# new

PATENT PENDING

## Cylinders with controlled return

SPECIAL SPRINGS

# ADVANTAGES OF THE SPECIAL SPRINGS SYSTEM

- *Return stroke of the cylinder rods independent from press cycle.*
- *Return speed of cylinder rods independent from press speed.*
- *Return speed of cylinder rods constant and adjustable.*
- *Cylinder contrasting force: constant, increasing or decreasing from beginning to end of working cycle.*
- *Partial use of cylinder stroke possible at any time without system modifications.*
- *Quick and continuous dispersal of the heat produced during the cylinder working cycle, thanks to the presence of heat exchanger on the command unit.*
- *Maximum system reliability guaranteed by the constant renewal of the hydraulic fluid.*

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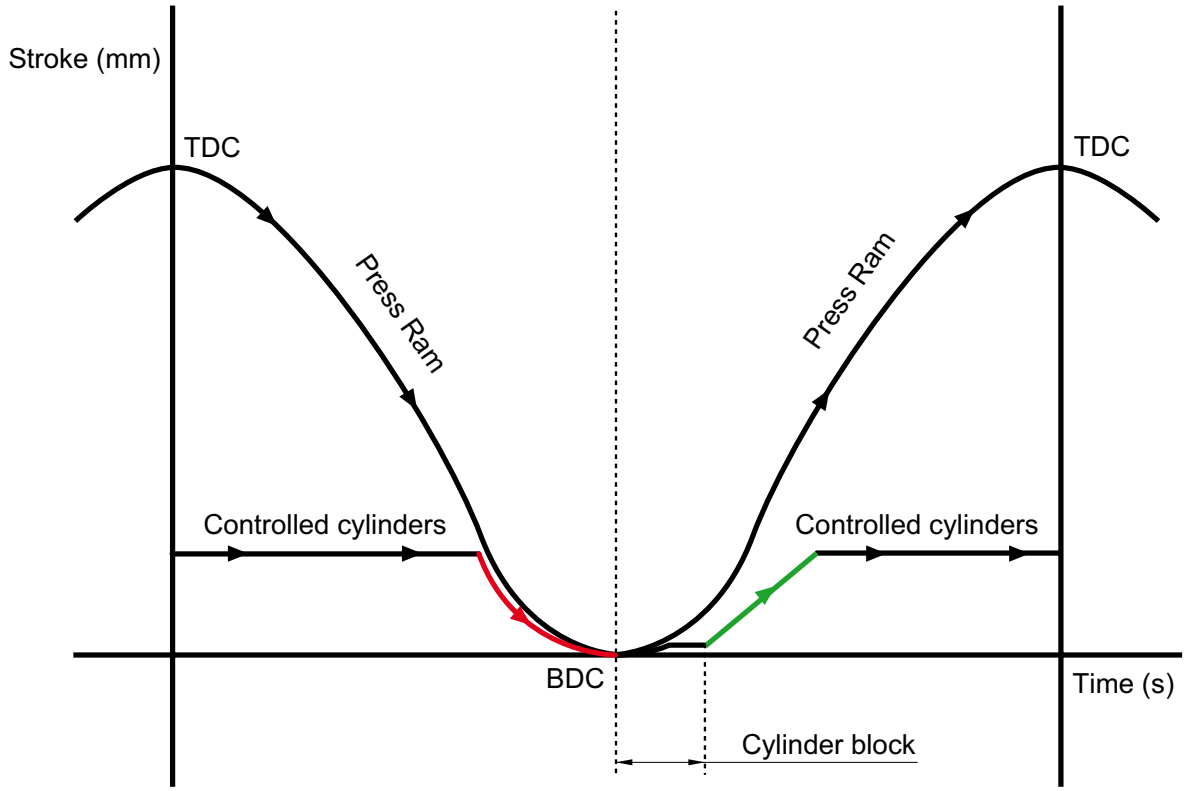
# INTRODUCTION

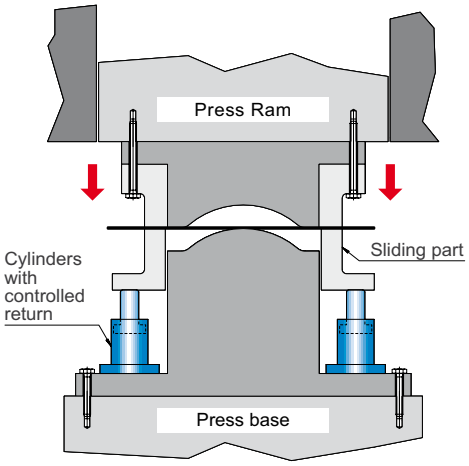
In order to meet the increasingly special and specific sheet metal forming requirements resulting from the need for complex and multi-profile geometries, Special Springs presents a new generation of cylinders with controlled return.




TDC: top dead centre
BDC: bottom dead centre

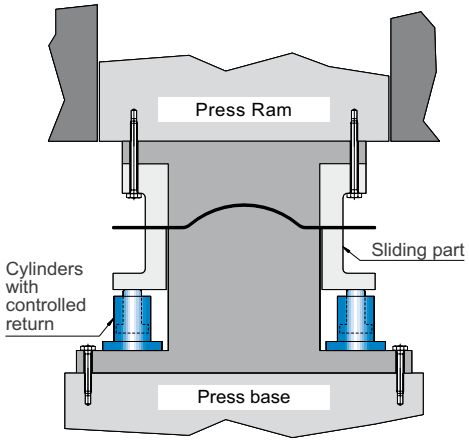
As shown on the illustration, the main characteristic of the system is the possibility to time and adjust the return stroke of the cylinder rod independently from the press cycle and speed.
The cylinder return is operated by an electrical distributor which receives its switch signal from the command unit of either a mechanical or hydraulic press.
In addition, the contrasting force displayed by the cylinders is constantly adjustable throughout the various phases of the working cycle according to the pre-set hydraulic pressure.

## *Practical example*



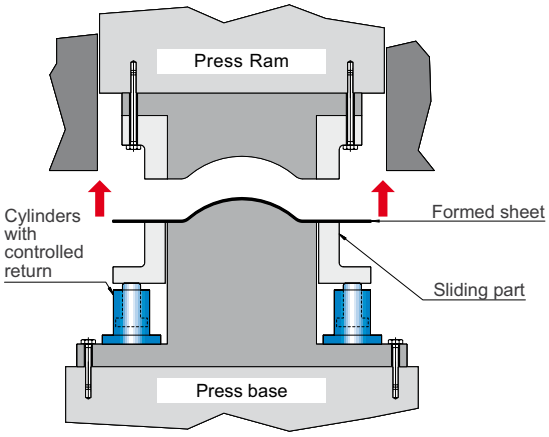

**START OF WORKING CYCLE**

- the press run is going down;
- the blank holder is opened and the cylinders are extended.



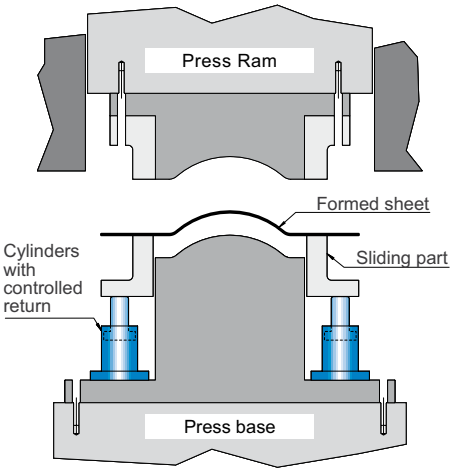

**END OF WORKING CYCLE**

- the press run is going down;
- the blank holder is closed and the cylinders are compressed.




**PRESS SLIDE RETURN WITH CYLINDER RETENTION**

- the press run is going up;
- the blank holder remains temporarily closed, with the cylinders still being compressed and blocked.



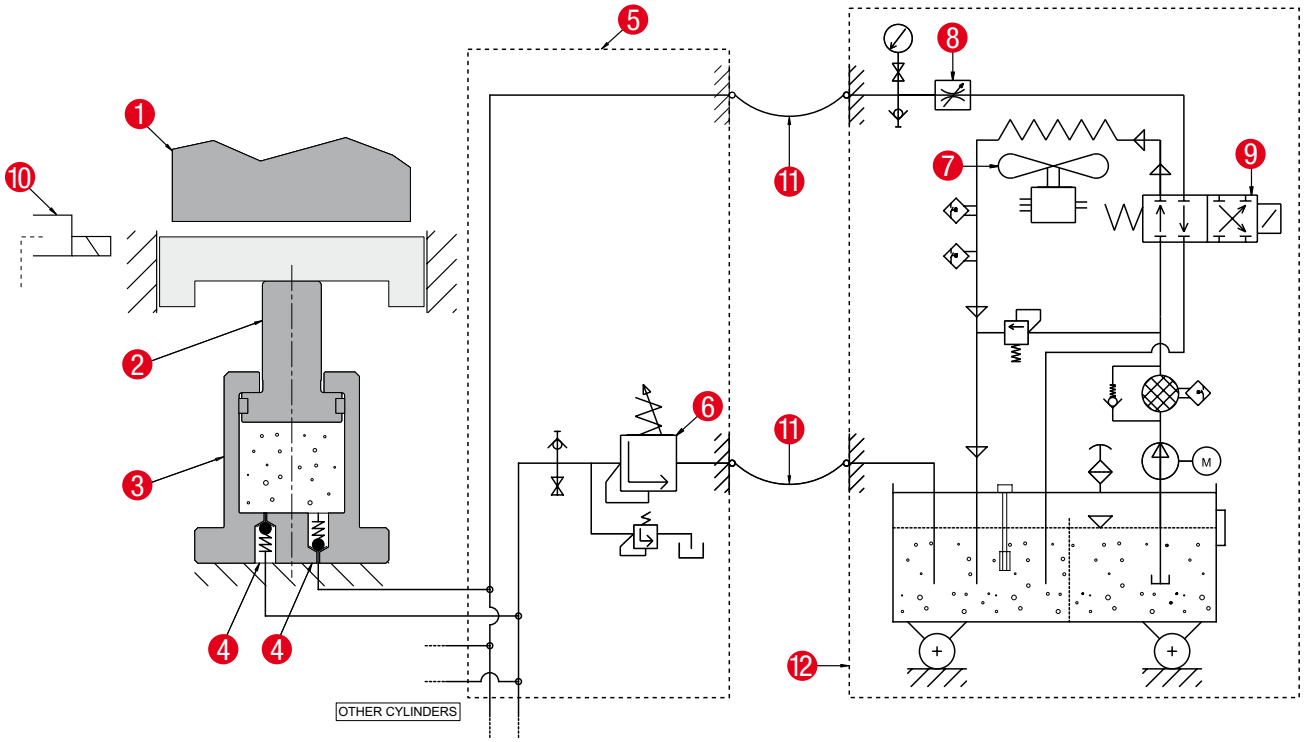

**BLANK HOLDER RETURN WITH CYLINDER EXTENSION AND PRESS AT TDC**

- the press run has gone up;
- the blank holder is going up and extracting the workpiece.

## *Practical example*

# SYSTEM DESCRIPTION

Specials Springs' system of cylinders with controlled return works exclusively with hydraulic fluid operated by the command unit.
Detailed view:




1 Press Ram.
2 Cylinder rod.
3 Cylinders with controlled return.
4 Retention valves. They intercept the flow of the hydraulic fluid into and out of the cylinders. Their presence enables to reduce the springback effect to a minimum.
5 Distribution unit with pressure-reducing valve.
6 Adjustable pressure-reducing valve. It regulates the outflow of hydraulic fluid during the cylinder compression phase. This pressure reducing valve ensures that the pressure, i. e. the cylinder contrasting force, remains constant.
7 Air-oil exchanger. It switches on automatically and ensures that the fluid temperature remains constant.
8 Compensatory flow regulator, to guarantee constant speed during the return phase.
9 Two-position, two-way electrical distributor. When its coil is off, it shunts the hydraulic fluid into the air-oil exchanger; when its coil is on, it shunts the hydraulic fluid into the return circuit of the cylinders.
10 Electromagnetic safety sensor: checks the correct position of the sliding tool part, which is jam-prone at the end of cycles.
11 Flexible hose-pipes with quick coupling connectors to distribution unit.
12 Wheeled command unit.

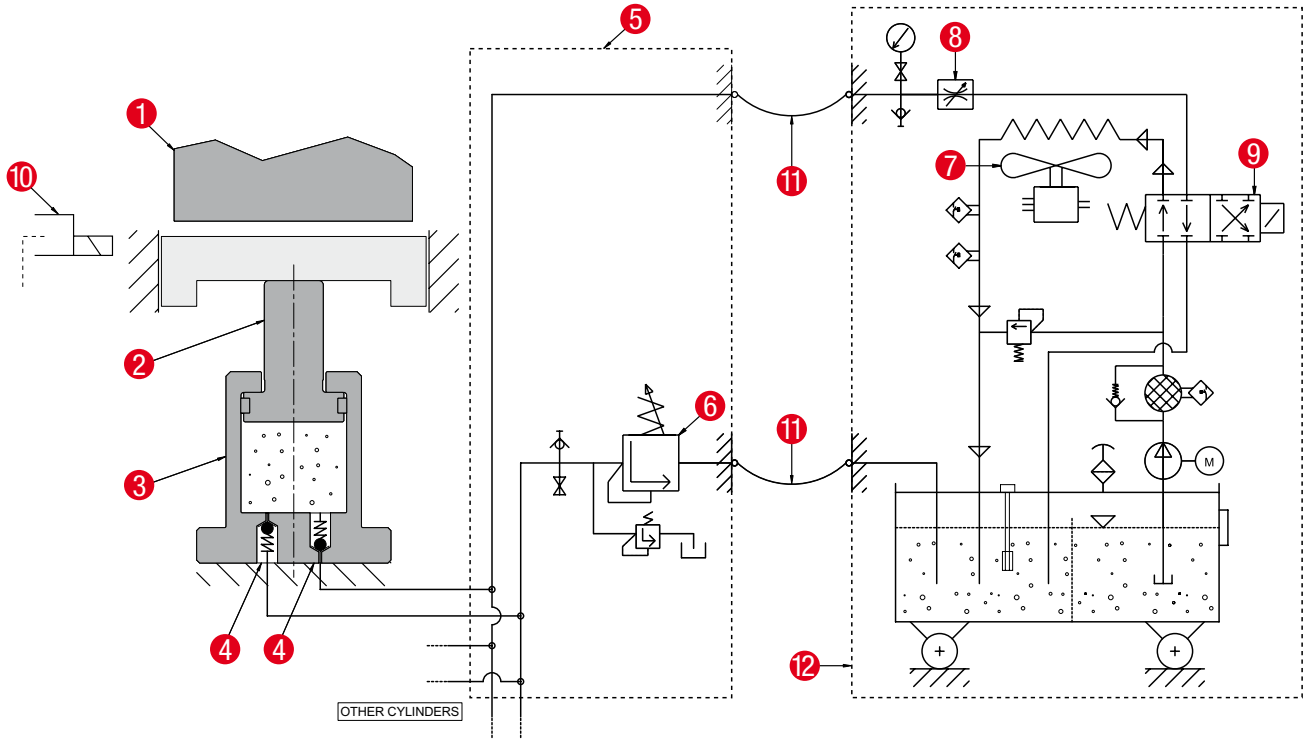
The positioning of the cylinders inside the tool is free and depends solely on the projects requirements; the command unit must be placed near by the press, in an open area so as not to be in the way or create a nuisance.
The use of hydraulic fluid enables an easy and optimal regulation of heat dispersal thanks to the heat exchanger which switches on automatically whenever the need arises.
This guarantees maximum reliability and operational constancy, allowing for working speeds of up to 25 cycles per minute.
Although the intrinsic compressability of the hydraulic fluid at the end of the compression phase results in a slight subsidence of rod retention, the extent of the latter is guaranteed to reach at most 0.2mm.

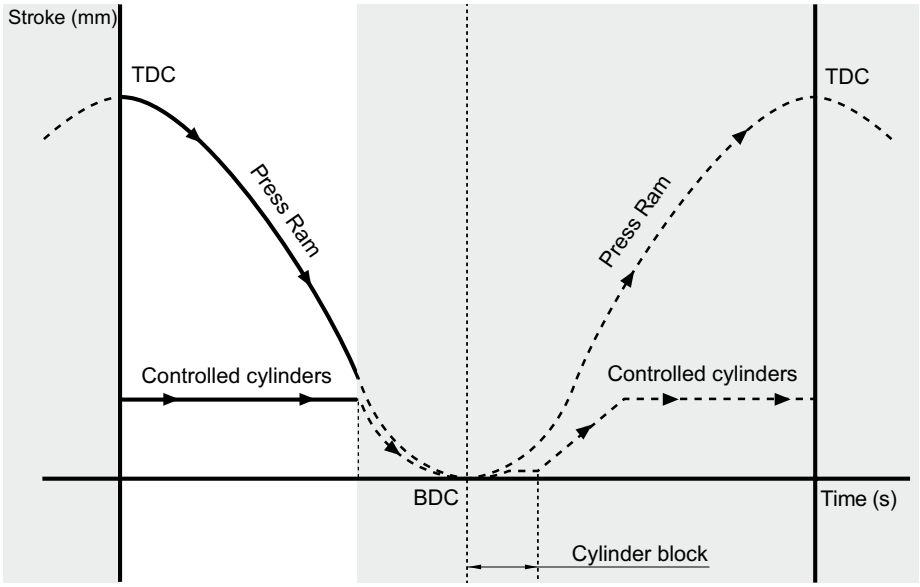
The air contained within the system must always be drained.
This operation must take place during the installation and loading procedure of the hydraulic fluid, hence it is necessary for the cylinders to be accessible.
Once this operation has been performed, it is possible to disconnect the quick coupling connectors from the command unit and to proceed with the tool assembly.

# PHASE-BY-PHASE SYSTEM DESCRIPTION

*Phase 1*

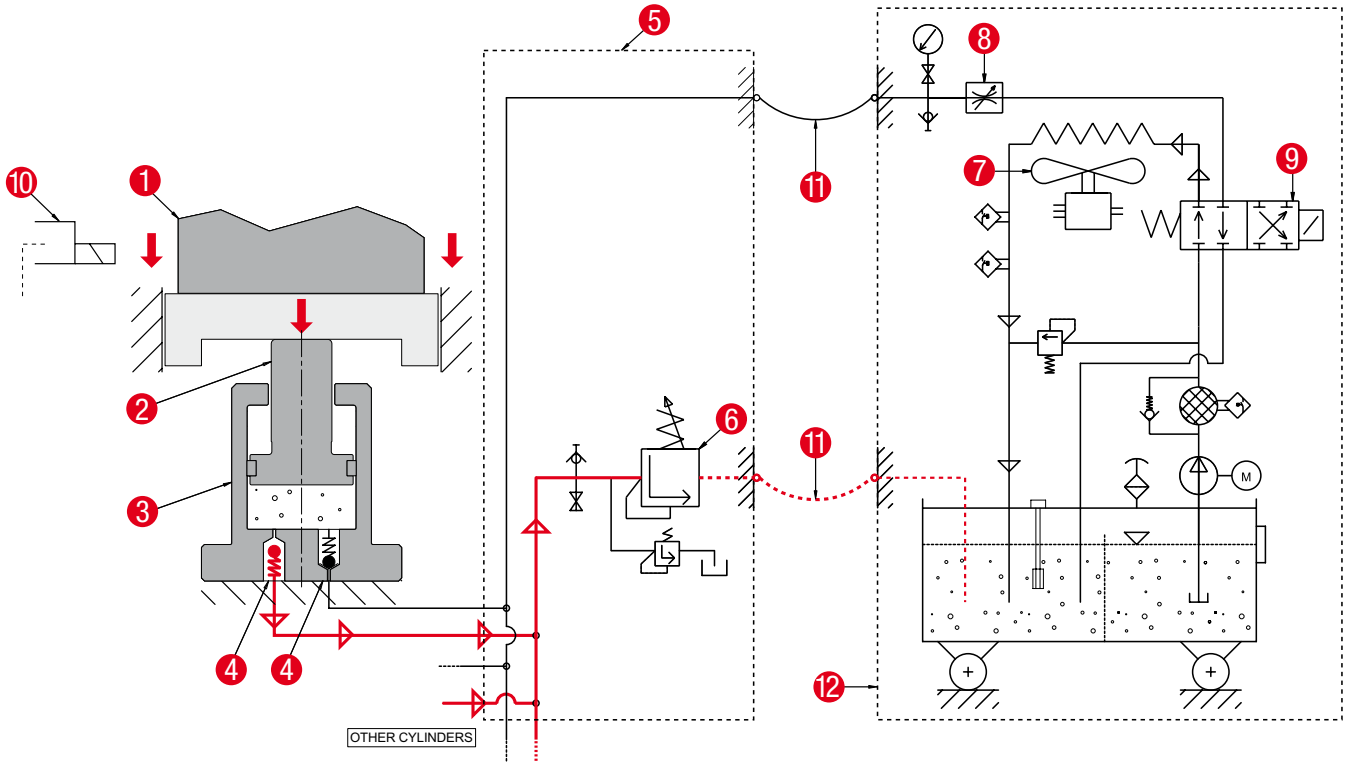
For easier understanding, the following illustrations include a single cylinder with controlled return connected to a command unit. In reality, installations are made up of any number of cylinders according to practical requirements.
It will be the responsibility of Special Springs' technical office to determine, after consultation with the end user, what type of command unit is suitable for any specific installation.

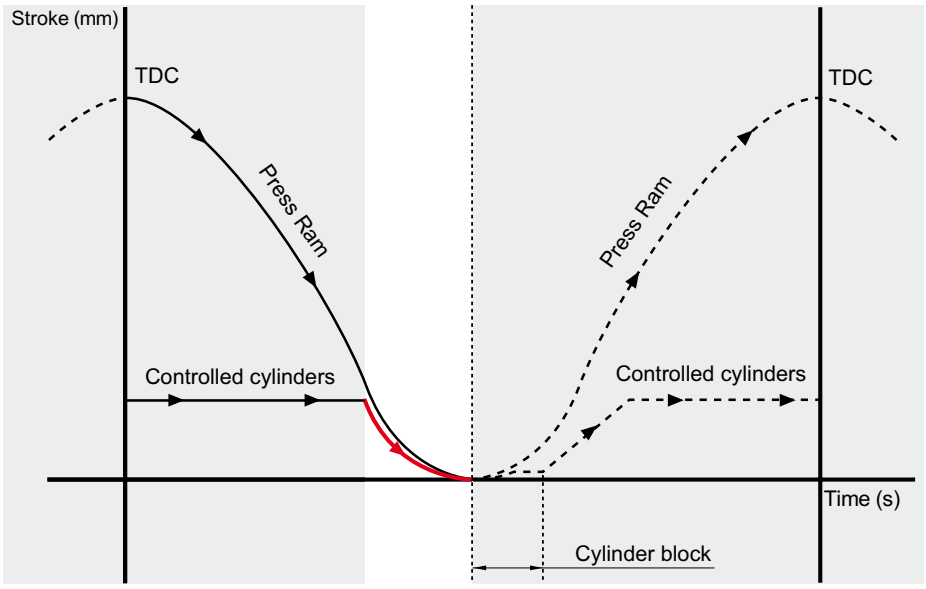



The Ram of the press **1** is at TDC, the cylinder rods **2** are completely extended, the retention valves **4** and the pressure-reducing valve **6** stand idle. All the fluid pumped by the command unit **12** flows through the circuit of the air-oil exchanger **7**, which switches on and off automatically – thanks to a pre-set thermostat – in order to maintain the fluid at constant temperature.
The cylinders with controlled return are completely full of fluid.
**During this phase, the system does not produce any contrasting force.**

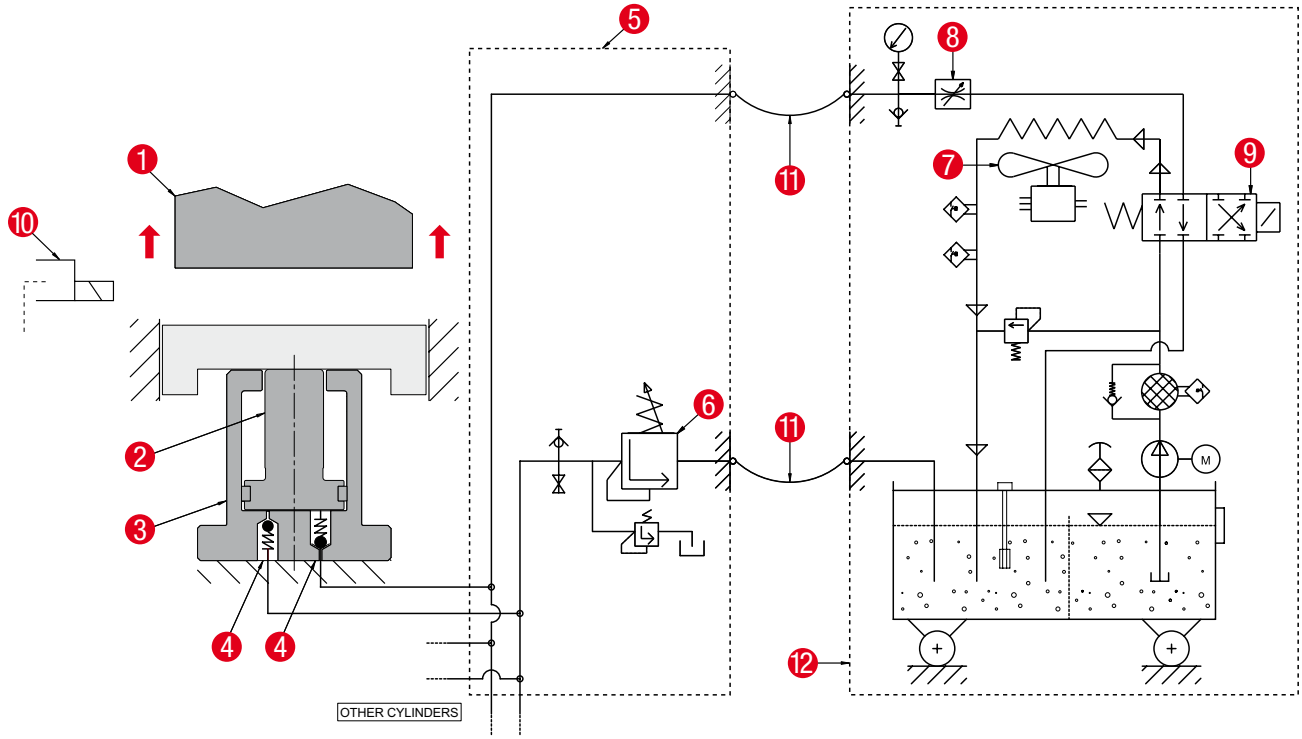
*Phase 2*

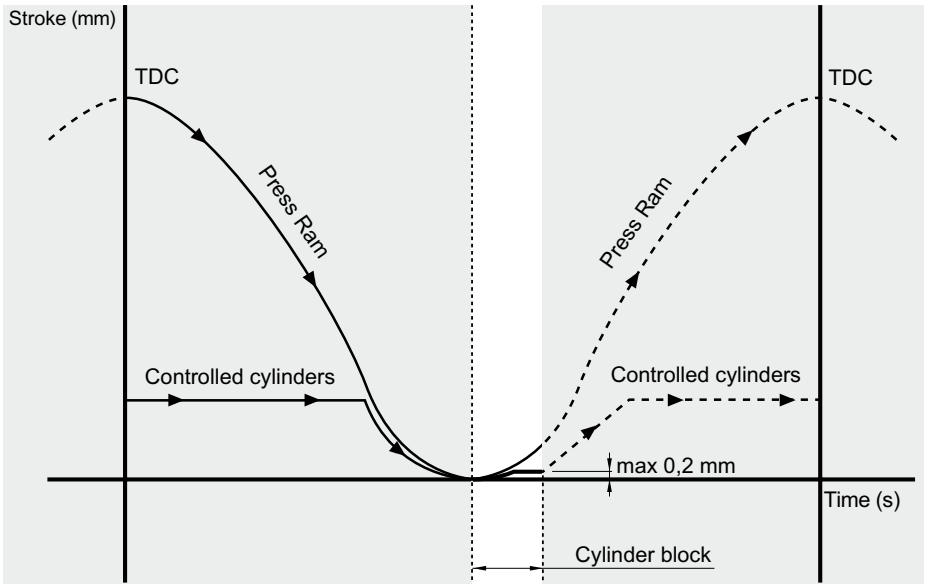



The Ram of the press **1** starts going down; the cylinder rods **2** compress and the fluid contained inside the cylinders flows through the retention valve **4** towards the pressure-reducing valve **6**, which generates a counter-pressure, i. e. a contrasting force. **This force may be either constant, increasing or decreasing over the whole extent of the stroke**. The fluid pumped by the command unit **12** goes on flowing through the circuit of the air-oil exchanger **7**.

## *Phase 3*

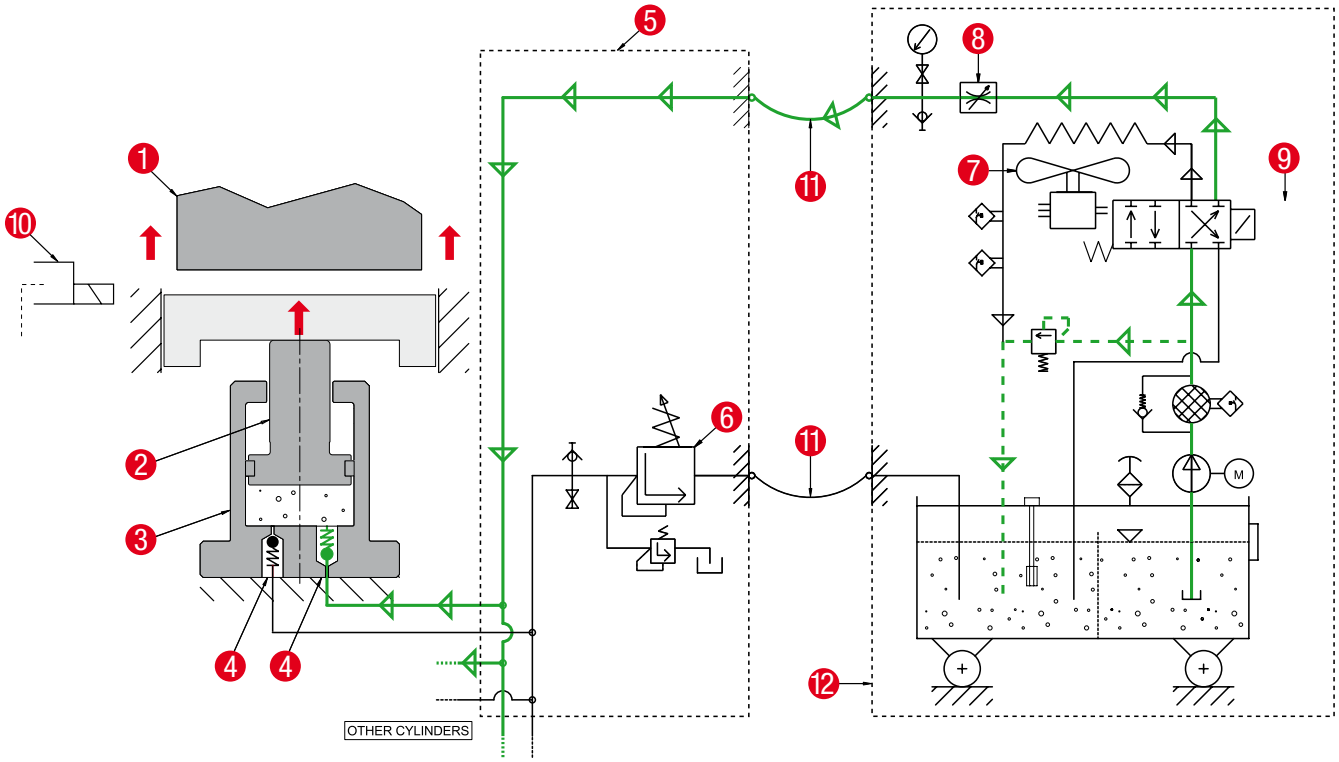


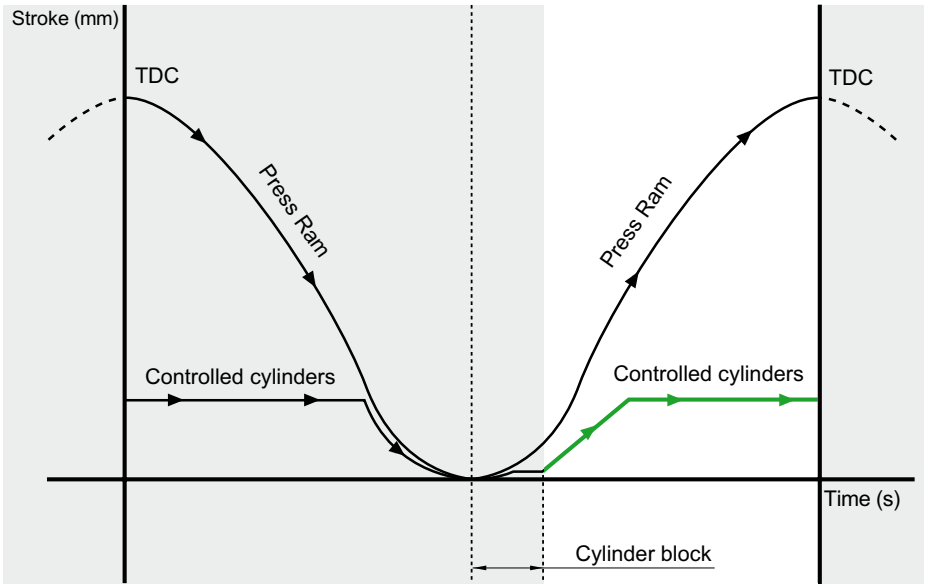




The Ram of the press **1** starts its return stroke from the BDC while the cylinder rods are blocked at the BDC (the retention is possible even with partial rod strokes). In case the full stroke is used, no fluid is left inside the cylinders **3**, whereas in case of partial stroke use, some residual volume is left. The retention valves **4** stand idle and the pressure-reducing valve **6** no longer produces any contrasting force. It is during this phase that the fluid compressability leads to the so-called Springback* effect for an extent of 0.2 mm maximum.
The fluid pumped by the command unit **12** goes on flowing through the circuit of the air-oil exchanger **7**.

***Springback** = slight subsidence in the retention of the cylinder rods, hence of the blank holder. Maximum extent: 0.2 mm.

*Phase 4*




During the return phase of the press **1**, a signal from the press command unit (angular position of the press shaft corresponding to a given position of the mobile slide) enables the operator to switch on the electrical distributor **9** so as to make the fluid flow through the return circuit of the cylinders.
The retention valve **4** lets flow as much hydraulic fluid is necessary for the rod return and does this at constant speed thanks to the compensatory fluid regulator **8**. The electromagnetic sensor makes sure that the mobile part performs the full extent of the return stroke. Unless this condition is fulfilled, it denies permission to move on to the next stage.
The excess amount of fluid pumped with respect to the quantity required by the system for the return stroke is made to flow directly into the command unit.

# CONNECTING OPTIONS

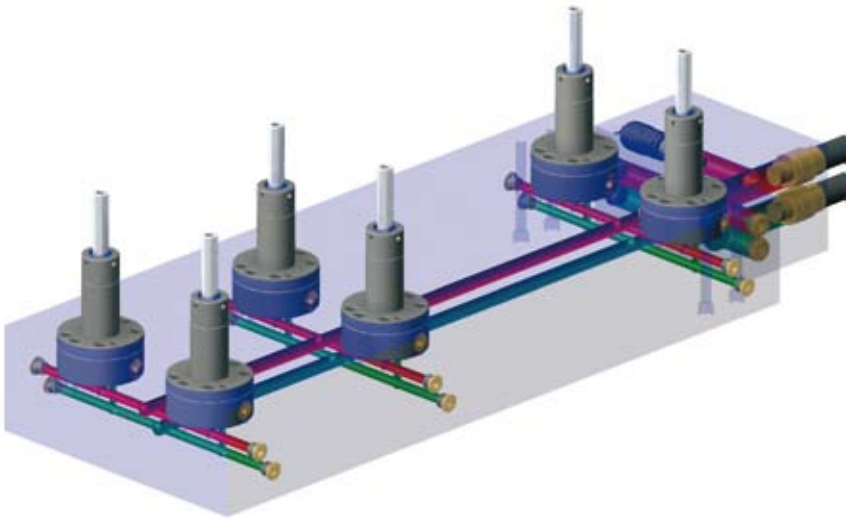
The Special Springs system has been designed so as to force the hydraulic fluid – during the compression phase – to flow from the cylinders through the pressure-reducing valve and proceed at low pressure into the command unit.

For functional reasons, the pressure-reducing valve has been integrated into the distribution unit which is always mounted on the tool. The connection between distribution and command unit is provided by two flexible hose pipes with quick coupling connectors of different sizes.
Such a solution ensures that making the tool fully operative again is an extremely fast and safe process which does not require any new system calibrations.

**Note:** *Provided it has the required characteristics, a command unit can be connected to different tools. In such a case, it is necessary to check and re-adjust the system calibration values before each use.*

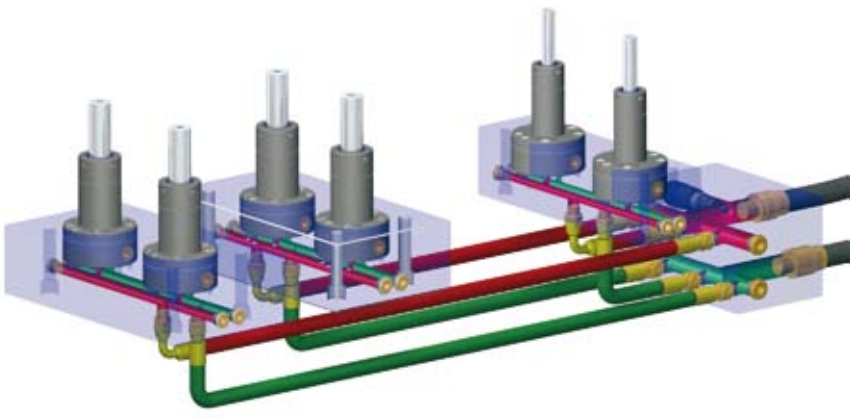
## • Connection with manifold plate

The cylinders are interconnected and mounted directly on the plate which features pre-designed pipes for the fluid to flow through. Such a solution has the following advantages: it uses less space on the tool; leaks are less likely to occur; it provides a cleaner operational environment: there are no hose pipes inside the tool.



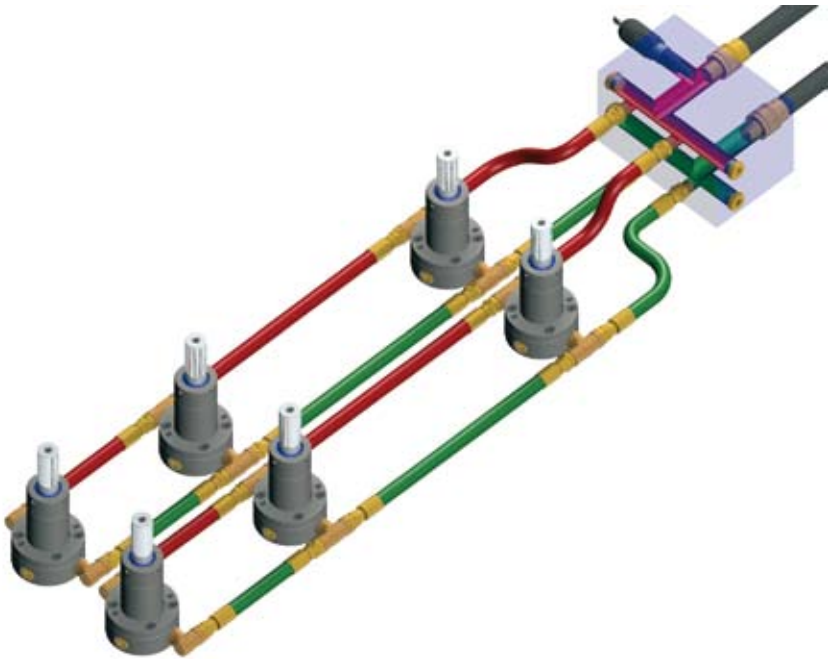
## • Mixed connection

Cylinder groups are mounted and interconnected through specific plates which are individually connected to the distribution unit.



## • Connection with flexible hose pipes

The cylinders are mounted directly on the tool and interconnected by means of flexible hose pipes.



Using same-length connectors (be they of the flexible or rigid type) between the cylinders and the distribution unit guarantees the simultaneous return of the rods during the release phase of the cylinder block.
If such condition is not met, it is still possible to achieve an almost simultaneous return provided the mobile part of the tool, which is first blocked and then released, is properly guided.

# PRODUCT INFORMATION

Once you have specified the total amount of the force which is required and the number of pressure points, you can move on to choose the best suitable cylinder among the ones that are available. At the planning stage, it is always advisable to add a 20%-safety margin to the maximum pressure which the cylinders are normally designed to withstand.

### *How to calculate the Force*

In order to find out how much contrasting force **F** is produced by a single cylinder, simply multiply the calibration pressure **P** of the pressure-reducing valve by the net cross-section of the piston rod **S**.

**F = P x S**

- Maximum calibration pressure of pressure-reducing valve: 250 bar
- Minimum calibration pressure of pressure-reducing valve: 30 bar
- **S** cross-section: specified on each model

### *How to calculate the Pressure*

In order to find out the calibration pressure of the pressure-reducing valve, simply divide the contrasting force produced by the cylinder by the net cross-section of the piston rod.

**P = F / S**

### *Key to the abbreviations*

**F** = contrasting force produced by the cylinder
**S** = net cross-section of the piston rod
**V** = volume of oil contained in the cylinder
**P** = pressure of the fluid inside the cylinder (corresponds to the calibration pressure of the pressure-reducing valve)

### *Example:*

Total force required for plate forming = **35 Ton**.

Number of pressure points on tool = **8**

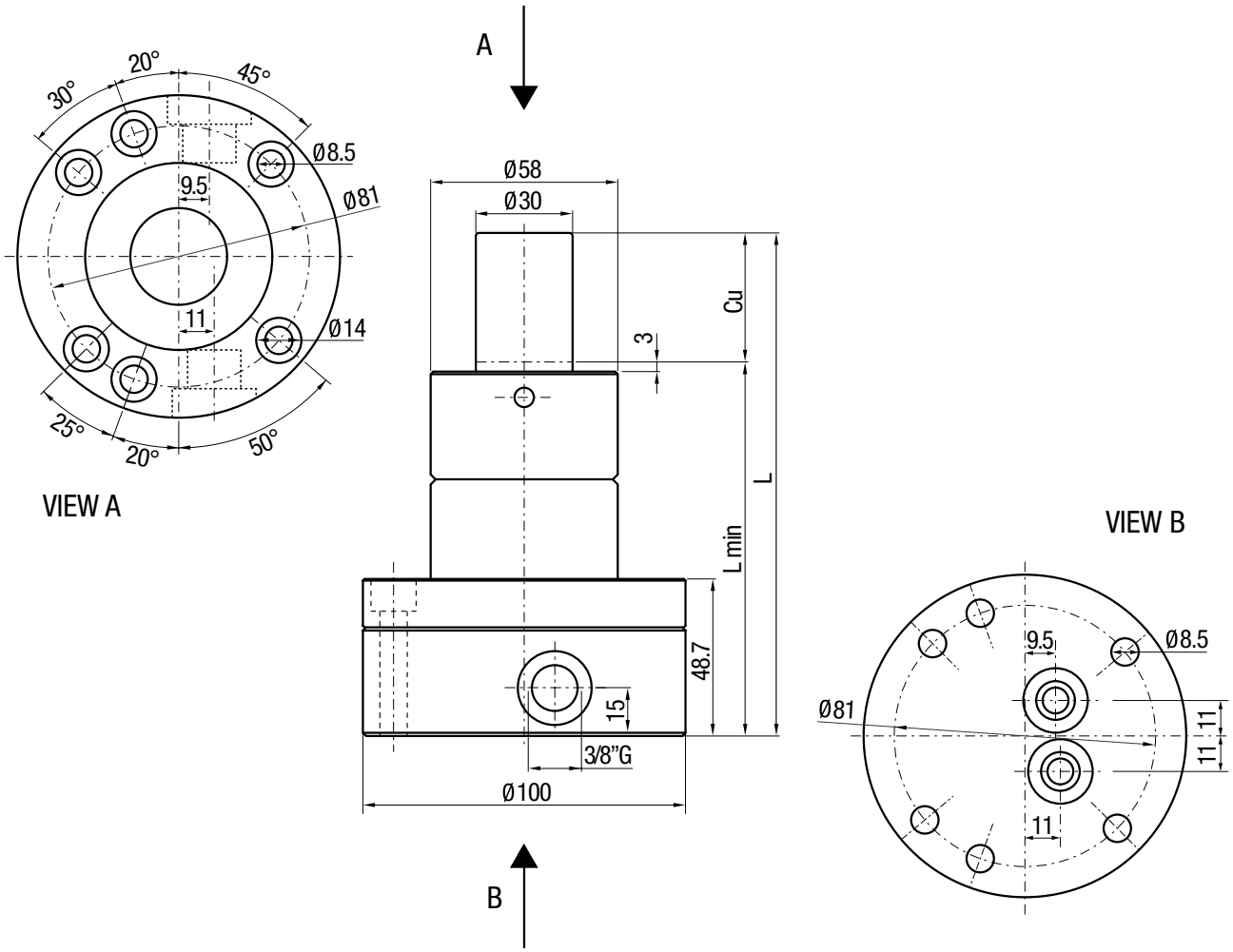
Each cylinder will produce a contrasting force equal to **35/8 = 4,4 Ton** (4400 daN)

The **AC 5700** model with a net cross-section of **22,9 cm²** is suitable (the stroke choice is free).

The working pressure equals therefore **4400/22,9 = 192 bar**

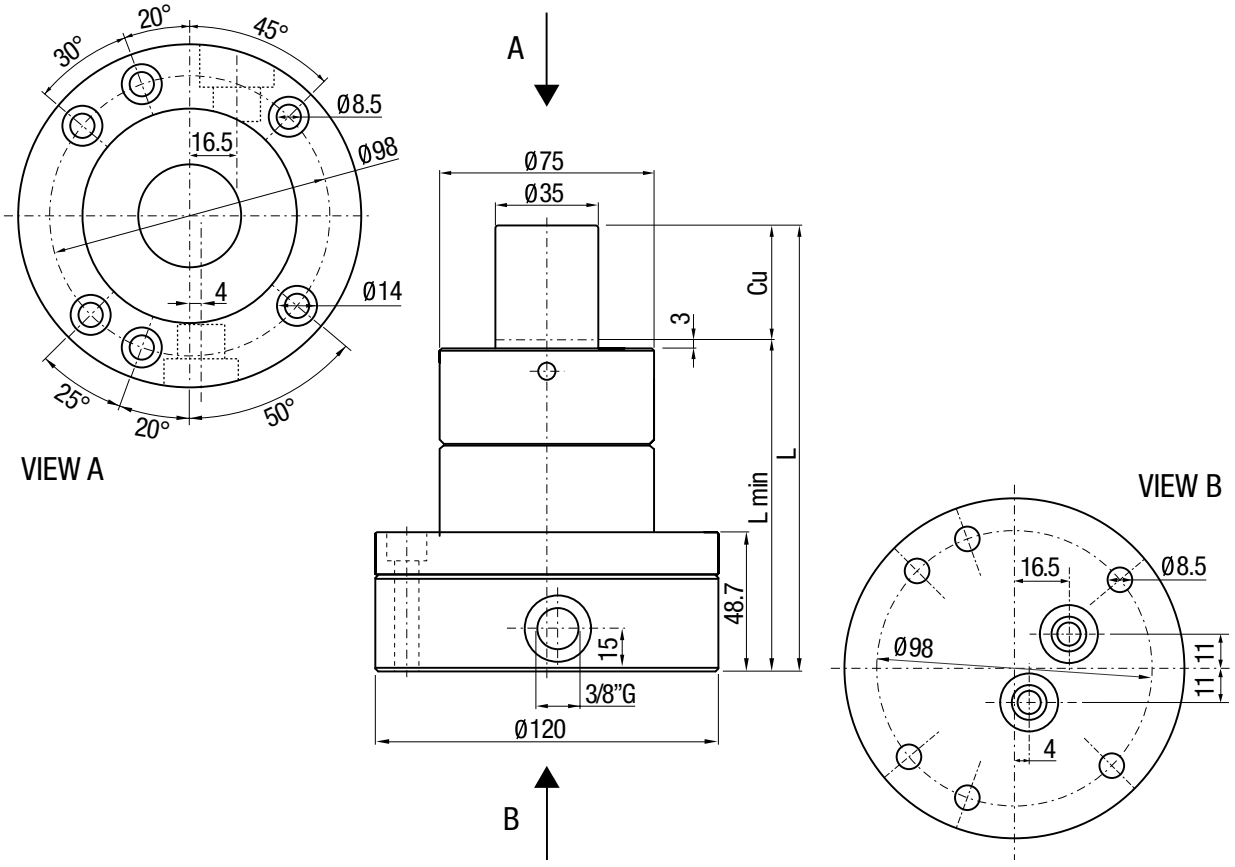
# AC 3100






| MODEL | Stroke Cu [mm] | L [mm] | L min [mm] | F max (daN) a 250 bar | F min (daN) a 30 bar | S [cm²] | V cons. [cm³] |
|---|---|---|---|---|---|---|---|
| AC 3100 - 25 - A | 25 | 126 | 101 | 3140 | 380 | 12,57 | 31,4 |
| AC 3100 - 50 - A | 50 | 176 | 126 | 3140 | 380 | 12,57 | 62,8 |
| AC 3100 - 80 - A | 80 | 236 | 156 | 3140 | 380 | 12,57 | 100,5 |
| AC 3100 - 100 - A | 100 | 276 | 176 | 3140 | 380 | 12,57 | 125 |
| AC 3100 - 125 - A | 125 | 326 | 201 | 3140 | 380 | 12,57 | 157 |

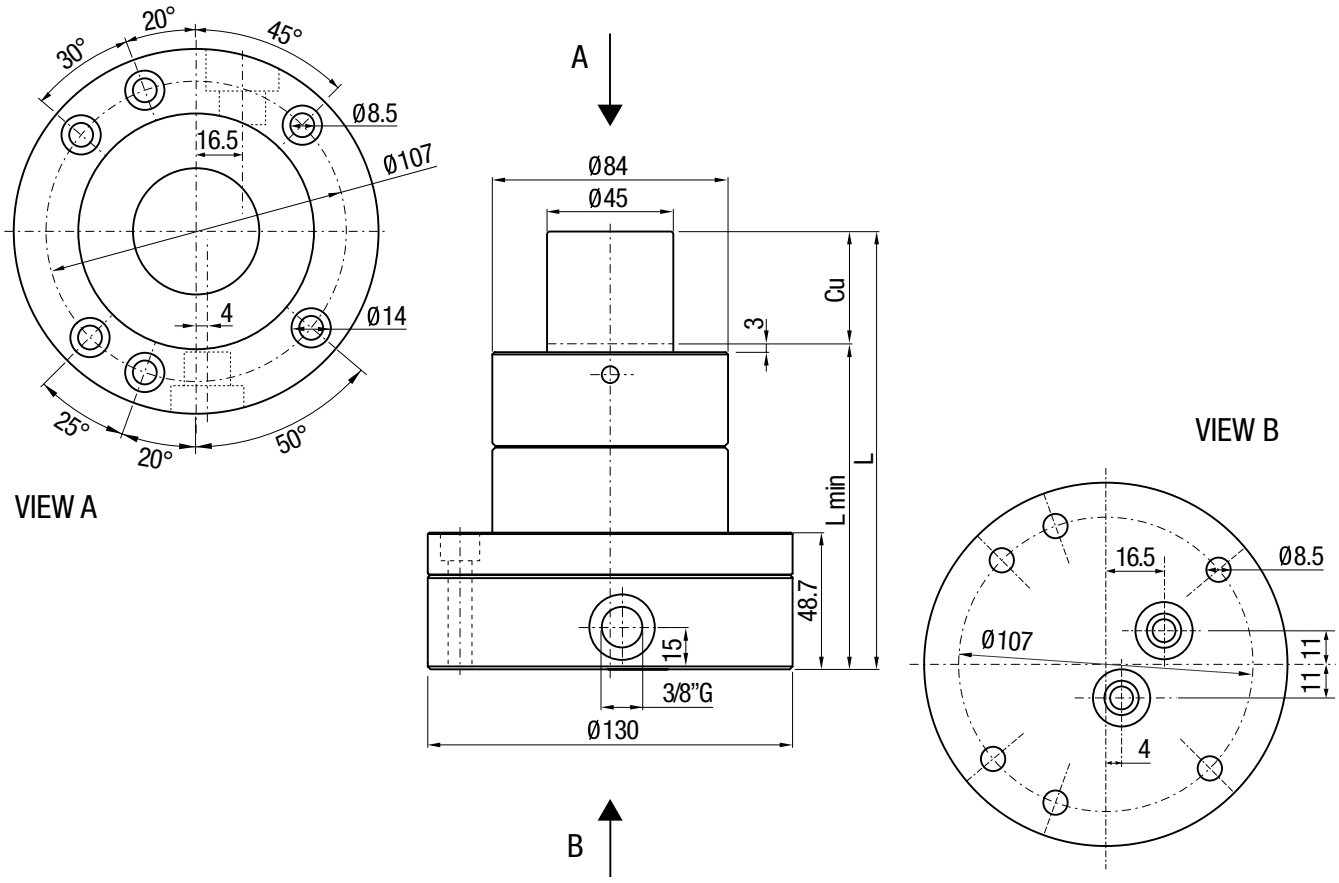
# AC 5700




| MODEL | Stroke Cu [mm] | L [mm] | L min [mm] | F max (daN) a 250 bar | F min (daN) a 30 bar | S [cm²] | V cons. [cm³] |
|---|---|---|---|---|---|---|---|
| AC 5700 - 25 - A | 25 | 126 | 101 | 5725 | 690 | 22.9 | 57 |
| AC 5700 - 50 - A | 50 | 176 | 126 | 5725 | 690 | 22.9 | 114,5 |
| AC 5700 - 80 - A | 80 | 236 | 156 | 5725 | 690 | 22.9 | 183 |
| AC 5700 - 100 - A | 100 | 276 | 176 | 5725 | 690 | 22.9 | 229 |
| AC 5700 - 125 - A | 125 | 326 | 201 | 5725 | 690 | 22.9 | 286 |

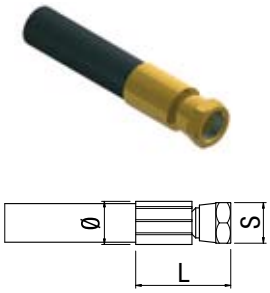
# AC 7800





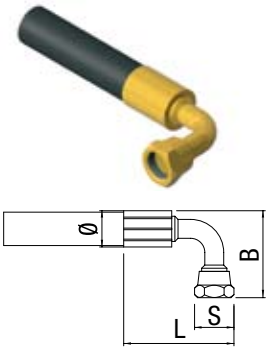

| MODEL | Stroke Cu [mm] | L [mm] | L min [mm] | F max (daN) a 250 bar | F1 min (daN) a 30 bar | S [cm²] | V cons. [cm³] |
|---|---|---|---|---|---|---|---|
| AC 7800 - 25 - A | 25 | 126 | 101 | 7790 | 935 | 31.17 | 78 |
| AC 7800 - 50 - A | 50 | 176 | 126 | 7790 | 935 | 31.17 | 156 |
| AC 7800 - 80 - A | 80 | 236 | 156 | 7790 | 935 | 31.17 | 249 |
| AC 7800 - 100 - A | 100 | 276 | 176 | 7790 | 935 | 31.17 | 312 |
| AC 7800 - 125 - A | 125 | 326 | 201 | 7790 | 935 | 31.17 | 390 |

# ACCESSORIES



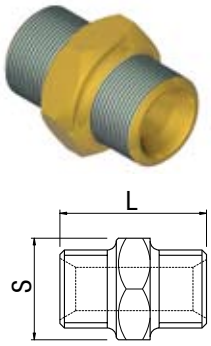

Flexible hose pipe, straight connection, **R9** (high-pressure) type for the compression phase and **R1** type for the return phase of the cylinder rods.
The length of the supplied items will suit the customer's requirements.

| | 3/8" | 1/2" | 3/4" | | | |
|---|---|---|---|---|---|---|
| Ø | 27 | 28.5 | 37 | | | |
| L | 63 | 67 | 83 | | | |
| S | 22 | 27 | 32 | | | |



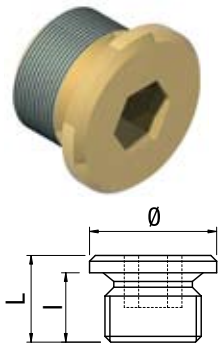

Flexible hose pipe, 90° connection, **R9** type for the return phase of the cylinder rods; available in the following sizes:
The length of the supplied items will suit the customer's requirements.

| | 3/8" | 1/2" | 3/4" | | | |
|---|---|---|---|---|---|---|
| Ø | 27 | 28.5 | 32.5 | | | |
| L | 75 | 92 | 82 | | | |
| B | 53 | 63 | 80 | | | |
| S | 22 | 27 | 32 | | | |



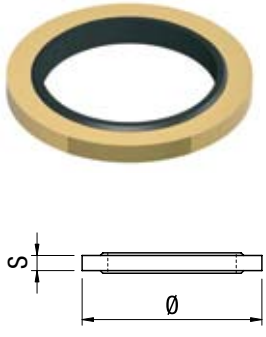

Nipple for connecting the various hose pipes to the system.

| | 3/8" | 1/2" | 3/4" | | | |
|---|---|---|---|---|---|---|
| L | 34 | 40 | 46 | | | |
| S | 22 | 27 | 32 | | | |




Sealing tap.

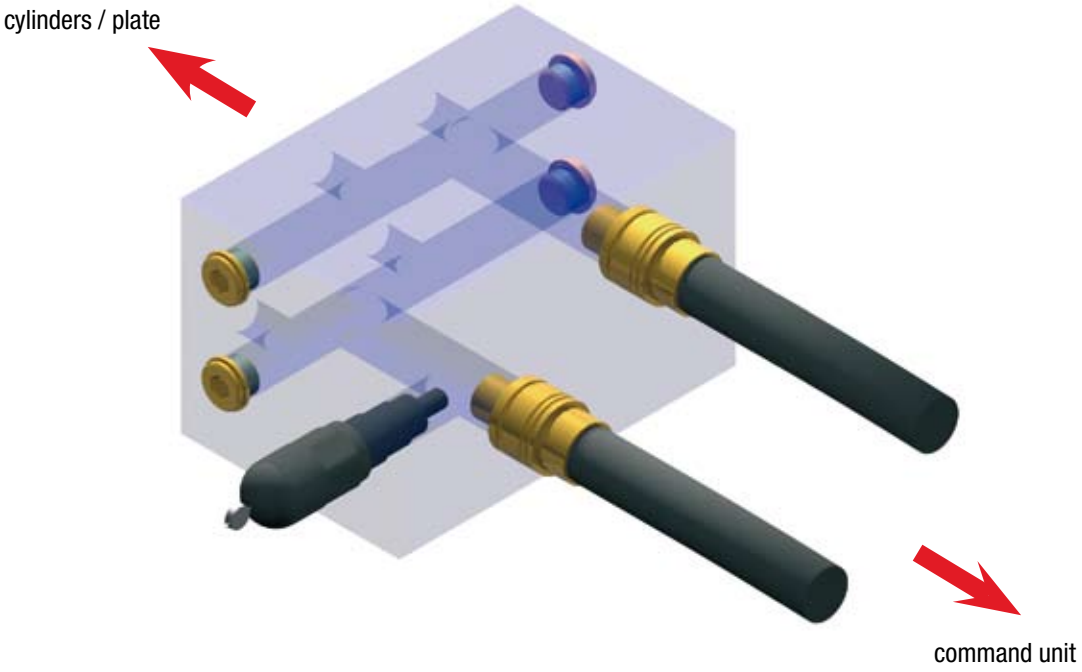
| | 3/8" | 1/2" | 3/4" | 1" | 1 1/4" | 1 1/2" |
|---|---|---|---|---|---|---|
| Ø | 22 | 27 | 32 | 40 | 50 | 55 |
| L | 17 | 19 | 21 | 23 | 23 | 23 |
| I | 12 | 14 | 16 | 16 | 16 | 16 |




High pressure seal washer.

| | 3/8" | 1/2" | 3/4" | 1" | 1 1/4" | 1 1/2" |
|---|---|---|---|---|---|---|
| Ø | 24 | 29 | 35 | 43 | 54 | 59 |
| S | 2 | 2.5 | 2 | 2.5 | 3 | 3 |

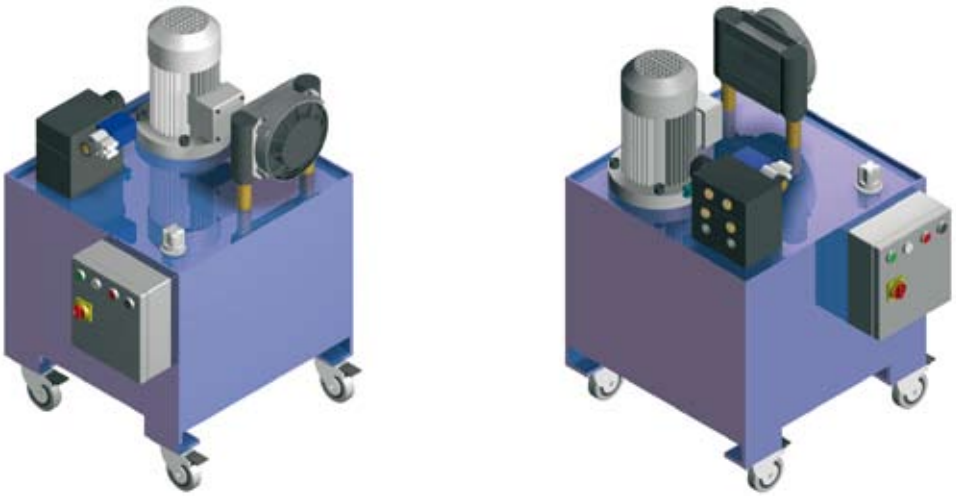
## • Distribution unit




Size according to installation.

## • Command unit

Special Springs will take into account the characteristics of your installation in order to determine the best suitable command unit. The latter will be supplied in a wheeled version and with its own control box to supervise the various working phases of the installation



Sizes according to installation. Power supply in conformity with the norms of the country of use.

# FAQ'S

| | |
|---|---|
| **Can I use the cylinder stroke partially, and possibly modify it, or must I always use 100% of the nominal stroke?** | You can use any percentage of the nominal cylinder stroke and you can always adjust it according to your requirements and without any limits. |
| **Is it possible to block the rod return in any position?** | Yes. |
| **Is it possible to adjust the return speed of the rod?** | Yes. |
| **What speed can the system achieve?** | Speed and rate vary from installation to installation. For further information, contact Special Springs' technical office. |
| **Is it possible to use cylinders of different sizes and strokes within a single installation?** | Yes. For further information, contact Special Springs' technical office. |
| **How does the contrasting force behave during the rod compression phase?** | Unless programmed differently, the force remains constant during the whole extent of the stroke. |
| **What kind of pipes can I use for connecting cylinders inside the tool?** | The size and type of pipes vary according to the installation and are usually decided at the dimensioning stage. For further information, contact Special Springs' technical office. |
| **How many cylinders can I connect to a single command unit?** | As a rule, there are no limits. For further information, contact Special Springs' technical office. |
| **How are cylinders and command unit connected?** | The connection is made by means of flexible hose pipes with quick coupling connectors onto the distribution unit attached to the tool. To connect cylinders and distribution unit, you may use flexible hose pipes or tubular plates suitable for oil flow. |
| **Can I use the same command unit with different tools?** | Yes, you can, provided the specifications of the command unit are suitable for such a use. For further information, contact Special Springs' technical office. |
| **How does the fluid which circulates inside the system cool down?** | Thanks to the air-oil exchanger which is to be found on the command unit. |
| **Is it always necessary to cool down the circulating fluid?** | Yes. This takes place automatically thanks to a temperature sensor which switches the exchanger on. |
| **What maintenance does the system require?** | Oil change should occur every 5,000 working hours or every 2,5 years at the latest; always check the oil level before the start of a new production process; fill up if necessary. All cylinders are maintenance-friendly. |
| **How do I make sure that the installation gets the input it needs for it to function?** | Just interface the command unit with the Press control unit. |
| **Can I use the Special Springs system with any type of Press?** | Yes. |

# TROUBLESHOOTING

| TYPES OF FAILURES | CAUSE | SOLUTION |
|---|---|---|
| **The command unit does not work.** | *The system is disconnected from the power source.* | Connect the Press to the electric power supply. |
| | | Check whether the supplied tension is suitable. |
| | *The level of hydraulic fluid is insufficient (warning light of the control box is on).* | Fill up using suitable fluid (see “User’s and maintenance guide”). |
| **The cylinder rods do not return/remain compressed.** | *The oil temperature is too high (warning light of the control box is on).* | Check the air/oil exchanger. |
| | | Make sure there are neither obstacles nor interruptions on the pipes which connect the cylinders to the unit. |
| | *Obstacles, mechanical parts hinder the return.* | Remove the obstacle. |
| | *Pipes are misconnected.* | Make sure that the connection is right. |
| | *Quick couplings are not connected.* | Connect properly. |
| | *The command unit does not pump any fluid.* | Check the command unit. |
| | *The blank holder is jammed.* | Check the tool guide. |
| | *The press PLC or tool sensor signal is faulty.* | Check the system logics. |
| **The cylinder rods are not blocked.** | *Pipes are misconnected.* | Make sure that the connection is right. |
| | *Presence of air inside the installation.* | Drain air out of the installation. |
| | *The press PLC or tool sensor signal is faulty.* | Check the system logics. |
| **The sheet is not properly formed.** | *The contrasting force is not correct.* | Adjust the response pressure of the pressure-reducing valve (max. 250 bar). Contact Special Springs’ customer service. |
| | | The system is either over- or under-sized. Contact Special Springs’ customer service. |
| | *The blocking of the cylinder rods occurs at the wrong time.* | Check the system logics. |
| | *The quality/ductility of the raw material has changed.* | Adjust the response pressure of the pressure-reducing valve (do not exceed 250 bar). Contact Special Springs’ customer service. |

# QUESTIONNAIRE

Preliminary information required for carrying out a first dimensioning of the hydraulic control system. The more precise the information, the easier it will be for us to determine the best suitable system.

**1) No. of cylinders with controlled return and maximum contrasting force for each cylinder**

☐ No. _____ cylinders with a force of _____ kgf each
☐ No. _____ cylinders with a force of _____ kgf each
☐ No. _____ cylinders with a force of _____ kgf each

**2) Total force required during cylinder return phase**

$F_{tot.}$ return _____ kgf (must take account of the weights to be lifted and of the estimated friction)

**3) Effective cylinder stroke**

CL = _____ mm

Please specify whether:
☐ minimum extra-stroke margin is _____mm

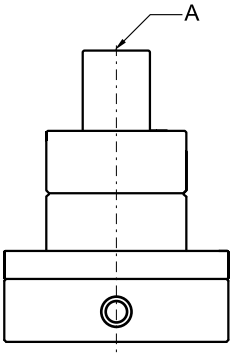
**4) Guide of the mobile unit of the blankholder (or die) activated by the hydraulic cylinders in the return phase is:**

☐ Well guided
☐ Not much guided
☐ Not guided

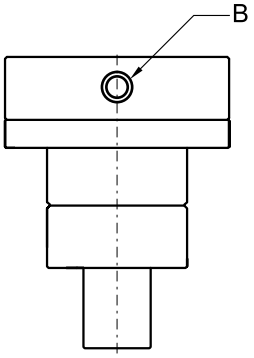
Options b) and c) preclude the possibility to make the hydraulic cushion with Special Springs' delay system for the hypothetical lack of parallelism of the mobile unit in the return phase

**5) Cylinder layout. Please illustrate the cylinder layout and indicate the axis:**

**6) Accessibility of cylinders for air bleeding operations during start-up (installation)**




☐ accessible A
☐ accessible B
☐ accessible A and B
☐ non-accessible A and B



**7) Cylinder interconnection technique**

☐ manifold plate suitable for hydraulic connections
☐ various plates and various flexible hose pipes
☐ flexible hose pipes and connectors

**8) Cylinder return modalities**

☐ return after a sufficiently precise retention phase
☐ return after retention phase and without any precise springback requirements
☐ "slowed down" return to create a gap between cushion and slide

**9) Feeding of the press**

☐ manual
☐ automatic

**10) Production rate (workpiece rate)**

how many workpieces per minute: No. = _____ workpieces/min.

**11) Type of press**

☐ hydraulic
☐ mechanical with simple rod mechanism
☐ mechanical with complex rod mechanism
☐ to be used on different presses

**12) Specifications of the press**

$S_{Ram}$ = _____ mm

$L_{connecting\ rod}$ = _____ mm

Rotation speed of the crank shaft when the press slide is moving: _____ round/min
When using multiple presses, specify the above mentioned features for each machinery

.....
.....

For a more precise definition of the delay system, specify the press slide position versus the main shaft angle

**13) Ram stops at BDC (lowest point) as part of production cycle**

☐ yes, for $\Delta t$ ____ sec. (hydraulic press).
☐ no, because the production takes place on a mechanical press.

**14) Ram stops at TDC (highest point) as part of production cycle**

☐ yes, for $\Delta t$ ____ sec
☐ no, because the slide does not stop at TDC.

**15) Cylinders return stroke end and beginning**

☐ Cylinders must start the return stroke when the press slide is at _____ compared to the BDC
☐ Cylinders must finish the return stroke when the press slide is at _____ compared to TDC

**16) Interface between press and cylinders return phase**

☐ Press PLC
☐ Sensor positioned on the die
☐ Other _____

**17) Delay system installation**

☐ By toolmaker. Address _____
☐ By end user. Address _____

**18) Country where the installation is being used:**

.....
.....

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