KD Test Notes – 4/7/17 (VanCauteren/Laslo)
Procedure 15.0 (a – g) Phase-to-Phase MTA adjustment
Westinghouse I.L. 41-490J

a) Use test connection from IL pg 54 (IA=13, IB=15, IC=17, 19 jumpered to 12, 18-16-14 common to neutral). Test #5 is just an A-B fault. You can use control panel or start an A-B automated test and open control panel to have it pre-populated with values. Set the phase angle in control panel to match desired MTA of relay and current and voltage to equal the impedance the relay is set at. Once the values are tweaked they can be saved for convenience in running the test in the future. Test #6 is just a B-C fault (simply use "fault" rotate in control panel).

b) Note that when reading voltage across the caps, C2A and C2C are often (apparently) swapped; that is, the outside cap is C2C and the 2nd one from the left (from the back) is C2A. The I.L shows C2A on the outside and C2C to the right…
Parts a) and b) dial in the AB and BC MTA as close as they can go based on their sensitivities at the time the test is done. Part g) may be needed if they are not well balanced compared to each other…You may also need to redo parts a) and b) if the 'balance' is adjusted.

c) These are the values the I.L wants you to use with the assumption that the relay is set as in part 11.1 (Table on page 16) Thus, for a 0.75-21.2 Ohm relay >> 5.04 ohms (S=1, T=5.8, M=0.15). <u>All the numbers for section 15.0 are based on these settings from the table</u>. You can either change taps to match the I.L. to get exact numbers and then change back when you are done, or you can recalculate current and voltage to match the impedance your relay is set for. The tests appear to work quite well with other tap settings but the numbers will not be exactly the same – of course but the calculations are easily done.

d) By tweaking P2A for A-B faults and P2C for B-C faults we were able to get voltage readings around 0.15 volts on the appropriate cap. *If your initial reading across the cap is more than a few volts, you probably have a hookup error or wrong voltage/current values*. Readings may be higher if the relay has intentionally been mis-adjusted but otherwise the relay should be relatively in balance. You'll definitely know something is wrong if you can't balance the reading – a small tweak of the pot should produce a substantial change in voltage across the cap; it's easily recognizable.
Note that instead of varying the angle it is much easier to just set the current applied to the MTA and tweak the pot or slide-wire to be the point where the lowest voltage across the capacitor is achieved.

e) Back off stationary contact and adjust spring so contact floats if you want to perform the baseline adjustment. Note that practice has demonstrated that this step can often be skipped, along with part f) and you can generally just proceed to step g) in most cases unless the relay has serious calibration issues.

f) Just follow as it says (Baseline core adjustment).

g) Most important step for <u>balance</u> of the 3 phase-to-phase elements:

1) Apply A-B fault with very low current and voltage values that match set relay impedance and adjust core again so contact just closes at the expected current value. The book uses 2V fault voltage and 0.2A current approximately.
2) Fault rotate to apply B-C fault and contact should still just close at about the same values as in part 1)… if not find the best "happy medium" between A-B and B-C by rotating the core until they are matched.

3) Fault rotate again and apply C-A fault and adjust XLAC until contacts just close at the same values as parts 1) and 2).

Note: Even though the book gives a range of where the contacts should pick up the important part here is to get A-B, B-C, C-A tests all to just close the contact at the same value. They are then balanced and you should no longer have any issues with one MTA being off from the other two. If all values are on the high (or low) side, the spiral spring tension is probably slightly high (or low) and a small tweak will generally bring all quantities right into spec.

Other Notes:

1) Be sure to have all 3 voltages on. Example, if applying an A-B fault be sure VC is on also at 70v.
2) Values we used with relay set to 5.04 ohms for test 15.0 a-e P2A and P2C adjustment. Va=33.15@-63, Vb=33.15@-117, Vb=70@-270, I1=2.97@-75, I2=2.97@-255, I3=0
3) Values we used with relay set to 5.04 ohms for test 15.0 g core adjust and balance. Va=35.01@-88.4, Vb=35.01@-91.6, Vc=70@-270, I1=0.22@-75, I2=0.22@-255, I3=0
4) If the relay was drastically out of adjustment you may need to run through the steps a)-g) a second time, but twice through will generally bring any relay that has properly functioning components right into specification. A failed component like a bad capacitor should be considered if the relay fails to coming into specification when steps a)-g) are followed.
5) Failed capacitors can be found fairly easily using the resonant voltage tests described in section 3.3 (p. 31) of the instruction manual. Note that only brand-new capacitors will likely completely meet the specifications listed in section 3.3 so a capacitor that has a slightly low resonant circuit voltage may still calibrate just fine; it is capacitors that are significantly degraded that we are looking for as those whose capacitance values have significantly drifted are the ones that will not allow the relay to stay within calibration specifications. Of course any capacitors that are suspect due to value deviation or physical deficiencies should be replaced.