Introduction

NIRECO EPC® / CPC System

EPC is a NIRECO registered trademark which stands for Edge Position Control. This control system automatically and uniformly aligns the edge positions of products (strips) in rolling, heat treatment, pickling and surface treatment of thick plates and thin plates. CPC (Center Position Control), which controls the center position of the strip, is also widely used as an application of EPC. This system can be easily installed in either a new or existing plant.

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(winding reel control system)
An overview of EPC®/CPC

- **Production cost reduction and labor saving**
  The use of EPC eliminates the need for side trimmers, which were previously used to remedy strip edge position inconsistency, and protects the sides of coils. Operations such as strip surface treatment, lamination, marking and cutting can be carried out at the required position, without waste, helping to reduce production costs and save labor. Continuous production lines have become increasingly common, as a means for improving productivity, and line speeds have increased, so a growing number of plants cannot make their products without EPC. CPC systems control the position of the center of the web. CPC control keeps the web centerline without changing the position of the sensors in situations where the web will keep running regardless of changes in web width (large changes such as splices).

- **Feedback-based automatic control**
  EPC is a feedback-based automatic control system. With EPC control, the correction distance for the controlled subject is measured and compared to the target value, with corrective action to match the target value when any discrepancy arises.

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**Nireco provides EPC and CPC systems, and a variety of other control and measurement units for all types of plants.**

- EPC and CPC systems, strip width gauges, precision right angle gauges, and electroplating line edge mask servo units for all types of processing lines
- Iron and steel metal industries
- Marking systems for slabs, blooms, billets and semi-finished products; marking systems for hot rolled and cold rolled products; marking of labels, metal tags and other items
- Mold eddy current type level sensors for use in continuous casting
- Fuel and air pressure and flow process control systems for blast furnaces, gas and coke furnaces, sintering and other fuel furnaces
Detection Section

Capacitance Autowide Sensor
AWC Series
AWC640/AWC790/AWC940/1090

The Capacitance Autowide Sensor AWC is a sensor system that provides continuous, contactless detection of the center position of a strip moving on a line, for use in Center Position Control (CPC).

Like our previous sensors, the sensor is maintenance free and can be used continuously with no decline in sensitivity caused by wear over time, giving stable, long-term service. The sensor is now a far easier product to use, offering improvements such as taking away the need for on-field calibration*.

* If there are metal structural elements close to the sensor, simple adjustment may be required.

Features

- No field calibration required
- Maintenance free
- Uninfluenced by light
- Insensitive to dirt, scale
- Unaffected by passline changes or wavy edges

Operating principles

The Capacitance Autowide AWC Series generates lines of electric force between electrodes situated on each side of the strip, and calculates the position of the strip between the electrodes from the changing amount in the number of lines (see Figure 1). The sensor has two sets of transmission and reception electrodes that are installed opposite each other with the strip between them. The transmitter electrode generates electric force lines and the receiver receives them. When a strip enters between the transmitter and reception electrodes, the difference in the blocked transmitter electrodes causes a variation in the force lines received by the reception electrodes (see Figure 2). Therefore, by calculating the lines of electric force received by the reception electrodes, the position of the strip becomes apparent.
Example of application to a CPC system

Steering roller system (with intermediate guide roller)

Payoff reel system (unwinder)
Autowide

Autowide AWL

This is a sensor used for a strip meandering prevention system (CPC), for a wide range of processing lines. While the line is running, both edges of the strip are detected, and the strip center is detected from the difference between the detection signals. By using the Autowide, it becomes possible to always detect the strip center position even if the strip width changes. This sensor is essential in CPC. This sensor is constructed so that it is not easily affected by up-down fluctuations of the path line or by outside light.

Autowide AWL (LED type)

This is a digital/analog type sensor in which a silicon photo diode (SPD) is used as the detection element and an LED is used as the projector. The LED projector has 6 times or more the lifetime of a fluorescent lamp. The light source is lit up and tuned at high frequency, so it is not easily affected by outside light (the effect is about 1/50 or less than a standard AW).

Example of configuration of a CPC using the Autowide

For details on the control section see page 12, for details on the amplification section see page 14.
Control Section
(Servo Valve)

Powerguide PG
This is a high response, high output spool type servo valve.

Servoguide M550-AM
This is a spool type small electro-hydraulic servo valve, constructed for easy maintenance in one piece with the hydraulic unit.

Servojet SJ
This is a high response, high output dry type hydraulic jet pipe type servo valve using hydraulic jet pipe.
Features of the SGA3000

- The LCD screen makes it easy to check setting values and output signal status.
- All operations use the push buttons on the control panel for parameter settings.
- Control is possible by P, I or PI action.
- A line speed signal input enables automatic adjustment of control gain to compensate for changes in line speed. PLG signal input enables stagger winding.
- Sensor signals can be taken from up to two sensor systems, enabling cascading control operation.

Example of application to a CPC system
EPC amplifier SA600

The SA600 is an analog operational amplifier for use in controlling a strip meandering prevention system (CPC, EPC). The Autowide linear sensor and position transmitter can all be used in combination with this amplifier. In addition, both voltage and current signals can be input. External shift setting input can be applied.

EPC amplifier SA700

The SA700 is an analog operational amplifier used for control of a strip meandering prevention system (EPC). This is a single-function, simple type amplifier; a photohead and position transmitter can be used. External shift setting input cannot be applied.
Combination with various EPC/CPC control systems and sensors

Payoff reel CPC

Steering roll CPC <180° wrap>

Steering CPC for use inside furnaces

Tension reel CPC
The 3 Basic Methods of EPC / CPC
Basic control system for EPC/ CPC

There are three basic types for controlling edge position: Payoff reel, steering roller and tension reel. The type used depends on the process.

Example of EPC/CPC implementation

In various types of processing lines, when a coil is rewound into the line, it is necessary to feed the strip with its edge or center in a constant position. At this time, with the coil on the mandrel, the strip edge (EPC) or strip center (CPC) position is controlled by moving the payoff reel, in EPC and CPC, unless the detector position and roll arrangement are correct and the strip tension is maintained at an appropriate value, the control cannot be expected to be effective. It is also necessary to determine the correct selections for machine trolley mass, coil mass, reel movement speed and atmospheric conditions, as well as to select the correct unit.
**Steering roll CPC (Intermediate guide roll control system)**

In all types of line processing, it is necessary to correct meandering of the running strip. CPC applied by means of a steering roll mechanism properly moves the strip to the direction of the inclination of the roll and aligns the strip center with the line center. Several steering methods are used; they can be classified into the following 2 categories.

**Center pivot types**

These steering systems are in widespread use; there are a 2-roll center pivot type and a 1-roll center pivot type. The amount of meander correction is determined by the amount of movement produced by the span of 2 rolls (or the diameter of 1 roll) and the roll inclination angle. The angle roll inclination does not cause movement of the strip on the entry side. Formulas for calculating the steering entry side and exit side roll spans are given on the next page.

Steering entry side and roll span calculation formulas are given on the next page.

2-roll steering center pivot type
Steering roll (Intermediate guide roll control system)

Steering entry side and exit side roll span calculations:

\[ L > 2 \times (3.5) \times \theta \times w \left( \frac{3}{W} - 1 \right) \]

1-roll steering center pivot type

Z-wrap steering center pivot type

\( \theta \): displacement angle (degrees)
\( E \): strip elongational elastic coefficient (kN/m/mm)
\( t \): strip thickness (mm)
\( T \): strip tension (N/m)
\( L \): entry / exit roll span (mm)
\( W \): strip width (mm)
End pivot type

The steering roll virtual support point is on the steering entry side. The steering action is similar to that in the case of end pivot steering. It is applied to a section before and after the roll where the strip tension is small.

Roll entry side span calculation formula

\[ L > \frac{W}{3} \left( \frac{C + E}{F} \right) \]

- \( C \): amount of correction (mm)
- \( E \): static longitudinal elastic coefficient (N/mm² (kgf/mm²))
- \( t \): strip thickness (mm)
- \( T \): strip tension (kgf)
- \( L \): entry side roll span (mm)
- \( W \): strip width (mm)

End pivot type

Some analogous types of CPC, though they are not the same as the end pivot type, are shown in the diagrams at right.
Tension reel EPC, CPC (winding reel control system)

In various types of processing lines, when the coil is wound up at the end of the line, and when it is necessary to align the coil edge or the coil center at a constant position during the wind-up, control is applied by moving the tension reel while winding the strip up on the mandrel.

The carousel reel windup EPC method, in which 2 reels are coupled together, has been 100% successful within Japan.

In EPC and CPC, it is necessary to determine the correct detector position, roll arrangement and strip tension. At the same time, it is also necessary to determine the correct machine trestle mass, coil mass, necessary cylinder speed and atmospheric conditions.
Carrousel tension reel EPC
In this method 2 mandrels are mounted on a common disc which revolves while the strip is wound up on the No. 1 reel and the No. 2 reel. There are many factors which require caution in planning. One sensor is shared by the two reels.

Carrousel tension reel EPC
1. Layout

2. Specifications for purpose of estimate

<table>
<thead>
<tr>
<th></th>
<th>Line specification</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Line speed</td>
<td>Max</td>
<td>m/min</td>
</tr>
<tr>
<td>1.2</td>
<td>Strip thickness</td>
<td>Max</td>
<td>mm</td>
</tr>
<tr>
<td>1.3</td>
<td>Strip width</td>
<td>Max</td>
<td>mm</td>
</tr>
<tr>
<td>1.4</td>
<td>Tension</td>
<td>Unit</td>
<td>N</td>
</tr>
<tr>
<td>1.5</td>
<td>Strip material</td>
<td>Carbon steel</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>1.6</td>
<td>Mechanism mass</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td>Coil mass</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td>Friction coefficient</td>
<td>μ</td>
<td></td>
</tr>
<tr>
<td>1.9</td>
<td>Operating forces</td>
<td>N</td>
<td>(Piston rod thrust)</td>
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<td>1.10</td>
<td>Manipulated variable</td>
<td>Shifting value</td>
<td>± mm</td>
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<tr>
<td>1.11</td>
<td>Cylinder size</td>
<td>Bore</td>
<td>mm</td>
</tr>
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<td>2.1</td>
<td>Controlled system</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Payoff reel</td>
<td>Steering reel</td>
</tr>
<tr>
<td>3.1</td>
<td>Control method</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>EPC</td>
<td>CPC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Payoff reel</td>
<td>Steering reel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Arm method</td>
<td>Arm less method</td>
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<td></td>
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<td>Arm gap</td>
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<td>Hydraulics unit</td>
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<td></td>
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<td>Provide</td>
<td>Motor</td>
</tr>
<tr>
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<td>Not provide</td>
<td>Not apply</td>
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<td>Cooling water</td>
<td>Temperature</td>
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<td>Not provide</td>
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<td>Power supply</td>
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<td></td>
<td></td>
<td>Instrument power supply</td>
<td>340 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instrument power supply</td>
<td>340 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Motor power supply</td>
<td>340 V</td>
</tr>
</tbody>
</table>

3. Selection table

Cylinder speeds for each line speed

<table>
<thead>
<tr>
<th>Line speed</th>
<th>Payoff, Tension reel</th>
<th>Steering reel</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 to 100 m/min</td>
<td>5 to 10 mm/sec</td>
<td>5 to 10 mm/sec</td>
</tr>
<tr>
<td>100 to 200 m/min</td>
<td>10 to 15 mm/sec</td>
<td>5 to 10 mm/sec</td>
</tr>
<tr>
<td>200 to 400 m/min</td>
<td>15 to 25 mm/sec</td>
<td>10 to 15 mm/sec</td>
</tr>
<tr>
<td>400 to 600 m/min</td>
<td>25 to 35 mm/sec</td>
<td>15 to 20 mm/sec</td>
</tr>
<tr>
<td>600 to 900 m/min</td>
<td>35 to 45 mm/sec</td>
<td>20 to 30 mm/sec</td>
</tr>
<tr>
<td>900 m/min or more</td>
<td>40 mm/sec or more</td>
<td>30 mm/sec or more</td>
</tr>
</tbody>
</table>

We reserve the right to change the specifications in this catalog without prior notice to improve and update our products.

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