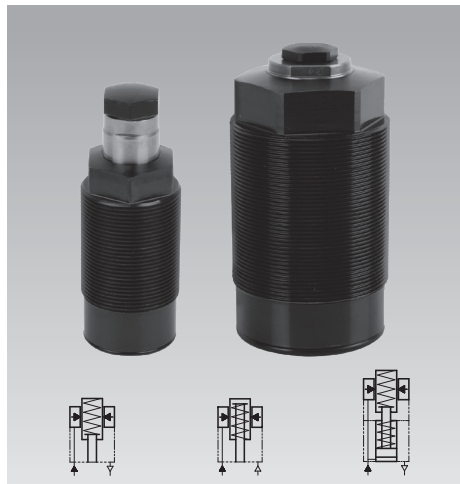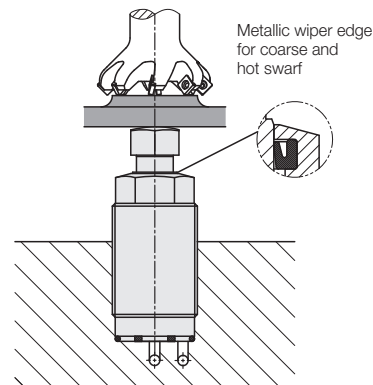# Threaded-Body Work Supports
## 3 function types, with metallic wiper edge, optional contact control
## single acting, max. operating pressure 500 bar



### Advantages
- Space-saving threaded-body version
- 4 sizes available
- Load force up to 42 kN
- Workpiece contact by spring force or pneumatically adjustable (type 1941)
- Optional pneumatic contact control
- Metallic wiper edge
- Protected FKM wiper
- Inner parts protected against corrosion
- Venting of the spring area
- Connection of positive air pressure protection possible
- Protection cap available as accessory
- Integrated orifice for flow rate limitation (type 1942)
- Mounting position: any
- Connection of positive air pressure protection up to 4 bar is possible



Metallic wiper edge for coarse and hot swarf

### Application
Hydraulic work supports are used to provide a self-adjusting rest for workpieces and avoid their vibration and deflection under machining loads.

The threaded-body design allows for space-saving and direct installation into the fixture body. Hydraulic oil supply and venting are made via drilled channels.

### Description
In the body of the threaded-body work supports a thin-walled locking bush is integrated, which locks cylindrically around the freely-movable support plunger when pressurising the element with hydraulic oil.

There are three variations of plunger actuation:

1. Spring force
2. Pneumatically
3. Hydraulically and spring force

The correct contact at the workpiece can be controlled with the optional pneumatic contact control.

The body with metallic wiper edge protects the subjacent FKM wiper against coarse and hot swarf.

### Important notes
Work supports are not suitable to compensate side loads. The support plunger must not be stressed by tensile load.

The admissible load force as per diagram is valid for static and dynamic load.

Machining forces can generate vibrations, whose amplitude exceeds far an average value, and this can cause yielding of the support plunger.

Remedy: Increase the safety factor or the number of work supports.

In dry machining applications, with minimum quantity lubrication or in case of accumulation of very small swarf, there can be a swarf hold-up in the area of the metallic wiper edge.

Remedy: Regular cleaning or mount protection cap (see page 2).

Operating conditions, tolerances and other data see data sheet A 0.100.

### Installation and connecting possibilities
**Drilled channels**
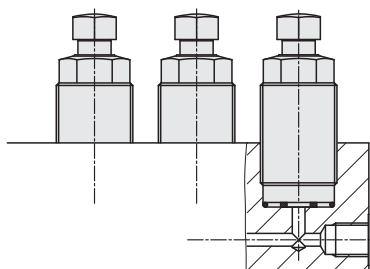


### Function
Description on page 2 and page 5.

### Pneumatic contact control
Description see page 5.

### Combination with clamping elements
With this combination, clamping and machining forces will add up:

    clamping force
+  max. machining force
_____
=  minimum support force x safety factor

Rough calculation from practice:

**Required support force ≥ 2 x clamping force**

To increase the safety, a support force as high as possible should be achieved

- by using a larger work support
 or
- by using the max. operating pressure of 500 bar by installing a little intensifier (e.g. data sheet D 8.756), in the supply line of the work supports

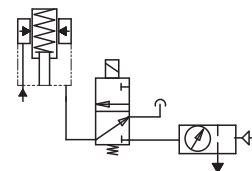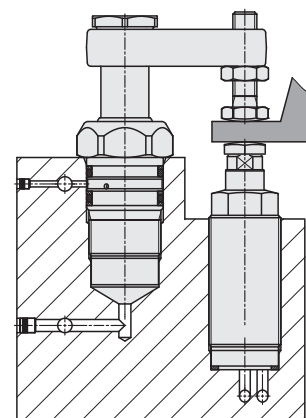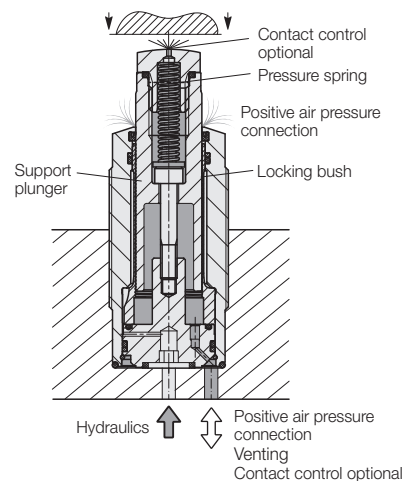### Positive air pressure connection
To guarantee functioning of the work supports, a vent port is imperative. No liquids may enter the end of the bore hole (see also data sheet G 0.110 „Venting of the spring area").

It is recommended to connect positive air pressure protection. While locking the support plunger, the positive air pressure must not exceed 4 bar. If the support plunger is not locked, the positive air pressure must be reduced to a maximum of 0.2 bar.

The positive air pressure connection must be free of oil and water.

### Example type 1940 XXX
Support plunger in off-position extended



Contact control optional
Pressure spring
Positive air pressure connection
Locking bush
Support plunger

Hydraulics
Positive air pressure connection
Venting
Contact control optional



Connection of positive air pressure protection

### Spring force
### Part no. 1940 XXX



### Pneumatically
### Part no. 1941 XXX



### Hydraulically and spring force
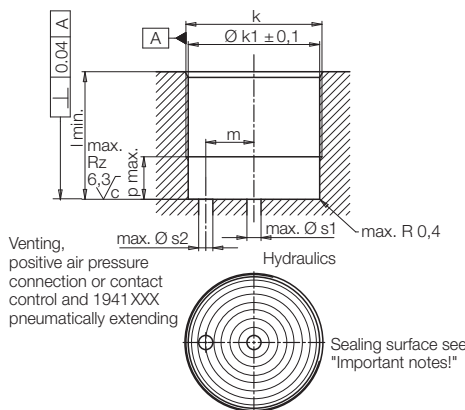### Part no. 1942 XXX
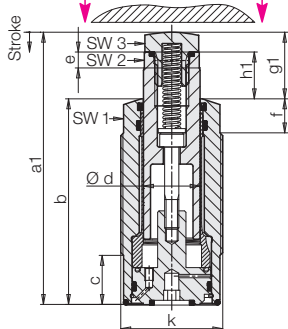


**Off-position:**
Support plunger extended
Contact by spring force

When inserting the workpiece, the support plunger is pushed back, the spring force has to be overcome (see page 4).
The support plunger will be locked by hydraulic pressure and can compensate forces in axis direction.
After unclamping, the support plunger still contacts the workpiece with spring force, until the workpiece will be unloaded from the fixture.

**Porting details**



Venting, positive air pressure connection or contact control and 1941 XXX pneumatically extending

Sealing surface see "Important notes!"

**Important notes!**
Machining
The code letter c in the surface finish symbol for the sealing surface stands for a concentric groove direction (see drawing), that is given in case of a lowered sealing surface.
In the case of circularly milled surfaces leakages can occur, since the grooves run at right angle to the sealing surface.
Pay attention when mounting:
The location hole must be dry and oil-free to ensure that no liquids penetrate into the spring area of the work supports.
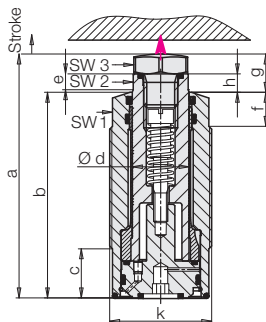When exchanging work supports:
To get a dry location hole, the hydraulic oil in drilled channels must be removed.

**Protection cap** (accessories)
The protection cap is fixed by means of the standard contact bolt to the support plunger.
It shall be used above all, if a strong coolant jet is directed onto the support plunger or the wiper edge.



Top view
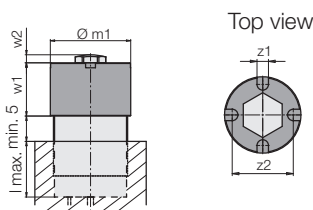
**Off-position:**
Support plunger retracted
Extend and contact with air pressure

The support plunger contacts the workpiece by air pressure. The contact force is proportional to the air pressure less spring return force (see page 4).
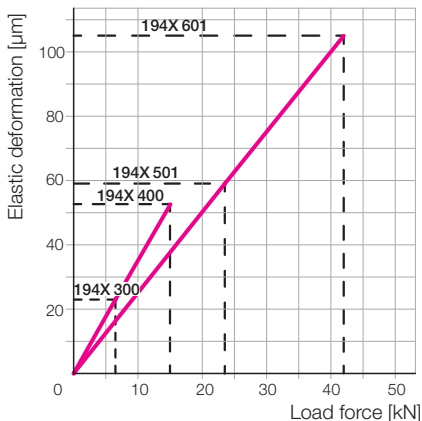The support plunger will be locked by hydraulic pressure and can compensate forces in axis direction.
For retraction, hydraulic and air pressure will be released and the support plunger retracts by spring force to its off-position.

**Adm. load force F**
**as a function of the operating pressure p**
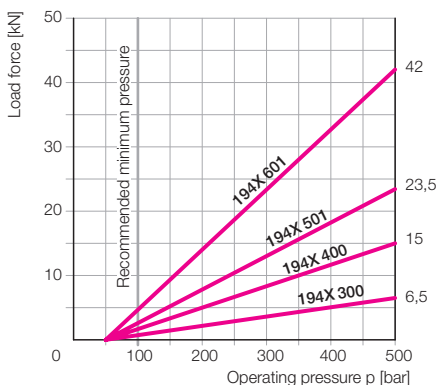


**Elastic deformation with load force F and operating pressure 500 bar**
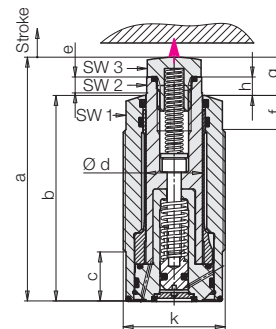


**Off-position:**
Support plunger retracted
Extend with hydraulics
Contact by spring force

The support plunger is extended by a hydraulically pressurised small piston and contacts the workpiece with spring force.
The support plunger will be locked by increasing hydraulic pressure and can compensate forces in axis direction.
For retraction, the hydraulic pressure will be released. The small piston retracts by spring force to its off-position and also retracts the support plunger.

**Required dimensions for self-made contact bolts**

Valid for
1940 300
1941 300 ($\varnothing v = 6.7$; $q = 5.5$)
1942 300
194 X 400 (without undercut $\varnothing 9.1$)
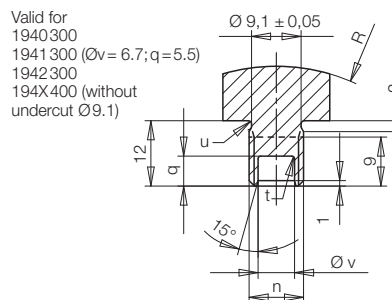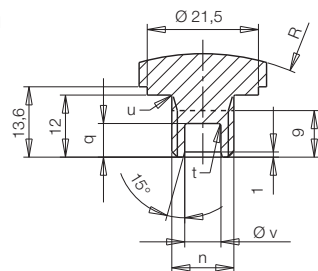


Valid for
194 X 501



Valid for
194 X 601



**Contact bolt for contact control**

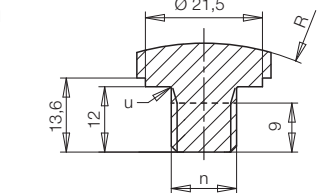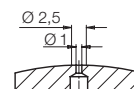| | | 6.5 | | 15 | 23.5 | 42 |
|---|---|---|---|---|---|---|
| **Adm. load force (500 bar)** | [kN] | 6.5 | | 15 | 23.5 | 42 |
| Support plunger Ø d | [mm] | 16 | | 20 | 28 | 32 |
| **Stroke** | **[mm]** | **8** | **15** | **10** | **10** | **16** |
| Recommended minimum pressure | [bar] | 100 | | 100 | 100 | 100 |
| **Type** | | | | | | |
| 1940 Spring contact force min./max. | [N] | 10/13 | – | 14/25 | 22/35 | 34/64 |
| Recommended pressure for positive air pressure connection | [bar] | 0.2 | – | 0.2 | 0.2 | 0.2 |
| 1941 Pneumatic contact force at 1 bar | [N] | 20 | – | 31.4 | 61.5 | 80 |
| minus spring return force min./max. | [N] | 24.5/35 | – | 19/31 | 22/35 | 31/52 |
| 1942 Spring contact force min./max. | [N] | 10/13 | 10/23 | 14/25 | 22/35 | 32/61 |
| Spring return force min./max. | [N] | 19/39 | 16/57 | 30/52 | 47/69 | 67/88 |
| Max. pressure of positive air pressure connection | [bar] | 0.2 | | 0.2 | 0.2 | 0.2 |
| Max. return pressure | [bar] | 1 | | 1 | 1 | 1 |
| Required oil per stroke | [cm$^3$] | 0.5 | 1 | 0.8 | 1.54 | 3.22 |
| Elastic deformation with load and 500 bar operating temperature | [µm/kN] | 3.5 | | 3.5 | 2.5 | 2.5 |
| Operating temperature | [°C] | 0…70 | | 0…70 | 0…70 | 0…70 |
| Tightening torque | [Nm] | 60 | | 100 | 200 | 400 |
| a | [mm] | 75.5 | 82.5 | 86 | 90 | 115 |
| a1 | [mm] | 83.5 | | 96 | 100 | 131 |
| b | [mm] | 59 | 66 | 72.5 | 78 | 102.5 |
| c | [mm] | 8.5 | | 17.5 | 20.5 | 20.5 |
| e | [mm] | 6 | | 5.6 | 3 | 4 |
| f | [mm] | 10.5 | | 12 | 12 | 18 |
| g | [mm] | 16.5 | | 13.5 | 12 | 12.5 |
| g1 | [mm] | 24.5 | | 23.5 | 22 | 28.5 |
| h | [mm] | 6.5 | | 6.5 | 4 | 4.5 |
| h1 | [mm] | 14.5 | | 16.5 | 14 | 20.5 |
| k | [mm] | M30x1.5 | | M36x1.5 | M48x1.5 | M60x1.5 |
| Øk1 | [mm] | 28.4 | | 34.4 | 46.4 | 58.4 |
| l min. | [mm] | 21 | | 35 | 42 | 46 |
| l max. | [mm] | 37.5 | | 49 | 53.5 | 65.5 |
| m | [mm] | 10 | | 12 | 17 | 22 |
| Øm1 | [mm] | 35 | | 40 | 52 | 65 |
| n | [mm] | M10 | | M12 | M12 | M12 |
| p max. | [mm] | 8 | | 15 | 18 | 18 |
| q | [mm] | 19 | | 15 | 6.5 | – |
| Øs1 max. | [mm] | 8 | | 10 | 14 | 16 |
| Øs2 max. | [mm] | 2 | | 4 | 5 | 5 |
| t | [mm] | 0.5 | | 0.2 | 0.5 | – |
| u | [mm] | 0.6 | | 0.3 | 0.3 | 0.3 |
| Øv | [mm] | 6 | | 6.9 | 7 | – |
| w1 | [mm] | 28 | | 30 | 30 | 43 |
| w2 | [mm] | 10 | | 7 | 6.4 | 6.4 |
| z1 | [mm] | 5 | | 6 | 8 | 8 |
| z2 | [mm] | 28 | | 32 | 43 | 53 |
| R | [mm] | 35 | | 45 | 45 | 45 |
| SW1 | [mm] | 24 | | 30 | 41 | 50 |
| SW2 | [mm] | 13 | | 17 | 22 | 27 |
| SW3 | [mm] | 17 | | 19 | 22 | 22 |
| Weight, approx. | [kg] | 0.32 | 0.35 | 0.55 | 1.0 | 2.3 |

| **Part no.** | | 6.5 | | 15 | 23.5 | 42 |
|---|---|---|---|---|---|---|
| **Contact by spring force** | | 1940 300**P** | – | 1940 400**P** | 1940 501**P** | 1940 601**P** |
| **Pneumatically extended** | | 1941 300**P** | – | 1941 400**P** | 1941 501**P** | 1941 601**P** |
| **Hydraulically extended and spring force** | | 1942 300**P** | 1942 305**P** | 1942 400**P** | 1942 501**P** | 1942 601**P** |

**P** = Option contact control (see also page 5)

| **Accessories** | | 6.5 | 15 | 23.5 | 42 |
|---|---|---|---|---|---|
| **Protection cap (splash guard)** | | 3546 110 | 3546 111 | 3546 112 | 3546 113 |
| Weight protection cap | [kg] | 0.023 | 0.025 | 0.032 | 0.062 |
| **Contact bolt for contact control** | | 3614 390 | 3614 389 | 3614 391 | 3614 418 |
| **Contact bolt without contact control** | | 3614 330 | 3614 388 | 3614 420 | 3614 419 |

# Contact forces on the workpiece

## Spring force
**Part no. 1940 XXX**



Venting · Hydraulics
Positive air pressure connection
Contact control
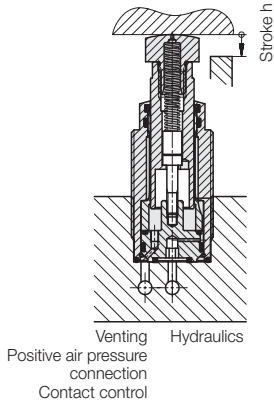
Spring contact force $F_{F0}$ as a function of the stroke of the support plunger h



$$F_{F0} = F_{F0min.} * (R_2 + h)$$

Pneumatic contact forces ($F_S$, $F_P$) as a function of the air pressures ($p_S$, $p_A$)



$$F_S = A * p_S$$
$$F_P = A * p_A$$

---

## Pneumatically
**Part no. 1941 XXX**



Pneumatics "Extending" · Hydraulics
Contact control

Pneumatic contact force $F_p$ as a function of the air pressure $p_A$



$$F_p = A * p_A$$

Spring return force $F_R$ as a function of the stroke of the support plunger h



$$F_R = F_{F1min.} + (R_1 * h)$$

---

## Spring force
**Part no. 1942 XXX**



Venting · Hydraulics
Positive air pressure connection
Contact control

Spring contact force $F_{F2}$ as a function of the stroke of the support plunger h



$$F_{F2} = F_{F2max.} - (R_2 * h)$$

Pneumatic contact forces ($F_S$, $F_P$) as a function of the air pressures ($p_S$, $p_A$)



$$F_s = A * p_s$$
$$F_P = A * p_A$$

---

### Constant

| 1940- | 300 | 400 | 501 | 601 |
|---|---|---|---|---|
| $F_{F0min.}$ | 10 | 14 | 22 | 34 |
| $R_2$ | 0.364 | 1.103 | 1.34 | 1.82 |
| A | 20.1 | 31.4 | 61.5 | 80 |
| Weight force* | | | | |
| Support plunger [N] | 0.5 | 1.3 | 2.5 | 3.9 |
| Protection cap [N] | 0.23 | 0.25 | 0.32 | 0.62 |

### Constant

| 1941- | 300 | 400 | 501 | 601 |
|---|---|---|---|---|
| $F_{F1min.}$ | 24 | 19 | 22 | 31 |
| $R_1$ | 1.34 | 1.26 | 1.26 | 1.3 |
| A | 20.1 | 31.4 | 61.5 | 80 |
| Weight force* | | | | |
| Support plunger [N] | 0.5 | 1.3 | 2.5 | 3.9 |
| Protection cap [N] | 0.23 | 0.25 | 0.32 | 0.62 |

### Constant

| 1942- | 300 | 305 | 400 | 501 | 601 |
|---|---|---|---|---|---|
| $F_{F2max.}$ | 13 | 23 | 25 | 35 | 61 |
| $R_2$ | 0.364 | 0.875 | 1.103 | 1.34 | 1.82 |
| A | 20.1 | 20.1 | 31.4 | 61.5 | 80 |
| Weight force* | | | | | |
| Sup. plunger [N] | 0.5 | 0.6 | 1.3 | 2.5 | 3.9 |
| Prot. cap [N] | 0.23 | 0.23 | 0.25 | 0.32 | 0.62 |

**\*** For vertical installation: top [-], down [+]. See examples.

---

**Example** Work support 1940 300
Protection cap 3546 110
Vertical upward installation
Pres. of pos. air pres. con. 0.2 bar
Stroke of support plunger h = 4 mm

spring force $F_{F0} = F_{F0min.} + (R_2 * h)$
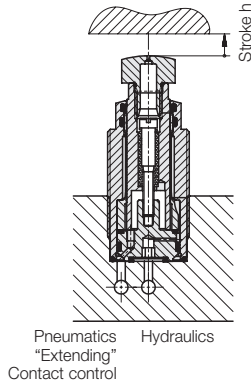$F_{F0} = 10 + (0.364 * 4)$ = 11.45 N

+force of pos. air pres. con. $F_S = A * p_S = 20.1 * 0.2$ = 4.02 N
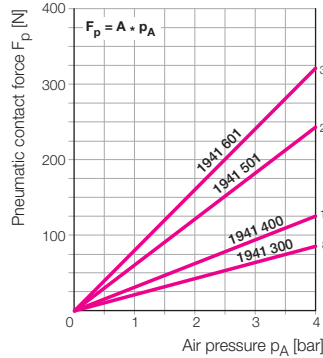
– weight force support plunger = 0.50 N
– weight force protection cap = 0.23 N
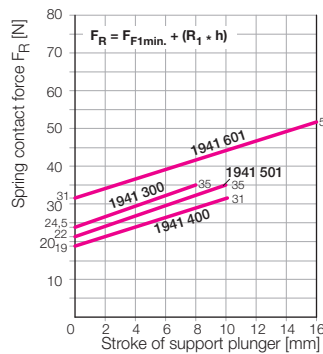
contact force = 14.74 N

---

**Example** Work support 1941 501
Vertical upward installation
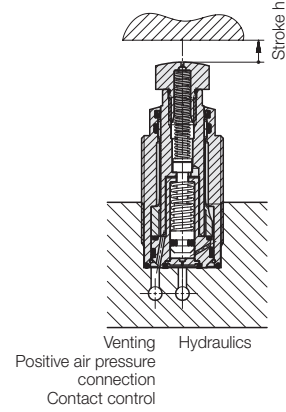Air pressure 1.5 bar
Stroke of support plunger h = 7 mm

pneumatic force
$F_p = A * p_A = 61.5 * 1.5$ = 92.25 N
– spring return force $F_R$
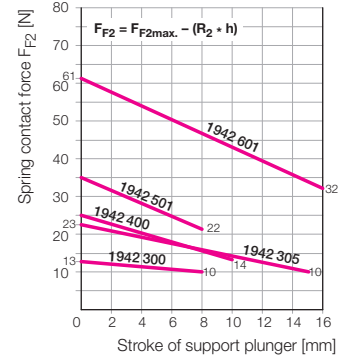$F_R = F_{F1min.} + (R_1 * h) = 22 + (1.26 * 7)$ = 30.82 N
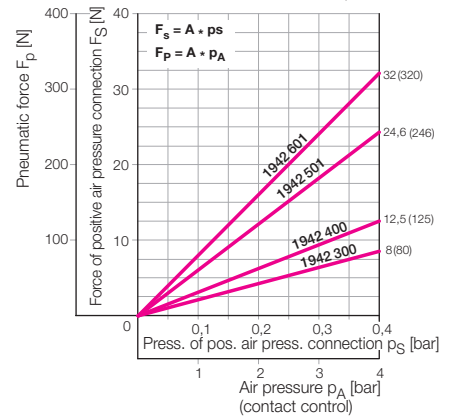– weight force support plunger = 2.50 N

contact force = 58.93 N

---

**Example** Work support 1942 400**P**
Vertical upward installation
Contact control 2 bar
Stroke of support plunger h = 4 mm

spring force
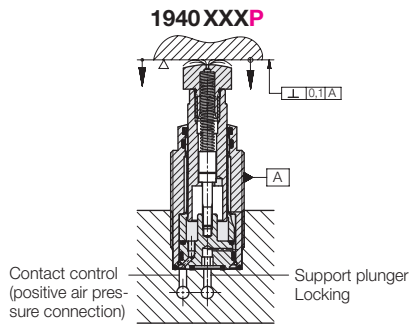$F_{F2} = F_{F2max.} - (R_2 * h) = 25 - (1.103 * 4)$ = 20.58 N
+ pneumatic contact force $F_p$
$F_P = A * p_A = 31.4 * 2$ = 62.80 N
– weight force support plunger = 1.30 N

contact force = 82.08 N

---

Subject to modifications

### 1940 XXX**P**

Contact control (positive air pressure connection) — Support plunger Locking

**Off-position:**
Support plunger extended with spring force.
Positive air pressure connection of 0.2 bar switched on, if required.
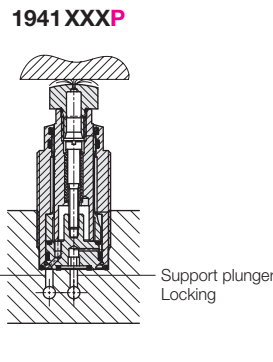
**Function sequence**
Workpiece loading
and clamping on fixed points.

Switch on contact control
After the message "support plungers are in contact"
Hydraulic clamping of support plungers.

Machining of the workpiece
Switch off contact control or reduce pressure of positive air pressure connection to 0,2 bar.

Alternative
Leave the contact control continuously switched on.
Advantage:
Acts as a positive air pressure connection.
Disadvantages:
Higher contact force of support plunger
Signals workpiece contact before the workpiece is clamped to fixed points.

### 1941 XXX**P**

Extend support plunger + contact control (positive air pressure connection) — Support plunger Locking

**Off-position:**
Support plunger retracted with spring force.
Positive air pressure connection of 0.2 bar switched on, if required.

**Function sequence**
Workpiece loading
and clamping on fixed points.

Switch on pneumatic pressure to extend and contact control
Support plungers move pneumatically against the workpiece
After the message "support plungers are in contact"
Hydraulic clamping of support plungers.

Machining of the workpiece
Switch off contact control or reduce pressure of positive air pressure connection to 0,2 bar.

**Important note!**
Before unclamping, switch off pneumatic pressure and contact control or reduce pressure of positive air pressure connection to 0.2 bar to allow retraction of the support plunger by spring force.

### 1942 XXX**P**

Contact control (positive air pressure connection) — Extend support plunger + Locking
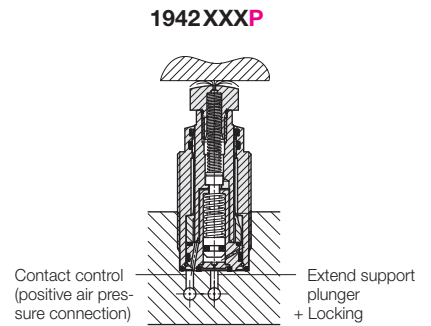
**Off-position:**
Support plunger retracted with spring force.
Positive air pressure connection of 0.2 bar switched on, if required.

**Function sequence**
Workpiece loading
and clamping on fixed points.

Switch on hydraulics for support plunger
Support plungers extend hydraulically, they are in contact with the workpiece by spring force and are hydraulically locked.

Switch on contact control
After the message "support plungers are in contact"

Machining of the workpiece
Switch off contact control or reduce pressure of positive air pressure connection to 0,2 bar.

**Important note!**
Before unclamping, switch off pneumatic pressure for contact control or reduce pressure of positive air pressure connection to 0.2 bar to allow retraction of the support plunger by spring force.

---

**Limits of application**
The pneumatic contact control can only be used if
• the contact surface at the workpiece is square to the axis of the work support.
• the contact surface is machined.
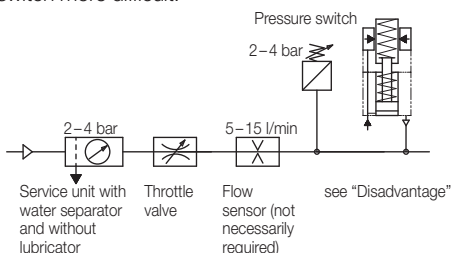• the air is free of oil and water.

**Signal conversion: pneumatic - electric**
If the contact bolt is in contact with the workpiece, the little nozzle will be closed.
An electro-pneumatic measuring device can either measure the pressure increase or a drop of the air flow rate.

**1. Pressure switch**
Advantage
Easy adjustment.

Disadvantage
When contacting the workpiece, the tightness of the nozzle depends on the surface quality of the contact surface and depending on the workpiece more or less large changes in air pressure are possible. With an increasing number of work supports, the pressure differences will decrease and this makes the process-safe setting of a pressure switch more difficult.
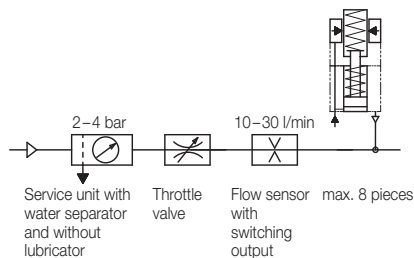
Pressure switch
2–4 bar

2–4 bar    5–15 l/min    see "Disadvantage"

Service unit with water separator and without lubricator | Throttle valve | Flow sensor (not necessarily required)

Recommendation
If several work supports have to be controlled, a flow measurement is preferable.

**2. Flow meter**
The flow meter should have a digital display and at least one adjustable limit switch with a binary output (e.g. type SFAB of FESTO).
Advantages
For the flow measurement, an air pressure of 2 to 4 bar is sufficient so that the support plunger contact force at the workpiece is still relatively low.
Simple adjustment of the switching point:
1. Measure the flow rate (Qmin) when all support plungers are in contact with the workpiece.
2. Repeat the measurement if 1 support plunger has no contact (Qmax).
3. Enter and save
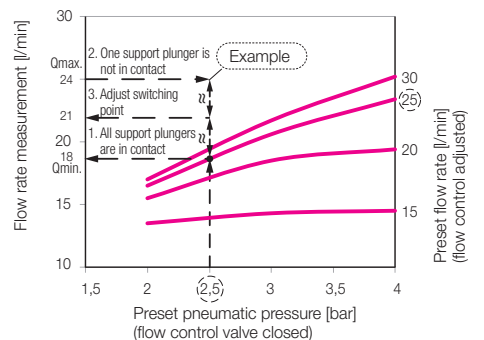   switching point = 0.5 x (Qmin + Qmax).
Disadvantages
If the difference (Qmax – Qmin) is too small, increase the flow rate or reduce the number of support points per sensor.

2–4 bar    10–30 l/min

Service unit with water separator and without lubricator | Throttle valve | Flow sensor with switching output | max. 8 pieces

Alternatives
The air gap sensor SOPA from FESTO has an integrated compressed air preparation, as well as two solenoid valves for measuring air and positive air pressure connection.
The device can be expanded to 4 measuring circuits.

**Diagram for switching point determination**
for flow meters with built-in limit switch as a function of the flow rate and the pneumatic pressure. The curves were determined in the test and apply for the following situation:
"In clamped mode, at least one work support of maximum 8 off is not correctly in contact with the workpiece."

Flow rate measurement [l/min] vs Preset pneumatic pressure [bar] (flow control valve closed). Preset flow rate [l/min] (flow control adjusted).
- 2. One support plunger is not in contact
- Example
- 3. Adjust switching point
- 1. All support plungers are in contact

**Example** 8 work supports 1942 400**P**
Preset pneumatic pressure    2.5 bar
Preset flow rate    25 l/min

As per diagram:
Flow rate, if all work supports
are in contact    approx. 18 l/min
Flow rate, if at least one
support plunger is not in contact   approx. 24 l/min
Switching point    = 0.5 * (18 + 24) = 21 l/min
The limit switch at the flow meter is adjusted to 21 l/min.

**3. Differential pressure switch**
Differential pressure switches (e.g. PEL-System) require only 0.5 to 1.5 bar working pressure.
The exact adjustment of a setting nozzle under practical conditions is required.

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