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Application Report
AC Drives for Punch Press

The versatility, operating efficiencies and installation economies of general purpose adjustable frequency AC drives are bringing them increasing popularity as replacements for aging eddy current drives in a wide variety of applications.

While eddy current drives served for many years on metal forming and punch presses, winders, overhead and floor conveyors, they were never really suitable for applications requiring reverse cycling—and are rapidly being replaced by adjustable frequency drives.

Adjustable frequency drives are simple to install and set up, with instant access to operating parameters through digital LED readouts. In contrast to inflexible eddy current drives, they offer digital inputs for simple, accurate entry of a wide variety of operational settings.

Additionally, digital control provides zero drift for improved application efficiencies throughout the speed range.

The combined simplicity of an AC drive and standard inverter-duty motor reduces mechanical complexity and, therefore, user maintenance requirements.

Digital repeatability facilitates simple, accurate entry of parameter settings for modification of functions including jog, braking, momentary power loss override, remote speed reference inputs, overtorque detection, multi-step speed settings and accel/decel time selection.

AC drives easily support serial communications, along with features and modifications which are difficult or impossible to accomplish with an eddy current drive. Features are usually provided as "standard" or as easily-installed options.

Virtually all modern AC drives provide protective functions including motor overload, overheat, overcurrent, undercurrent, phase loss and ground fault as standard.

Ratings of 150% starting torque mean that the user does not pay for unnecessary overload protection, while a bypass option allows the drive to switch automatically to line power in applications requiring uninterrupted operation.

High-performance adjustable frequency drive design offers significant improvements in press operation. In addition to increased productivity and lower production costs, when compared to eddy current drives, AC drives provide:
• Ability to select optimum press speeds thereby reducing scrap and lengthening die life.
• Increased press speeds to take advantage of improved press techniques.
• Ability to integrate a series of presses into a mechanized line because feed speeds can be precisely coordinated.
• Flexibility to meet changing operational needs.

Other AC drive benefits include flexibility which allows for easy modifications through software versus mechanical changes which are very expensive on a comparative basis.

Flexibility also means that operating changes can be made and presses brought back on line quickly, reducing both setup and down times.

Higher Speeds, Higher Production
Press drive motors are normally selected for a 3:1 speed range. This is necessary because while the press load may be essentially constant torque as press operating speed varies, the motor load may remain constant.

A mechanical press derives much of its working energy during the work stroke from the flywheel. During the remainder of the cycle, the motor brings the flywheel back to rated speed to restore its energy. Flywheel kinetic energy is proportional to the square of its speed. Therefore, a press has only as much work capacity when operating at 20 strokes per minute as when operating at 40 strokes per minute. Since there is less energy available from the flywheel at low speeds, the motor has to assume a larger percentage of the press load, and therefore must deliver more torque. Application of an adjustable frequency drive, however, allows operators to run their presses at much higher speeds to increase production while at the same time saving energy through more efficient use of flywheel kinetic energy.

Drive Replacement Considerations
When replacing an eddy current drive with an AC adjustable frequency drive consideration must be given to overload requirements of the particular press.

As an example, consider the following replacement of an eddy current drive with an AC adjustable frequency drive: A 350 ton press with an existing 40 hp eddy current drive, 1800 rpm, 460V-3/60 input, 50 FLA, using a NEMA B,
squirrel cage induction motor, 200% starting torque, 220% eddy current coupling peak torque.

As suggested in Table 1, a 40 hp inverter duty high efficiency squirrel cage induction motor, suitable for belted output, packaged with a 50hp drive would be appropriate. This selection would provide accelerating torque comparable to the eddy current drive being replaced.

As a second example, consider converting a constant speed, NEMA D motor to an adjustable frequency drive. This is a 400 ton press with an existing 40hp NEMA D main press motor, 8-13% slip, 460V, 52 FLA, 1800 rpm.

When converting an existing constant speed main press motor to adjustable frequency, it is important to ensure that motor insulation is appropriate for inverter duty. Insulation Class F at a Service Factor of 1.15 is minimum. Class H at SF 1.25 is optimum.

Another factor to consider is motor frame construction. For example, 3U frame motors are typically capable of continuous operation at 120-25% rated torque. If the motor is required to operate above its 100% rating, it is recommended that a drive one size larger than that shown in Table 1 be selected.

Due to the high starting torque characteristics, approximately 300% of rated torque in this example, the time to accelerate the flywheel to rated speed will increase. This due to the typical drive starting torque capacity of 150% of rated. Per the table, a 460V, 50 hp drive is suggested.

Summary

AC adjustable frequency drives offer a multitude of advantages over eddy current drives in a wide variety of applications. In contrast to inflexible eddy current drives, adjustable frequency drives offer digital repeatability for simple, accurate entry of a wide variety of operational settings. Digital repeatability and control provide zero drift for improved application efficiencies throughout the speed range.

Installation and setup are comparatively simple, with instant access to operating parameters through digital LED readouts. Additionally, virtually all modern general purpose Ac drives are designed to perform superbly with any standard inverter duty motor.

Table 1

Approximate Press Tonnage	NEMA D Motor (8-13% Slip)	Eddy Current Drive w/ NEMA B Motor	AC Inverter-Duty SCI Motor, NEMA B *	AC Drive 460V
	Horsepower	Horsepower	Horsepower	Horsepower
160-200	20	20	20	25
200-250	25	25	25	30
250-300	30	30	30	40
300-400	40	40	40	50
400-500	50	50	50	60
500-600	60	60	60	75
600-750	75	75	75	100
800-1000	100	100	100	125
1250	125	125	125	150
1500	150	150	150	200

* The application of the different classes of motors varies between the various press manufacturers. Consult the press manufacture for recommended horsepower if replacement of the existing motor is desired, since the size required is based upon tonnage, strokes per minute, lenght of stroke, etc.

Note: Table 1 is intended for reference only. Consult a Yaskawa representative for detailed information for your specific modification.