

### **DC to DC Drive Specification**

The DC adjustable voltage drive(s) shall be Hubbell Type 4960 and shall convert standard DC power to adjustable voltage DC power to control DC series or shunt motors. The drive shall be sized or duty rated with a full load ampere capacity equal to or greater than the full load current value of the connected motor or motors. The 60-minute rating shall be used to determine the full load current value for shunt motors, and the 30-minute rating shall be used to determine the full load current value for series motors. The drive power devices shall provide a minimum overload capacity of 150% of full load current for one minute and 200% full load current for three seconds. The drive power devices shall be connected to provide static voltage and current reversals. The drive shall provide continuous current, type B control, and shall accept regenerative power returned from connected loads.

For travel motions, the drive shall control connected DC motors via the standard “four collector” connection where the armature circuit is voltage and current reversing, and the field circuit is single polarity, voltage or current regulated. Series DC motor operation with the above described connection shall be possible with the series holding brake coil connected in series with the motor series field, and requiring no further connection points to the drive. Shunt DC motor operation with the above described connection shall be possible with the utilization of a separate shunt brake controller. When the controlling circuit command changes from a higher speed point to a slower speed point, the drive shall provide electrical braking to slow the motor. When the controlling circuit commands a stop, the drive shall electrically brake the motor to zero speed before applying the holding brake.

For hoisting motions, the drive shall control connected DC motors via the standard “four collector” connection with power limit switch contacts wired to interrupt power to the motor armature and the brake coil circuits of a series DC motor. When tripped, the power limit switch contacts shall establish a resistive dynamic braking circuit to electrically brake the motor independent of the DC drive. The DC drive and control system shall provide a means to drive lower out of a tripped limit to mechanically reset the power limit switch and recover control of a suspended load. Should the power limit switch fail to reset, the DC drive and control circuit shall limit the lowering speed to safe values or set the holding brake to stop the load. Additionally, the DC drive and control circuit shall provide for Emergency or Power Loss Dynamic Braking. While operating in the hoisting direction, a power loss condition shall stop the motor and load. While operating in the lowering direction, the drive and control shall continue to lower the load in a controlled fashion until such motion is commanded by the control system to stop. In an emergency power loss situation, a spring closed contactor and resistor shall establish a separate, self-exciting dynamic braking circuit so that when the mechanical holding brake is manually released, a suspended load can be lowered under controlled means. Under normal operating conditions, the DC drive and control system



shall verify the motor's ability to produce rated load torque before releasing the mechanical holding brake. When the controlling circuit command changes from a higher speed point to a slower speed point, the drive shall provide electrical braking to slow the motor. When the controlling circuit commands a stop, the drive shall electrically brake the motor to zero speed before applying the holding brake.

For all motions, the DC drive and control circuit shall provide adjustable inverse time and instantaneous overload protection. When multiple motors are powered from a common drive, inverse time and instantaneous overload protection shall be provided for each motor circuit. The DC drive and control circuit shall also provide field loss protection for series and shunt DC motors. Should a non-fatal fault condition stop drive operation, returning the master switch or other command operator to a neutral off position shall reset the drive's fault condition and allow operation to resume. The DC drive shall also provide visible, illuminated indication of capacitor bank charge and / or the presence of DC bus voltage.

Multiple drives shall be capable of being connected to a common DC bus. This connection allows recovered, regenerated power to be shared with other drives and motors. If the recovered DC power is not needed by the other drives on the common bus, a shunt regulator system shall operate to dissipate the recovered energy in resistors sized for that purpose.



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