Estimating Infeed Ratings for Common DC Bus Drive Systems used in Web Conveyance Applications

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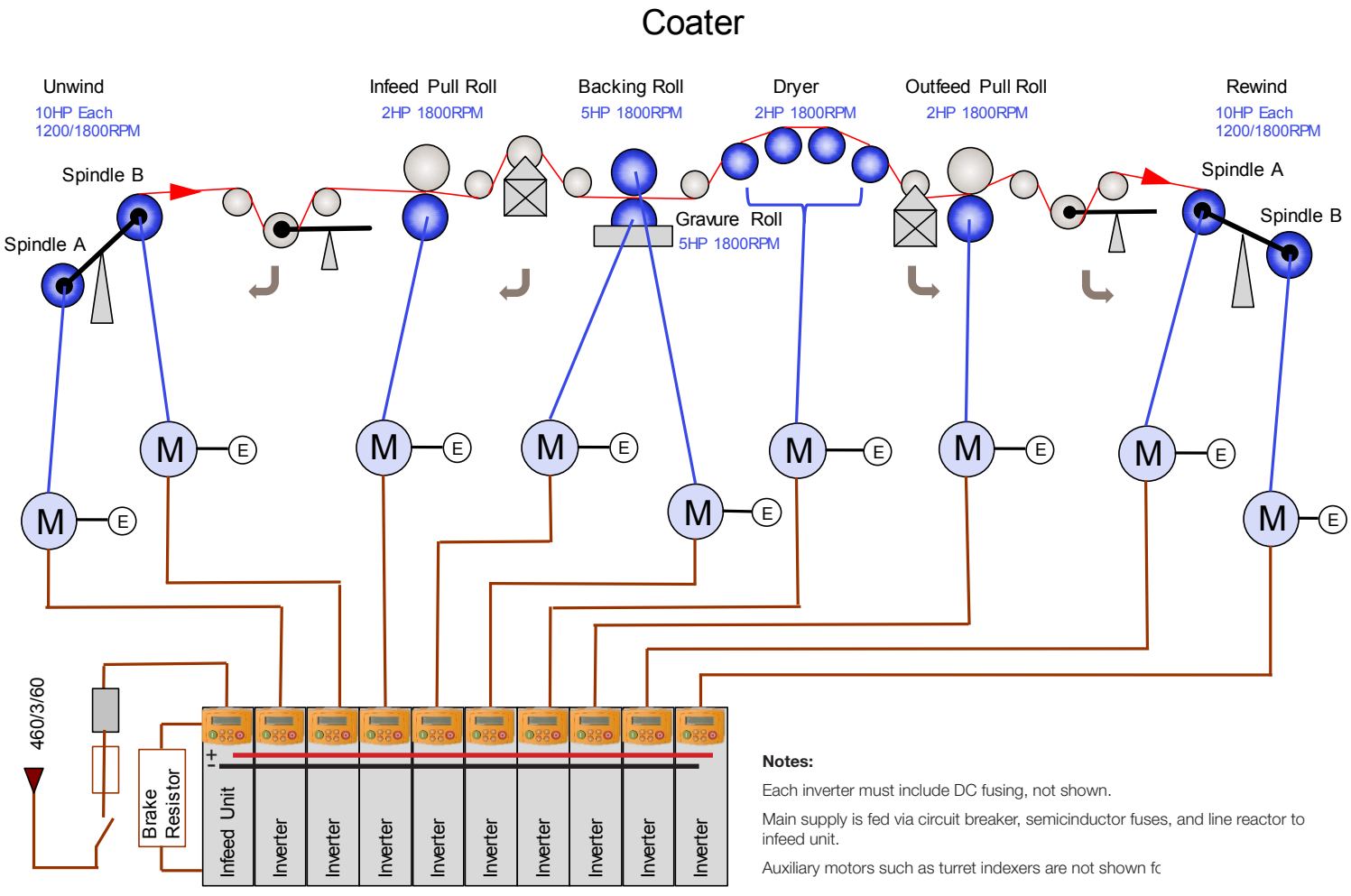
Many web conveyance machines such as printing presses, converting lines and related machinery are powered by common DC bus connected AC Vector drives. This arrangement cost effectively allows energy from sections that are being overhauled and regenerating energy to share that energy with the sections that are motoring.

Most common DC bus drive systems consist of an infeed section or rectifier to convert the incoming 3 phase AC to DC and multiple inverters, one per motor, to convert the common DC bus to individual variable frequency/variable voltage outputs to each motor. In simplest terms, the infeed section should be sized equal to the sum of all the connected motors.

Example: If two 10 HP and three 5 HP motors were used, the infeed would, in simplest terms need to be rated for a minimum of 35 HP.

In reality, most web conveyance lines are made up of sections that always motor, sections that only operate during certain points in the manufacturing process, sections which continuously regenerate and center driven winders and unwinders with additional factors to consider. This adds complexity to the sizing exercise. Using the example below; we will attempt to provide guidance for sizing the infeed for a typical converting machine.



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An example of an estimation of infeed unit rating for a typical converting line

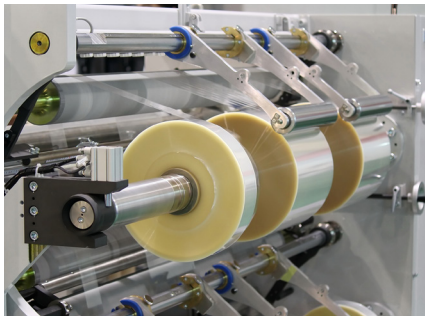
Considerations and assumptions:

- While some intermediate drives may regenerate under certain circumstances; for this exercise we will assume they are all motoring during operation.
- The acceleration considerations are such that all sections can be ramped-up / down within a typical inverter's 150% for 60 second OL rating.
- During normal operation: U/W spindle B is active and U/W spindle A is off. R/W spindle A is active and R/W spindle B is off.
- During the worst-case load situation, when both the U/W and R/W are executing the splice sequence simultaneously; in addition to the drives operating during normal operation, both a new full roll on U/W spindle A and a new incoming core on R/W spindle B are being accelerated to line speed.
- Required web HP is 2HP and the U/W and R/W core to full roll ratio is 5:1 (e.g. 3.5" OD core / 17.5" dia. Full roll)

The table below shows all four possible scenarios; normal operation, normal operation while rewind splicing; normal operation while unwind splicing and normal operation with simultaneous unwind and rewind splicing. The last scenario is less common as the machine sequence of operation can be designed to avoid it.

Section	Motor HP	Web or Process HP	Normal Operation	Normal Ops plus R/W splice	Normal ops plus U/W splice in progress	Worst case normal ops plus both turrets splicing
			Running Web or Process HP			
U/W A	10	2	0	0	10	10
U/W B	10	2	-2	-2	-2	-2
Infeed	2	2	2	2	2	2
Coater Gravure	5	5	5	5	5	5
Coater Backing	5	5	5	5	5	5
Dryer	2	2	2	2	2	2
Outfeed	2	2	2	2	2	2
R/W A	10	2	0	0.5	0	0.5
R/W B	10	2	2	2	2	2
Sub Total	56	24	16	16.5	26	26.5

While likely a worst-case estimate, acceleration of the new full roll could, in theory, take full motor power for a short duration (perhaps 10 to 15 seconds) The 10HP figure errs on the safe side.



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One additional consideration for infeed selection is the fact that it contains the precharge circuit which charges the capacitors in all the inverter sections upon initial power-up. In many cases there is more connected HP than actual running HP since not all drives run at the same time. However since all the inverters are connected to the DC bus, the infeed must charge the capacitors in all of them, not just those operating. A good rule of thumb is to avoid connecting inverters totaling more than 150% of the infeed unit's HP rating. That is, in cases where the connected HP exceeds the running HP, ensure the infeed is rated for not less than 66% of total connected HP.

In this example the infeed section could be sized for 25HP+/- based upon running HP alone. However the connected HP exceeds running HP. 56HP connected vs. 26.5HP running. Therefore the infeed should be increased to 38HP or greater to cover the precharge requirement discussed in the preceeding paragraph.

This is also based upon the assumption that all inverters and the selected infeed will be capable of 150% overload for 60 seconds which is more than adequate to supply the required power to accelerate both the new incoming roll and the new core simultaneuosly. Parker offers infeed ratings for their 890 series drives at: 25HP, 45HP, 90HP and 135HP. The 45HP unit should be more than adequate. Even though the center driven unwind and rewind sections are rated 10HP in order to provide adequate torque at full roll diameter, both never require more than 2HP. This is because at core they operate at rated speed and voltage and very low current, which is $1/5^{th}$ of motor power, and at full roll they operate at $1/5^{th}$ speed and full torque (full current) which is also $1/5^{th}$ of motor power. 2HP in both cases.

Based upon this common web conveyance example, the first statement at the top of page 2: "In simplest terms, the infeed section should be sized equal to the sum of all the connected motors." really applies only if there are no continuously regenerating sections such as unwinds and all sections are in simultaneous operation.

Additional support for web conveyance drive systems is available:

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