

# Design of tube hydroforming machine and its application

**HYPREX**



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# Design of tube hydroforming machine

## Basic tube hydroforming process sequence

**Prebending**  
(Draw bending)



**Preforming**



**Hydroforming**



*Draw bending  
machine*

*Preforming press*

*Hydroforming press*

## A typical example of machine arrangement for hydroforming process sequence

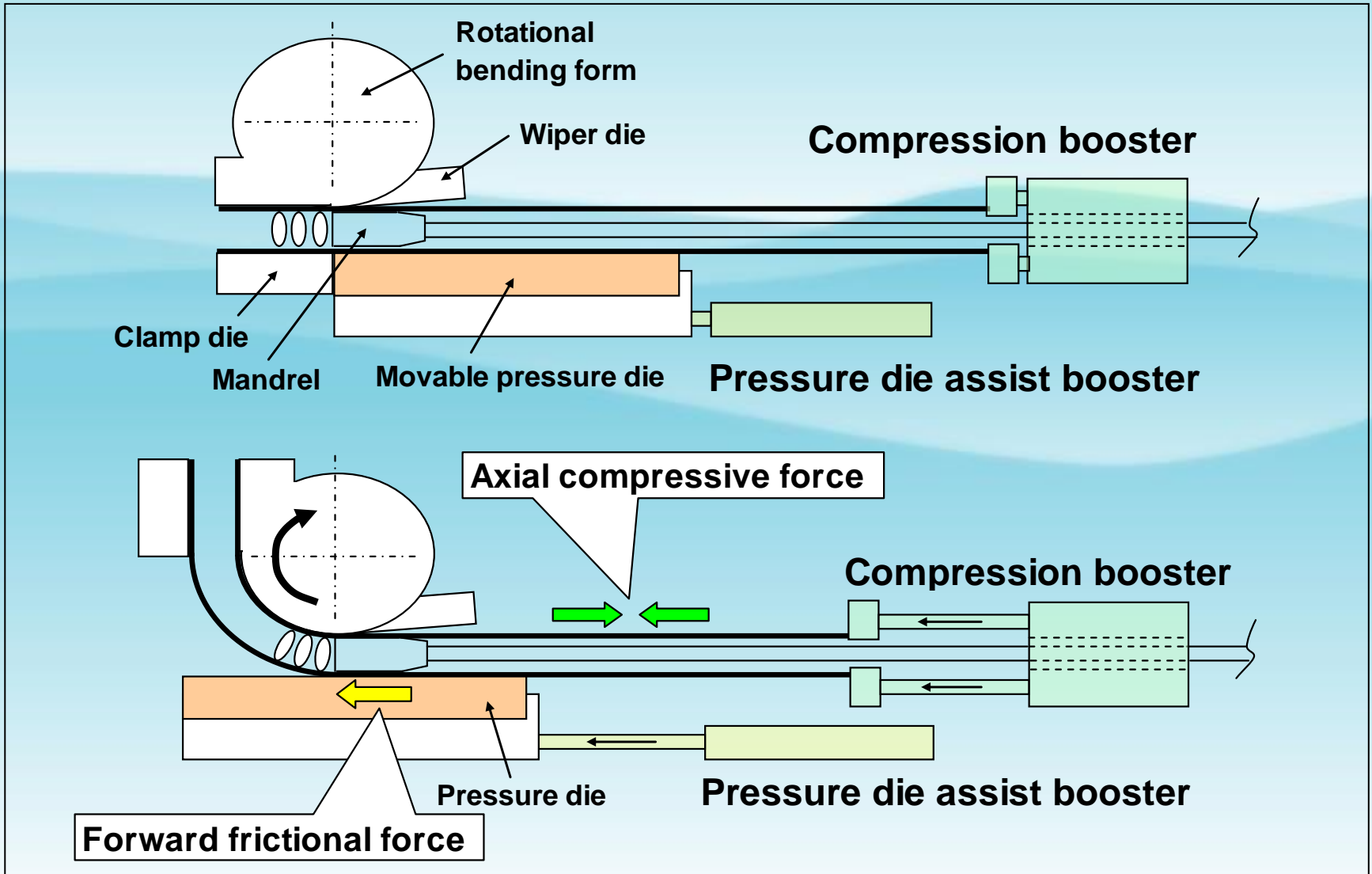


**Hydroforming press**

**Preforming press**

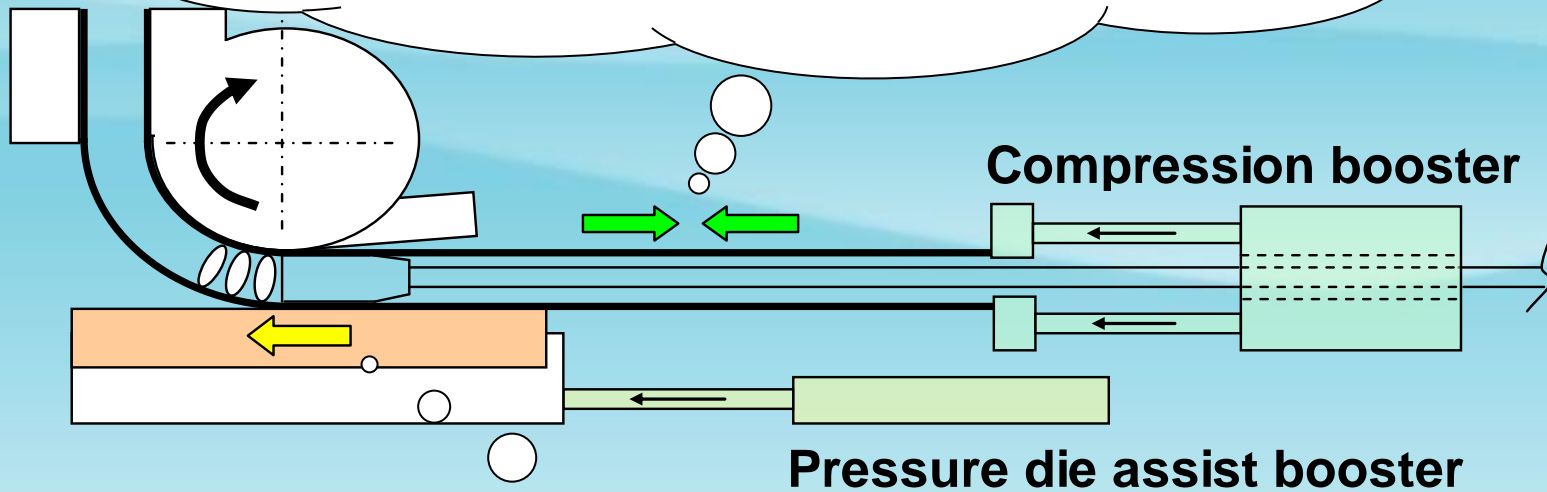
**Draw bending machine**

## Design of draw bending machine (1)



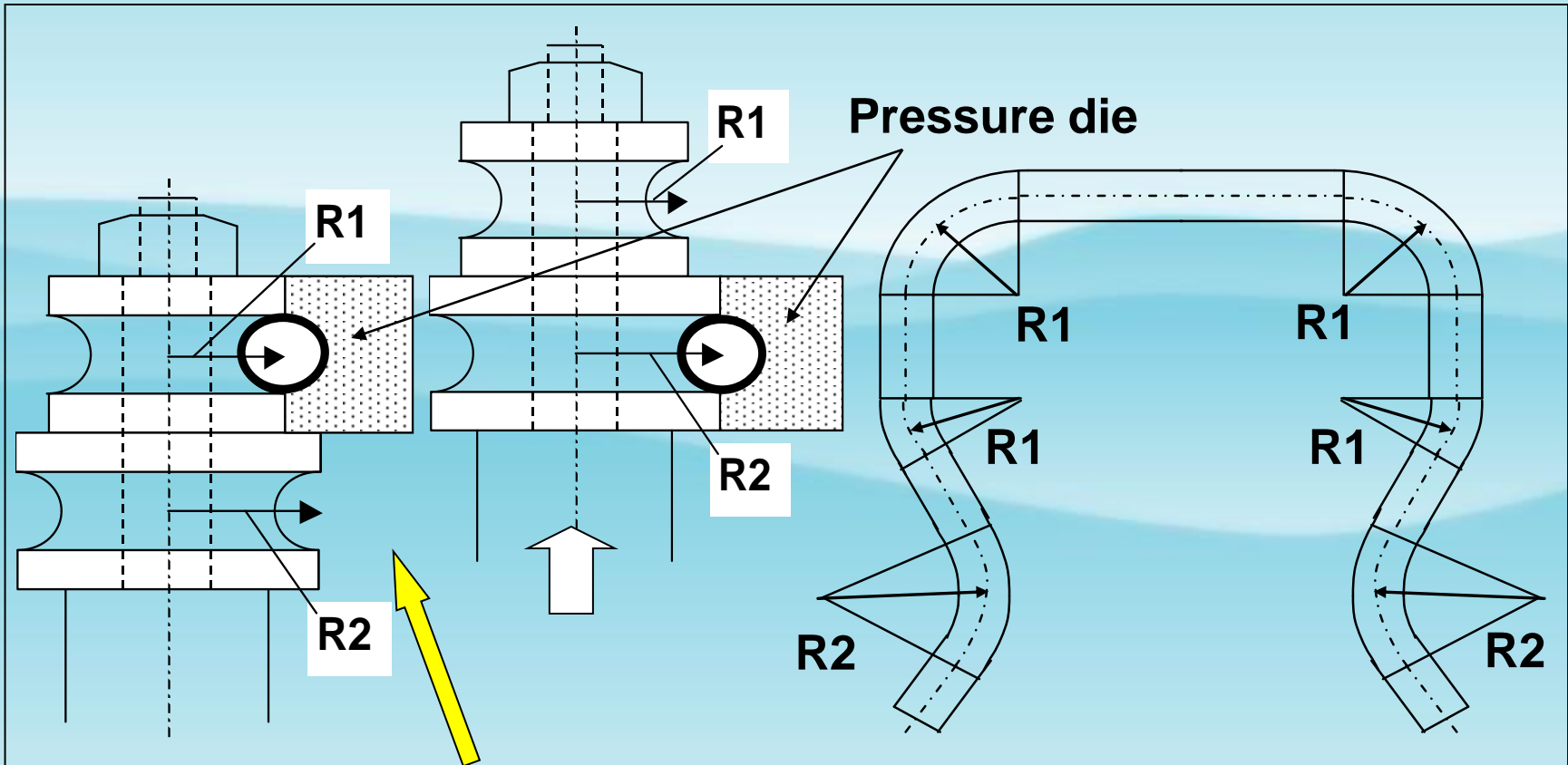
# Design of draw bending machine (2)

**Axial compressive force is effective to increase the thickness of the bend after the subsequent hydroforming.**



**Forward frictional force is effective to decrease the reduction of the peripheral length of the bend during the draw bending.**

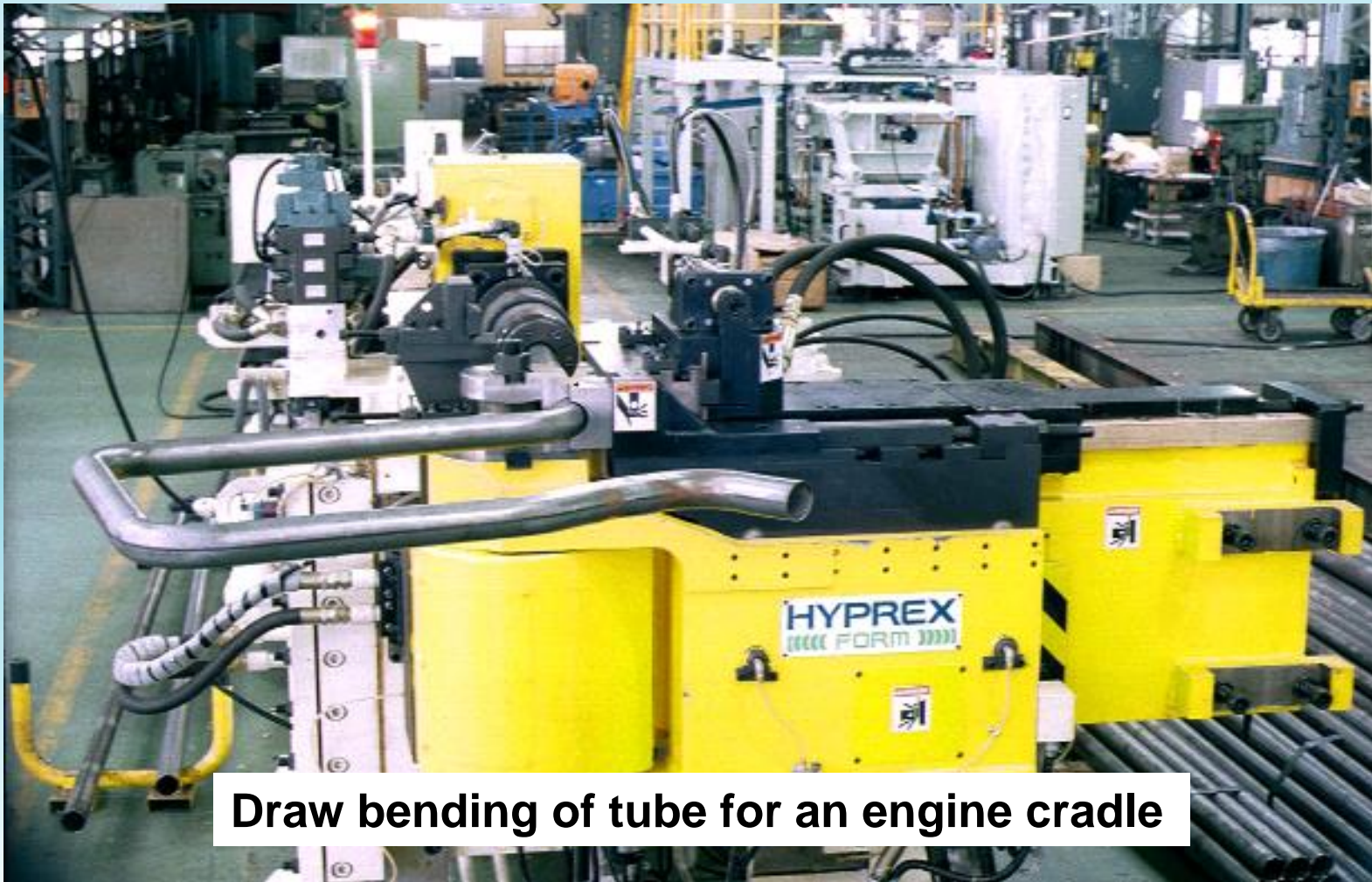
# Design of draw bending machine (3)



**Stacked bending forms for different radius bends progressively in one part (number of bending forms: 2~5)**



## An example of draw bending machine in the hydroforming process sequence

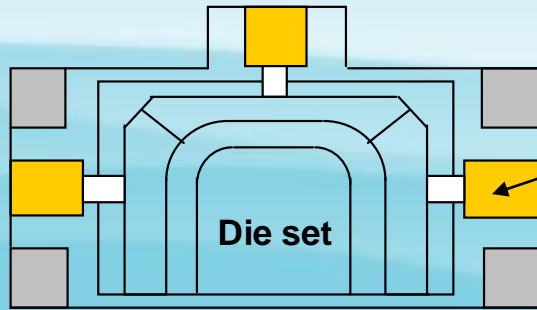


**Draw bending of tube for an engine cradle**

# Design of preforming press

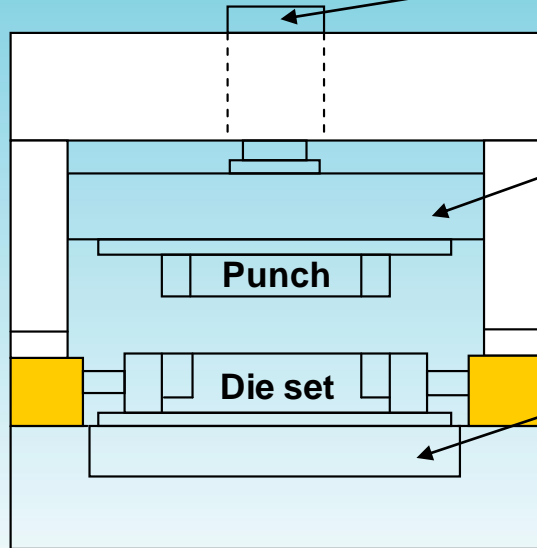
## Single-purpose press

(An example for an engine cradle)



Horizontal cylinders

Slide cylinder

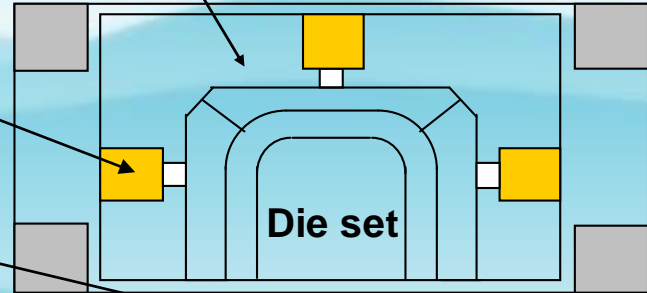


Slide

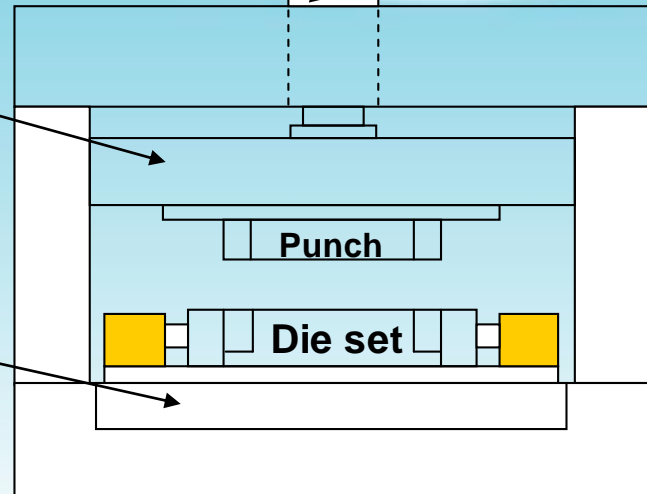
Moving bolster

## Multi-purpose press

Common plate



Die set

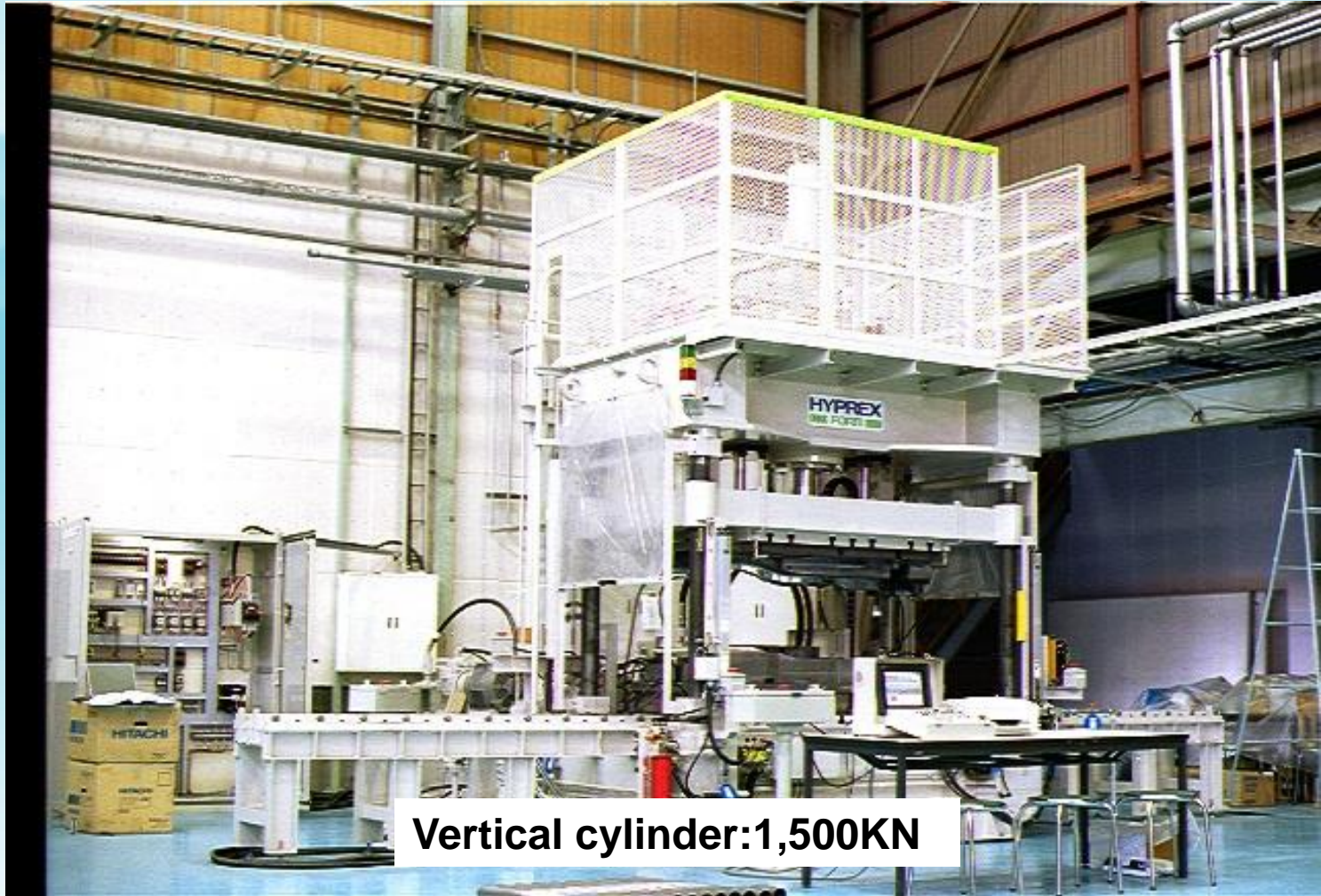


Punch

Die set



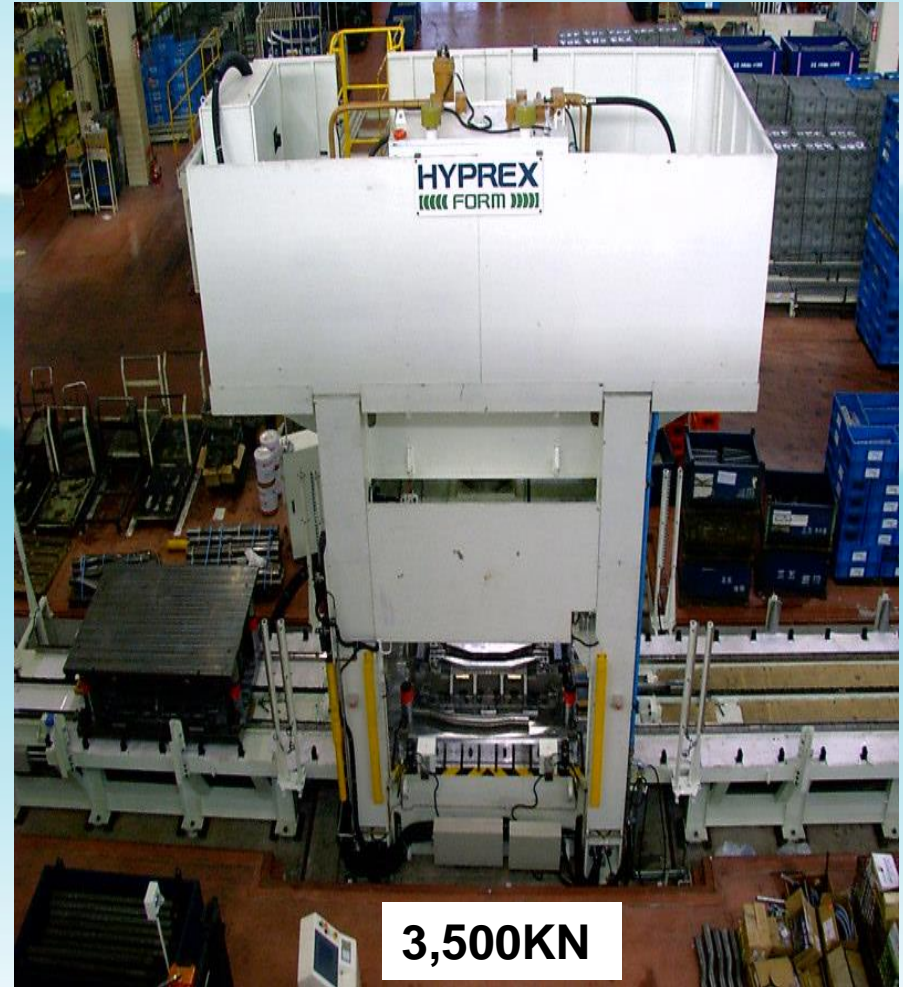
## An example of single-purpose preforming press



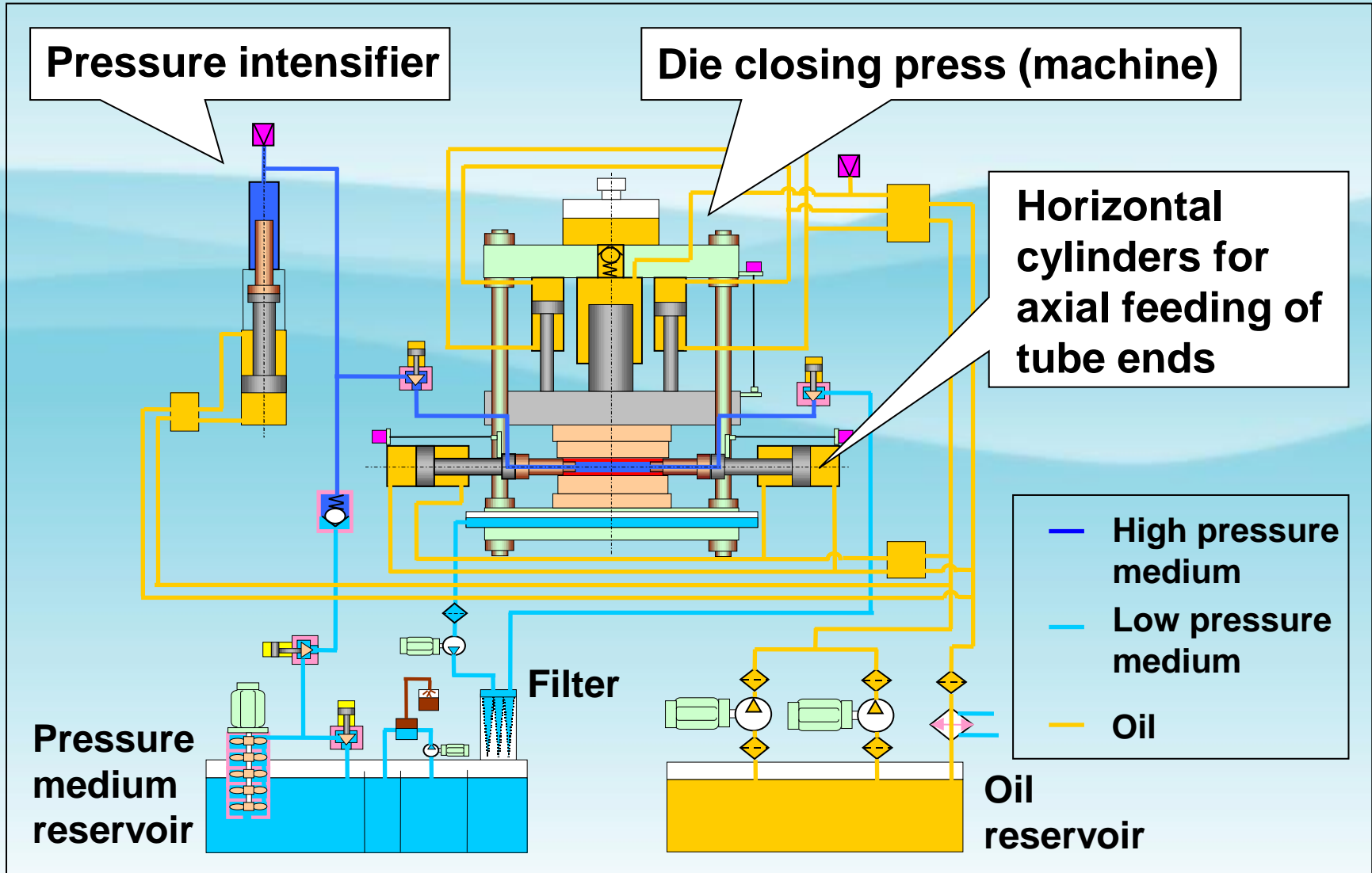
**Vertical cylinder:1,500KN**



## Examples of multi-purpose preforming press

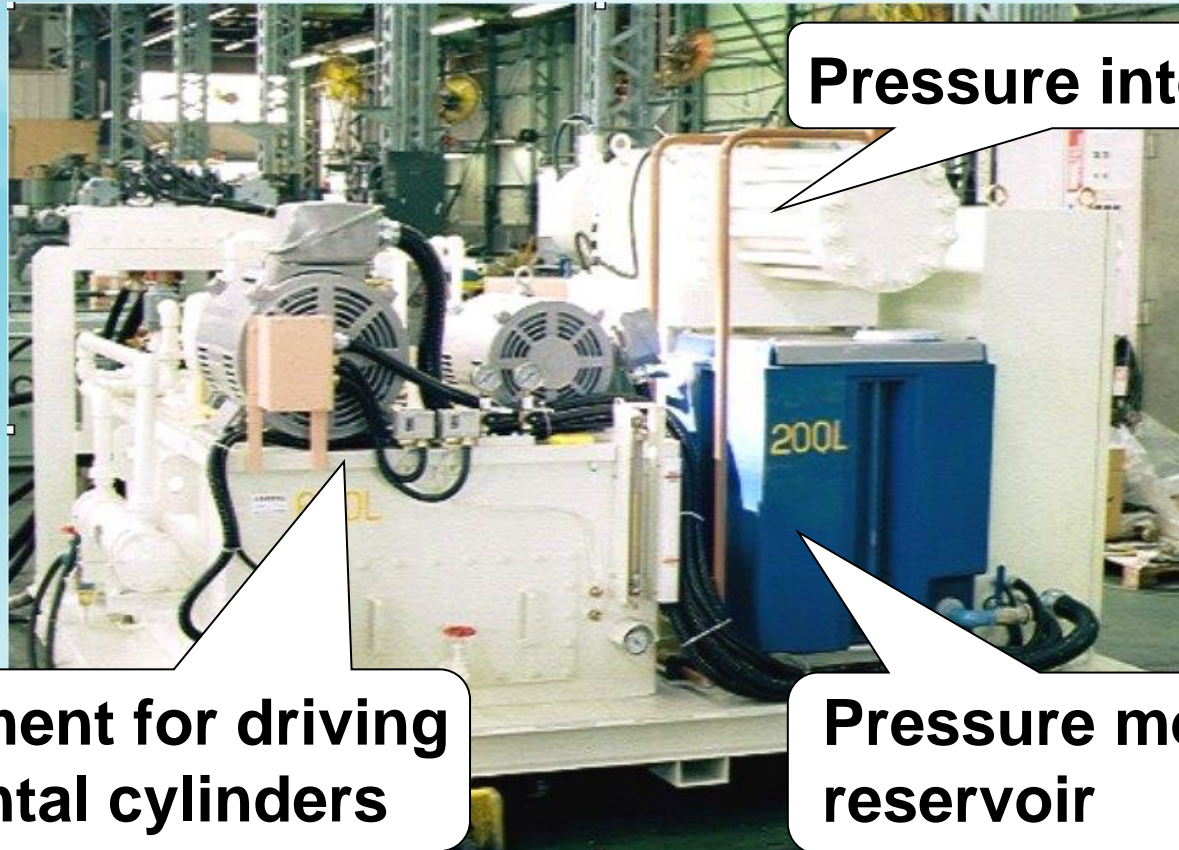


## Basic composition of hydroforming machine



## Retro-fit hydroforming press

Re-use of hydraulic press as a hydroforming press by adding the horizontal cylinders and pressure intensifier



Pressure intensifier

Equipment for driving horizontal cylinders

Pressure medium reservoir



# Concept of hydroforming machine

## 1. Machine type:

Single-purpose press (machine) or  
Multi-purpose press

## 2. Die closing system:

Hydraulic die closing or  
Mechanical die closing

## 3. Material handling:

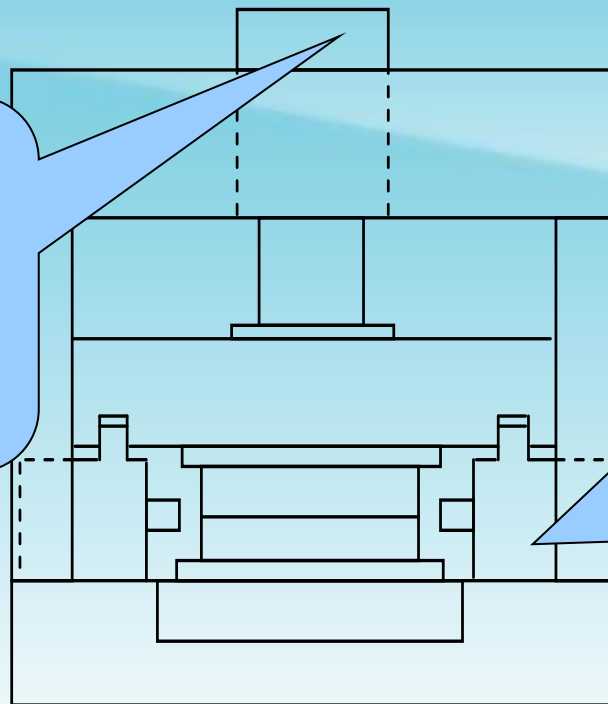
Loading & unloading in the press or  
outside the press



# Single-purpose hydroforming press

- Features:**
- (1) Fixed target product**
  - (2) Compact press size (Height & Area)**
  - (3) High productivity**

**Slide cylinder  
with a minimum  
force and stroke  
necessary to the  
die closing**



**Horizontal cylinder  
with a minimum  
force and stroke  
necessary to the  
axial feeding of the  
tube end**

## Examples of single-purpose hydroforming press

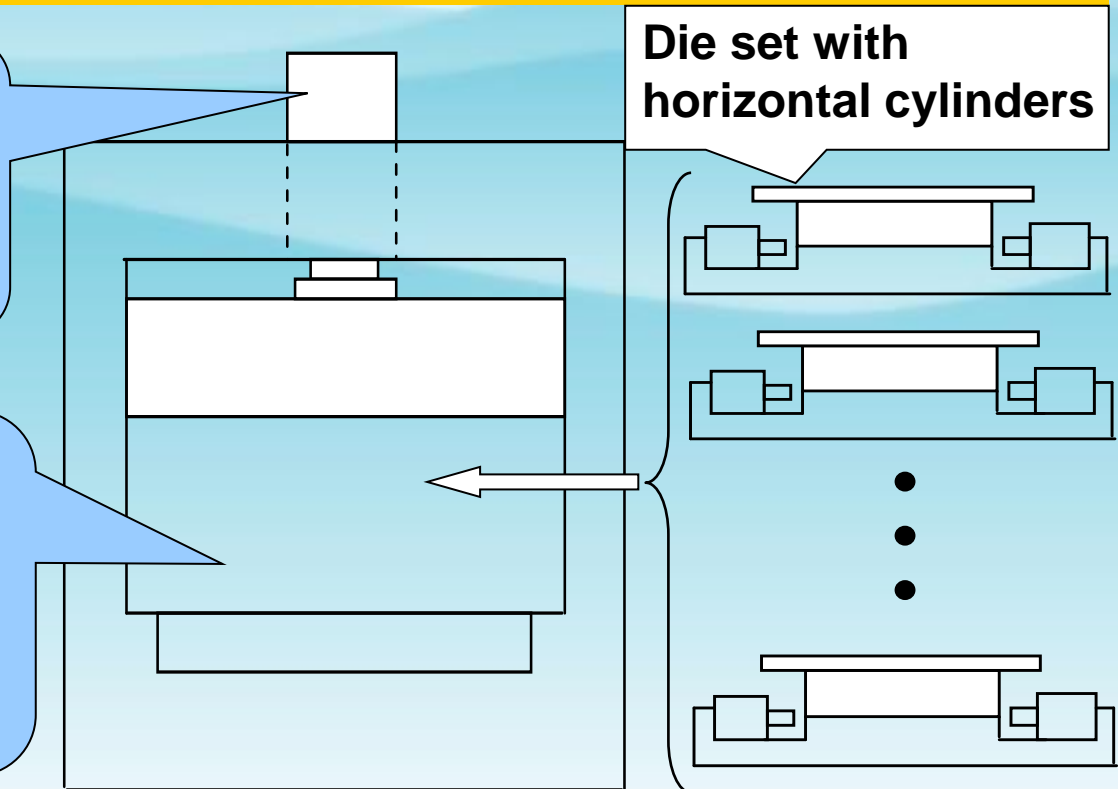


# Multi-purpose hydroforming press (1)

**Features: (1) Conventional hydraulic press  
(2) Horizontal cylinders for axial feeding of tube ends are installed in each die set.**

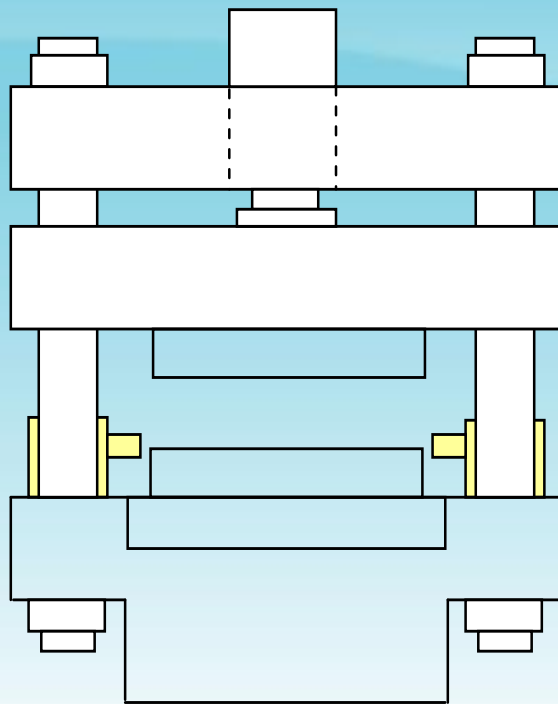
**Slide cylinder with force and stroke necessary to closing all die sets**

**Space with area and height necessary to setting the largest die set and handling the workpiece**

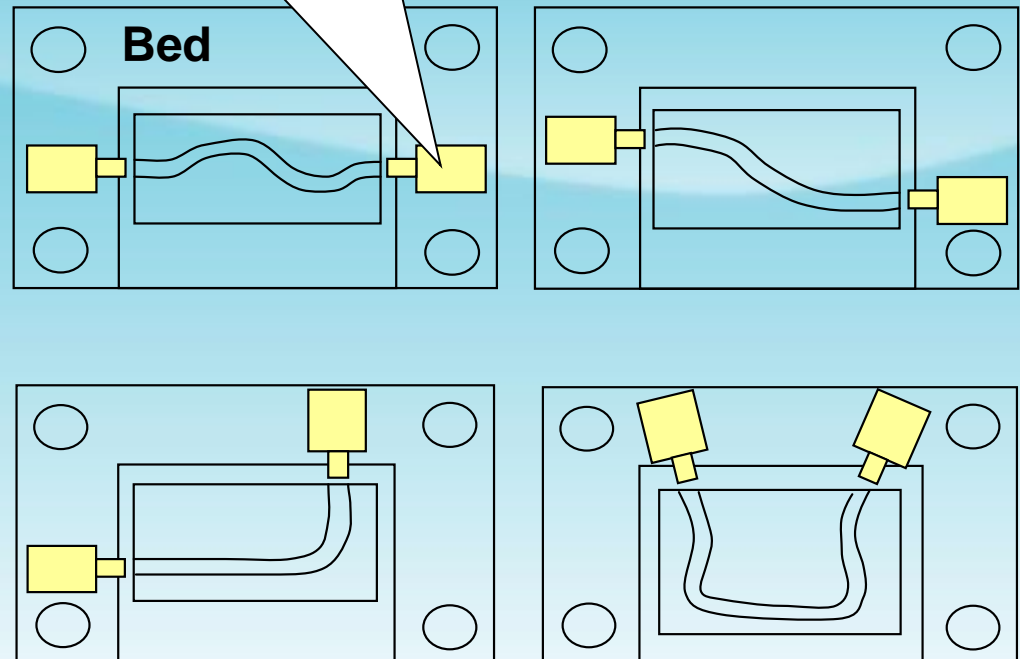


# Multi-purpose hydroforming press (2)

**Features: (1) Flexible positioning of horizontal cylinders on the bed**  
**(2) Horizontal cylinders are commonly used for several die sets.**



Horizontal cylinders





## Examples of multi-purpose hydroforming press(1)





## Examples of multi-purpose hydroforming press(2)



**Die closing force:50,000KN**

# Concept of hydroforming machine

## 1. Machine type:

Single-purpose press (machine) or  
Multi-purpose press

## 2. Die closing system:

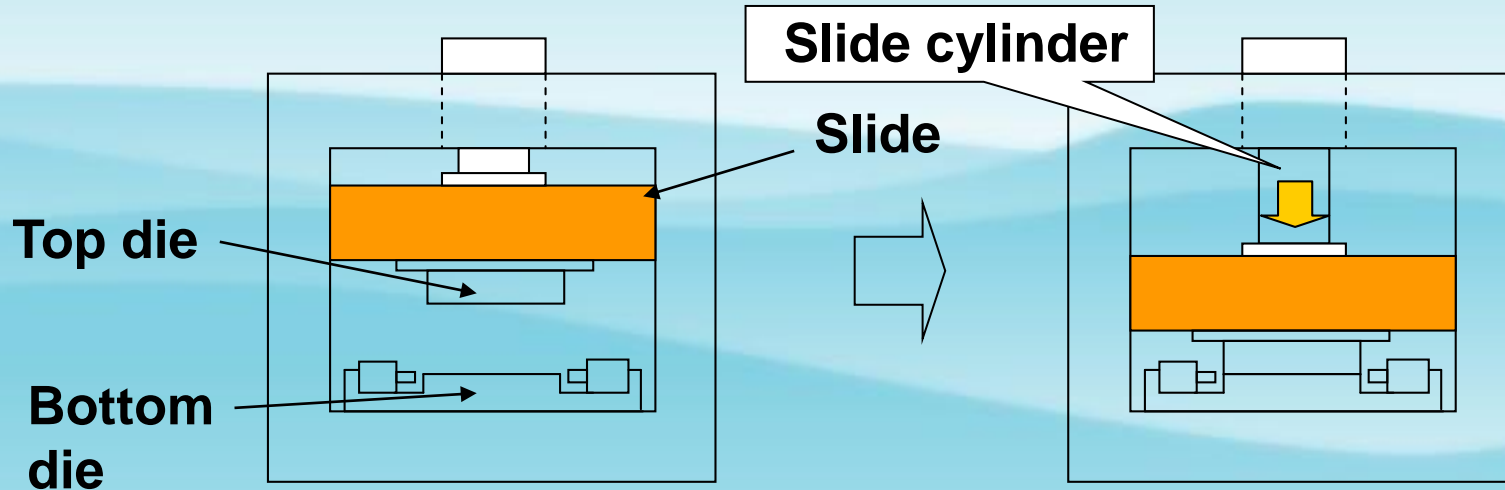
Hydraulic die closing or  
Mechanical die closing

## 3. Material handling:

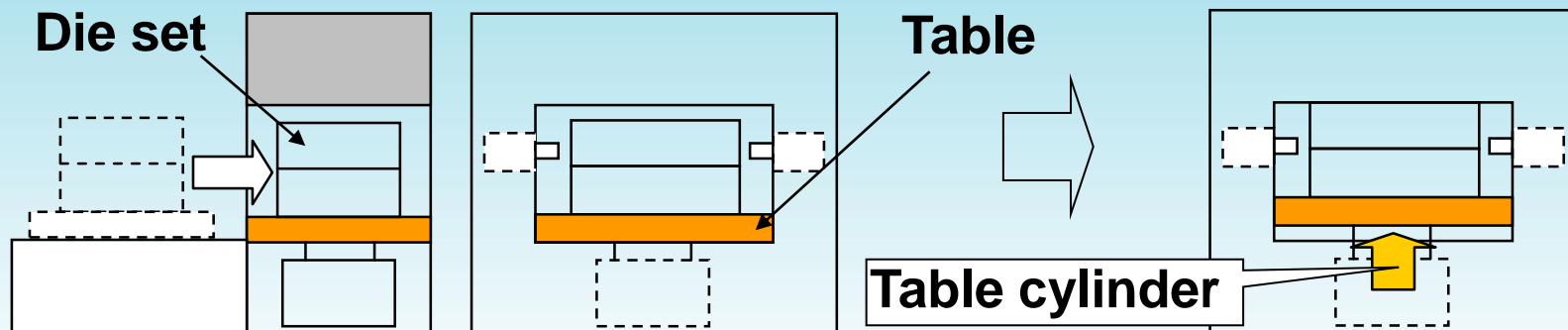
Loading & unloading in the press or  
outside the press

# Hydraulic die closing

## (1) Die closing by slide cylinder

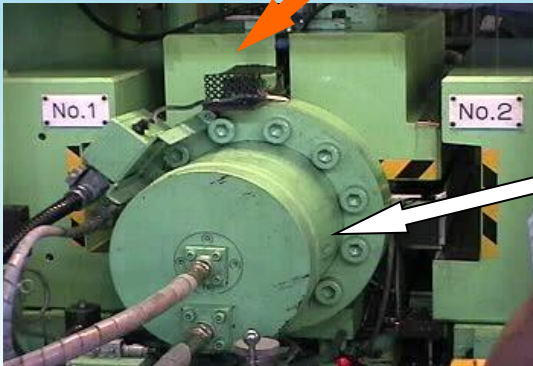
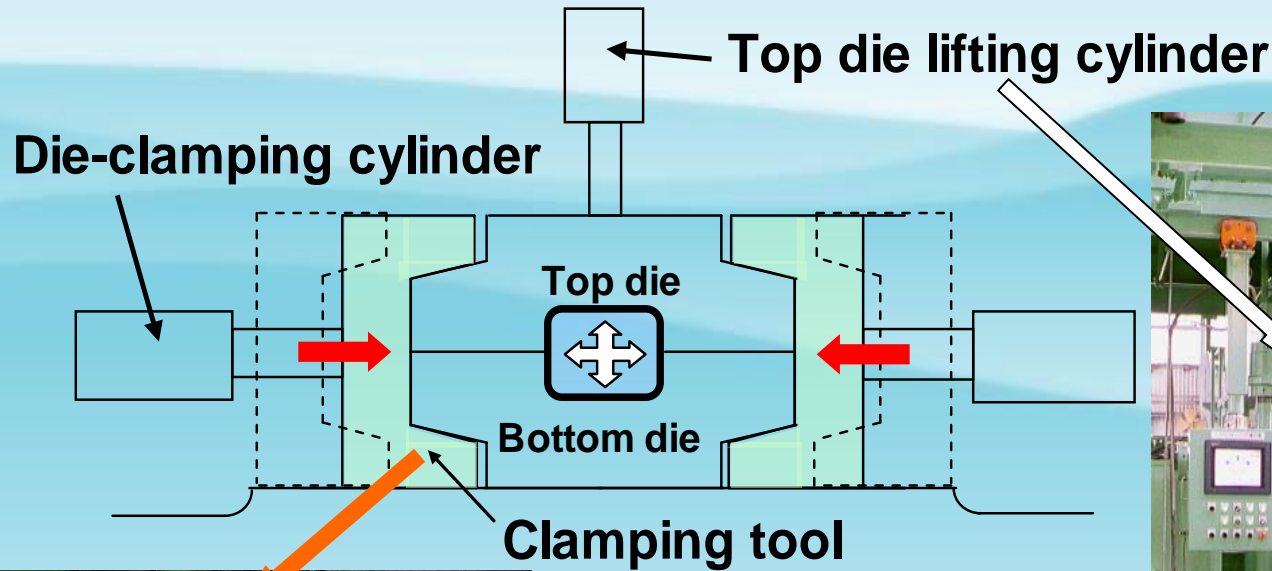


## (2) Die closing by table lifting cylinder

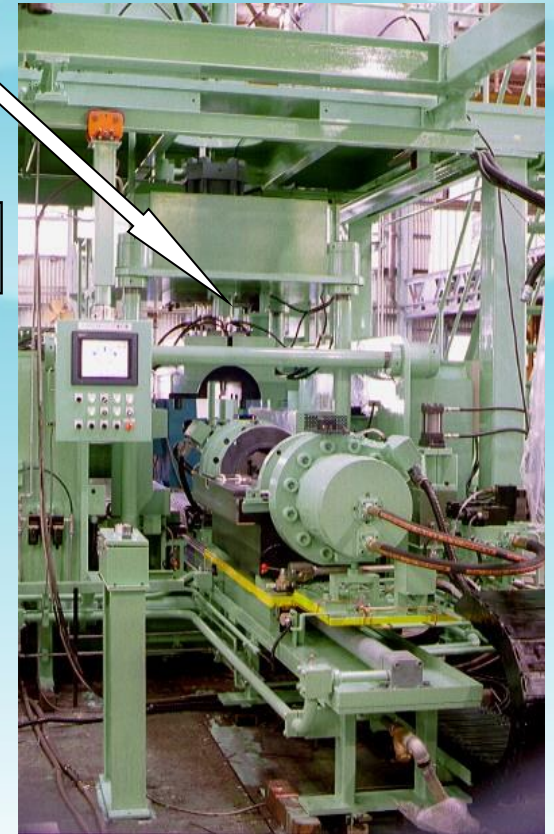


## Mechanical die closing (1)

### Transverse clamping of top and bottom dies



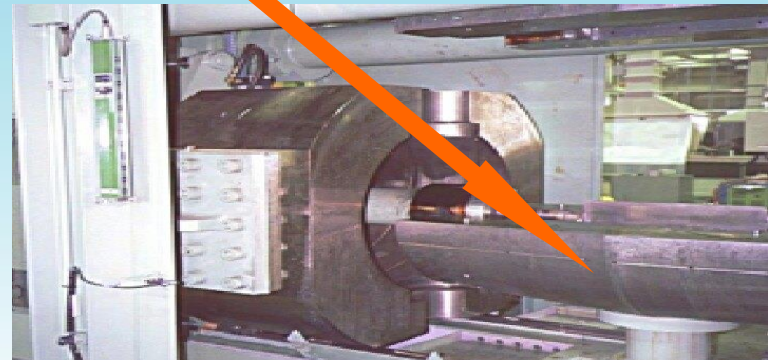
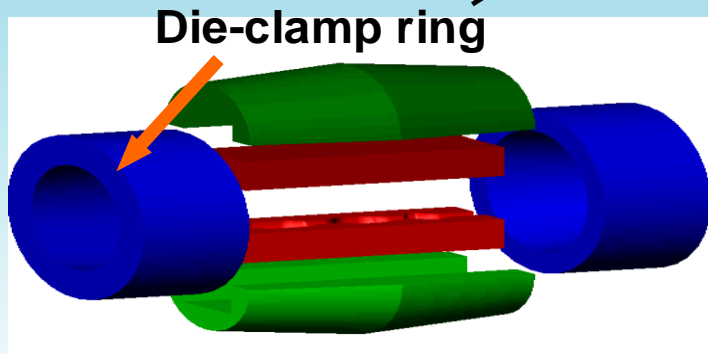
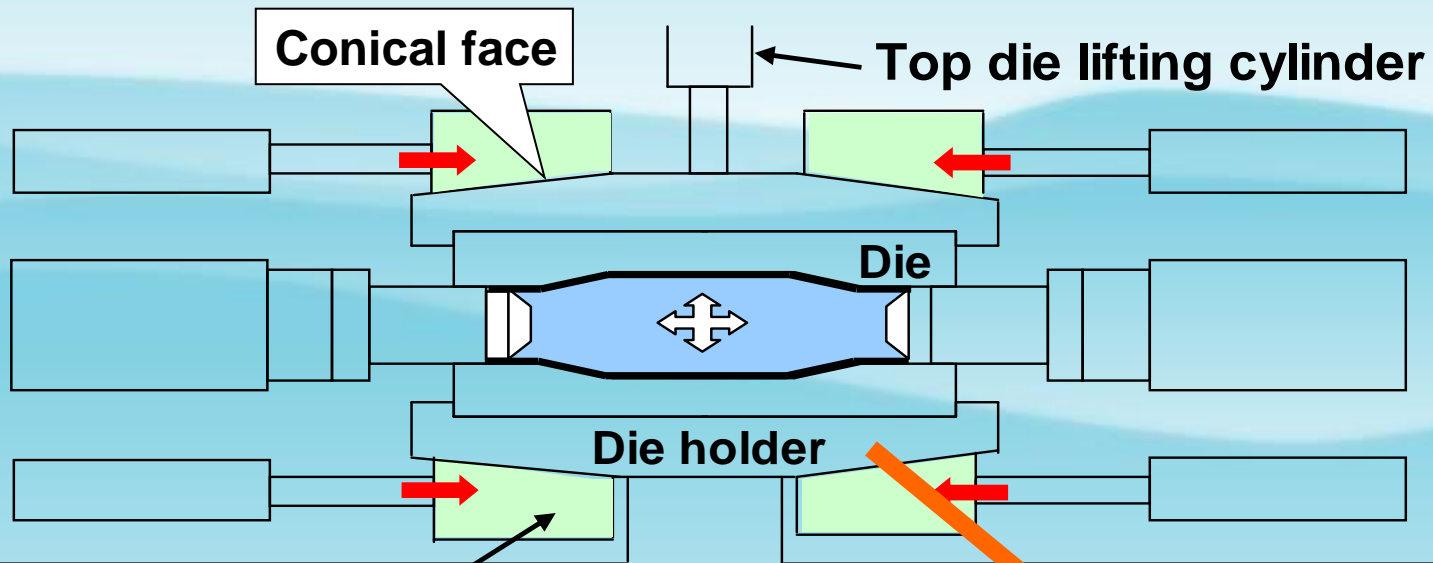
Cylinders for axial feeding of tube ends





# Mechanical die closing (2)

## Longitudinal clamping of top and bottom dies





# Concept of hydroforming machine

## 1. Machine type:

Single-purpose press (machine) or  
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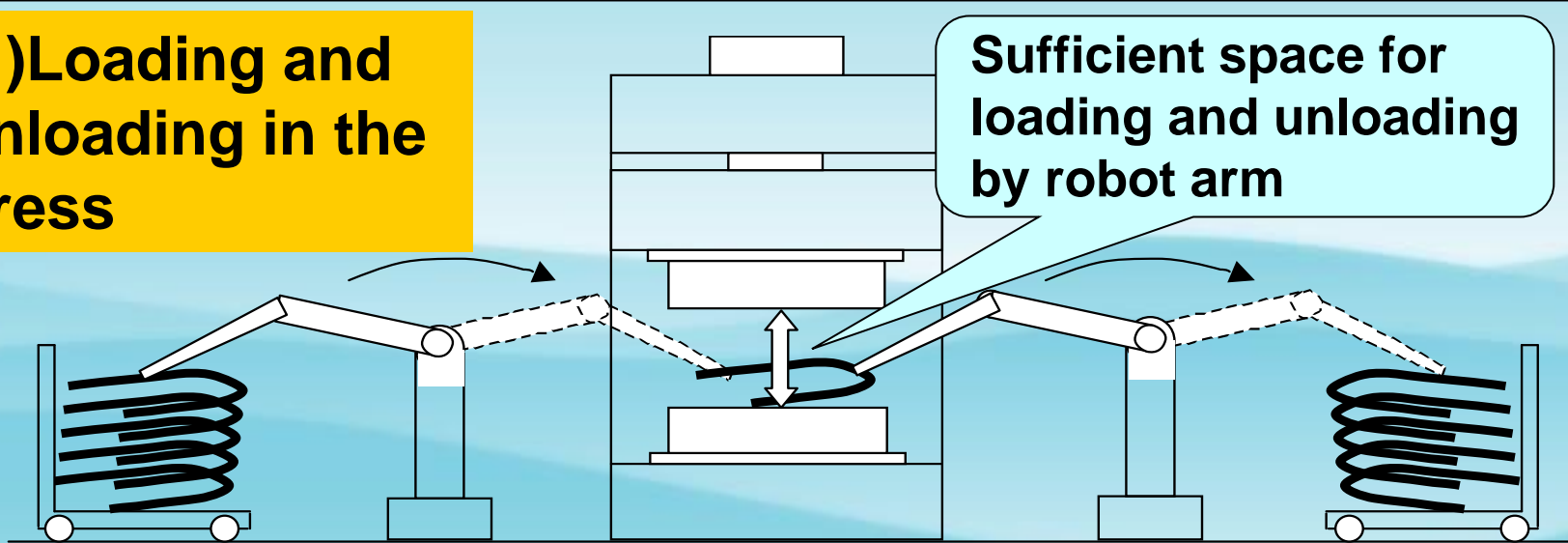
Hydraulic die closing or  
Mechanical die closing

## 3. Material handling:

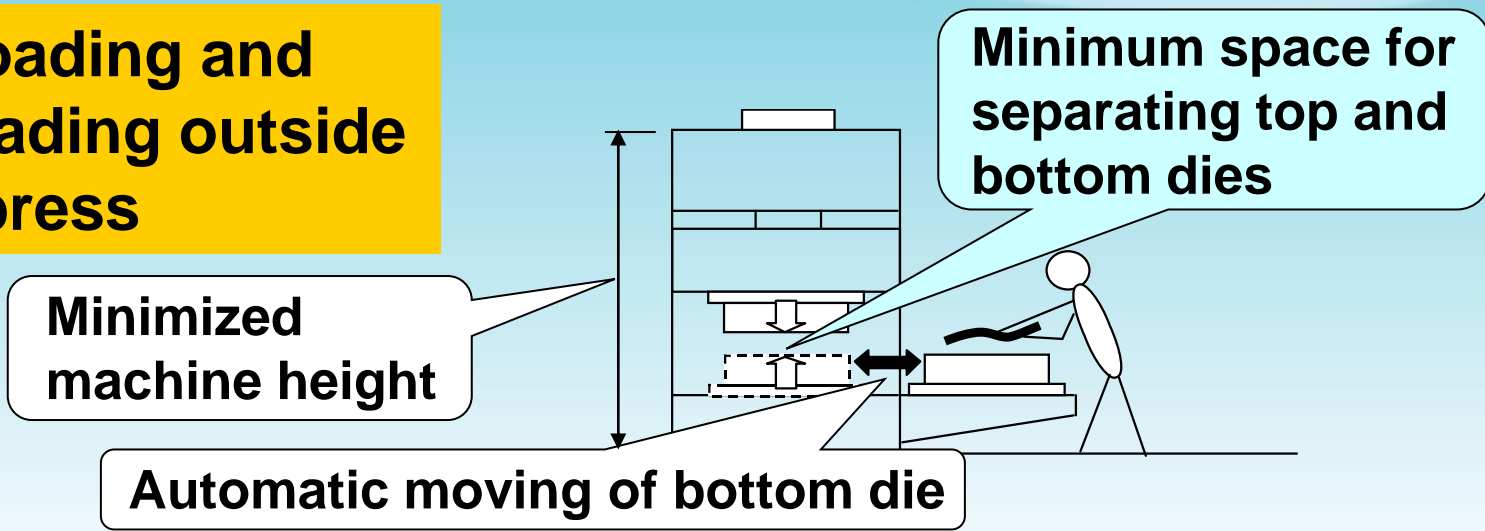
Loading & unloading in the press or  
outside the press

## Material handling

**(1) Loading and unloading in the press**



**(2) Loading and unloading outside the press**



# Specifications of hydroforming press

## Die closing force

Standard classification

## Axial feeding of tube ends

Axial feeding force  
Double acting horizontal cylinder

## Pressure intensifier

Maximum pressure, Pressure control

## Productivity

Parallel forming, Shuttle die

## Quick die change system

Moving bolster etc.

# Standard classification of die closing force

**A: Vertically projected area of die cavity**

**Die closing force**  
 $F \geq P_{max} \times A$

**F**

Top die

Bottom die

$P_{max}$

Class of die closing force	Automotive parts in mass production (Japan)
<b>~10,000KN</b>	Exhaust parts Steering parts etc.
<b>15,000KN</b>	Sub-frames Cross members etc.
<b>25,000KN</b>	Perimeter frames Cross members etc.
<b>35,000KN</b>	Suspension members Engine cradles Cross members etc.
<b>50,000KN</b>	Cross members etc.

# Specifications of hydroforming press

## Die closing force

Standard classification

## Axial feeding of tube ends

Axial feeding force  
Double acting horizontal cylinder etc.

## Pressure intensifier

Maximum pressure, Pressure control

## Productivity

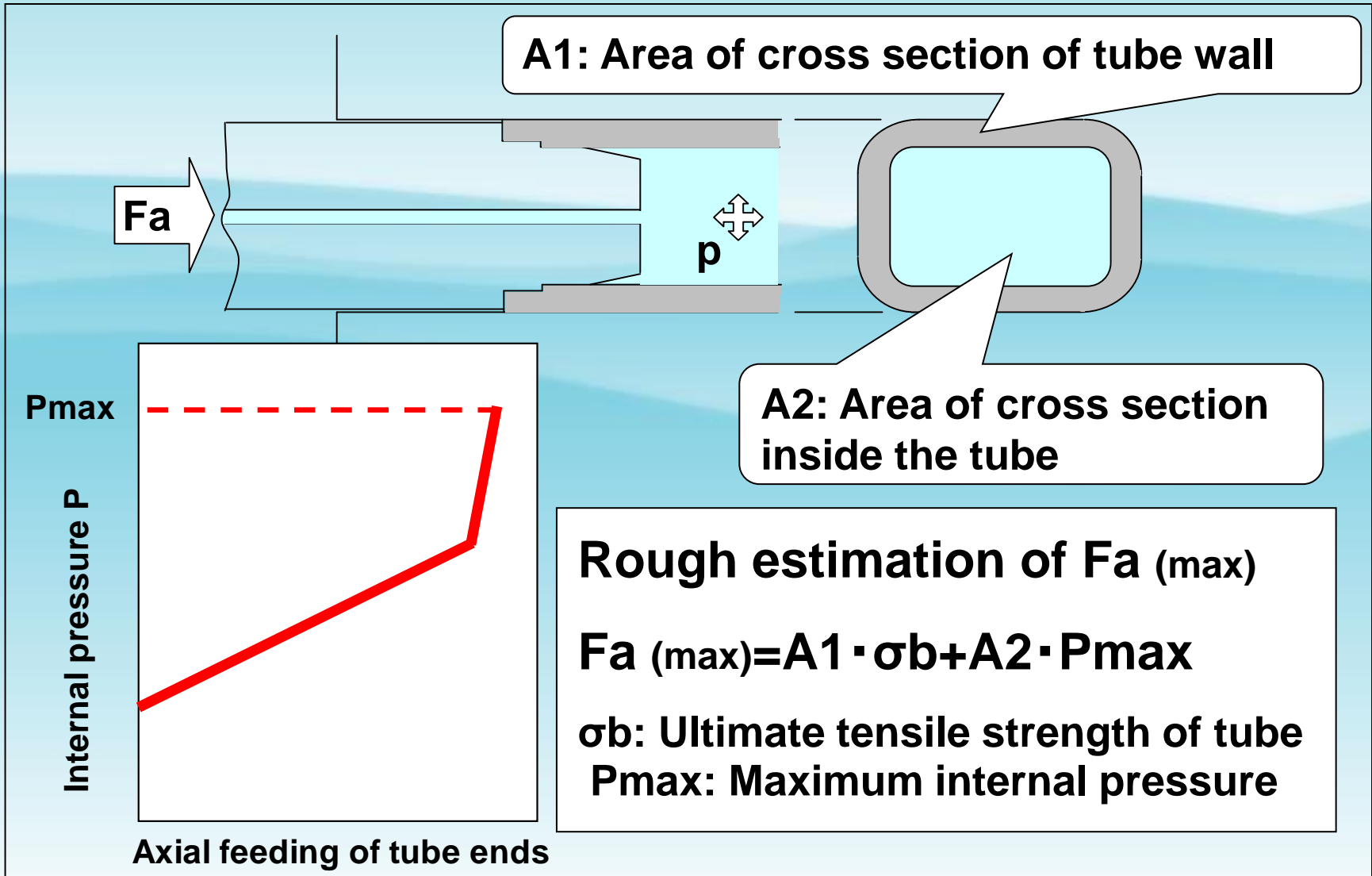
Parallel forming, Shuttle die

## Quick die change system

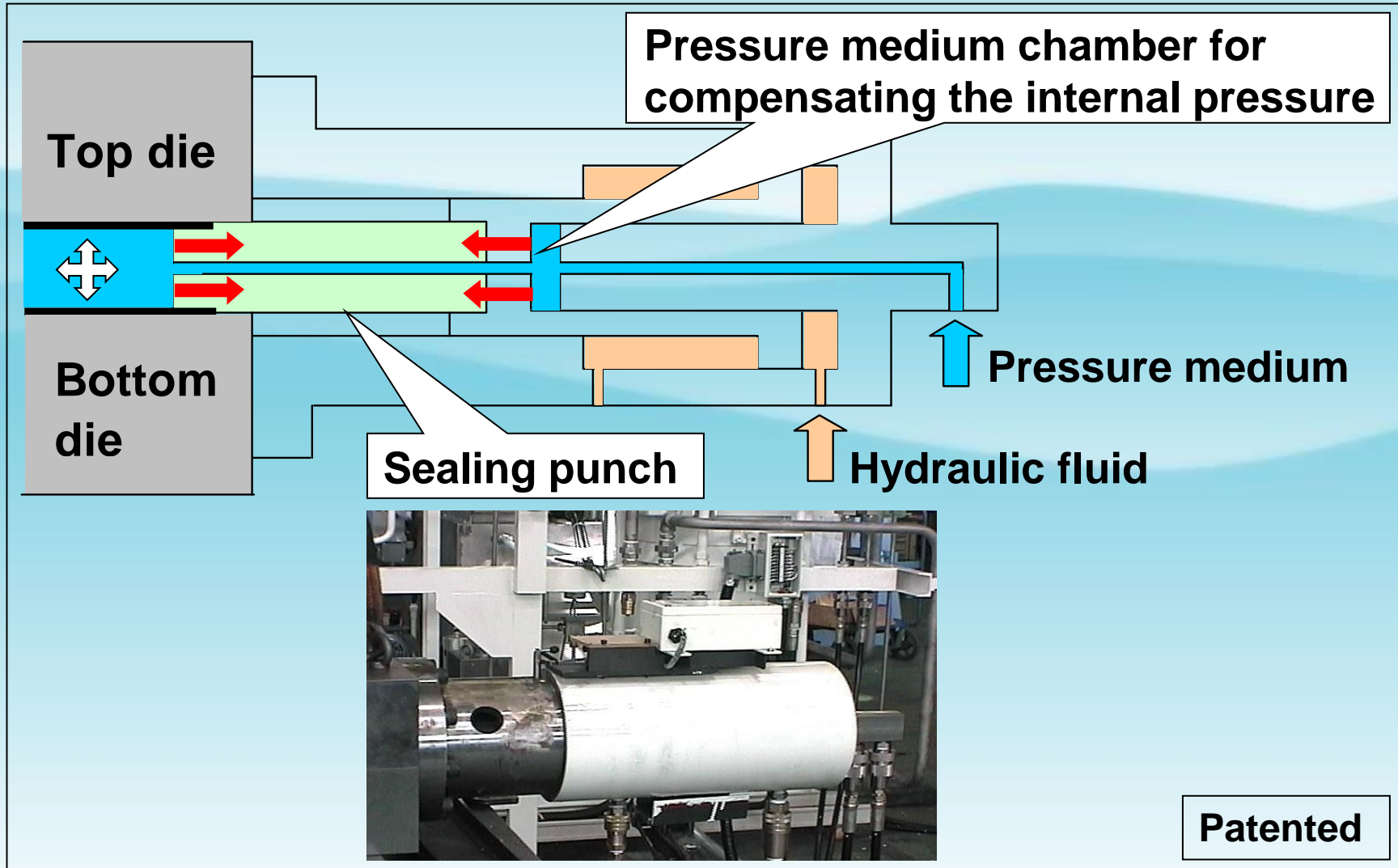
Moving bolster etc.



# Axial feeding force of tube end

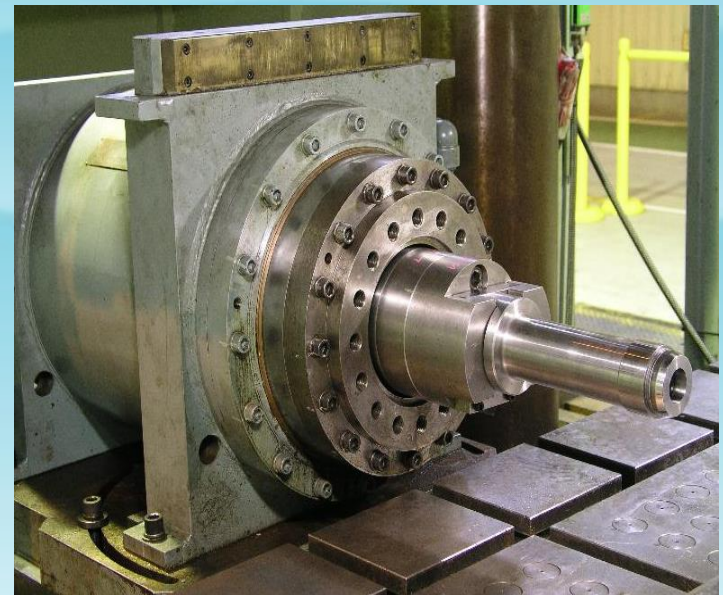
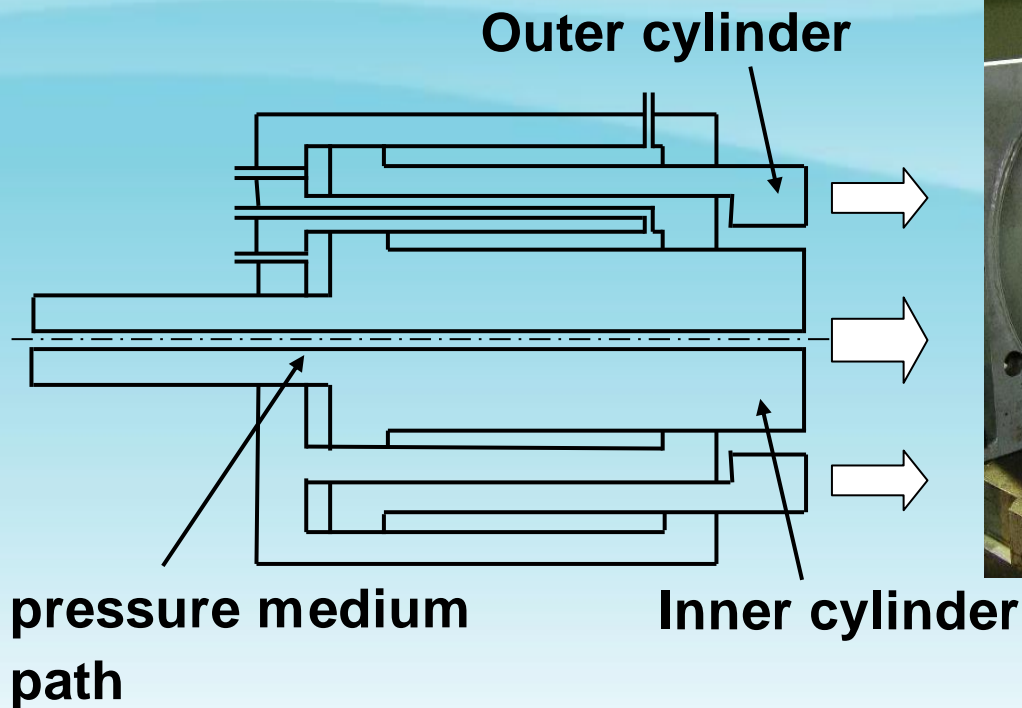


# Energy-saving horizontal cylinder



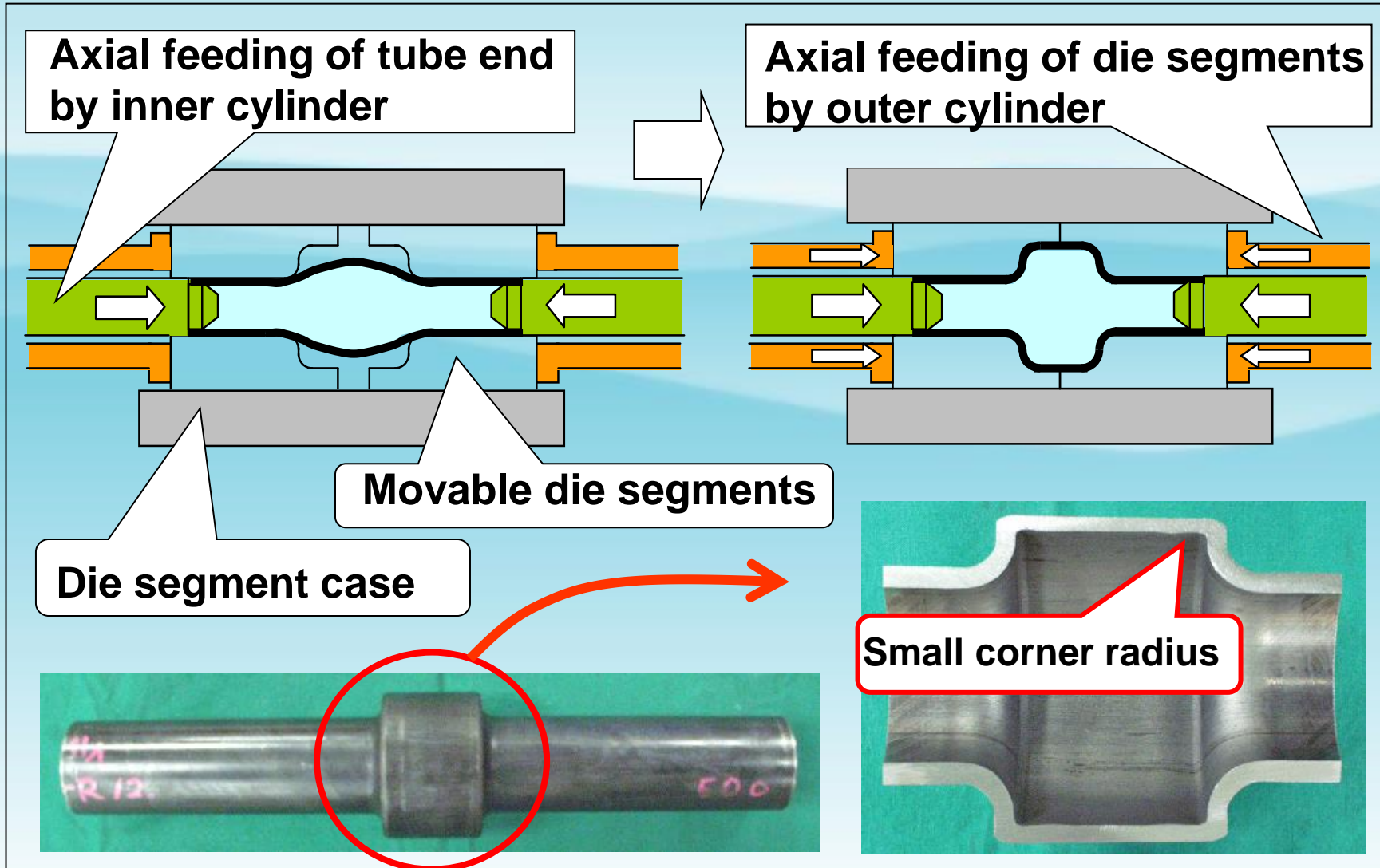
# Double-acting horizontal cylinder

**Features: (1) Co-axial inner and outer cylinders  
(2) Independent feed control**

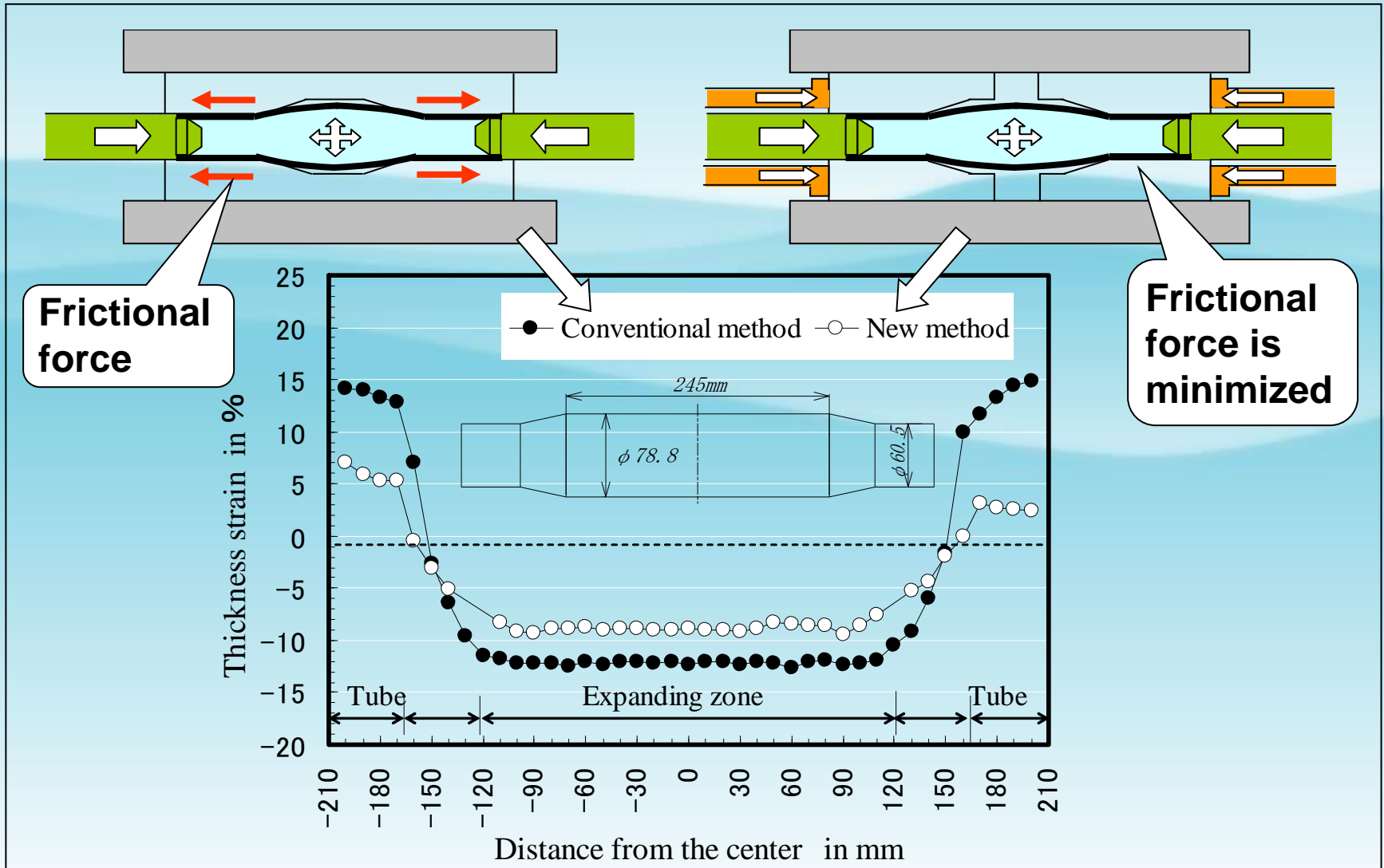


**Patented**

## Functions of double-acting horizontal cylinder (1)



# Functions of double-acting horizontal cylinder (2)



**Frictional force**

**Frictional force is minimized**

# Specifications of hydroforming press

## Die closing force

Standard classification

## Axial feeding of tube ends

Axial feeding force  
Double acting horizontal cylinder

## Pressure intensifier

Maximum pressure, Pressure control

## Productivity

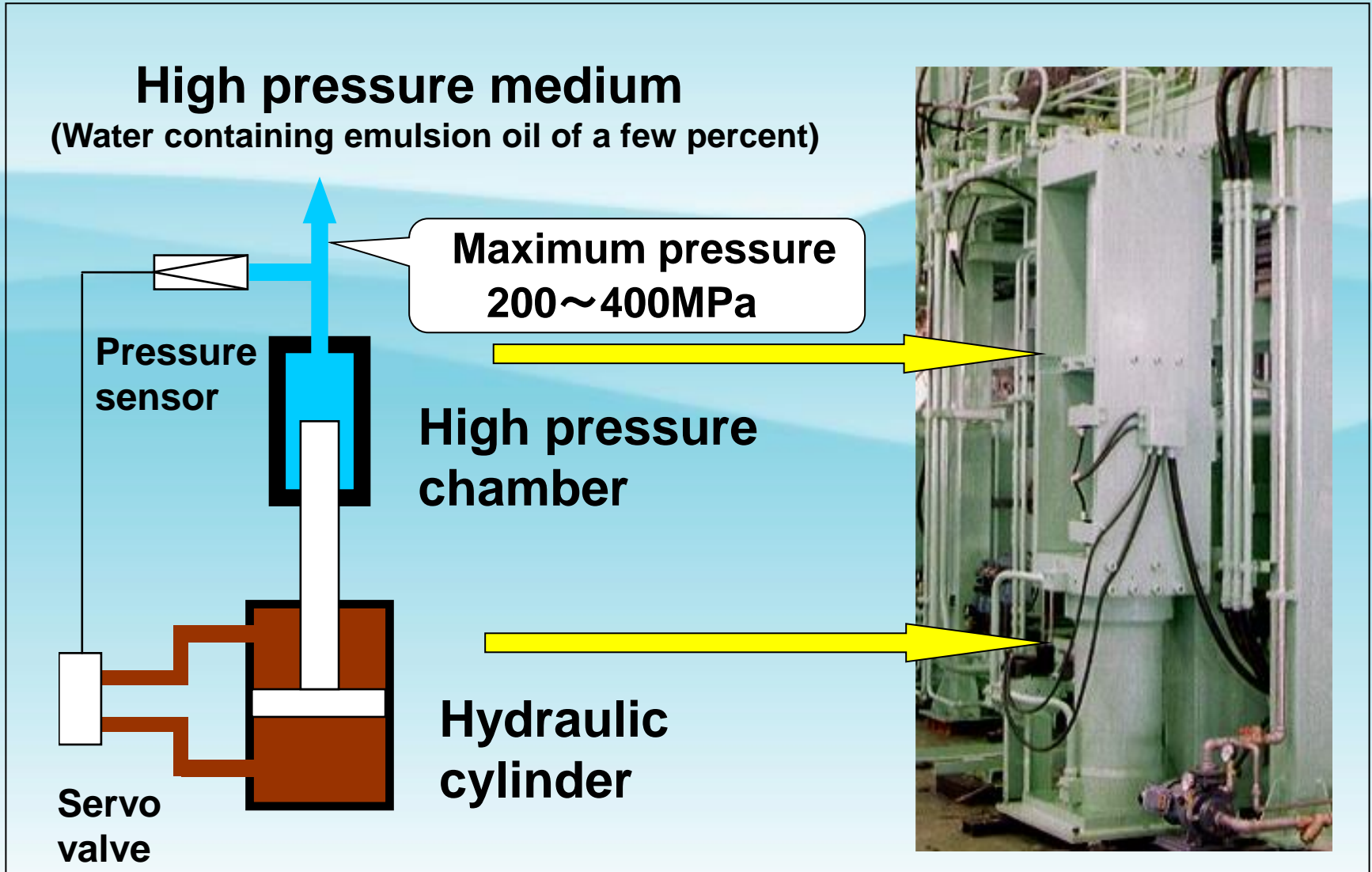
Parallel forming, Shuttle die

## Quick die change system

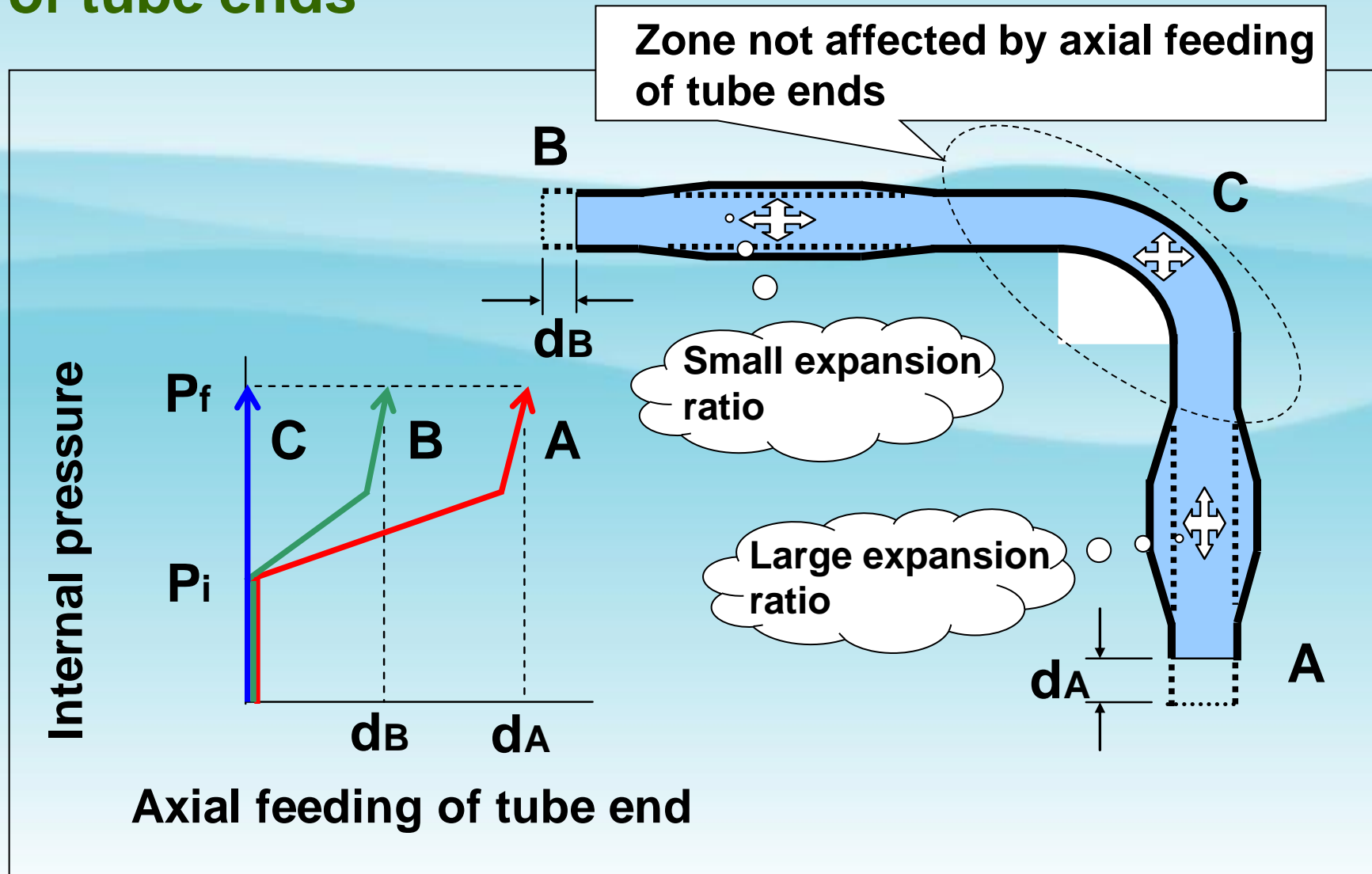
Moving bolster etc.



# Pressure intensifier



# Control of internal pressure with axial feeding of tube ends



# Specifications of hydroforming press

## Die closing force

Standard classification

## Axial feeding of tube ends

Axial feeding force  
Double acting horizontal cylinder

## Pressure intensifier

Maximum pressure, Pressure control

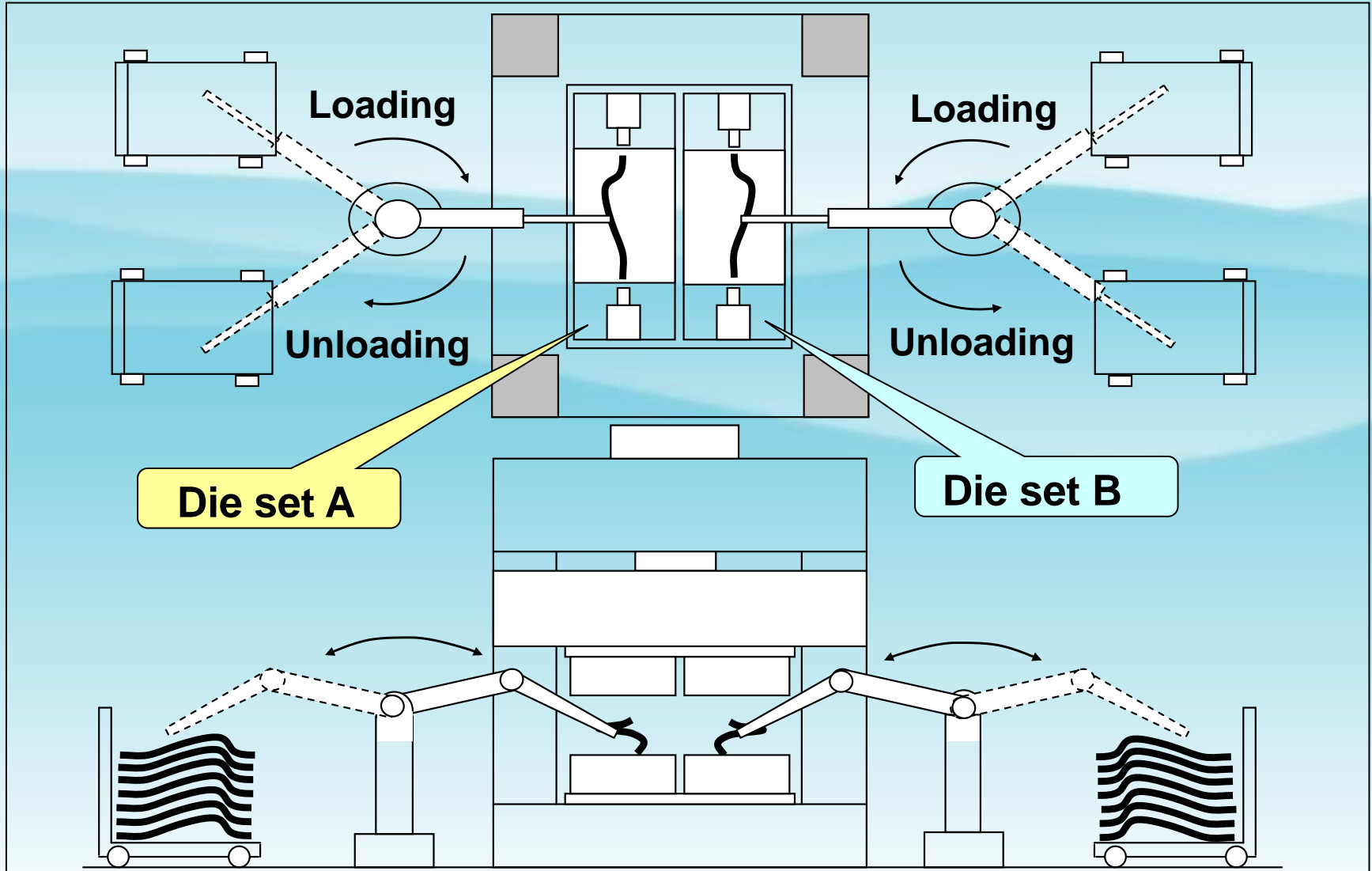
## Productivity

Parallel forming, Shuttle die

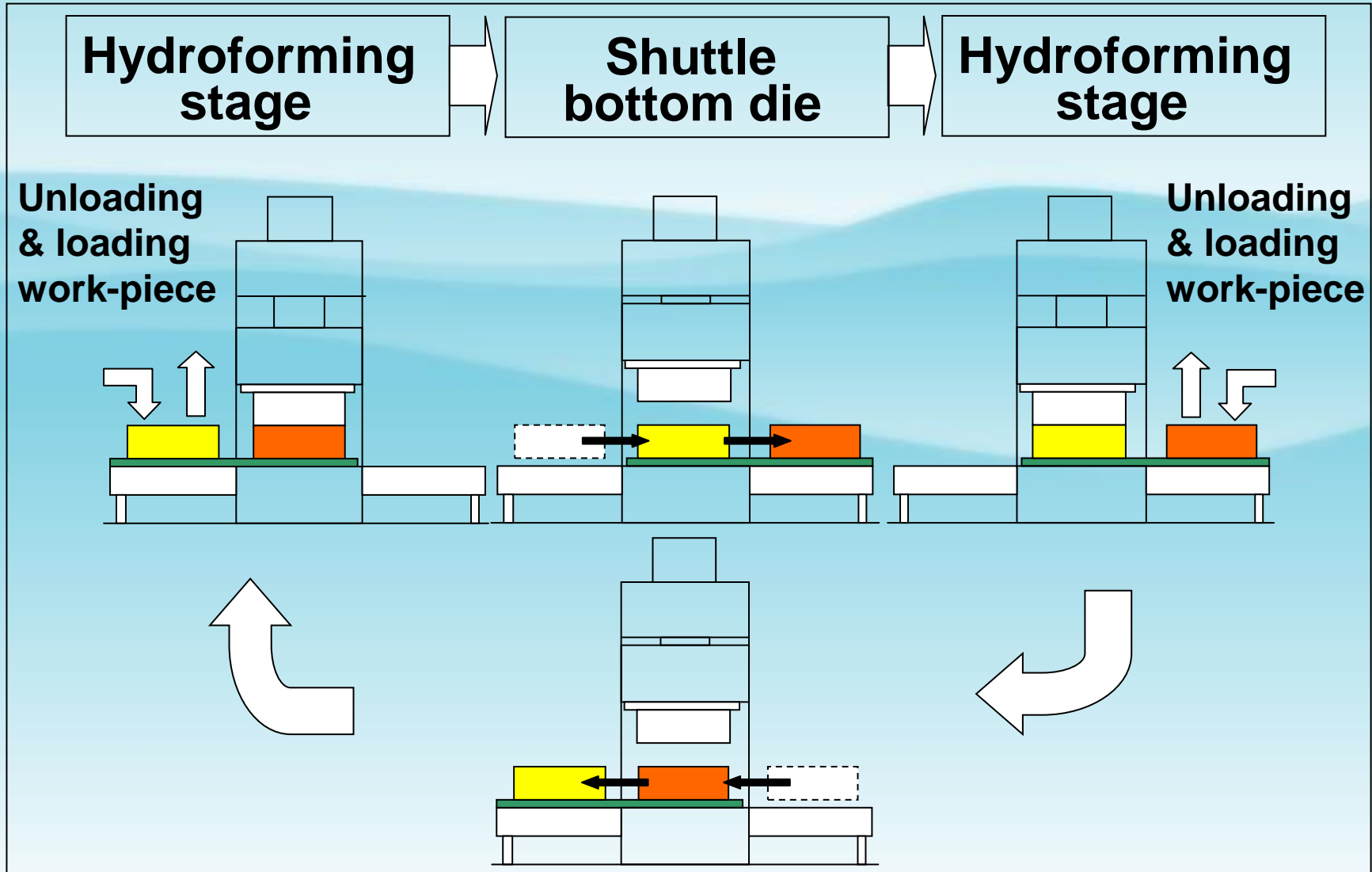
## Quick die change system

Moving bolster etc.

# Improvement of productivity by parallel forming



# Cycle-time reduction by shuttle die system



# Specifications of hydroforming press

## Die closing force

Standard classification

## Axial feeding of tube ends

Axial feeding force  
Double acting horizontal cylinder

## Pressure intensifier

Maximum pressure, Pressure control

## Productivity

Parallel forming, Shuttle die

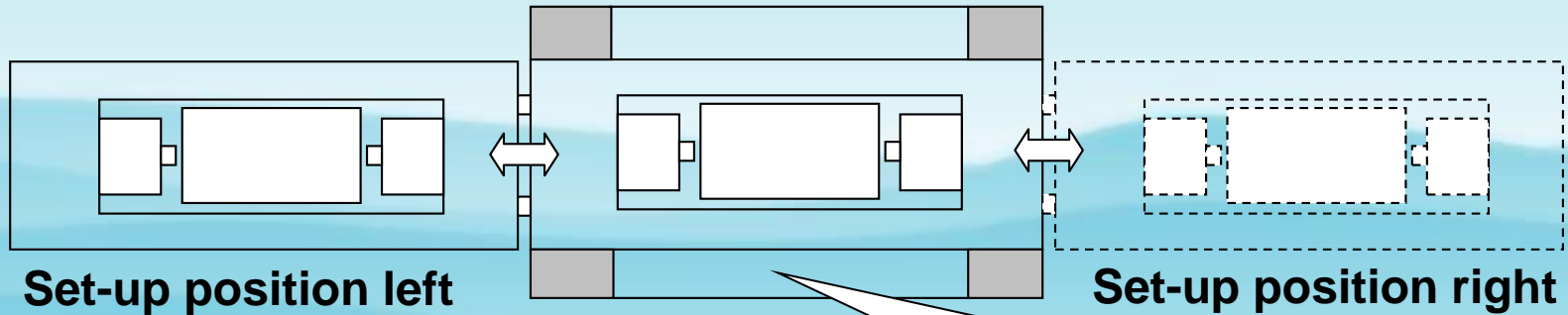
## Quick die change system

Moving bolster etc.



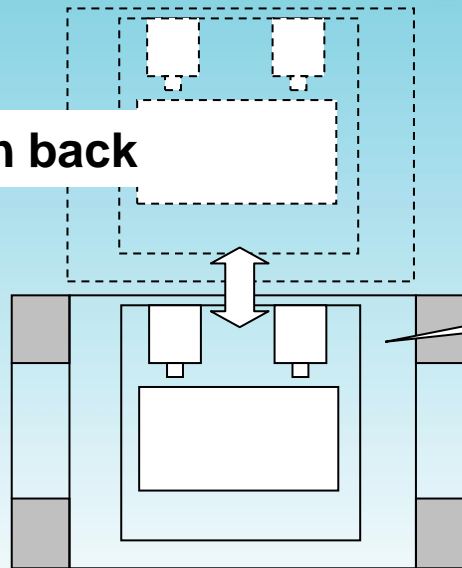
# Quick die change system (1)

## Moving bolster



Traversing direction left-right

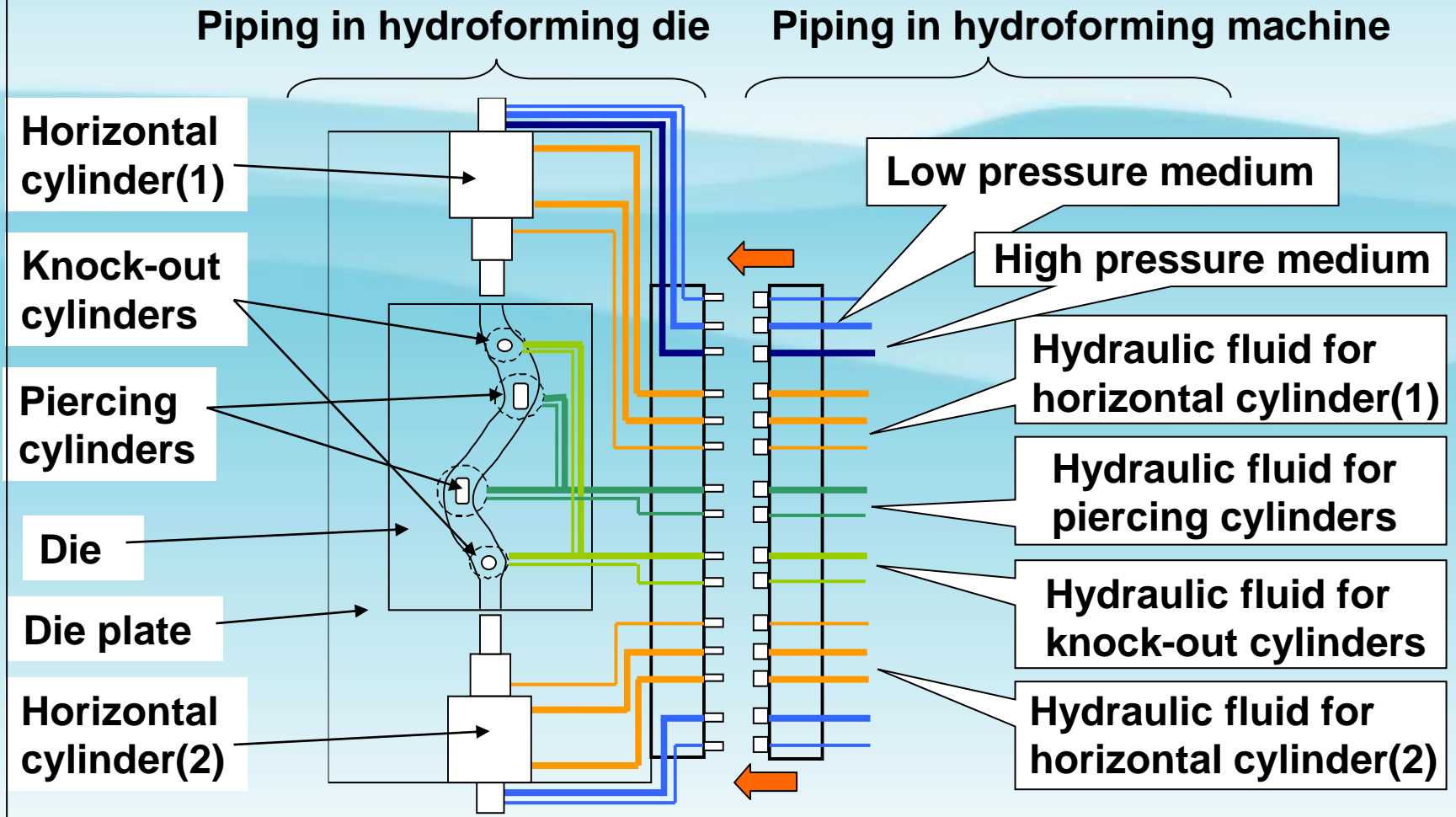
Set-up position back



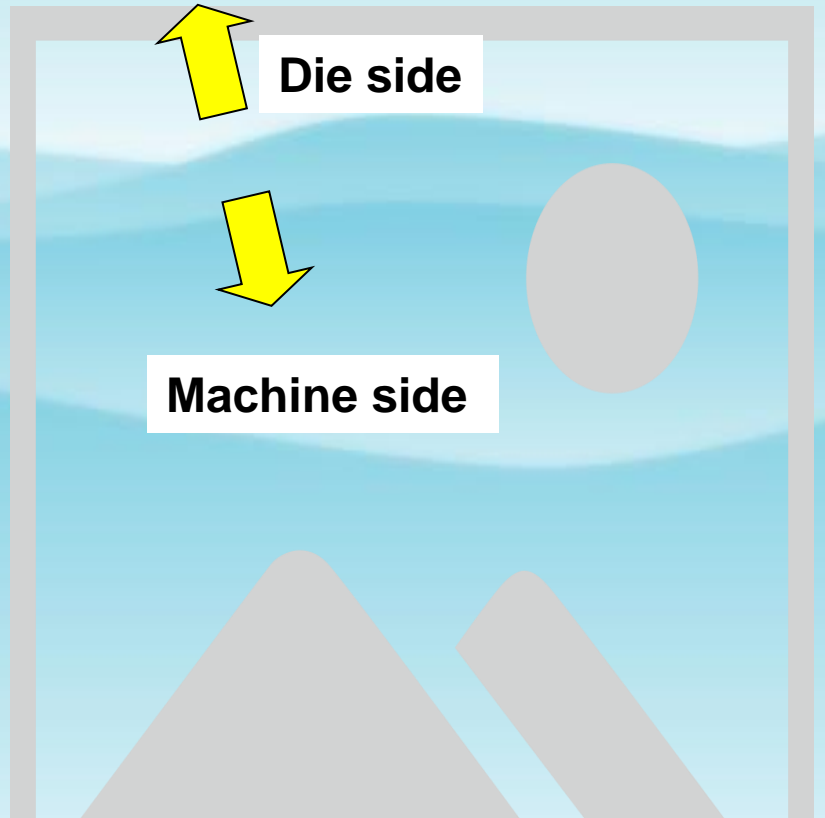
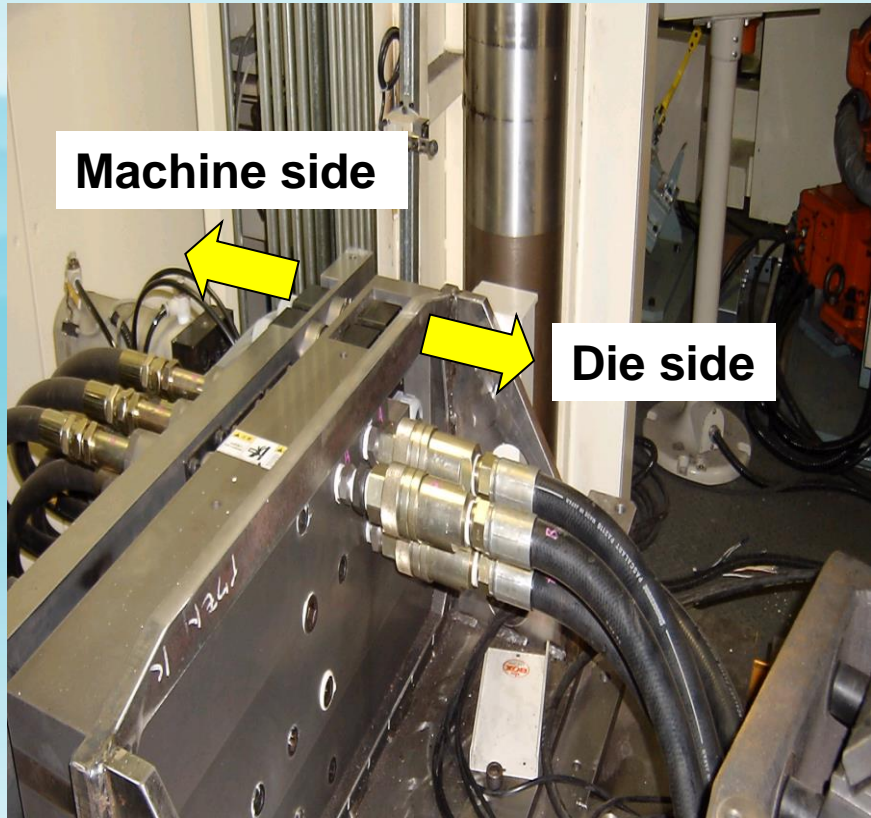
Traversing direction front-back

# Quick die change system (2)

## Automatic coupling device



# Examples of automatic coupling device



***The End***