MagneTek

Application Note DSD 412-116

DATE: September 23, 2005

SUBJECT: Isolation Transformer Selection for DSD 412 Elevator Drives

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Magnetek recommends making the nominal Vac line-line input to the drive equal to or greater than the Full Load Vdc required by the elevator motor. This will allow the drive to fully operate correctly when the power line sags down to 90% of rated, and to continue to operate without fail with several line cycles down to 80% of rated. [The unit will shut down with less than 80% of rated voltage input.] **If you anticipate utility power sags to below 90%, multiply Vac by 1.05 or 1.1 to prevent brown-out problems.** [Affects KVA rating in step 4 on the next page by the same number.]

Magnetek recommends using a full rated Isolation Transformer rather than a buck-boost auto-transformer. Magnetek also recommends that the secondary side *should not be grounded.*
Here are 4 good reasons to use an Isolation Transformer...

1) **Has Voltage Isolation**: Voltage isolation from 'grounded' utility power allows the elevator to keep operating even with a minor grounding fault in the motor. (Armature or Field) No 'melt-downs' due to carbon dust or other insulation failure.

2) **Absorbs Line Notching**: A Voltage isolation transformer will help filter and absorb line notching (caused by SCR operation) keeping it away from primary building power distribution.

3) **Helps with Utility Surges**: A voltage isolation transformer will help prevent line to ground utility surges from reaching elevator equipment. This helps to survive lightning and utility power switching activity.

4) **Has Sufficient Impedance for Drive**: The drive needs 2% to 8% reactive source impedance (%Z) on input power. The %Z requirement here is relative to the motor drive size, not the utility KVA.

   An Isolation Transformer will automatically have 3-5%Z on the secondary side and be sized for the application.

   The %Z of an Auto-Transformer will vary with the buck-boost ratio and usually require additional line reactors to supply more impedance. Each installation will need to be examined as to the relative impedance of the utility feeder source, the %Z added by an auto-transformer, and additional reactance requirements, without exceeding the 8% upper limit. [Something else to design, evaluate, purchase, mount, etc., per installation.]

The **KVA size** of a drive isolation transformer for elevator duty is somewhat subjective and also depends on the expertise of the transformer manufacturer.

1) The elevator load is cyclic. Up to 2.5X current is required for accel/decel, 'rated' current while running (skewed by payload and direction), but almost no current during floor wait times. In the USA we give this a 0.8 usage factor.

2) Use of a business elevator is time-of-day cyclic during the workweek. Rush hours are about 1 hr long. Idle times allow equipment to cool. Apartment building elevators have intermittent use and idle periods 24/7. Most buildings need only a 1 hr heat rating for the transformer. A continuous full load rating at full KVA is costly overkill.

3) Transformer must have adequate cooling as installed, by open ventilation or fan forced. Must have ability to handle up to 2.5X current w/o saturation. Must be designed by knowing the internal temperature rise time constants and resulting lifetime effects in order to achieve a 1 hour rating Vs a continuous duty rating. This allows a typical size reduction of almost 30%.

4) **SO**...The net recommended result is:

A. Transformer Secondary Vac = Vdc (motor nameplate full load volts) X 1.05
Re-read the beginning paragraph regarding power line sags. Select a multiplier of 1.05 or 1.10 accordingly

B. Transformer secondary Iac = $Idc_{(motor)}$ X $\sqrt{2/3}$
w/ overload requirement up to 2.5X

C. The drive will demand the following KVA from the transformer secondary when operated at full speed and load.

$$\text{KVA} = \frac{V_{dc} \times I_{dc} \times \sqrt{2/3} \times 1.05 \times \sqrt{3}}{1000}$$

Which reduces to $\frac{V_{dc} \times I_{dc}}{673}$ **when the voltage multiplier is 1.05.**

D. To reduce transformer size and cost you can tell the transformer manufacturer to supply this KVA rating for 1 hour.

The 1 hour rating should be so indicated on the nameplate of the transformer. Utility fusing for the primary side must be based on the stated KVA and primary side line voltage in accordance with local code regulations.