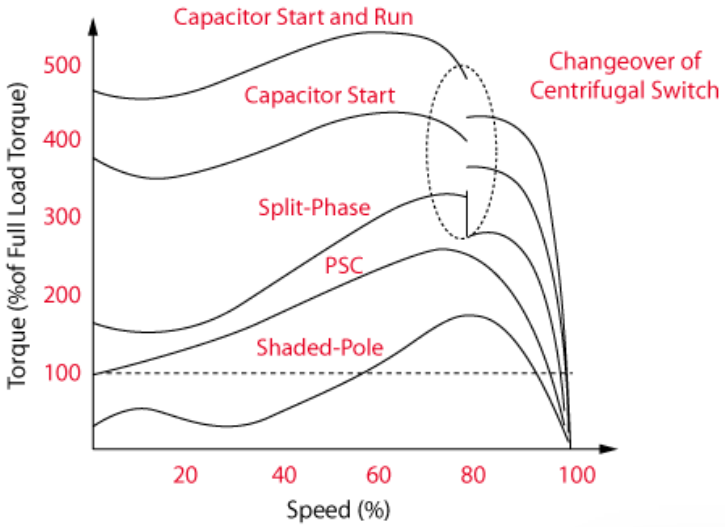
Question for Eng-Tips.com

My query is around the relative torque output of Capacitor Start (CS) and Cap Start/Cap Run (CSCR) induction motors, especially when they are loaded up to the point where they will stall.

My investigation to date turns up the graph below to illustrate torque vs motor rpm for various types of induction motors (everyone who uses this graph seems to have copied&pasted from each other and I don't know where the original came from)



Torque-Speed Curves of Different Single-Phase Induction Motors

However my query is that I think that the shape of the CSCR graph is wrong, or at least doesn't match my observation of the one I have (see the background document attached) nor the many other speed/torque curves.

Can I get from some knowledgeable electrical eng. person

- Which single phase induction motor type has the greater peak (breakdown) torque, CS or CSCR, if they were both the same rated HP?

and

- Which type stalls at lower rpm?

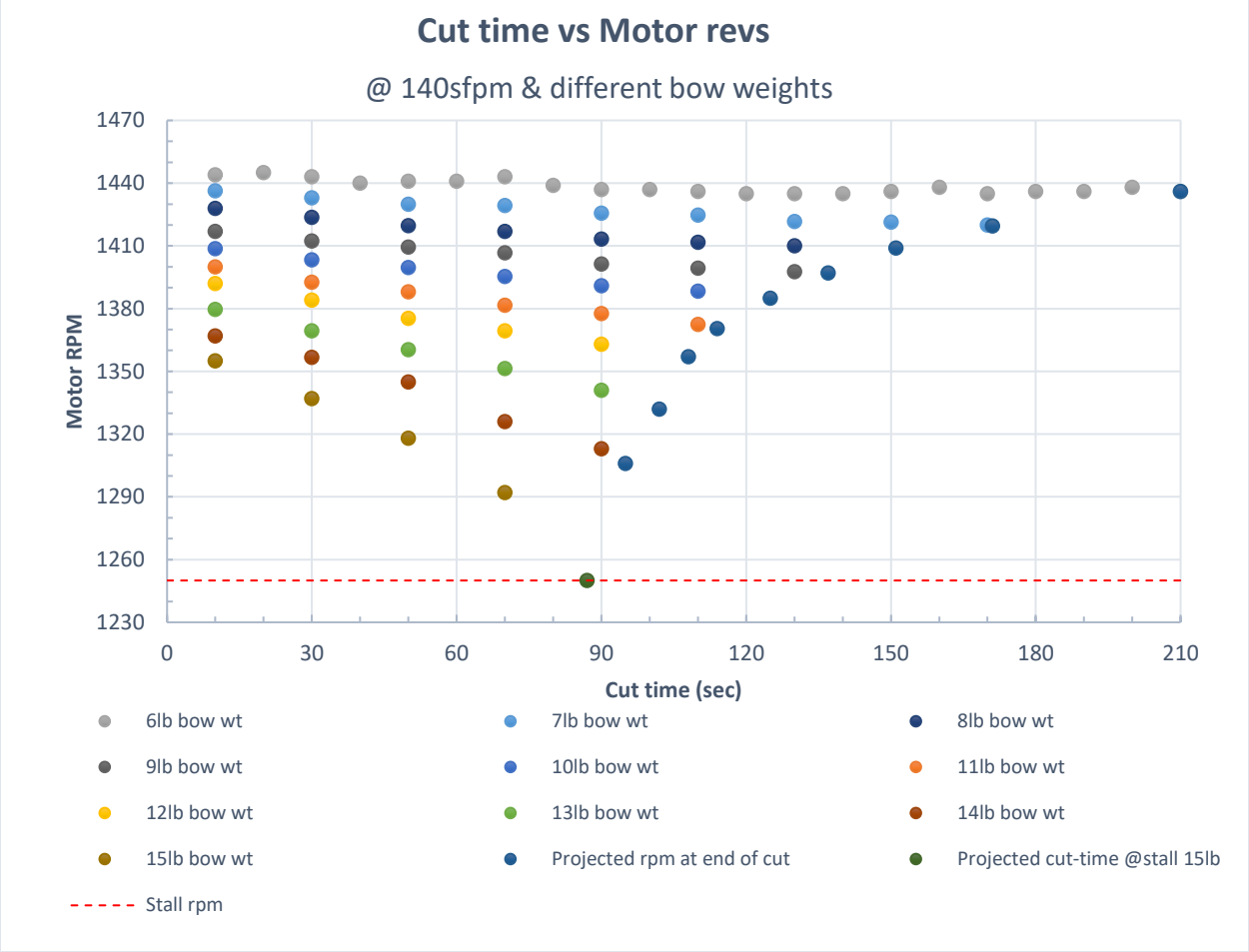
Background

The motors in question are running the small 4"x 6" horizontal/vertical bandsaw. They drive a 3-step pulley then a 20:1 worm drive gearbox (so load is high friction type). Because of the changing angle of the sawframe to the horizontal as the cut progresses, the motor load gradually increases throughout the cut.

Experiments I have done, as graphed below, show that the rpm of the motor falls with increasing weight on the teeth (measured as 'bow weight' which is how 'feed' is controlled on these saws) and also falls slightly as the load increases throughout each run. The graph below shows an orderly progression of decreasing rpm through the cut given a particular bow weight and shorter cut-time with increased bow weight on the teeth.

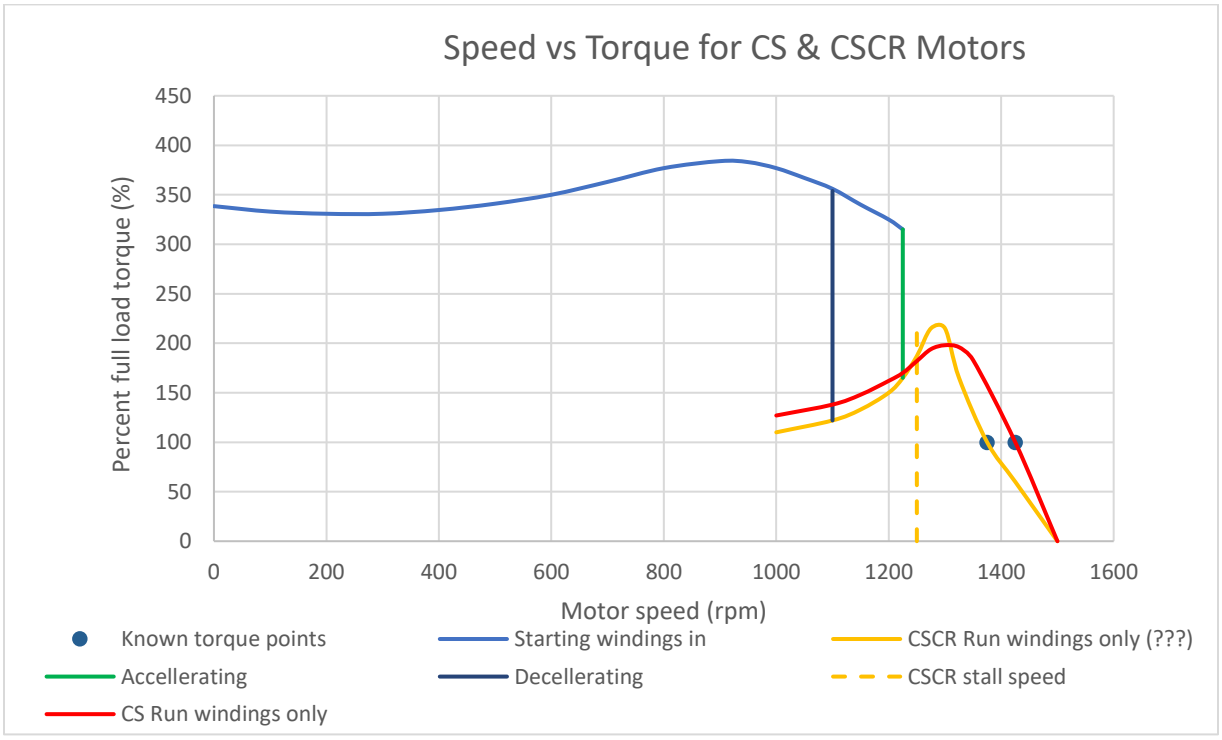
Note:

- The line of blue dots at RHS is the projected rpm at the observed end-of-cut time
- For the lowest line (15lb bow weight), the revs drops to the 1250rpm stall speed of the motor and it doesn't complete the cut, the lowest (olive) dot is projected cut time when it stalled.



The above was done with a ½HP CSCR motor, of Italian make, and the stall speed was as near as I could tell, 1250rpm (50Hz supply). The nameplate says motor develops rated HP at 1375rpm, which I take to mean 100% rated torque is developed at 1375rpm

From what I understand, and my observations, the general shape of the speed vs torque graph is something like below:



The shapes I drew were determined by:

- Both motors have zero torque at synchronous speed (1500rpm)
- CS motors in general, develop rated HP at 1425rpm (95% 0f synchronous speed) while
- This CSCR motor develops rated HP at 1375rpm (from name plate).
- Most speed vs torque graphs show CS motors to have about 200% of rated torque at breakdown torque point (contrary to the graph shown at the top of the 1st page)
- The CSCR motor was observed to stall at 1250rpm, so torque presumably is in steep decline at that point
- The yellow line shape is entirely speculative – I don't know if CSCR motor breakdown torque is higher or lower than a CS motor (I suspect it is lower because, CSCR motors are similar to low-torque Permanent Split Capacitor motors, but I drew it higher and weird shape so as not to presume any answer)
- If breakdown torque of CSCR is the same as a CS motor then necessarily its peak is 'narrrower' (less spread) than a CS, since it develops its rated horsepower at lower revs than CS and stalls at 1250rpm (no idea where a CS motor stalls as I don't have one to test).
    - If so a CSCR motor would not be as good as a straight CS motor in these bandsaws, as it would have less 'lugging power', just as a peaky sportscar engine has less lugging power than a truck engine of the same HP

People like to run these bandsaws with as heavy weight on the teeth as possible (while hopefully not stalling) since it decreases the time it takes to cut a given workpiece. The motors' are pretty well always running above their rated-HP rpm. Since they are most often run for only a few minutes at a time, the extra heat produced does not affect the longevity of the motor.

Most of these bandsaws are delivered with CS motors, but replacements are increasingly likely to be CSCR, as these saws often burn out the motors by being left unattended while cutting and the motor stalling as the load creeps up through the cut.

The question of which motor has the highest and broadest breakdown torque is important for me, since I get asked which motor is best to drive a bandsaw (I'm one of the 'technical experts' in our user-group for these saws (https://groups.io/g/4x6bandsaw).

Thanks - John Vreede