay which results in a time delayed trip.

### Testing

PLEASE REFER TO MANUFACTURER'S BULLETIN BEFORE PROCEEDING WITH TEST

#### Types of Tests

- 1. MHO Unit M1 First (#1) zone Reach and Torque Angle
- 2. MHO Unit M2 Second (#2) zone Reach and Torque Angle
- 3. MHO Unit OM3 Third (#3) zone Reach, Maximum Torque Angle and Offset.

#### Equipment Required

- 1. MULTI-AMP Model SR-51 Relay Tester
- 2. MULTI-AMP Model CS-5 or CS-6 Phase Shifter & Phase Angle Meter

#### Power Required

- Input: 3-phase at approximately 200 VA for Model CS-5 120 volts, 60 hz, 1-phase at approximately 1.0 kva for Models SR-51 and CS-6
- NOTE: All mechanical maintenance and adjustments should be performed prior to the electrical tests. Follow recommended procedures as outlined in the manufacturer's bulletin (except when "As Found" tests are required).

Relay must be level for tests.

### SETUP OF EQUIPMENT BEFORE TEST

- Place Model CS-5 or CS-6 to the left of Model SR-51. 1.
- Place the relay at a convenient location so that easy connections can be made to all terminals, or 2.
- 2a. Place Model CS-5 or CS-6 and Model SR-51 close to the relay at the switchboard so that the test lead length is kept to a minimum and the relay operation can be observed during testing.
- If the relay is to be tested on the switchboard, remove plugs 3. from the top and bottom of the unit and replace them with test plugs. Remove bottom plug first.
  - WARNING: During removal of cover and plugs, be careful not to activate the Target and Seal-in contacts as this can cause tripping of the circuit breaker.

4. Make sure the Main Switches on CS-5 or CS-6 and SR-51 are OFF.

- 5. Connect Model CS-5 to a suitable source of 3-phase power.
  - Connect Model SR-51 and CS-6 (when used) to a suitable source 6. of single-phase power as indicated on the nameplate.

SETUP OF CONTROLS BEFORE TEST - MODEL SR-51

POSITION CONTROL

"Power ON" Switch..... OFF Strate Control of the second strate of the se

"Timer Operation Selector" Switch... UPPER-"N.O. MAINT.", LOWER-"CONT."

"Main Control.....Zero (counterclockwise)

"Aux. Power" Switch....."EXT."

in upper 1/3 of voltmeter scale

"Voltmeter Selector" Switch....."AC Output #3"

en de Peño siguesi "Aux. Control".....Zero (counterclockwise)

in upper 1/3 of ammeter scale

"Voltage Relay Test" (DET) Switch.....Set "NORM"

"Output #1-#2" Switch.....Output #1

3 - 99

minam

MODEL CS-5 or CS-6

	SETU	IP OF CONTROLS BEFORE TEST - MODEL CS-5 or CS-6
1.175	CONT	PROL
	"Pow	OFF
· · ·	Inpu	it Voltage SelectorAs Required (Not on CS-6)
	Phas	se Shift Adjust CoarseAny Position
		se Shift Adjust Fine
	Swit	tch (upper right)Phase Shift Output
	Test	ting M <sub>1</sub> Unit (Zone 1) for Reach and Phase Angle
	1.	Connect Model SR-51 and Model CS-5 or CS-6 together as described in Section 2 under "Use of Phase Shifter and Phase Angle Meter".
	2.	Connect SR-51 "AC Output #3" binding posts to the relay M1 unit potential coil terminals. Observe polarity.
	3.	Connect all the relay current coils in series by jumpering the proper relay terminals. This series circuit is then connected to the SR-51 "Output #1" binding posts. Observe polarity.
	<b>4</b>	Connect a pair of light leads from the SR-51 binding posts marked "Relay Contacts" to the relay terminals associated with the relay M1 unit trip circuit contacts.
· .	5.	Turn "Power ON" Switch ON. Both test sets (SR-51 and CS-5 or CS-6) "Power ON" lights should glow.
	6.	Initiate SR-51 by pressing "Initiate" Switch.
	<b>7</b> .	Rotate "Main Control" on SR-51 clockwise to energize current coils of relay until the desired value of test current is read on the SR-51 Main Ammeter (suggested 5 amperes). The Continuity light should glow.
	8.	Adjust the "Coarse" and "Fine" controls on the CS-5 or CS-6 until the phase angle meter indicates the presumed angle of maximum torque for the $M_1$ unit. (Example: 60° current lag voltage)
	9.	Rotate the "Aux." Control on the SR-51 clockwise to increase voltage applied to the relay $M_1$ unit potential coil until the voltmeter indicates a voltage approximately 15-20 volts higher than the voltage where the continuity light extinguishes.
	10.	Rotate the "Aux." Control on the SR-51 counterclockwise until the Continuity Light flickers. Observe and record the values of voltage, current and phase angle. Calculate "Reach".
		i san ing panganan na sanaraharan ing panganan k

•

•

•

11. Return SR-51 "Main" and "Aux." Controls to zero.

12. Repeat Steps 7 through 10 for two other values of phase angle to determine that the presumed angle of maximum torque was really the true angle of maximum torque for the relay  $M_1$  unit. (suggested -15° and +15° from angle chosen in Step 8.

13. Turn "Power ON" Switches OFF on both SR-51 and CS-5 or CS-6.

Testing M2 Unit (Zone 2) for Reach and Phase Angle

- 1. Repeat Step 1 above ("Testing M1 Unit").
- 2. Connect SR-51 "AC Output #3" binding posts to the relay M2 unit potential coil terminals. Observe polarity.
- 3. Repeat Step 3 above. ("Testing M<sub>1</sub> Unit)
- 4. Connect a pair of light leads from the SR-51 binding posts marked "Relay Contacts" to the relay terminals associated with the relay M2 unit trip circuit contacts.
- 5. Repeat Steps 5, 6, 7 for "Testing M<sub>1</sub> Unit".
- 6. Adjust the "Coarse" and "Fine" Controls on the CS-5 or CS-6 until the Phase Angle Meter indicates the presumed angle of maximum torque for the M<sub>2</sub> unit. (Example: 75<sup>o</sup> current lag voltage)
- 7. Repeat Steps 9-13 above. (Testing M1 Unit)

Testing OM3 Unit (Zone 3) for Reach, Phase Angle and Offset.

1. Repeat Step 1 "Testing M1 Unit".

...

- 2. Connect SR-51 "AC Output #3" binding posts to the relay OM3 unit potential coil terminals. Observe polarity.
- 3. Repeat Step 3 "Testing M1 Unit".
- 4. Connect a pair of light leads from the SR-51 binding posts marked "Relay Contacts" to the relay terminals associated with the relay OM3 unit trip circuit contacts.
- 5. Repeat Steps 5, 6 and 7 "Testing M1 Unit".
- 6. Adjust the "Coarse" and "Fine" Controls on the CS-5 or CS-6 until the Phase Angle Meter indicates the presumed angle of maximum torque for the OM<sub>3</sub> unit. (Example: 75° current lag voltage)
- 7. Repeat Steps 9 through 12 above. ("Testing M1 Unit")
- 8. Repeat Step 7 "Testing M1 Unit".

10. R W	epeat Steps 9 and 10 "Testing M1 Unit" except the calculation ill be Offset of the OM3 unit.
	en 19 maarta – Sener Standing van 1989 en staatstelik en Stille geboerdige en geheerde je geheerde je geheerde Geboerd
	,这些"你不能是你的事情,我还是你要做 <sup>了你们的</sup> 。"他们的话道:"你是你们,我不是你的话,我是""我们。" "
	an an an anna 1860. Sheannan anna an anna an anna an anna 1869. Anna Anna 1918 anna an anna an Anna an Anna anna an an Anna an Anna an Anna an Anna an anna.
,	
9802333 10000-18032. 1	and an an an an an ann an an an an an an an
	i a taki a Magaalika dari tari ti ji a magada arawaa ta ar
langi sa Sinang gan sagari	್ರಾಂಗಿಸಿದ್ದ. ಕಲ್ಲಿ ಕರ್ಷಕ್ರಿಗಳ ನಿರ್ದೇಶಗಳು ಮನ್ನು ಗೌಧಿಗೆ ಕ್ರಮಗಳು ಕರ್ಷಕ್ರಿಗಳು ಗಾರ್ಕಿಕ್ಸ್ ಎಂದು ಗೌಧಿಗಳು ವಿಷ್ಣಿಸಿದ್ದ ನ ಸಂಗಾಧದಿಕ್ಕೆ ಎಂದಿಗಳು ಪ್ರದೇಶಕ್ರಿಗಳು ಮಾಡ್ಯವರ್ಗಿ ಸಿದ್ದಾನಿಕ್ಕಾಗಿ ಗೌಧಿಗಳು ಕರ್ಷಕ್ರಿಗಳು ಪ್ರಕಾರ ವರ್ಷಕ್ರಿಗಳು ಪ್ರಕಾರ್ ವರ್ಷ ಕ್ರಾಮಗಳು ಕ್ರಾಗ್ ಗಾಗ್ಗಳ್ಳು ಎಂಗಿಗಳು ಹಿಂದು ಸಿದ್ಧ್ರ ವರ್ಷವಿದ್ದ ಗಾಡಿದ್ದರು. ಗಾಡಿದ ಪ್ರಕಾರ ಗ್ರಾಗಿಗಳು ಹೊಂದು ಗೌಧಿಗೆ ಸಹಿತ ವ ಕರ್ಷಕ್ರಿಗಳು ಕ್ರಾಗ್ ಗ್ರಾಗ್ಗಳು ಬಿಂದು ಸಿದ್ದಾನಿಕ್ಕೆ ವರ್ಷವಿದ್ದ ಪ್ರಕಾರ ಸಹಿತಿಗಳು ಸಹಿತಿಗಳು ಪ್ರಕಾರ ಗ್ರಾಗಿಗಳು ಹೊಂದು ಸಹಿತಿಗ
	ಿಗಳು ಕ್ಷೇತ್ ಜಾರ್ಥಿಗಳು ತನ್ನ ಸಂಶೇಷಣೆ ಮತ್ತು ಸೇವಿ ಕ್ಷೇತ್ರಗಳು ಮತ್ತು ಸಂಶೇಷಣೆ ಮತ್ತು ಸಂಶೇಷಣೆ ಮತ್ತು ಸ್ಥಾನಗಳು ಸಂಶೇಷಣೆ ಸಂಶ
	。 《北京建築》(第二世内文字集合))(《中国文》(第二世)(第二世)(第二世)(第二世)(第二世)(第二世)(第二世)(第二世)
	en en effettigen bei effettigen en en en entreperten en her men general en en Besterne en e

افران الإيرام محقات الميانية القارية والكليم في محمد الأسطى المؤمن الأسال الحاصي والمعاطي الأسطار ال - المحمد المحمد المحمد المحمد المحمول المراجع والمحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد ا المحمد الحمد في محمد المحمد المحمد في محمد والمحمد والمحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد الم

 $\sim 10^{-3}$  s and the set of the transfer of the set o

un artístico dato a atom Célend<sup>a</sup>, Cartes Contes Constanto de Centro da Constanto da Constanto e esta data daterio de Constante Antonio estas o altas a constante Antonio da Cartes da Constante Constante Antonio e Antonio (Constantes) da Cartesta (Constantes)

化学校 化生产 医试验检尿道 化分子 化试验 了,这些道路给你的家庭提供的名字,并不可能的。"

· 注意,于是"你开放"的"第三个"的"好好",还是我们的人。"

#### DISTANCE (IMPEDANCE) RELAY

# (Westinghouse Type HZ)

#### GENERAL

The HZ relay is a high speed zone distance impedance type relay providing either an instantaneous or a time delay trip. The total relay contains five (5) major units, namely, three (3) instantaneous imped-ance units, a directional unit and a synchronous timer, each of which is described below:

#### Instantaneous Impedance Units

These units work on the balance-beam principle. A magnetic beam is pivoted between two voltage actuated coils which produce a magnetic pull on one end of the beam, and a current actuated coil which produces a magnetic pull on the other end of the beam. When the pull produced by the current coil exceeds the pull produced by the voltage coils, the beam tips and closes the relay trip circuit contacts. The values of voltage and current required to tip the beam and close relay trip circuit contacts, may be varied through the use of a core screw and taps on the relay current coil.

#### Directional Unit

This is a polarized electromagnetic unit with a pivoted armature. There are two (2) potential coils and one (1) current coil. The unit is designed so that for all current/voltage phase relationship between current lead 100° to current lag 80° passing through 0° lag, torque is produced to close the unit's contacts. For all the other current/voltage phase relationships, the directional unit's contacts are restrained.

#### Synchronous Timer

This is a motor driven timing unit that provides a time delay for closing the relay trip circuit contacts in Zones 2 and 3.

TESTS TO BE RUN Balance - Impedance Unit Zone 1 Balance - Impedance Unit Zone 2 Pickup of Directional Unit Pickup Impedance Units Zone 1, Zone 2, Zone 3 Timing Test - Zone 2 Impedance Unit Timing Test - Zone 3 Impedance Unit Pickup of Target and Seal-In

### 

TEST PROCEDURES

ALWAYS CONSULT MANUFACTURER'S LITERATURE BEFORE STARTING TEST Balance - Impedance Unit - Zone 1 SETUP OF CONTROLS BEFORE TEST - MODEL SR-51 POSITION CONTROL "Power ON" Switch.....OFF "Timer Operation Selector" Switch.....UPPER-"N.O.MAINT." LOWER-"CONT." "Main Control".....Zero (counterclockwise) "Aux. Power" Switch....."INT." be read on UPPER 1/3 of scale "Aux. Selector" Switch..... Voltage "Aux. Control".....Zero (counterclockwise) be read on UPPER 1/3 of scale "Voltage Relay Test" (DET) Switch.....Set "NORM" "Output #1-#2" Switch.....Output #1 Connect SR-51 to a suitable source of power as indicated on the 1. nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT. Connect Zone 1 current coil to "Output #1". 2. Connect Zone 1 potential coil to "AC Output 3". 3. Connect Continuity light across terminals on relay so as to 4. observe operation of Zone 1 contacts. Block directional unit contacts closed. 5. Turn "Power ON" Switch ON. "Power ON" light should glow. 6. Initiate unit by pressing "Initiate" Switch. 7.

- 8. Rotate "Aux. Control" clockwise until 35 volts is applied to voltage coils.
- 9. Rotate "Main Control" clockwise until Zone 1 contacts close as indicated by glowing of Continuity light.
- 10. Record this value of current.
- 11. Return both "Aux. Control" and "Main Control" to zero (counterclockwise).
- 12. Rotate "Aux. Control" clockwise until 5 volts is applied to voltage coils.

- 13. Rotate "Main Control" clockwise until Zone 1 contacts close as indicated by glowing of Continuity light.
- 14. Record this value of current. It should be approximately 1/7th of value record in Step 10.

and the second second

15. Remove all relay blocking.

Balance - Impedance Unit Zone 2

- 1. Same setup of controls and hookup as for Zone 1, except Zone 2 coils and contacts are connected to test unit; Timer Contacts "T1" are jumpered; directional unit contacts are blocked closed.
- 2. In Step 8 use 60 volts.
- 3. In Step 12 use 10 volts.
- 4. In Step 14 second current should be approximately 1/6th of first current.
- 5. Remove jumper from "T1" contact.
- 6. Remove blocking directional unit.

Balance - Impedance Unit Zone 3

1. No electrical test recommended. Beam should be balanced when both current and potential coils are de-energized.

Pickup of Directional Unit

 SETUP OF CONTROLS
 MODEL SR-51 RELAY TESTER

 CONTROL
 POSITION

 "Power ON" Switch.....OFF
 "Timer Operation Selector" Switch.....OFF

 "Timer Operation Selector" Switch......UPPER-"N.O.MAINT."

 LOWER-"CONT."

 "Main Control"......Zero (counterclockwise)

3 - 106	
nder der eine States verscheiden zu die der Stehen die eine States verscheiden der St	POSITION
"Aux. Power" Switch	· · · · · · · · · · · · · · · · · · ·
"Voltmeter Range" Switch	1.5 or 7.5 depending upon position of "D.E.T." Switch
"Voltmeter Selector" Switch	•••••• <b>**D••E•T••</b>
"Aux. Selector" Switch	"D.E.T."
"Aux. Control"	Zero (counterclockwise)
"AC Range" Switch	<b></b>
"Main Ammeter Range" Switch	5A or 10A depending upon position of "D.E.T." Switch
"Voltage Relay Test" (DET) Switch	Position 1-4 (as desired)
"Output #1-#2" Switch	"Output #1"
1. Connect SR-51 to a suitable source of nameplate and ground. BE SURE THE M THE "POWER ON" LIGHT.	of power as indicated on the MAIN SWITCH IS OFF. CHECK
2. Connect Polarity terminal (±) of rel operating coil to the Polarity term The other relay operating coil term: the desired <u>tap</u> of "Output #1".	inal (±) of "AC Output #3". inal should be connected to
3. Connect the relay voltage polarizing terminals. The Polarity terminal ( izing coil should be connected to <u>Ne</u> "AC Output #3".	t) of the relay voltage potar-
4. Connect Continuity light so as to of unit contacts. If necessary, block observation.	other contacts to allow this
5. Turn "Power ON" Switch ON. "Power	
6. Initiate unit by pressing "Initiate	
7. Rotate "Main Control" clockwise unt close as indicated by glow of Conti	il relay directional contacts
8. Read and record values of voltage a	
9. Remove blocking from relay.	n Prezistante de la construction de l Prezistante de la construction de la
an a	en 1997 - Santa S 1997 - Santa Sa

. .

	Pickup Impedance Units Zone 1, Zone 2, Zone 3			
	Test Equipment Required Model SR-51 Relay Tester Model CS-5, CS-6 or CS-7 Phase Shifter Note: Please refer to CS-7 instruct with Model CS-7	& Phase Angle Meter ion book when testing		
	SETUP OF CONTROLS - MODEL SR-51	n an an Ngalanak (mar 1000) an an an an an Albana (mar 1000) Tanan an an Angalan an Anna an		
	CONTROL	POSITION		
	CONTROL "Power ON" Switch	OFF		
1 	"Timer Operation Selector" Switch "Main Control"	UPPER-"N.O.MAINT."		
	"Main Control"	Zero (counterclockwise)		
	"Aux. Power" Switch	<b>"EXT. "</b> Ital and the second state in the		
	"Voltmeter Range" Switch	So that test voltage may be read on UPPER 1/3 of scale		
	"Voltmeter Selector" Switch	an an Albana an Albana an Albana an Albana A' <b>AC-3</b> 11 an Albana an Albana an Albana		
	"Aux. Selector" Switch	"AC-3 150"		
	"Aux. Control"	Zero (counterclockwise)		
	"AC Range" Switch	10A. Jacob et al. March and et al. Alexandre and a second s		
	"DC Range" Switch	na <b>5A</b> .a.a.l.( garen anegezia (€)		
	"Main Ammeter Range" Switch	So that test current may be read on UPPER 1/3 of scale		
. •	"Voltage Relay Test" (DET) Switch	Set "NORM"		
	"Output #1-#2" Switch	"Output #1"		
	SETUP OF CONTROLS - Model CS-5 or CS-6	an an an an ann an tha an tha an tha an an an tha an th Tha an tha an t		
342	CONTROL CONTROL DE CARACTER DE CAR	POSITION		
	"Power ON-OFF" Switch	.OFF		
	"Input Voltage Selector"	As required (Not on CS-6)		
	"Phase Shift Adjust Coarse"	Any position		
	"Phase Shift Adjust Fine"	.Counterclockwise		
	Switch (upper right)	"Phase Shift Output"		

- 1. Connect SR-51 "AC Output #1" to relay current operating coil terminals. The relay current coils should be connected in series. Observe polarity.
- 2. Connect all relay potential polarizing coils in parallel and across "AC Output #3" binding posts. Observe polarity.
- 3. Connect Continuity light so as to observe operation of Impedance Unit #1 trip circuit contacts.
- 4. Turn "Power ON" Switches ON. "Power ON" lights should glow.
- 5. Initiate unit by pushing "Initiate" Switch.
- 6. Adjust current through operating coils of relay to the desired value by rotating the "Main Control" on the SR-51 clockwise. (suggested 5 amps.)
- 7. Adjust Phase Shifter to desired Phase Angle. (suggested relay angle of maximum torque.) Continuity light should glow.
- 8. Increase applied voltage by rotating "Aux. Control" on SR-51 clockwise until Continuity light is extinguished. Increase voltage 10-15 volts above this point. Then slowly decrease voltage by counterclockwise rotation of "Aux. Control" on SR-51 until the Continuity light glows. Record these values of current, voltage and phase angle as pickup of Zone 1 Impedance Unit.
- 9. Return "Main Control" and "Aux. Control" to zero positions.
- 10. Jumper relay timer contacts.
- 11. Connect Continuity light to observe operation of Impedance Unit #2 trip circuit contacts.
- 12. Repeat Steps 6-9 above. Record the values of current, voltage and phase angle as pickup of Zone 2 Impedance Unit.
- 13. Connect Continuity light to observe operation of Impedance Unit #3 trip circuit contacts.
- 14. Repeat Steps 6-9 above. Record the values of current, voltage and phase angle as pickup of Zone 3 Impedance Unit.
- 15. Turn test sets OFF and remove all relay blocking and jumpers.
  - 茶村 小学 アイ・システム・ション・オイト・ション・ション しょう うせんたいかい ほんばん () 支援が構

Timing Test - Zone 2 Impedance Unit				
SETUP OF CONTROLS BEFORE TEST - MODEL SR-51				
CONTROL	POSITION			
"Power ON" Switch	(1) 「日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日本の日			
"Timer Operation Selector" Switch	.UPPER - "N.O. MOM" LOWER - "CONT."			
"Main Control"	Zero (counterclockwise)			
"Aux. Power" Switch				
"Voltmeter Range" Switch	So that test voltage will be read on UPPER 1/3 of scale			
"Voltmeter Selector" Switch	AC EXT."			
"Aux. Selector" Switch	"DC 150V"			
"Aux. Control"	.Zero (counterclockwise)			
"AC Range" Switch				
"DC Range" Switch				
"Main Ammeter Range" Switch	So that test current will be read on UPPER 1/3 of scale			
"Voltage Relay Test" (DET) Switch	Set "NORM" of the there is a state			
"Output #1-#2" Switch	"Output #1"			
SETUP OF CONTROLS BEFORE TEST - MODEL CS-5	<u>or CS-6</u>			
CONTROL	POSITION			
"Power ON-OFF" Switch	이 것 같은 방법에 가장 가지 않는 것 같은 것 같은 것 같은 것 같은 것 같은 것 같은 것 같이 같이 있다.			
"Input Voltage Selector"	· · · · · · · · · · · · · · · · · · ·			
"Phase Shift Adjust Coarse"	• • "A"			
"Phase Shift Adjust Fine"	Counterclockwise			
Switch (upper right)	"Phase Shift Output"			

- 1. Connect SR-51 "AC Output #1" to relay current operating coil terminals. The relay current coils should be connected in series. Observe polarity.
- 2. Connect all relay potential polarizing coils in parallel and to "Phase Shifter Output" terminals of CS-5 or CS-6. Observe polarity.
- 3. Connect a pair of light leads from "Phase Shifter Output" terminals on CS-5 or CS-6 to "External Voltmeter" terminals on SR-51.
- 4. Connect "DC Output" binding posts on SR-51 to relay terminals so that lower contact switch of relay may be energized.
- 5. Rotate "Aux. Control" 1/2 turn clockwise.
- 6. Turn "Power ON" Switches ON. "Power ON" lights should glow.
- 7. Set Pointer Pre-Set on Main Ammeter to 1/2 division below desired test current. This value of current should be high enough to pick up Zone 2 Impedance Unit. It may be calculated from relay settings and voltage available from "Phase Shifter Output".
- 8. Rotate "Main Control" clockwise to increase current to desired value. Jog "Initiate" Switch. Set CS-5 or CS-6 to desired phase angle.
- 9. Connect "Relay Contacts" binding posts on SR-51 to relay terminals so that closure of "Timer 1" contacts may be observed.
- 10. Adjust "Timer Operation Selector" Switch, UPPER-"N.O. MAINT.", LOWER - "TIMER".
- 11. Initiate unit by pressing "Initiate" Switch.
- 12. Record time to trip.

Timing Test - Zone 3 Impedance Unit

Repeat Steps 1 through 12 above except that in Step 9, connect so as to time closure of Timer 2 contacts.

and the second states and

Pickup of Targets

See DC Target and Seal-In test procedure.

and a second second

#### TYPICAL TESTS FOR DC AUXILIARY RELAYS Model SR-51 Only

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING
- <u>Type of Tests</u> erver jack that is a subscription of the server of and service
Pickup • Dropout C.MEALAN Constraint for the organization of Depth 4 S
SETUP OF CONTROLS BEFORE TEST CONTROL POSITION
CONTROL POSITION
"Power ON" SwitchOFF
"Timer Operation Selector" SwitchUPPER-"N.O.MAINT" LOWER-"CONT".
"Main Control"
"Aux. Power" Switch"INT"
"Voltmeter Range" SwitchSo that desired test voltage will be read in upper 1/3 of scale
"Voltmeter Selector" SwitchDC
"Voltmeter Selector" SwitchDC "Aux. Selector" Switch150 or 300 DC
"Aux. Selector" Switch150 or 300 DC
"Aux. Selector" Switch
"Aux. Selector" Switch
"Aux. Selector" Switch150 or 300 DC "Aux. Control"Zero (counterclockwise) "AC Range" Switch

Testing Pickup and Dropout

- 1. Connect Model SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect relay operating coil terminals to "DC Output" binding posts of test set.
- 3. Connect light leads from test set binding posts marked "Relay Contacts" to trip circuit contact terminals of the relay.

•

\*.

•

.

5.	. Initiate unit by pressing "Initiate" Switch.		
б.	Rotate "Aux. Control" clockwise to increase output until continuity light glows.		
7.	Read pickup voltage on voltmeter. Record.		
8.	Rotate "Aux. Control" counterclockwise to decrease output until continuity light extinguishes.		
9.	Read dropout voltage on voltmeter. Record.		
10.	Turn test set OFF.		
	t al Alexandra ann an t-ann an		
	na an an an ann an an an an ann an an an		
	e en anterior en en el completar a conservar a conservar a l'Arreste y transmitte		
·	1910 - Anna Anna Anna Anna Anna Anna Anna An		
	erre en la servicie de la companya d La companya de la comp		
	● 建築 (1) 「「「」」」」「「」」」「「」」「「「」」「「「」」」「「」」」「「」」」		
n din Roman Roman Roman Roman	3. Constant of the start of the constant of the start		
le, le v	n. 1990 – <sup>A</sup> nterska androg, eester of try ketiker op statenske op oak 1990 – <sup>an</sup> tersk filler 1990 – Anton Station, soar		
	en la Marine a la Marten que para el Corre d'Arre el Arre de la construcción destructura el Arre el Arre el Ar A la constructura el constructura Arenera con tractar a distructura el constructura el Marine el Arre este De		

•

### TESTING DC TARGET AND SEAL-IN UNITS (Operations Indicator)

The operating coil of the Target and Seal-In unit is usually located in the same circuit as the relay trip circuit contacts. Therefore, when using the relay's trip circuit terminals as a connection to energize the Target unit operating coil, the relay's trip circuit contacts must be closed or shunted. Testing Always refer to manufacturer's literature before testing. Type of Test 1. Pickup SETUP OF CONTROLS BEFORE TEST POSITION CONTROL "Power ON" Switch..... OFF "Timer Operation Selector" Switch.....UPPER-"N.O.MAINT." LOWER- "DC" .....Zero (counterclockwise) "Main Control"..... "Aux. Power" Switch..... "Voltmeter Selector" Switch....."EXT. AC" "Aux. Control".....Zerq (counterclockwise) "AC Range Switch".....lOA "DC Range" Switch.....As desired "Voltage Relay" (DET) Switch......Set "NORM" "Output #1-#2" Switch....."Output #1"

- 1. Connect Model SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect light leads from binding posts marked "Relay Contacts" to operating coil of Target and Seal-In units.
- 3. If necessary, close relay trip circuit contacts. This may be done electrically or mechanically. To close these contacts electrically, energize the proper operating coil from "Output #1" or "Output #2" of the test set. When "Output #1" is used, it will be necessary to adjust the test set Main ammeter switch so that the current required to close the relay trip circuit contacts may be read on the upper 1/3 of ammeter scale.
- 4. Turn "Power ON" Switch ON. "Power ON" light should glow.
- 5. Initiate unit by pressing "Initiate" Switch.
- 6. When relay trip circuit contacts are closed electrically, rotate "Main Control" clockwise to energize proper operating coil.
- 7. Rotate "Aux. Control" slowly (clockwise) to increase output until Target shows or Seal-In picks up.
- 8. Observe DC amperes on DC Ammeter and record.
- 9. Open relay trip circuit contacts. The DC trip circuit should remain energized through the Seal-In contacts.

an an an an an Africa an Africa ann an Airdeachailte an Airdeachailte an Airdeachailte an Airdeachailte an Aird

a tatisi ya kuto na kuto na kuto na kuto na kuto na kata na kuto na kata na kuto na kata na kuto na kuto na kut

#### TESTING INSULATION RESISTANCE

CONTROL	POSITION
"Power ON" Switch	·····OFF
	tchUPPER-"N.O.MAINT." LOWER-"OFF"
"Main Control"	Zero (counterclockwise
"Aux. Power" Switch	••••••••••••••••••••••••••••••••••••••
"Voltmeter Range" Switch	"INS. RES."
"Voltmeter Selector" Switch	
"Aux. Selector" Switch	"INS. RES."
"Aux. Control"	Zero (counterclockwise
"AC Range" Switch	
"DC Range" Switch	······································
"Main Ammeter Range" Switch	••••••••••••••• <b>••</b> • <b>500</b> ••••
	chSet "NORM."
	#1"Output"#1" #2@ 0. 20.020
Testing	

- 1. Connect the SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.
- 2. Connect high voltage test leads to terminals marked "INS. RES."
- 3. Throw "Power ON" Switch to ON. "Power ON" light should glow.
- 4. Initiate unit by pressing "Initiate" Switch.
- 5. Make sure test probes are separated.

W. Constant

- 6. Increase "Aux. Control" (clockwise) until reading of infinity is obtained on megohm scale of voltmeter on SR-51.
- 7. Apply test probes to the equipment to be tested. The relay components will not be harmed as long as one probe is applied to relay frame and the other to all external terminals of the relay. If the relay insulation is good, the megohmmeter should continue to read in upper 10% of scale.

#### CAUTION

TEST PROBES HAVE 1200 VOLTS AC IMPRESSED ON THEM. CARE SHOULD BE TAKEN IN HANDLING
#### n an baile ann an Anna an Anna an Anna an Anna an Anna ann an Anna an Anna an Anna an Anna an Anna an Anna. An Anna Anna an Anna an

# TYPICAL TEST FOR HEATER TYPE THERMAL MOTOR OVERLOAD RELAYS SETUP OF CONTROLS BEFORE TEST POSITION CONTROL "Power On" Switch.....OFF "Timer Operation Selector"......UPPER - "N.C. MOM", LOWER - "CONT" "Main Control"......Zero (counterclockwise) "Aux. Power" Switch....."INT" "Voltmeter Range" Switch......"300" "Voltmeter Selector" Switch......"EXT. AC" "Aux. Selector" Switch..... "VERN" "Aux. Control".....Zero (counterclockwise) "AC Range" Switch.....10A "Main Ammeter Range" Switch......So that test current may be read on upper 1/3 of scale. "Voltage Relay Test" (DET) Switch.....Set "NORM" "Output #1-#2" Switch.....Output #1

#### Test Procedure

- 1. Refer to manufacturer's literature for connection points and TIME-CURRENT Curves of the device to be tested.
- 2. Connect the test set to a suitable source of power as indicated on the nameplate. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.

シーク マークないと 切込さ しんげんかい ほいぼうかんしょう

- 3. Connect operating coil or heater of device to be tested to "Output #1" of the test set.
- 4. Connect relay contacts of device being tested to "Relay Contacts binding posts of test set.
- 5. Preset main ammeter needle 1/2 division below desired test current through the use of the pointer pre-set.

한 것이다. 이 관광 관리가 가지 않는 것은 것이 같이 있는 것이 같이 있는 것이다. 2000년 1987년 198

"Power ON" light should glow. Turn "Power ON" Switch ON. 6. Jog test set with "Initiate" switch and rotate "Main Control" 7. clockwise to increase current to desired value. Set "Timer Operation Selector" Switch, UPPER - "N.C. MAINT", LOWER - "TIMER". 8. Reset timer to zero. 9. Initiate unit with "Initiate" Switch and run test. 10. If minor adjustments in current are necessary, use "Aux. Control". 11. Timer stops and test set will de-energize when device under test 12. trips. Read timer and record results. Compare to manufacturer's 13. 

المعلمين في المعلمين المعلم بعد أنها من الألف على المال المعلمين العالي أن المعلم المعلمين في المعلم المعلمين معالم المعلمين أنه المعلم المعلم ألف المعلم المعلم المعلم المعلم العالم المعلم المعلمين في المعلم المعلم المعلم وهذه المعلمين في المعلم المعلم المعلم المعلم المعلم المعلم المعلم المعلمين المعلمات المعلمين المعلم المعلم المع والمعلم المعلم المعلمين المعلمين المعلمين المعلم وهذه المعلم معلم المعلم المعلم المعلم المعلم المعلم المعلم المعلم المعلم المعلم المعلمين المعلمين المعلم المعل والمعلم المعلم المعلمين المعلمين وهو إلى المعلم وهو إلى المعلم المعلم

가 있는 것 같아요. 가는 것 않는 것 같아요. 이들은 것 같아요. 가지 않는 것 가지 않는 것은 가지 않는 것 같아요. 이들은 것은 것 같아요. 이들은 것은 것 같아요. 이들은 것은 것이 같아요. 같아요. 것 같아요. 것 같아요. 것 같아요. 같아요. 한 것 같아요. 이들은 것 같아요. 이들은 것이 같아요. 이들은 것 같아요. 이들은 것은 것 같아요. 이들은 것 같아요. 이들은 것 같아. 이들

이 모양이 가슴 가지 않는

Frances (1997) 1998 - 1997 - 1997 1997 - 1997
Frances (1997) 1997 - 1997
Frances (1997) 1997 - 1997

ette det ette ender andere etterheiden er ender ender etterheiden etterheiden etterheiden etterheiden etterheid

n an	a bara da bara da serie da se Serie da serie da seri Serie da serie da ser
	the second s
	가 있는 것 같은 것 같은 것이 있는 것 같은 것 같
	<sup>1</sup> Dependence (where on the Angle end of the second se Second second se Second second sec

#### THERMAL OVERLOAD RELAYS

(Westinghouse Type BL-1) (General Electric Type TMC)

### GENERAL

The Westinghouse Type BL-1 is a thermal overload relay basically designed to provide overload running protection of a motor. The relay may be used anywhere if the current transformer ratio is such that at full load current of the motor, the relay receives between 2.5 - 5.0 amperes. The relay setting is changed by moving an indicator on a sliding scale and/or changing the position of short-circuiting links. When the scale pointer is set to one of the indicated current values (motor full load current), the relay contacts will close in approximately 60 minutes if the current increases to 125% of motor full load current. (NOTE: The full load current must have been flowing long enough for the temperature rise to reach a constant value.)

The General Electric Type TMC is a thermal relay also providing overload running protection for motors. The range of adjustment of the relay is from 2.01 - 5.09 amperes (current transformer secondary currents). However, the relay rating is changed through the use of 10 interchangeable operating coils. The relay is provided with a screw adjustment to vary the setting of each operating coil from 90% to 110% of the rated coil current.

Both the BL-1 and TMC relays are ambient compensated and are equipped with instantaneous elements for short circuit protection of a motor.

Testing

Type Of Tests

Time Current Characteristics Instantaneous Pickup

SETUP OF CONTROLS BEFORE TEST

CONTROL	POSITION
"Power	ON" SwitchOFF
"Timer (	Operation Selector" SwitchUPPER "N.O. MOM" LOWER "CONT."
"Main C	ontrol"Zero (counterclockwise)
"Aux. P	ower" SwitchINT
"Voltme	ter Range" Switch

4 - 7

٠

1 5

*.*-

CONTR		
"Volt	tmeter Selector" Switch"EXT. AC"	
"Aux.	· Selector" Switch	•
"Aux	. Control"Zero (counterclockwise)	
"AC F	Range" Switch	\$ () \$ ()
"DC F	Range" Switch	
"Mair	n Ammeter Range" SwitchSo that test current may be read in upper 1/3 of scale.	
"Volt	tage Relay Test" (DET) SwitchSet "NORM"	*.
"Outr	put. #1-#2 Switch	•••
Test:	ing for Time Current Characteristics	
1.	Refer to manufacturer's literature for connection points and TIME-CURRENT curves of the relay to be tested.	
2.	Connect the SR-51 to a suitable source of power as indicated on the nameplate. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT.	2
3.	Connect the relay thermal unit operating coil terminals to the test set "AC Output #1" terminals.	1e
4.	Turn "Power On" switch "ON". "Power On" light should glow.	
5,•	Use main ammeter pre-set to set the main ammeter needle appro imately 1/2 scale division below desired test current.	×-
6.	Jog the test set by alternately pressing and releasing the "initiate" switch. At the same time rotate the "Main Control clockwise, until the main ammeter needle moves off the pre-se and indicates the desired amount of test current.	L" et
1	Connect test set "Relay Contacts" binding post to the relay to circuit contact terminals associated with the relay thermal element.	tri
8.	If necessary allow the relay coil to cool down to approximate room temperature.	ely
9.	Set "Timer Operation Selector" Switch, UPPER - "N.O. Maint", LOWER - "TIMER".	
10.	Reset timer to zero.	

- Initiate unit with "Initiate" switch and run test. 11.
- If minor adjustments in current are necessary, use "Aux. 12. Control." · "你们,你们就是你们的,你们们的你们,你们就是你们的你们的?""你们,你们就是你们的你们。"
- Timer will stop and test set will de-energize when thermal 13. unit trip circuit contacts of relay close.
- Read timer and record results. Compare to manufacturer's 14. specifications.

# Testing Instantaneous Trip a second of the second states of the second second second second second second second

- Connect the SR-51 to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF. CHECK THE "POWER ON" LIGHT. 1.
- Connect instantaneous unit operating coil of the relay to "Output #1" of the test set. 2.
- Connect light leads from binding posts marked "Relay Contacts" 3. on the test set to instantaneous unit trip circuit contact terminals on the relay.
- 4. Set "Timer Operation Selector" Switch, UPPER "N.O. MOM", LOWER "FAST TRIP".
- Turn "Power ON" Switch ON. 5.

•

- Initiate unit by holding in "Initiate" Switch. 6.
- 7. Rotate "Main Control" (clockwise) to increase current until timer stops.
- Rapidly read this value of current and release "Initiate" switch. ۵.

	WARNING III	CURRENT IS FLOWI	NG THROUGH	THE RELAY CO	IL
an an an Taonaiche an g		INTTL "INTTIATE"	SWITCH IS	RELEASED.	
		THEREFORE, IT IS	IMPORTANT	TO READ THE	
	an a	VALUE OF CURRENT	RAPIDLY.	and a second	

9. Decrease setting of "Main Control" about 10% and jog the "Initiate" switch. Determine minimum setting of "Main Control" where relay instantaneous trip circuit contacts of the relay consistently close when the test set "Initiate" switch is pressed.

Read and record pickup current. 10.

11. Char Turn test set off, a care for the care of Astronal ecological de c

and the second second

## TESTING ROWAN MAGNETIC OVERLOAD RELAYS

- 1. Types of Tests from a straight and the set of the state and the state
  - a. Pick-up
  - b. Timing

NOTE: The pick-up test is not normally performed unless it is desired to change the setting, or it is suspected that the setting has been changed.

# Pick-up

- 1. Remove dashpot from the relay by releasing retainers and bearing pin. Set dashpot aside in an <u>upright</u> position.
- 2. Secure proper calibrating weight from manufacturer and suspend from lower control arm attached to relay armature.
- 3. Follow test set setup of controls and steps (1) through (4) under "Typical Tests for Heater Type Thermal Motor Overload Relays."
- 4. Turn"Power ON" Switch ON. Power ON light and continuity light should glow.
- 5. Initiate test set by pressing "Initiate" switch.
- 6. Rotate "Main Control" clockwise until continuity light is extinguished.
- 7. Read and record this value of current as pick-up.

#### Timing .

- 1. Remove calibrated weight and re-install dashpot if disconnected previously. Operate armature by hand several times to reset piston and oil.
- 2. Follow entire procedure for "Typical Test for Heater Type Thermal Motor Overload Relays."

a se manage en el company en artículos de la company de la company en el manegar el company el company el comp La company el company e

> a a stranda a seconda e configura da seconda a configura de la configura de la configura de la configura de la Deserva de la configura de la c

# TESTING MULTI-POLE MOLDED CASE CIRCUIT BREAKERS

ALWAYS REFER TO MANUFACTURER'S LITERATURE BEFORE TESTING

SETUP OF CONTROLS BEFORE TEST

nor additional

CONTROL	POSITION
"Power ON" Switch	.OFF
"Timer Operation Selector" Switch	
"Main Control"	.Zero (counterclockwise)
"Aux. Power" Switch	e information de la forma de la contra de la seguina de la contra de la contra de la contra de la contra de la Entre contra de la cont
"Voltmeter Range" Switch	
"Voltmeter Selector" Switch	.EXT AC
"Aux. Selector" Switch	"VERN"
"Aux. Control" "AC Range" Switch "DC Range" Switch	.lóa <sup>s</sup> - <sup>Berne</sup> re Stoulder - Left Lée west <sup>1</sup> alaintí - Charles Maria - Berne
"Main Ammeter Range" Switch	.So that desired test current may be read on upper 1/3 of scale.
"Voltage Relay Test" (DET) Switch	
"Output #1-#2" Switch	.Output #1
a eta la constanta en la la consegatión energia sera	elenen an an an an an an air a

# Testing

- 1. Connect test set to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS <u>OFF</u>. CHECK THE "POWER ON" LIGHT.
- 2. Connect one pole of circuit breaker to be tested to "Output #1" terminals of the test set.
- 3. Connect another pole of circuit breaker to be tested to "Relay Contacts" binding posts of the test set.

- Preset main ammeter needle 1/2 division below desired test current through the use of the pointer preset. Turn "Power ON" Switch "ON". "Power ON" light should glow. Close circuit breaker under test. Jog test set with "Initiate" switch and rotate "Main Control" (clockwise) to obtain desired test current. Adjust "Timer Operation Selector" Switch - UPPER - "N.C. MAINT", LOWER - "TIMER". Reset timer to zero. Initiate unit with "Initiate" Switch and run test. 10. If minor adjustments in current are necessary, use "Aux. Control". Timer stops and test set de-energizes when circuit breaker under test trips. Read timer and record results. Compare to manufacturer's specifications. Another and the second second

• And the second s

- a da de la sector parto se se se se parte a la company de la company de la company. La sector des se contra company de la company
  - a a set a secondar se se se se a la della della secondaria della della della della della della della della della La secondaria della de
  - under aller de la présión destrés de la série de la série de la serie de la serie de la serie de la serie de la
    - lan tanan tanan ta tan bara ta tan

4.

5.

6.

7.

8.

9.

11.

12.

13.

# TESTING SINGLE POLE MOLDED CASE CIRCUIT BREAKERS

e responsibilitzarra de estas de la responsa en la seconda en la estas en la

# NOTE: The MULTI-AMP test set must be equipped with a Current Actuator (optional accessory) to use this test procedure.

SETUP OF CONTROLS BEFORE TEST

# CONTROL POSITION "Power ON" Switch.....OFF

"Timer Operation Selector" Switch.....UPPER - "N.O. MOM" LOWER - "OFF"

"Main Control".....Zero (counterclockwise)

"Aux. Power" Switch....."INT"

"Voltmeter Selector" Switch......"EXT. AC"

"Aux. Selector" Switch......"VERN" Constant of the second second

"Aux. Control".....Zero (counterclockwise)

"AC Range" Switch.....10A

"Main Ammeter Range" Switch.....So that desired test current may be read on upper 1/3 of scale.

"Voltage Relay Test" (DET) Switch.....Set "NORM" "Output #1-#2" Switch.....Output #1

## Testing

1.	Connect test set to a suitable source of power as indicated on the nameplate and ground. BE SURE THE MAIN SWITCH IS OFF.
2.	Connect single pole circuit breaker to be tested to "Output #1" terminals of the MULTI-AMP.
3.	Preset main ammeter needle 1/2 division below desired test current through the use of the pointer preset.
4.	Turn "Power ON" Switch "ON". "Power ON" light should glow.
5۰	Close circuit breaker under test.

- 6. Jog test set with "Initiate" Switch and rotate "Main Control" (clockwise) to obtain desired test current.
- 7. Adjust "Timer Operation Selector" Switch, UPPER "N.O. MOM" LOWER - "TIMER".
- 8. Reset timer to zero.
- 9. Initiate unit with "Initiate" switch and run test.
- 10. If minor adjustments in current are necessary, use "Aux. Control".
- 11. Timer stops and test set de-energizes when circuit breaker under test trips.
  - 12. Read timer and record results. Compare with manufacturer's specifications.

# 医结肠管膜炎 化乙酰氨基乙酰氨基乙酰氨基乙酰氨基乙酰氨基

salaretta da superior de 5 🖅 🧎 - Maringer esperiore d

#### SERVICE DATA

Your MULTI-AMP test set basically uses straightforward circuits and components requiring little or no routine servicing except for cleanliness.

naar oo la alaan ta' alaa ah saar na sharan waxaa ah ah sharan ah ah

The following maintenance is recommended:

- 1. Open the unit every six months and examine for:
- a. adirt de la constant de la consta
  - corrosion с.
  - condition of relay contacts d.

2. Remove dirt with dry compressed air.

- Remove moisture by opening unit as much as possible and 3. putting it in a warm dry environment.
- As corrosion may take many forms, no specific recommenda-4. tions can be made for its removal.
- The contacts on relays and contactors should be examined 5. for pitting and burning. The contacts on control relays and contactors may be burnished with a diamond dressing tool if not too badly damaged. If excessive pitting or burning has occurred, the relay or contactor should be replaced.

#### Current Actuator

The minimum amount of output current which will cause the Thyratron tube to "fire" and operate the relay is between 10% and 20% of full scale on the ammeter. This point is factory set and may be adjusted in the field by means of the potentiometer on the control chassis. This potentiometer is located next to the Thyratron tube and has a screwdriver slot and shaft lock.

#### Adjustment:

- Set the controls on the unit so that output may be obtained. 1.
- Set "Main Control" at zero and put a short circuit across 2. the output of the unit. The lowest voltage, highest current tap and "Common for Ammeter" is used.

- 5 2
- 3. Set controls for "CA" operation.
- 4. Set "Ammeter Range" switch to any position.
- 5. Turn power ON and rotate "Main Control" until the ammeter indicates 20% of full scale.
- 6. Adjust the potentiometer until the timer hands just start running at this point.

...Notes:

- 1. If attempt is made to make the "CA" pick up at too low a current value, the unit will chatter when the load circuit is broken.
- 2. The sensitivity of the "CA" circuit will vary slightly due to the phase angle of the load and aging of the Thyratron tube.
- 3. If the "CA" refuses to operate, the 2D21 tube should be replaced first.

1. Superational research applies and structure of a construction (respective) on the second of a log one bit is constructed.

(1) يعنى يرزي وجل المحميلة العال المحمد الذار (1) من من المحمد الأرار المحمول الألم المحمد المحمد المحمد ال المحمد الحرار الذار (1) من العرب الذار المكان الحرار الذار المحال عليه العرب المحمد المحمد الإرار المحمد الذار المحمد الحرار المحمد الحرار (1) عن الحرار المحمد الحرار المحمد المحمد الحمد الحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد الحرار المحمد المحم المحمد المحم المحمد المحم المحمد المحم المحمد المحم المحمد المحم المحمد المحم المحمد المحم المحمد المحم المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحم المحمد المحم المحمد المحم المحمد المحمد المحمد المحمد المحمد الم

<sup>19</sup>られていたが、ただ、1994年の時代の「お」の「ション」をつかったが、日本ができたと思いた。 (1994年の1995)。 (1997年)

ار الآني المجمع الأفور في الأربعين من قال من عن من عن المحلة المحلة على عنه الأمار المعالم المحلة المحلة المحل المحلة المحلة

