

HEAVY DUTY EPC FOR AUTOMATIC STRIP GUIDING



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GENERAL

EPC® is a registered trade mark of Nireco Corporation and stands for Edge Position Control. The system is a control unit which performs strip (product) edge alignment in rolling processes, heat treatment, acid pickling, and surface finishing of thick and thin plates. As applications of EPC technology, the Center Position Control System (CPC System) and the Line Follower Control System (LFC System) have also been developed and are used widely. These systems, including the EPC System, can be adapted easily to a new or existing plant.

FEATURES

- **Precise control** The edge position or center line position of the strip can be controlled highly accurately.
- **Sensing element does not touch the strip** Edge position can be detected without touching the product.
- **Easy maintenance** Since the system has a simple and strong mechanical structure, it is trouble-free (One customer has been using it for more than 20 years continuously without any serious problem). Even if a problem occurs, trouble-shooting can be done easily at the installation site.
- **High sensitivity** Strip displacement to within $\pm 0.05\text{mm}$ can be detected.
- **High stability** Since the system employs hydraulic technology, the influence of friction and inertia is negligible, so continuous control of the operation is possible and frequency response characteristics are excellent.
- **High speed with heavy load** An operating power of a little under 50 tons is available when using a $\phi 300\text{ mm}$ work cylinder at a hydraulic pressure of 70 kgf/cm^2 .
- **High-speed operation** A speed of up to 50 mm/sec is available within the safety limits. Correct operation is guaranteed at high speeds.
- **No effect from power fluctuations**
- **Employment of integral action** Since an integral action is employed as the basic action of the system, the operating speed is in proportion to deviation, so deviation offset is eliminated.

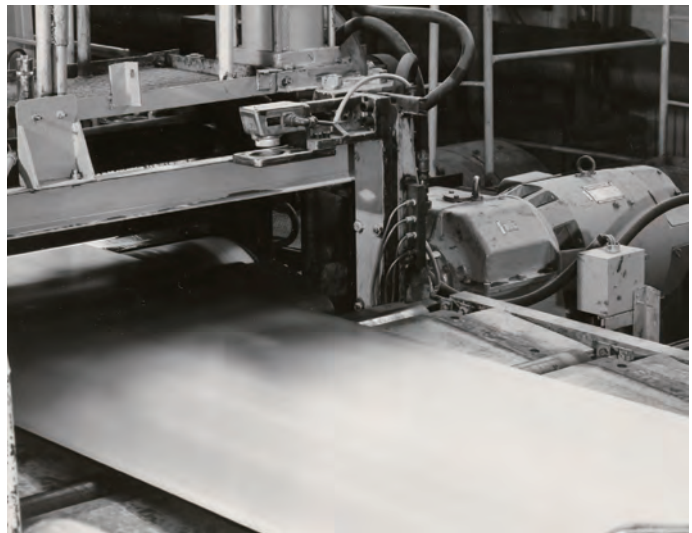


Photo 1 EPC System for Tension Reel (Photohead System)

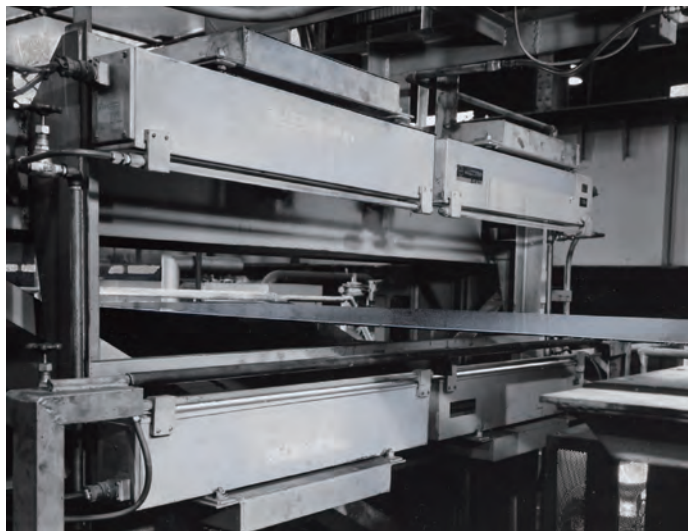


Photo 2 Steering Roll CPC (Autowide System)

OUTLINE OF EPC® SYSTEM

EPC is used widely in the following industries:

- (1) Iron and steel industry,
- (2) Light metal industry,
- (3) Copper rolling industry,
- (4) Printing and bookbinding industry,
- (5) Plastic and film industry,
- (6) Rubber and chemical industry,
- (7) Paper industry,
- (8) Fiber and textile industry.

The description in this booklet applies only to the steel and metal industries to cover (1), (2) and (3) in the list above. This machine can easily be installed in new or existing lines.

With the introduction of the EPC system, the side-trimming operation, which had previously been necessary to adjust the unevenness of the strip edge, will become unnecessary, and the lateral side of the coil will be protected. In addition, operations such as surface finishing, laminating, marking and cutting the strip can be performed at the desired position with minimal waste, so production and labor costs can be reduced. In recent years, many plants have introduced continuous production lines and higher line speeds to increase productivity. The EPC system is indispensable for such plants.

The EPC system is an automatic control system of the feedback type. This means that it always compensates for the difference, if any, between the desired value and the measured value regarding the position of the object to be controlled, while observing and feeding back the

results measured. Thus, a feedback system is established. In this type of automatic control system, the control object and control unit form a closed loop as shown by the block diagram in Fig. 2.

The working principle of an EPC system for making the strip position constant is explained below with reference to Fig. 3 and Fig. 4.

(1) Any deviation of the strip position from the correct position due to a disturbance is detected by the linear sensor.

Deviation (displacement) → Electric current signal
Strip edge displacement = Controlled variable

(2) The detected signal in (1) is amplified to actuate the moving coil.

Electric current signal → Amplified current signal

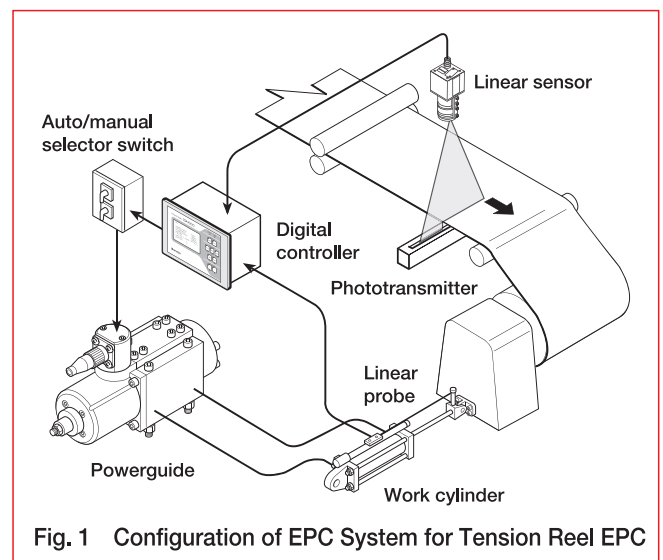


Fig. 1 Configuration of EPC System for Tension Reel EPC

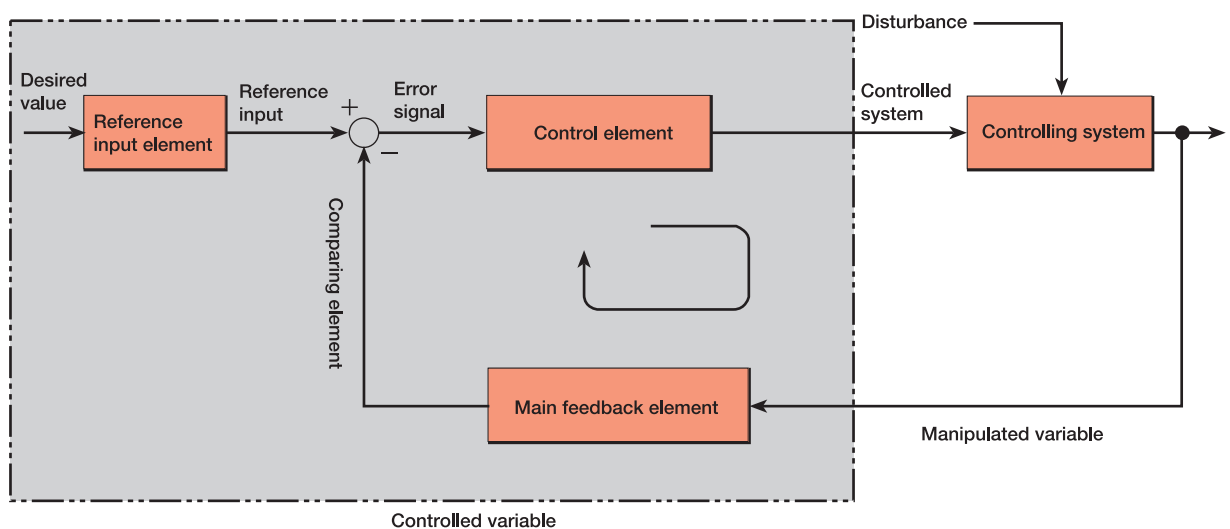


Fig. 2 Block Diagram of Automatic Control System

(4) As the strip passes the desired position (i.e., the target value), the force (i.e., the standard input) of the set spring and the output of the moving coil, which are determined by the signal detected at about the midpoint of the detection range of the linear sensor, are balanced so that spool remains centered.

Set spring = Standard input element

(5) The jet pipe (or spool) is moved laterally depending on the signal (operation control signal) indicating the deviation from the standard input of the strip edge position set in above (4).

(6) The displacement of the spool or jet pipe causes a differential pressure in the piston of the work cylinder.

The cylinder then moves so that the correct adjustment is made. This is how edge position control is performed.

(7) The operation mode selection switch is installed for selecting automatic operation mode or manual operation mode.

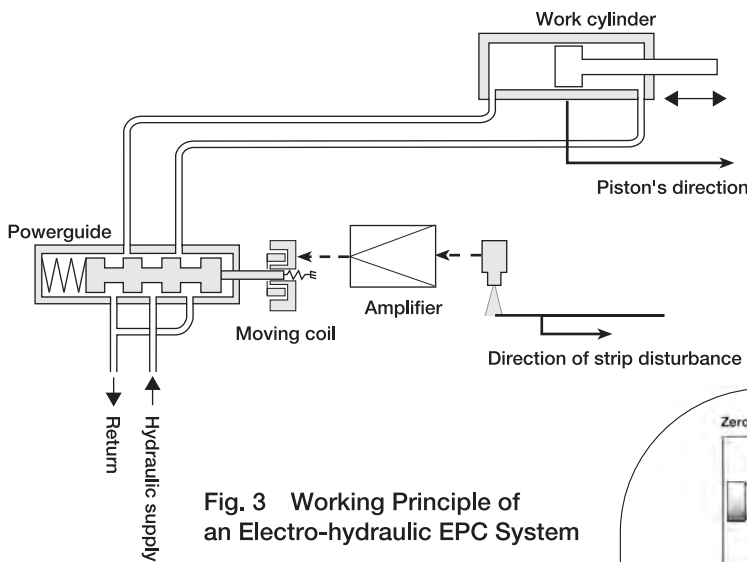
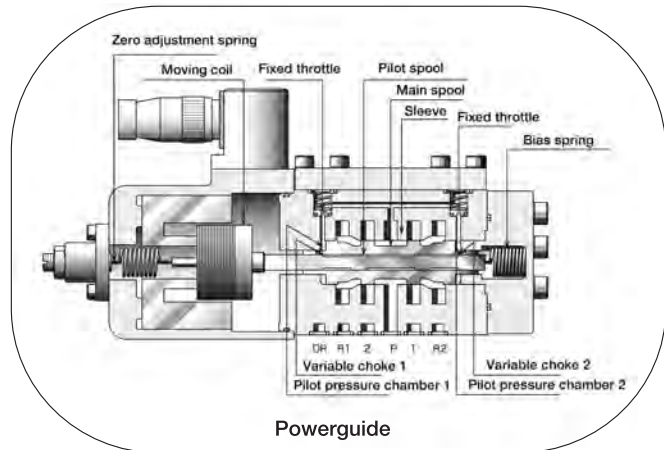


Fig. 3 Working Principle of an Electro-hydraulic EPC System



Photo 3 Powerguide (spool type)



Powerguide



Photo 4 Servojet (jet pipe type)

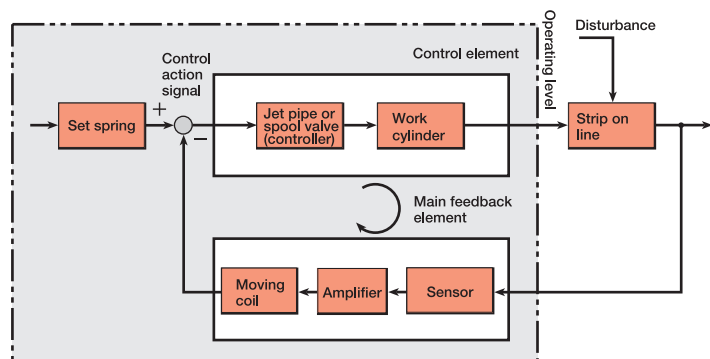


Fig. 4 Block Diagram of EPC system

BASIC CONTROL METHODS OF THE EPC/CPC

The following three basic methods can be used to control the strip edge position according to the process:

3.1 Payoff Reel Method

This method is used for feeding a strip whose edge is aligned in a straight line when a coil wound in telescopic form or an irregular form is fed to the subsequent operation such as an annealing line or a pickling line. In that case, the sensor's position is fixed and the whole reel unit is operated by the cylinder.

In such an application, it is important to install the sensor as close to the payoff reel as possible when the EPC system is installed. By doing so, the stability of the control system can be assured only by the control unit.

The centering method using two sensors is also used as an application of the payoff reel method where the strip width is irregular and the center position of the strip needs to be controlled precisely.

3.2 Steering Roll Method

A steering roll is used when the strip edge needs to be aligned in a straight line in the middle of a process, or when it is difficult to move the position of the tension or payoff reel in the case of an existing machine for which a major modification is necessary.

The following types of guide roll classified by mechanism are available.

(1) Center-pivot type guiding system (See Fig. 5)

As shown in Fig. 5, the center pivot type can set the rotation center at the center point of the plane at the entry roll of the steering roll assembly. This type of steering roll is used for a strip made of a material which could be torn and/or deformed permanently when a difference in tension between both strip edges occurs.

The strip cannot slip when the steering roll moves because the strip wraps around 180 degrees of the steering roll. However, if it should slip, rolls with a rubber wrapped up are used.



Photo 5 Steering roll CPC

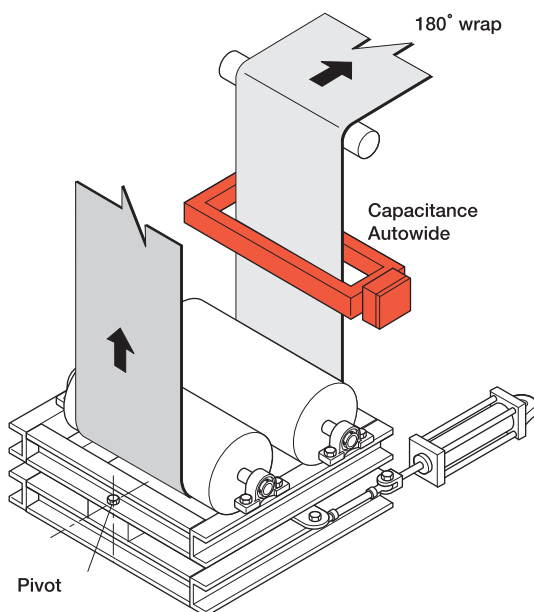


Fig. 5 Two-roll center pivot type

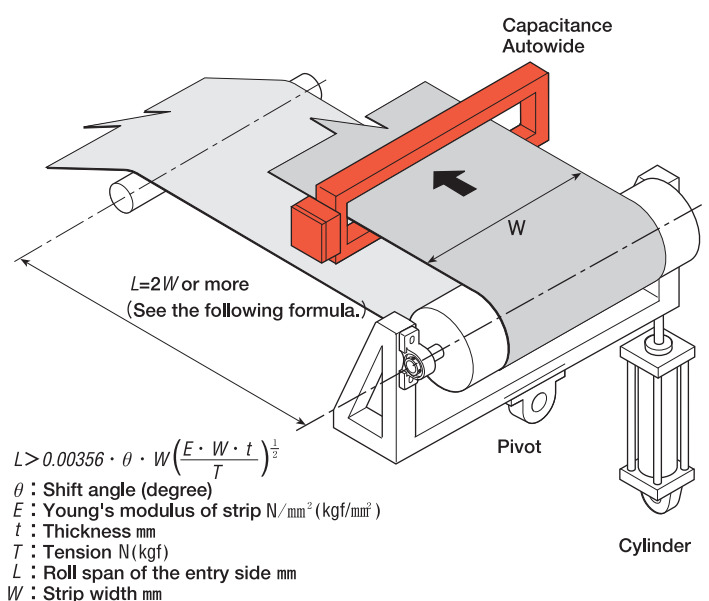


Fig. 6 System with a Large Roll, Which Has the Same Function as the Center Pivot Type

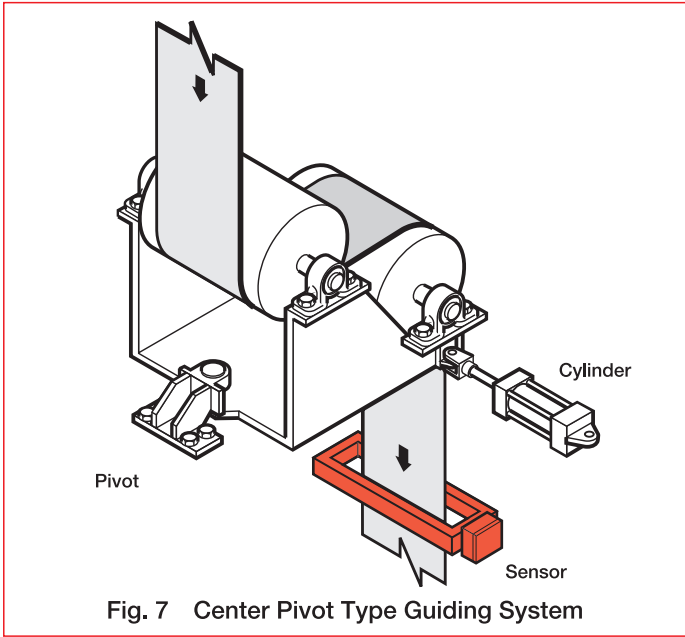


Fig. 7 Center Pivot Type Guiding System

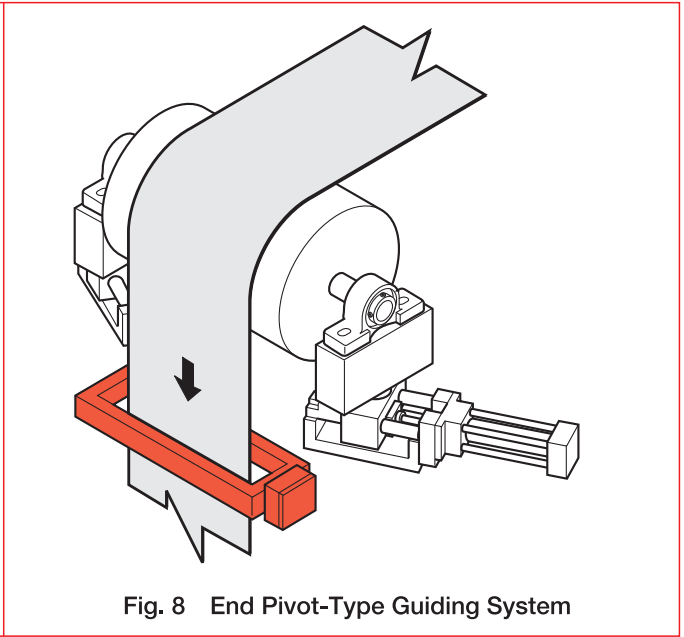


Fig. 8 End Pivot-Type Guiding System

The lateral displacement (correction volume) of the strip edge is obtained from the following relation

$$\text{Lateral displacement} = \text{Diameter of guide roll} \times \tan \theta$$

Where θ : shift angle (This angle must be within the range of ± 5 degrees)

Wrinkles will not occur on free paths where the web length between the steering roll and the input entry/exit idler rollers, is twice as long as the strip width or more.

However, because it is necessary to leave enough space for the path line, it may be more costly compared to the case of the end pivot type when installed on an existing machine.

(2) End Pivot-Type Guiding System

Fig. 8 shows the structure of the end pivot type, which is used to feed the strip and change the direction of the strip. If the roll is moved while taking a large value for distance "r \leq L" between the steering roll and the fulcrum which is the rotation center of the steering roll, the change in its tension and inclination will remain small for the same feed

length so that the amount of twisting remains minimal for almost no strain. Consequently, use of this type of EPC system will bring better results.

The important point using the end pivot type for the steering roll method is not to install an idler roll within the range of 5 times the strip width at the entry side of the steering roll and not to install a high-friction idler roll within the range of the strip width at the exit side of the steering roll.

It is also worth noting that the sensor should be installed as close to the steering roll as possible.

The end pivot type is useful when the work material absorbs the tension difference between strip edges, and a sufficient idler roll space is available in the entry and exit sides of the steering roll. This type is used more frequently than the center pivot type because it needs only one idler roll instead of two, less work space, and its mechanism is simple.

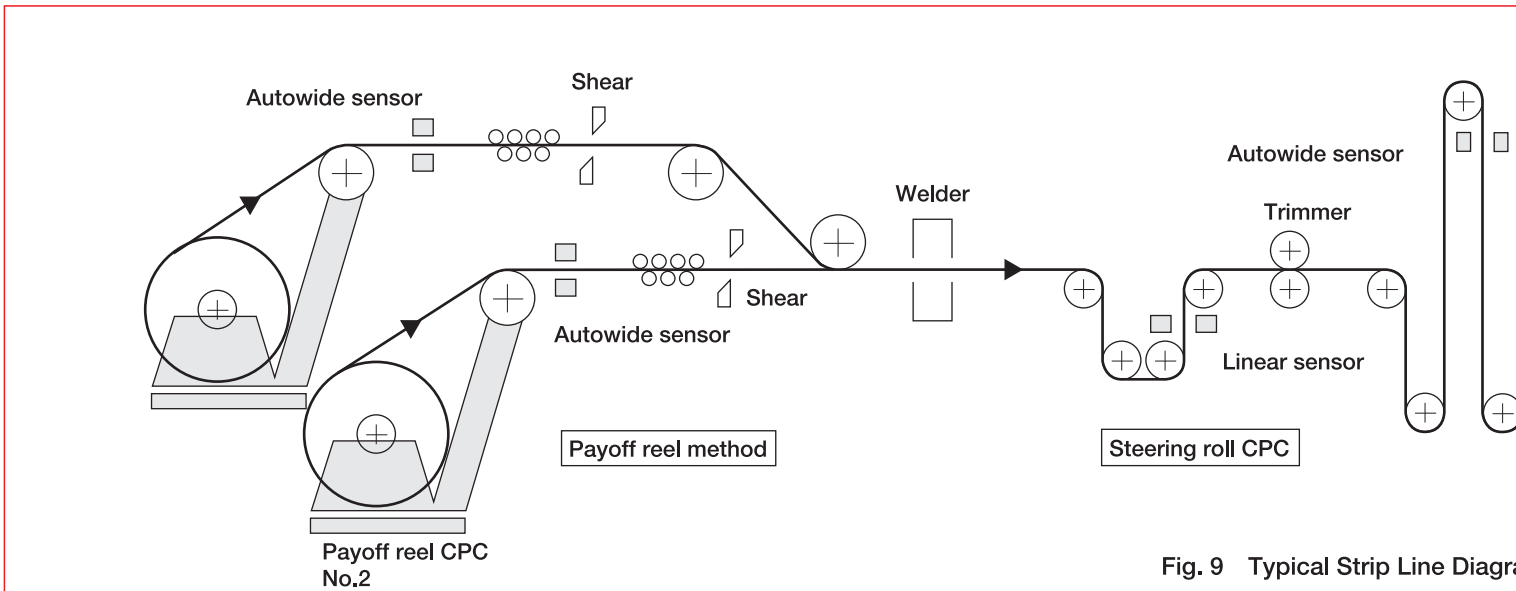


Fig. 9 Typical Strip Line Diagram

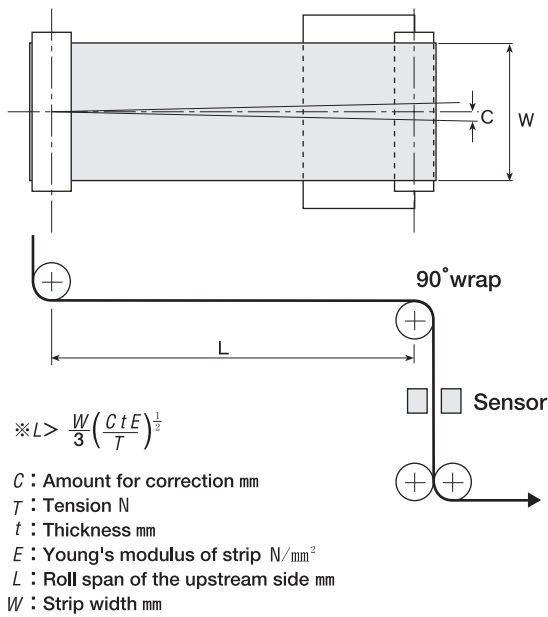


Fig. 10 End Pivot-Type Guiding System



Photo 6 Powerguide

3.3 Tension Reel Method

Fig. 11 shows an EPC system using the tension reel method. In this case, the sensor moves with the tension reel. The sensor should be installed as close to the tension reel as possible. If it can be installed on the tension reel, the object can be controlled without a time lag so that the stability of the system can be assured using only the control unit, as in the case of the payoff reel method.

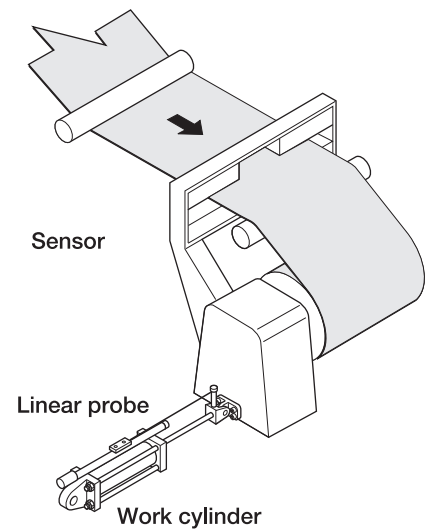
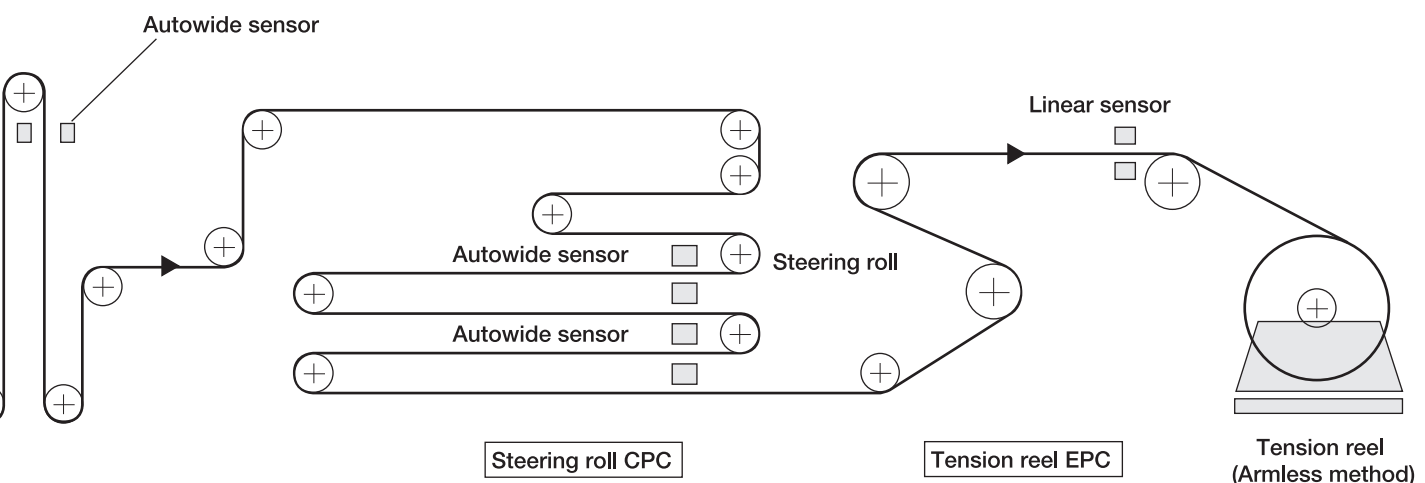


Fig.11 Tension Reel

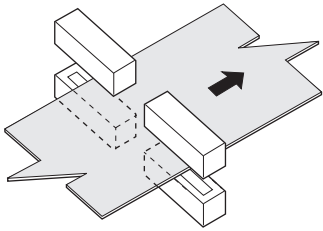
NOTE : Whatever method is used for the EPC system to be introduced, it is important to make the system time lag as small as possible. In practice there will be some restrictions such as the strip may be wrinkled depending on the manner of reel operation. Therefore, the best method and type should be selected considering the properties of the strip material and the plant conditions.



EQUIPMENT FOR THE EPC/CPC

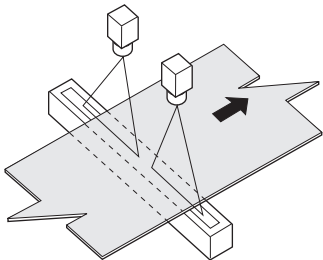
Sensors

① Autowide sensor AWL



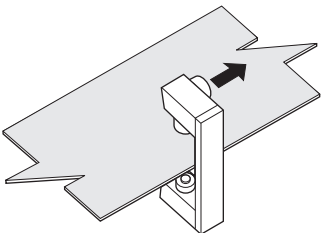
Used for Center Position Control (CPC) of strip. Even if a change in strip width occurs (for ex-ample, at the seam of strips), the system can be kept in operation.

② Linear sensor LSE



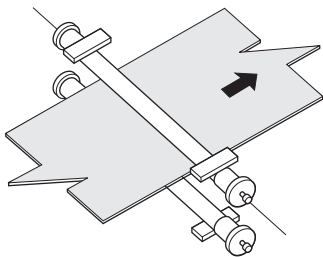
A sensor with the ability to combine EPC, CPC, line, edge, width and shape measurements.

③ Photohead PH



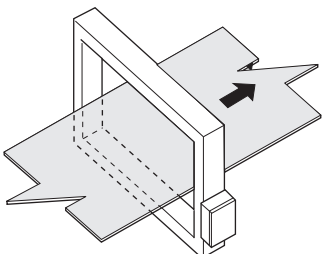
The Photohead is a photoelectric EPC sensor.

④ NS sensor (Electromagnetic induction type)



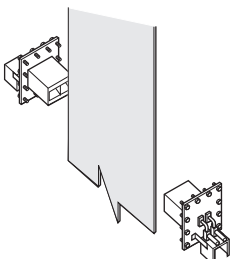
A maintenance-free sensor for CPC that can be used in environments with water, steam or corrosive gases.

⑤ Capacitance sensor AWC



A maintenance-free sensor for CPC, with a simple structure employing a change in capacitance between strip and electrode.

⑥ In-furnace electromagnetic-wave-type CPC sensor



A new maintenance-free sensor that emits electromagnetic waves from an antenna embedded in a furnace wall, and measures the position of a strip from the propagation time of an electromagnetic wave that is reflected back from the edge of the strip.



Photo 7 Linear sensor

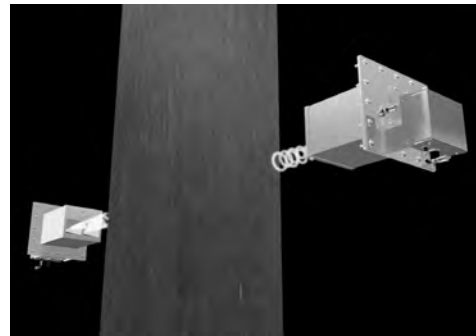
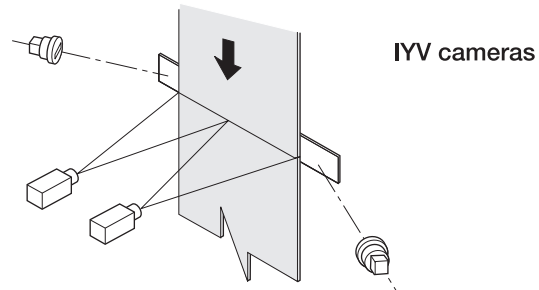
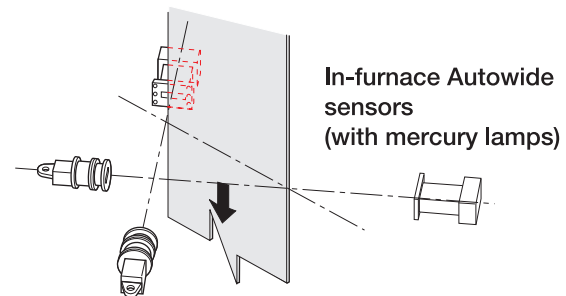


Photo 8 An electromagnetic-wave-type CPC sensor

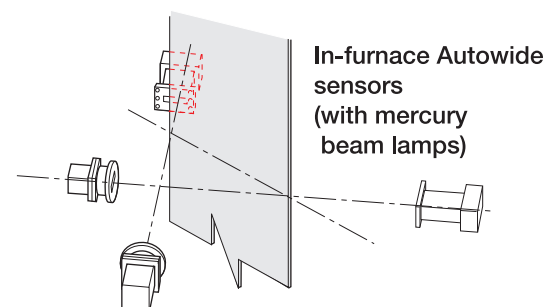
Discontinued Products



IYV cameras



In-furnace Autowide sensors (with mercury lamps)



In-furnace Autowide sensors (with mercury beam lamps)

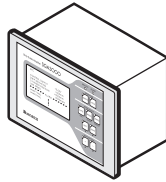
Amplifiers

Digital controller

Digital controllers are equipped with microprocessors.

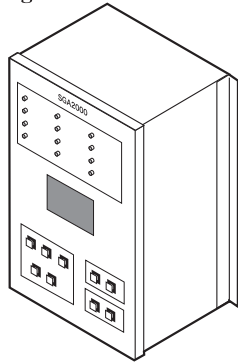
①Strip guide type SGA3000

The SGA3000 is a compact, lightweight amplifier with advanced functions similar to the SGA2000 that can be installed anywhere.



②Strip guide type SGA2000

The SGA2000 offers advanced EPC/CPC controls, such as stagger winding and cascade control, which are unavailable from conventional analog amplifiers.



③Strip guide amplifier for in-furnace CPC Strip guide type FSGA2000

Analog operation type:

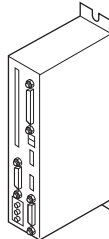
Servo amplifiers of this type operate and amplify the input signal from sensors, and output control signals to a controller.

①CPC amplifier SA600

for linear sensor or Autowide.

②EPC amplifier SA700

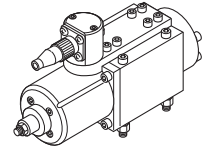
for Photohead.



Controllers (Servo Valve)

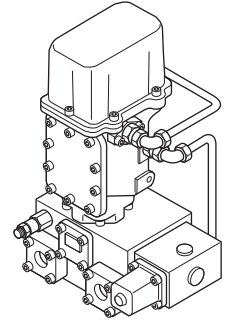
①Powerguide PG

This is a spool-type servo valve.



②Servojet SJ

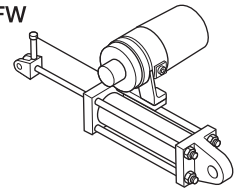
This is a hydraulic jet pipe-type dry servo valve with a high response and high power.



Position transmitters

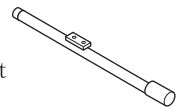
①Analog position transmitter FW

The FW is a wire position sensor with a built-in potentiometer that converts the changes in the position of linear motion into resistance values.

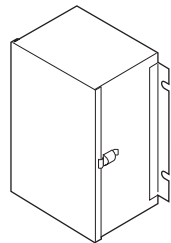


②Linear probe GYKM-LT

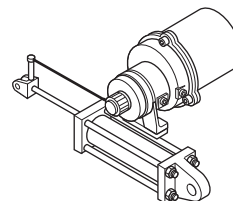
The GYKM-LT is a high-precision position sensor that uses a magnetostrictive wire and slide magnet for a linearity of less than 0.025% and a resolvability of less than 0.01%.



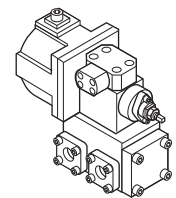
Discontinued Products



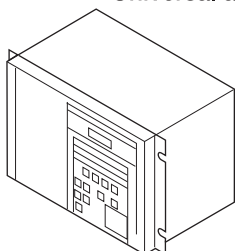
Universal amplifier UAI



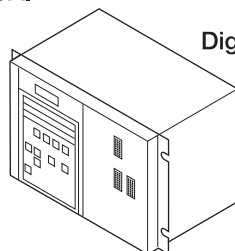
Digital position transmitter FW70



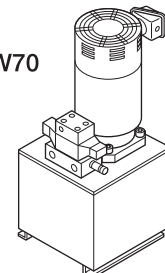
Powerguide PG**2



Digital controller DEC300



Digital controller DEC200



Gearless servo GS

EPC/CPC SYSTEMS AND SENSORS

Payoff reel EPC

Photofeald

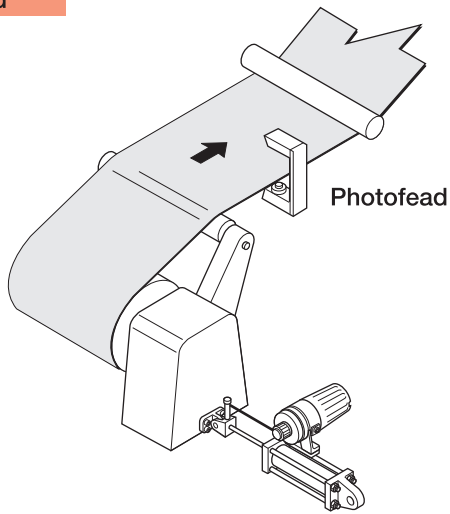


Fig. 12

Payoff reel CPC

Autowide

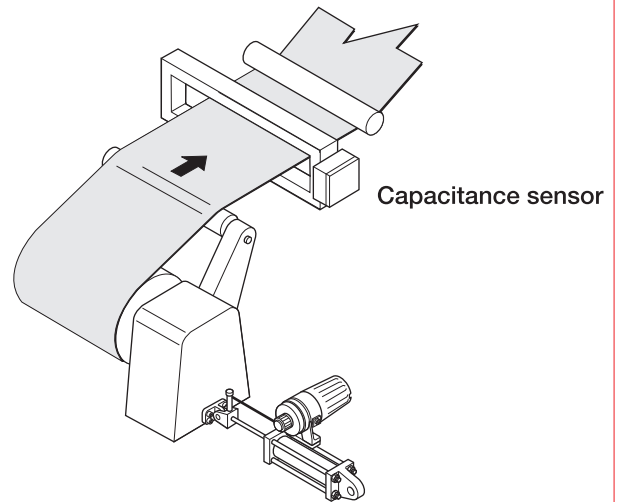


Fig. 13

Payoff reel EPC (double cone)

Photofeald

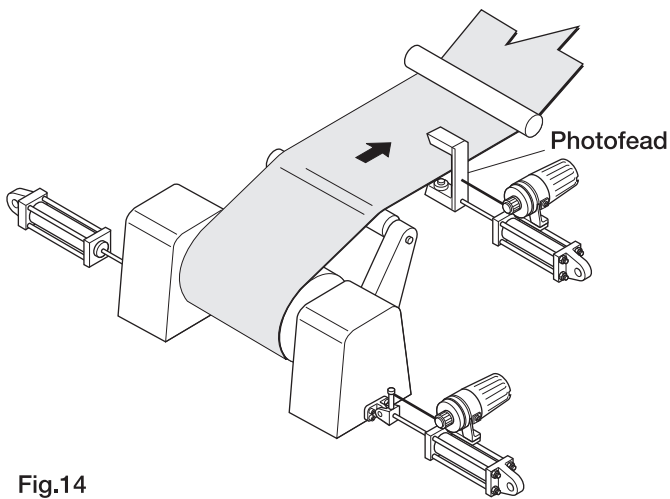


Fig.14

Steering roll CPC (180° wrap)

Autowide

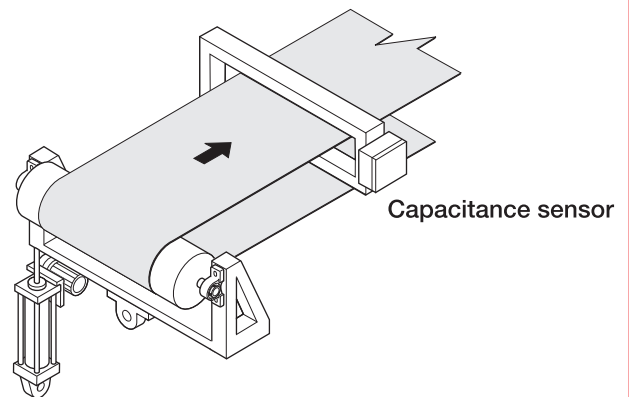


Fig.15

Steering roll CPC (two rolls)

Linear sensor

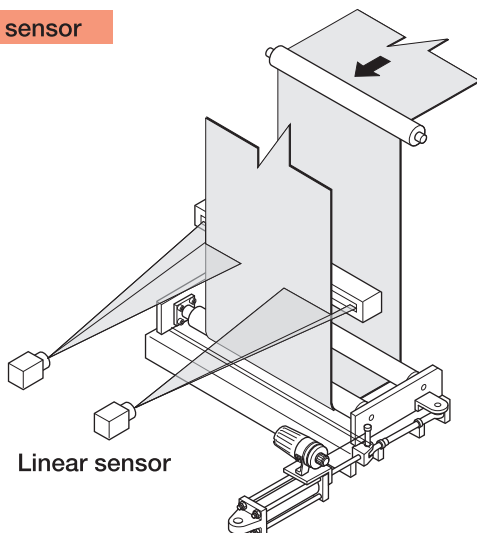


Fig.16

Steering roll CPC

Autowide for furnace

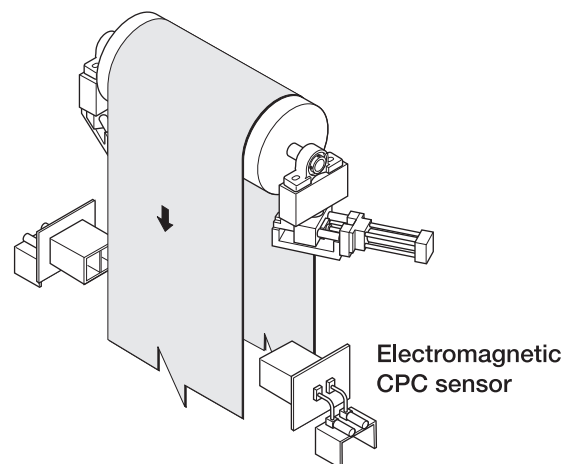


Fig. 17

Tension reel CPC

Autowide

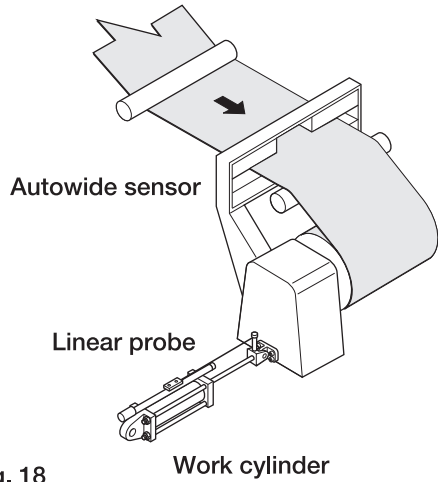


Fig. 18

Work cylinder

Steering roll CPC

Capacitance sensor

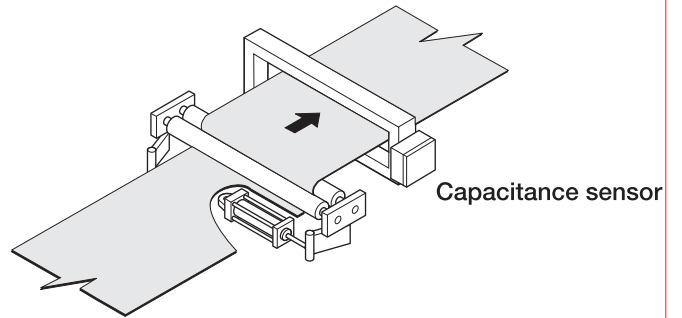


Fig. 19

Tension reel EPC (sequence type)

Photohead

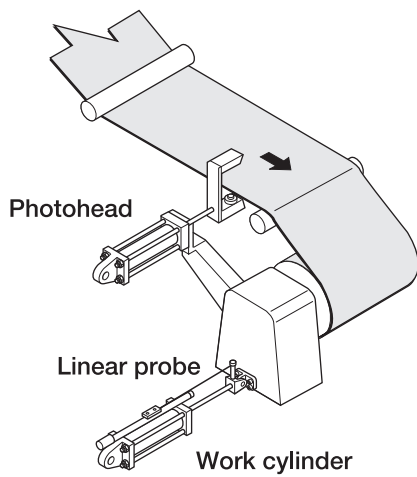


Fig. 20

Work cylinder

Tension reel EPC (belt-wraper simultaneous drive)

Linear sensor

Armless method

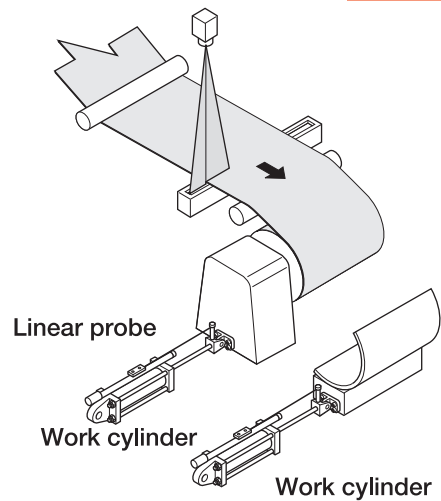


Fig. 21

Work cylinder

We reserve the right to change the specifications in this catalog without prior notice for improving and updating our products.



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