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ELEVATOR CONCEPTS LTD

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CONTROL CIRCUIT VOLTAGE DROP

Most Elevator Concepts relay controllers use a 24 VAC control circuit, with power for the circuit supplied by a transformer. 24 VAC is intrinsically safe, and also permits some signal fixture devices to be wired without the conductors being installed in conduit. Occasionally we receive troubleshooting calls related to voltage drop in the control circuit, characterized by the improper operation of coils and contactors. The most typical symptom of excessive voltage drop is chattering of the motor contactor. Voltage drop is caused primarily by one of three factors: excessive load on the transformer, undersized wire, or poor connections.

TRANSFORMER LOAD

The control circuit transformer is sized according to the electrical load. In these controllers, the circuit supplies current to control relays, indicator lamps, valve coils, and contactors. The power consumption of these devices is typically rated in volt-amps, or VA. Standard VA rating for these devices are as follows:

4PDT relay	1.2 VA
2PDT dip relay	.5 VA
Contactor	11 VA / 78 inrush
Light	1.7 VA
Valve coil	43 VA

To size the transformer, we first total the VA loads for all the devices that could be on at any one time to get the continuous VA rating. Then, we add to that total the inrush loads that may occur to get the inrush VA rating. The continuous VA rating is the nameplate rating of the transformer. The inrush rating is shown on this chart, which is based on 30% power factor at 95% secondary voltage:

Continuous VA	Inrush VA
25	25
50	170
75	236
100	298
150	590
200	1065
250	1290

If the load imposed on the transformer exceeds its capacity, the voltage will drop and some or all devices will not function properly.

WIRE SIZE

There are four factors that influence the voltage drop in a wire - the current being carried (I), the length of the circuit (L), the cross sectional size of the wire (Cm), and the resistance of the wire (K). To determine the voltage drop, use the following formula. The standard value for K for copper is 12.9; the Cm of 18 gauge wire =1620, 16 gauge = 2580, 14 gauge = 4110, 12 gauge = 6530.

$$\frac{2K \times L \times I}{Cm} = \text{Voltage drop}$$

Most relays and contactors will pick on 80% of rated voltage, which is approximately 20 volts in a 24 volt system. If the voltage drop in the wire exceeds 4 volts, you may have problems.

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TROUBLESHOOTING

If you suspect a voltage drop problem, this is a logical approach to troubleshooting.

1. Check voltage at the device with a voltmeter. If OK, see A & B. If not, proceed to 2
   A. Check that the device is rated at the same voltage as the controller; replace if incorrect.
   B. Verify that the device is in proper operating condition; replace with a known good device if possible.

2. Remove disconnect output leads from transformer and check voltage with no load. If low, first check input voltage. If input voltage is OK but output is low, replace transformer.

3. If the output voltage of the transformer is OK at no load, check the voltage at various points along the control circuit. Connect the common lead of your voltmeter to the common side of the transformer output . With the hot lead, check each point in the control circuit leading to the problem device, using the straight line wiring diagram as a guide. Typical points to check are the fuse, pit stop, hatch finals (if equipped), car top stop, car safety, car gate, car panel stop, doors closed, doors locked, direction limits.

4. If you find a point that shows a significant drop, try putting a jumper across the device (for example the door locks) just ahead of the drop. If that cures the problem, you have a problem with either poor connections or wire that is undersized for the length of the run. First verify each connection, and check all contacts in door locks, limits, etc. for oxidation or poor make up. If the connections and contacts are sound, use the formula described earlier to check the wire size. (To determine the amps of a device, divide the VA by the voltage.)

Example:

The up contactor chatters. Jumping the door lock circuit corrects the problem. Assume the circuit is 100 feet. Looking at the straight line, we see the door lock circuit feed the contactor, 8 control relays (4 of which can be on at once) and 4 indicator lights (2 of which can be on at once). The total VA of these devices is 86.2, using the inrush VA of the contractor. Divide by 24 to find the amps (I) of 3.59. Using the formula we find:

$$\frac{2(12.9) \times 100 \times 3.59}{1620} = 5.71 \text{ (18 gauge wire)} \qquad \frac{2(12.9) \times 100 \times 3.59}{4110} = 2.25 \text{ (14 gauge wire)}$$

With 18 gauge wire we have too much voltage drop. There are two ways to solve this problem: replace the undersized wire or reduce the amperage. Replacing the wire may be easy or difficult; every job is different. It is usually jobs with a lot of wire runs that have low voltage problems, making amperage reduction the most viable solution. We can substitute pilot relays for high current devices (such as contactors and valve coils) to reduce the amperage in the circuit, and use the pilot relay to operate the contactor directly. Another way to reduce the amperage is to increase the voltage - for example, changing all the relays, valve coils, contactors, light bulbs, and control circuit voltage to 120 vac. At 120 vac, the amperage is only 20% of what it is at 24 vac. ***Care must be used with solutions such as these. For instance, failure of the pilot relay to release may cause the contactor to stay in and cause an unsafe condition - several pilot relays may be required. When changing voltages, all devices and wiring must be rated for the new voltage. Contact the factory for specific guidance on making control changes.***

5. If there are no problems with connections or wire size (verify by jumping out all field wiring and there is excessive still voltage drop,) calculate the total VA load on the transformer. Check the VA rating of the transformer. Replace with proper size if necessary.

CALL US AT ANY TIME IF YOU HAVE QUESTIONS ABOUT VOLTAGE DROP, OR ANY OTHER PROBLEM WITH YOUR ELEVATOR. WE'RE HERE TO HELP YOU!