

# Axial piston variable pump A10VO Series 52 and 53



- ▶ For machines with medium pressure requirements
- ▶ Sizes 10 to 100
- ▶ Nominal pressure 250 bar
- ▶ Maximum pressure 315 bar
- ▶ Open circuit

## Features

- ▶ Variable pump with axial piston rotary group in swashplate design for hydrostatic drives in open circuit.
- ▶ Flow is proportional to drive speed and displacement.
- ▶ The flow can be infinitely varied by adjusting the swashplate angle.
- ▶ Stable bearing for long service life
- ▶ High permissible drive speed
- ▶ Favorable power-to-weight ratio – compact dimensions
- ▶ Low noise
- ▶ Excellent suction characteristics
- ▶ Electro-hydraulic pressure control
- ▶ Power control
- ▶ Electro-proportional swivel angle control
- ▶ Short control response times

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## Type code series 52

01	02	03	04	05	06	07	08	09	10	11	12
<b>A10V(S)</b>	<b>O</b>		/	<b>52</b>		-	<b>V</b>				

### Axial piston unit

01	Swashplate design, variable, nominal pressure 250 bar, maximum pressure 315 bar	<b>10</b>	<b>28</b>	<b>45</b>	<b>60</b>	<b>85</b>	<b>A10VS</b>
		●	-	-	-	-	<b>A10V</b>
		-	●	●	●	●	

### Operating mode

02	Pump, open circuit	<b>O</b>
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### Size (NG)

03	Geometric displacement, see table of values on page 10	<b>10</b>	<b>28</b>	<b>45</b>	<b>60</b>	<b>85</b>
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### Control device

04	Pressure controller	hydraulic					<b>DR</b>
	with flow controller	hydraulic	X-T open				<b>DFR</b>
			X-T plugged	with flushing function			<b>DFR1</b>
				without flushing function			<b>DRSC</b>
	with pressure cut-off	hydraulic	remote controlled				<b>DRG</b>
		electric	negative control	$U = 12\text{ V}$			<b>ED71</b>
				$U = 24\text{ V}$			<b>ED72</b>
		electric	positive control	$U = 12\text{ V}$			<b>ER71</b>
				$U = 24\text{ V}$			<b>ER72</b>
	Differential pressure control		electric control (negative control)				<b>EF..<sup>1)</sup></b>

### Series

05	Series 5, index 2	<b>10</b>	<b>28</b>	<b>45</b>	<b>60</b>	<b>85</b>	<b>52</b>
		●	●	●	●	●	

### Direction of rotation

06	Viewed on drive shaft	clockwise	<b>R</b>
		counter-clockwise	<b>L</b>

### Sealing material

07	FKM (fluoroelastomer)	<b>V</b>
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### Drive shaft

08	Splined shaft ISO 3019-1	Standard shaft					<b>S</b>
		similar to shaft "S" however for higher torque					<b>R</b>
		reduced diameter, limited suitability for through drive					<b>U</b>
		similar to shaft "U", however for higher torque only conditionally suitable for mounting with through drive. For mounting options, see page 66					<b>W</b>
	Parallel keyed shaft DIN 6885 limited suitability for through drive						<b>P</b>

### Mounting flange

09	ISO 3019-2 (ISO)	2-hole					<b>A</b>
	ISO 3019-1 (SAE)	2-hole					<b>C</b>
		4-hole					

1) See data sheet 92709 for precise specification

01	02	03	04	05	06	07	08	09	10	11	12
<b>A10V(S)</b>	<b>O</b>		/	<b>52</b>		-	<b>V</b>				

**Working port**

						10	28	45	60	85	
10	SAE flange ports	rear	not for through drive			-	●	●	●	●	<b>11</b>
	Fastening thread metric	laterally opposite	for through drive			-	●	●	●	●	<b>12</b>
		at side, offset 90°	not for through drive; available for counter-clockwise rotation only			-	-	●	-	-	<b>13</b>
	Threaded port metric	rear	not for through drive			●	-	-	-	-	<b>14</b>

**Through drive** (for mounting options, see page 66)

11	Flange ISO 3019-1	Hub for splined shaft <sup>1)</sup>								
	Diameter	Diameter								
	without through drive				●	●	●	●	●	<b>N00</b>
	82-2 (A)	5/8 in	9T 16/32DP		-	●	●	●	●	<b>K01</b>
		3/4 in	11T 16/32DP		-	●	●	●	●	<b>K52</b>
	101-2 (B)	7/8 in	13T 16/32DP		-	●	●	●	●	<b>K68</b>
		1 in	15T 16/32DP		-	-	●	●	●	<b>K04</b>
	127-4 (C)	1 1/4 in	14T 12/24DP		-	-	-	●	●	<b>K15</b>
		1 1/2 in	17T 12/24DP		-	-	-	-	●	<b>K16</b>
	127-2 (C)	1 1/4 in	14T12/24DP		-	-	-	-	●	<b>K07</b>
1 1/2 in		17T 12/24DP		-	-	-	-	●	<b>K24</b>	

**Connector for solenoids**

12	Without connector (without solenoid, only for hydraulic controls, without signs)										●	●	●	●	●	
	DEUTSCH - molded connector, 2-pin, without suppressor diode (for electric control)										-	●	●	●	●	<b>P</b>

● = Available    ○ = On request    - = Not available

**Notice**

- ▶ Observe the general project planning notes on page 72 and the project planning notes regarding each control device.
- ▶ In addition to the type code, please specify the relevant technical data.

1) In accordance with ANSI B92.1a

### Type code series 53

01	02	03	04	05	06	07	08	09	10	11	12
<b>A10V</b>	<b>O</b>			<b>/</b>	<b>53</b>		<b>-</b>	<b>V</b>			

#### Axial piston unit

01	Swashplate design, variable, nominal pressure 250 bar, maximum pressure 315 bar	18	28	45	63	72	85	100	<b>A10V</b>
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#### Operating mode

02	Pump, open circuit	<b>O</b>
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#### Size (NG)

03	Geometric displacement, see table of values on page 10	18	28	45	63	72	85	100
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#### Control device

04	Pressure controller	hydraulic									<b>DR</b>	
	with flow controller	hydraulic	X-T open								<b>DRF</b>	
			X-T plugged	with flushing function							<b>DRS</b>	
				without flushing function							<b>DRSC</b>	
	with pressure cut-off	hydraulic	remote controlled								<b>DRG</b>	
		electric	negative control	$U = 12\text{ V}$							<b>ED71</b>	
				$U = 24\text{ V}$							<b>ED72</b>	
		electric	positive control	$U = 12\text{ V}$							<b>ER71</b>	
				$U = 24\text{ V}$							<b>ER72</b>	
	Differential pressure control		electric control (negative control)		o	o	o	o	o		<b>EF..<sup>1)</sup></b>	
	Power control with pressure cut-off	hydraulic	Beginning of control	from 10 to 35 bar								<b>LA5D</b>
				36 to 70 bar								<b>LA6D</b>
				71 to 105 bar								<b>LA7D</b>
				106 to 140 bar								<b>LA8D</b>
				141 to 230 bar								<b>LA9D</b>
	remote controlled	hydraulic	Beginning of control	see LA.D							<b>LA.DG</b>	
	Flow control X-T plugged	hydraulic with flushing function	Beginning of control	see LA.D								<b>LA.DS</b>
				see LA.D								<b>LA.DC</b>
				see LA.D	o	o	o	o	o			<b>LA.EF</b>
	Electro-proportional control		positive control									
with pressure control				$U = 12\text{ V}$							<b>EP1D</b>	
				$U = 24\text{ V}$							<b>EP2D</b>	
with pressure and flow control (load-sensing)		X-T open		$U = 12\text{ V}$							<b>EP1DF</b>	
				$U = 24\text{ V}$							<b>EP2DF</b>	
with pressure and flow control (load-sensing)		X-T plugged		$U = 12\text{ V}$							<b>EP1DS</b>	
				$U = 24\text{ V}$							<b>EP2DS</b>	
with electrohydraulic Pressure control				$U = 12\text{ V}$							<b>EP1ED</b>	
				$U = 24\text{ V}$							<b>EP2ED</b>	

#### Notice

- Observe the project planning notes regarding each control device

<sup>1)</sup> See data sheet 92709 for precise specification

# A10VO 52&53系列柱塞泵

## A10VO Series 52 and 53 Piston Pump



01	02	03	04	05	06	07	08	09	10	11	12
<b>A10V</b>	<b>O</b>			<b>/</b>	<b>53</b>	<b>-</b>	<b>V</b>				

		18 28 45 63 72 85 100										
04	Electro-proportional control	positive control										
	with pressure control	$U = 12 V$		•	•	•	•	•	•	•	•	EK1D
		$U = 24 V$		•	•	•	•	•	•	•	•	EK2D
	Pressure and flow control with controller	X-T open	$U = 12 V$		•	•	•	•	•	•	•	EK1DF
	cut-off (load sensing)		$U = 24 V$		•	•	•	•	•	•	•	EK2DF
	Pressure and flow control with controller	X-T plugged	$U = 12 V$		•	•	•	•	•	•	•	EK1DS
cut-off (load sensing)		$U = 24 V$		•	•	•	•	•	•	•	EK2DS	
electrohydraulic pressure control with	controller cut-off	$U = 12 V$		•	•	•	•	•	•	•	•	EK1ED
		$U = 24 V$		•	•	•	•	•	•	•	•	EK2ED

### Series

05	Series 5, index 3	•	•	•	•	•	•	•	•	•	•	53
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### Direction of rotation

06	Viewed on drive shaft	clockwise								R
		counter-clockwise								L

### Sealing material

07	FKM (fluoroelastomer)								V
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### Drive shaft

08	Splined shaft ISO3019-1	Standard shaft	•	•	•	•	•	•	•	•	S
		similar to shaft "S" however for higher torque	•	•	•	•	•	•	•	•	R
		reduced diameter, limited suitability for through drive	•	•	•	•	•	•	•	•	U
		similar to shaft "U", however for higher torque only conditionally suitable for mounting with through drive. For mounting options, see page 66	-	•	•	•	•	•	•	•	W

### Mounting flange

09	ISO 3019-1 (SAE)	2-hole	•	•	•	•	•	•	•	•	C
		4-hole	-	-	-	•	•	•	•	•	D

### Working port

10	SAE flange ports Fastening thread metric	rear	not for through drive							11
		laterally opposite	for through drive							12
		at side, offset 90°	not for through drive; for counter-clockwise rotation only available							13

01	02	03	04	05	06	07	08	09	10	11	12
<b>A10V</b>	<b>O</b>			<b>/</b>	<b>53</b>		<b>-</b>	<b>V</b>			

**Through drive** (for mounting options, see page 66)

11	Flange ISO 3019-1	Hub for splined shaft <sup>2)</sup>								
	Diameter	Diameter		<b>18</b>	<b>28</b>	<b>45</b>	<b>63</b>	<b>72</b>	<b>85</b>	<b>100</b>
	without through drive			●	●	●	●	●	●	<b>N00</b>
82-2 (A)		5/8 in	9T 16/32DP	●	●	●	●	●	●	<b>K01</b>
		3/4 in	11T 16/32DP	●	●	●	●	●	●	<b>K52</b>
101-2 (B)		7/8 in	13T 16/32DP	-	●	●	●	●	●	<b>K68</b>
		1 in	15T 16/32DP	-	-	●	●	●	●	<b>K04</b>
127-4 (C)		1 1/4 in	14T 12/24DP	-	-	-	●	●	●	<b>K15</b>
		1 1/2 in	17T 12/24DP	-	-	-	-	-	●	<b>K16</b>
127-2 (C)		1 1/4 in	14T12/24DP	-	-	-	-	-	●	<b>K07</b>
		1 1/2 in	17T 12/24DP	-	-	-	-	-	●	<b>K24</b>

**Connector for solenoids**

12	Without connector (without solenoid, only for hydraulic controls, without signs)	●	●	●	●	●	●	●	
	DEUTSCH - molded connector, 2-pin, without suppressor diode (for electric control)	●	●	●	●	●	●	●	<b>P</b>

● = Available    ○ = On request    - = Not available

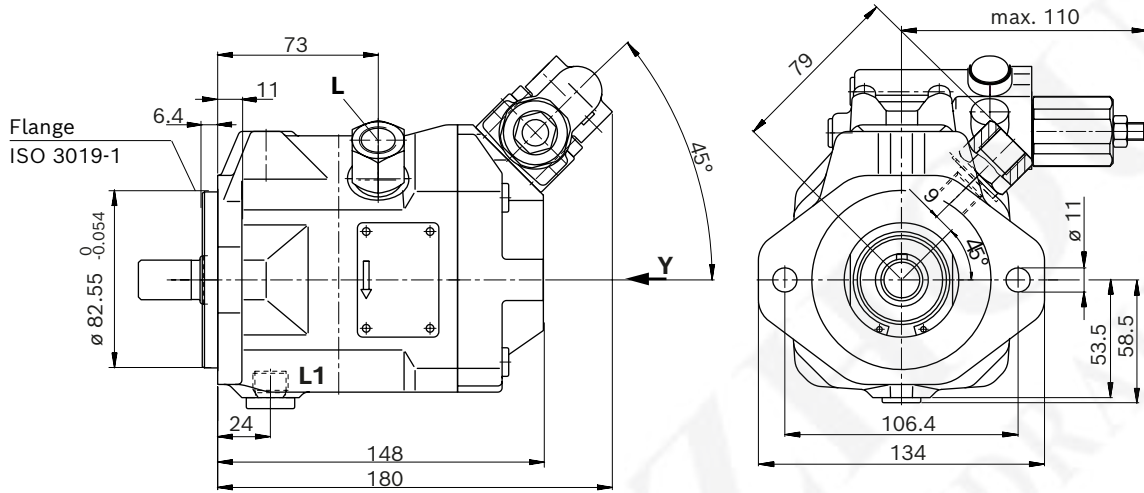
**Notice**

- ▶ Note the project planning notes on page 72.
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.

<sup>2)</sup> In accordance with ANSI B92.1a

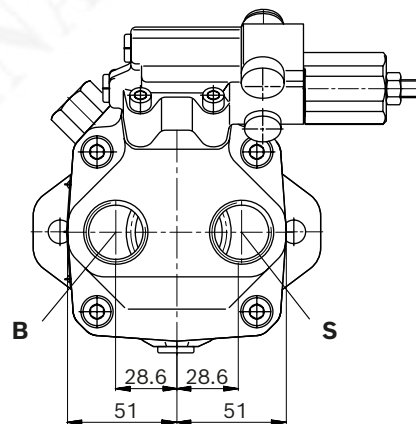
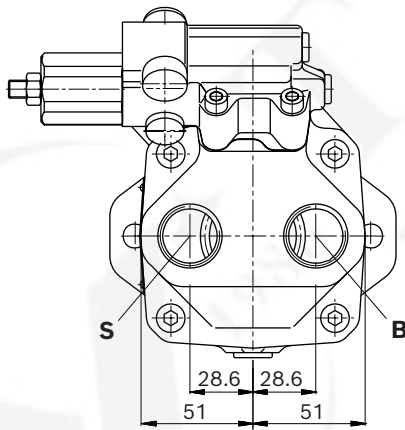
**Dimensions, size 10**

**DR - Pressure controller; mounting flange C SAE version SAE; series 52**



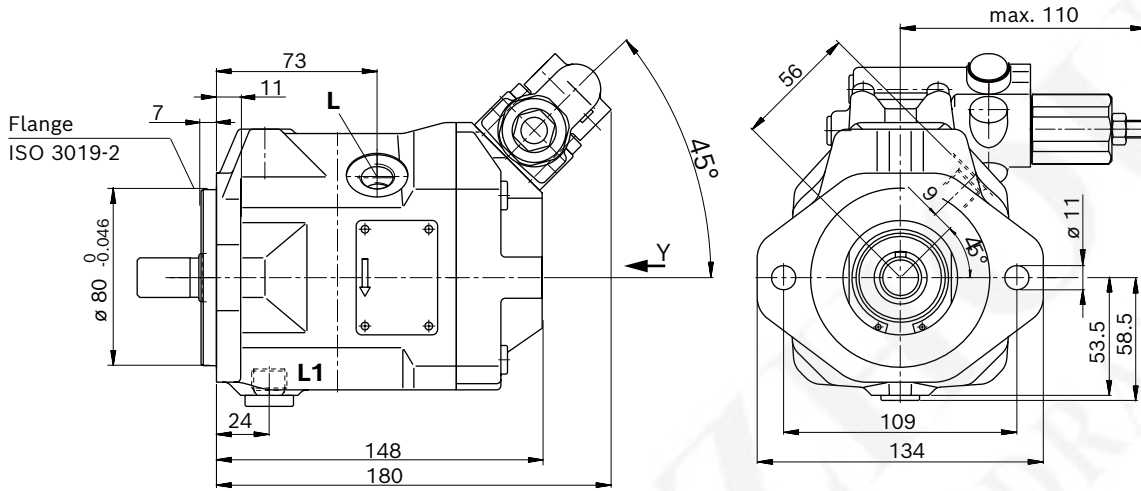
▼ **View Y**  
Valve mounting  
for clockwise  
rotation

▼ **View Y**  
Valve mounting for  
counter-clockwise  
rotation

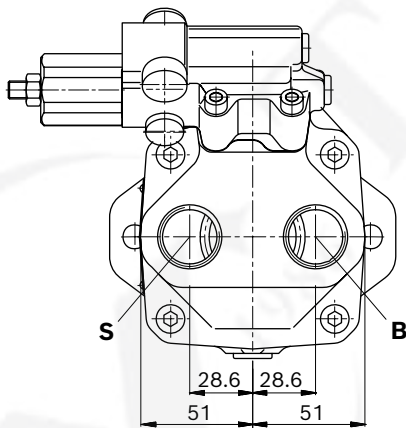


**Dimensions, size 10**

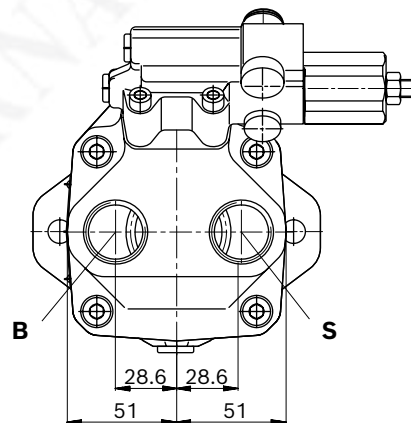
**DR - Pressure controller; mounting flange A metric; series 52**



▼ **View Y**  
Valve mounting  
for clockwise  
rotation

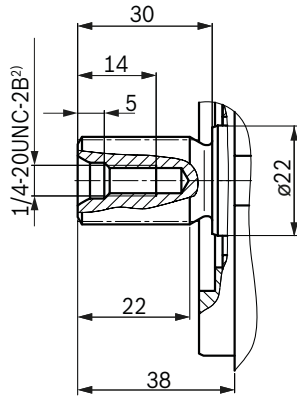


▼ **View Y**  
Valve mounting  
for counter-clockwise  
rotation



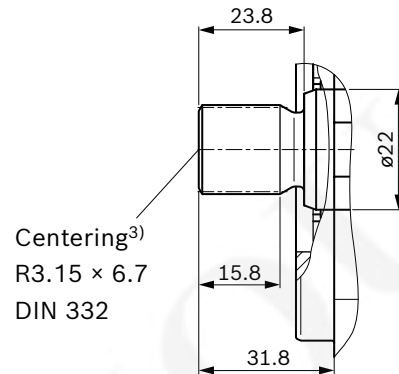
### ▼ Splined shaft 3/4 in (19-4, ISO 3019-1)

S – 11T 16/32DP<sup>1)</sup>



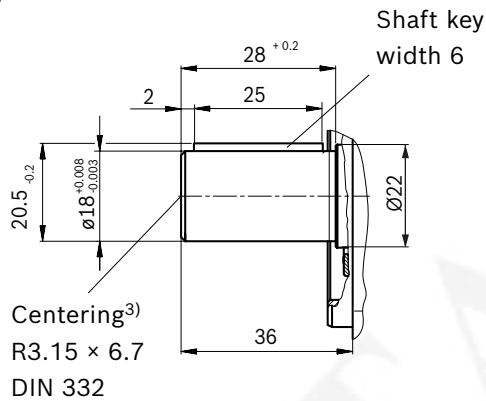
### ▼ Splined shaft 5/8 in (16-4, ISO 3019-1)

U – 9T 16/32DP<sup>1)</sup>



### ▼ Parallel keyed shaft DIN 6885

P – A6x6x25

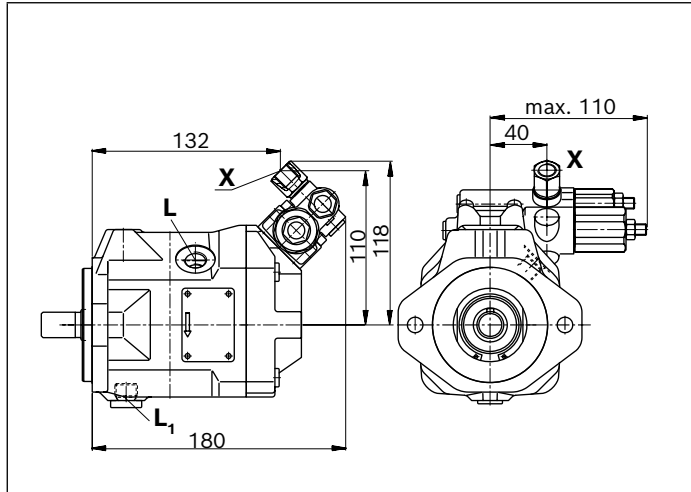


Ports	Standard	Size	$p_{max}$ [bar] <sup>4)</sup>	State <sup>7)</sup>	
<b>B</b>	Working port	DIN 3852	M27 × 2; 16 deep	315	O
<b>S</b>	Suction port	DIN 3852	M27 × 2; 16 deep	5	O
<b>Ports at mounting flange A metric</b>					
<b>L</b>	Drain port	DIN 3852 <sup>5)</sup>	M16 × 1.5; 12 deep	2	O <sup>6)</sup>
<b>L<sub>1</sub></b>	Drain port	DIN 3852 <sup>5)</sup>	M16 × 1.5; 12 deep	2	X <sup>6)</sup>
<b>X with adapter</b>	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	315	O
<b>Ports at mounting flange C SAE</b>					
<b>L</b>	Drain port	ISO 11926 <sup>5)</sup>	9/16-18UNF-2B; 12 deep	2	O <sup>6)</sup>
<b>L<sub>1</sub> with adapter</b>	Drain port	ISO 3852 <sup>5)</sup>	M16 × 1.5; 12 deep	2	X <sup>6)</sup>
<b>X with adapter</b>	Pilot pressure	ISO 3852	M14 × 1.5; 12 deep	315	O

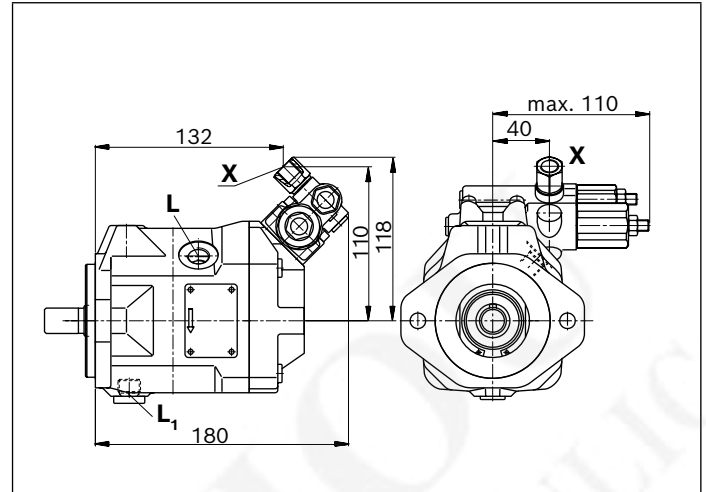
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
 2) Thread according to ASME B1.1  
 3) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw.  
 4) Depending on the application, momentary pressure peaks can occur.  
 Keep this in mind when selecting measuring devices and fittings.

5) The countersink may be deeper than specified in the standard.  
 6) Depending on the installation position, **L** or **L<sub>1</sub>** must be connected (also see installation instructions starting on page 69).  
 7) O = Must be connected (plugged on delivery)  
 X = Plugged (in normal operation)

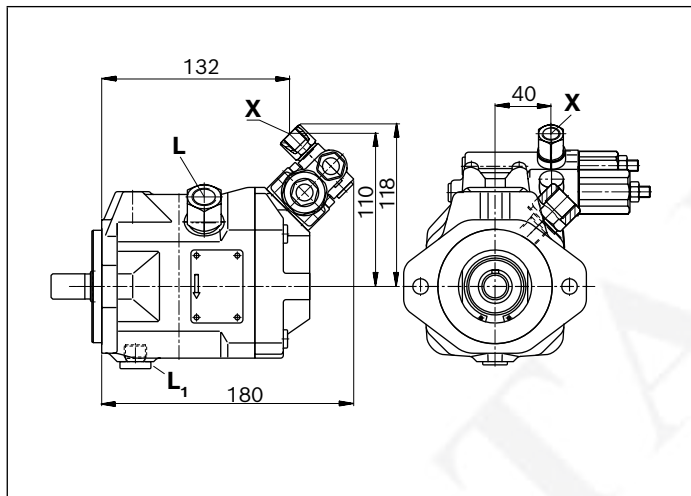
▼ DRG - Pressure controller, remotely controlled (metric)<sup>1)</sup>



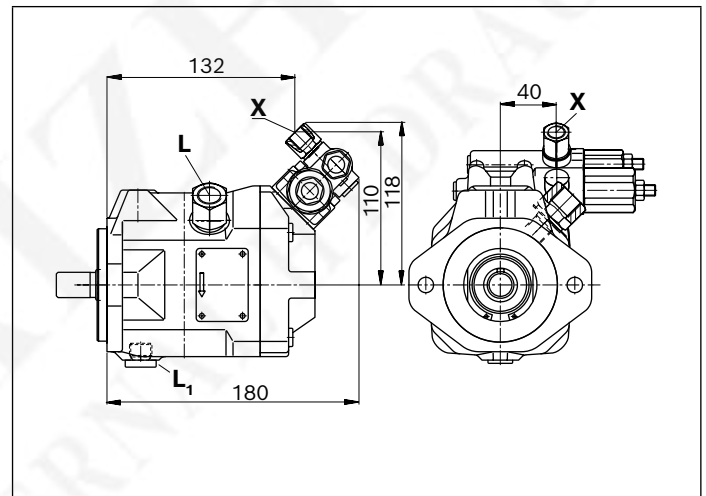
▼ DFR/DFR1 - Pressure, flow controller (metric)<sup>1)</sup>



▼ DRG - Pressure controller, remotely controlled (SAE)<sup>1)</sup>



▼ DFR/DFR1 - Pressure, flow controller (SAE)<sup>1)</sup>

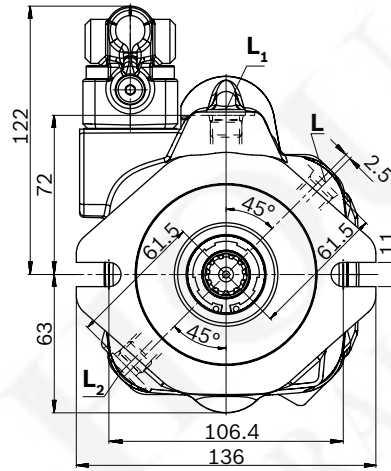
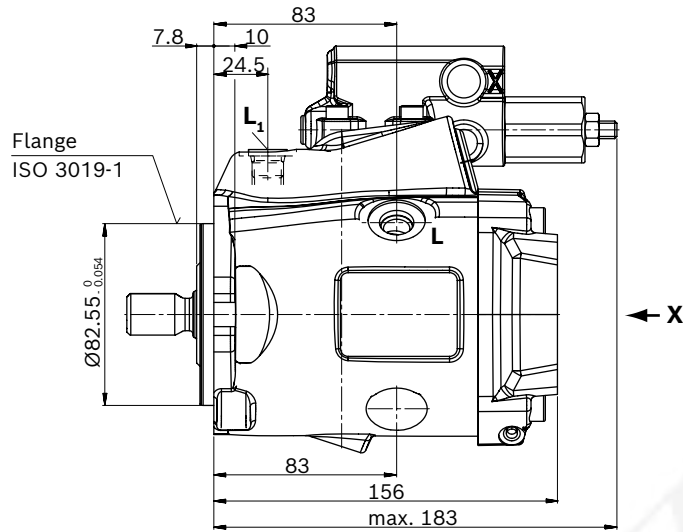


<sup>1)</sup> Valve mounting for clockwise or counter-clockwise rotation see page 11 and 12

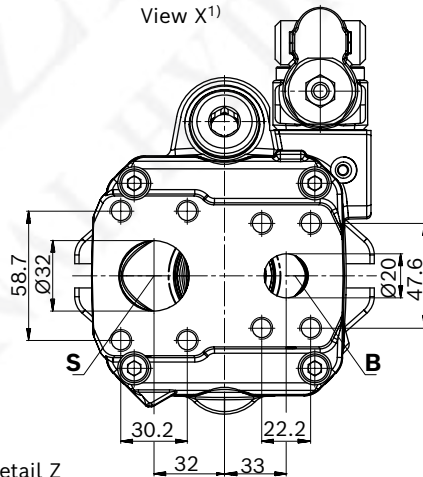
**Dimensions, size 18**

**DR - Hydraulic pressure controller; Clockwise rotation, series 53**

▼ **Port plate 11**

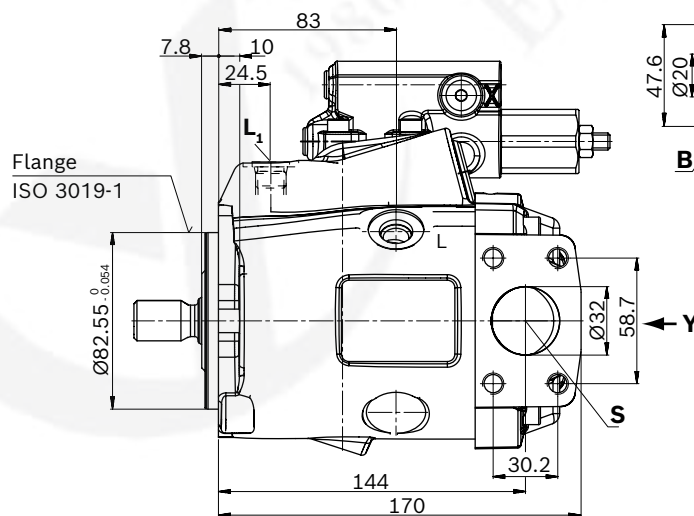


View X<sup>1</sup>)



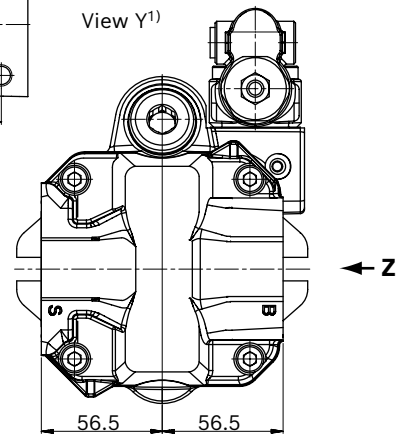
Detail Z

▼ **Port plate 12**



← Y

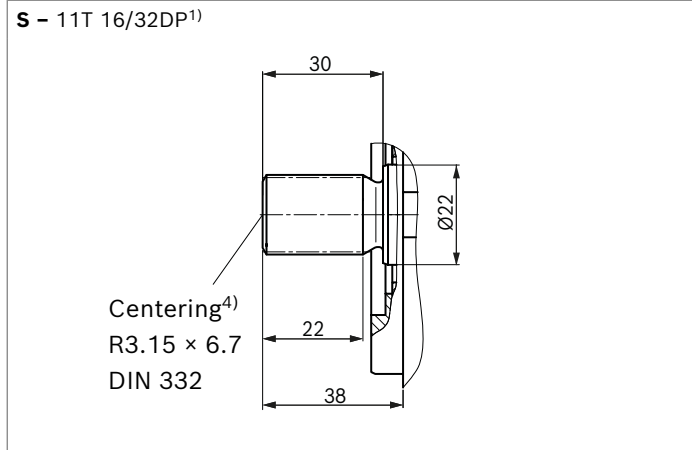
View Y<sup>1</sup>)



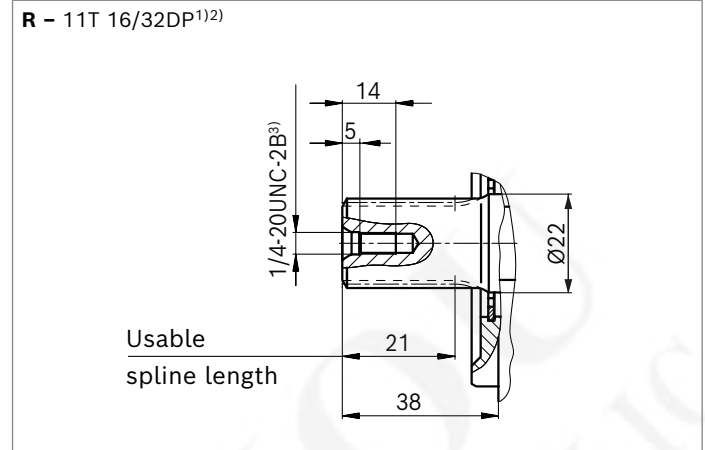
← Z

1) Dimensions of working ports turned through 180° for counter-clockwise rotation

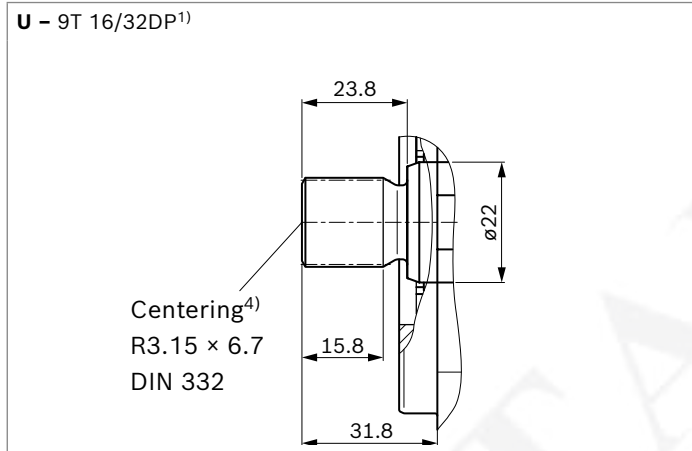
### ▼ Splined shaft 3/4 in (19-4, ISO 3019-1)



### ▼ Splined shaft 3/4 in (similar to ISO 3019-1)



### ▼ Splined shaft 5/8 in (16-4, ISO 3019-1)

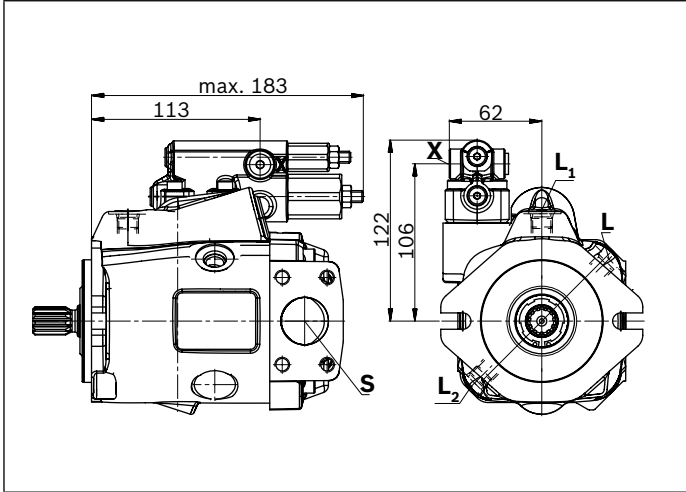


Ports	Standard	Size	$p_{max}$ [bar] <sup>5)</sup>	State <sup>8)</sup>
<b>B</b>	Working port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	3/4 in M10 × 1.5; 17 deep	315 O
<b>S</b>	Suction port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	1 1/4 in M10 × 1.5; 17 deep	5 O
<b>L</b>	Drain port	ISO 11926 <sup>6)</sup>	3/4-16UNF-2B; 12 deep	2 O <sup>7)</sup>
<b>L<sub>1</sub>, L<sub>2</sub></b>	Drain port	ISO 11926 <sup>6)</sup>	3/4-16UNF-2B; 12 deep	2 X <sup>7)</sup>
<b>X</b>	Pilot pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315 O

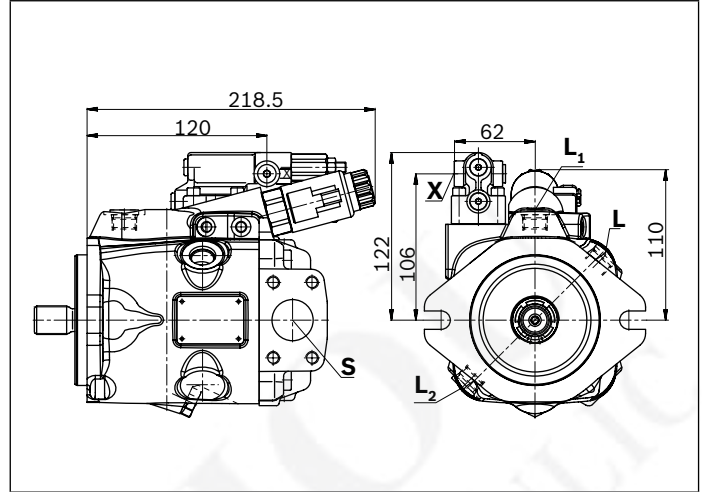
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.  
3) Thread according to ASME B1.1  
4) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw  
5) Depending on the application, momentary pressure peaks can occur.  
Keep this in mind when selecting measuring devices and fittings.

6) The countersink may be deeper than specified in the standard.  
7) Depending on the installation position, **L**, **L<sub>1</sub>** or **L<sub>2</sub>** must be connected (also see installation instructions starting on page 69).  
8) O = Must be connected (plugged on delivery)  
X = Plugged (in normal operation)

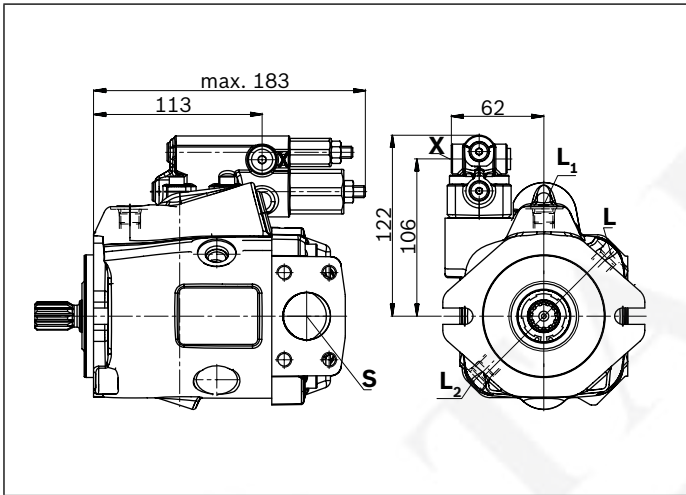
▼ DRG - Pressure controller, remotely controlled, series 53



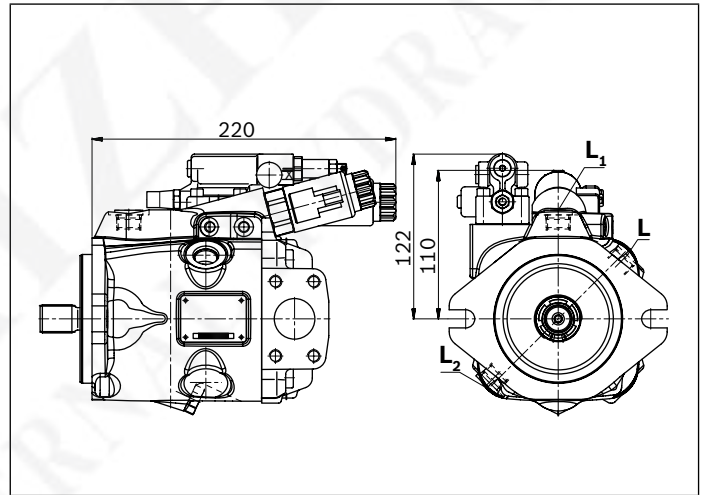
▼ EP.D. / EK.D. - Electro-proportional control, series 53



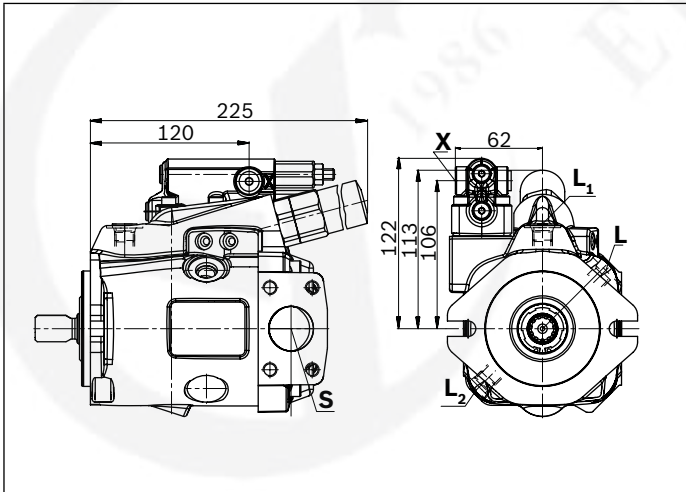
▼ DRF/DRS/DRSC - Pressure and flow controller, series 53



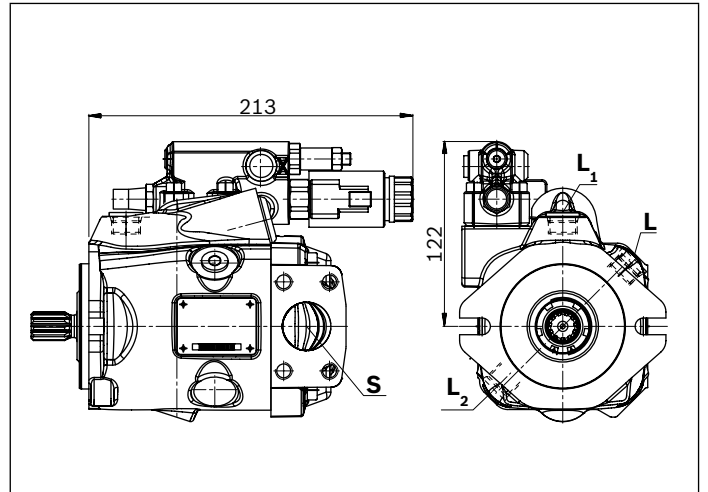
▼ EP.ED. / EK.ED. - Electro-prop. control, series 53



▼ LA.D. - Pressure, flow and power controller, series 53



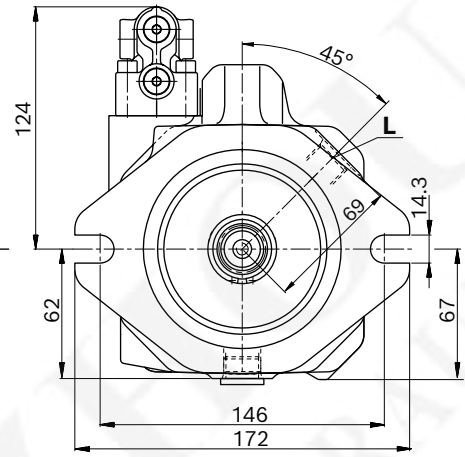
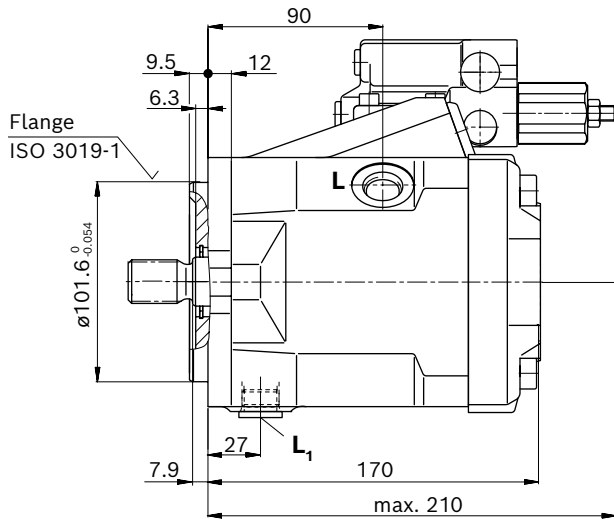
▼ ED7. / ER7. - Electro-prop. Pressure control, series 53



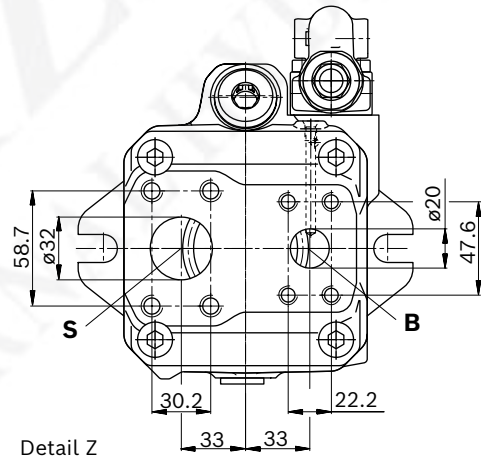
**Dimensions, size 28**

**DR - Hydraulic pressure controller; Clockwise rotation, series 52**

▼ Port plate 11

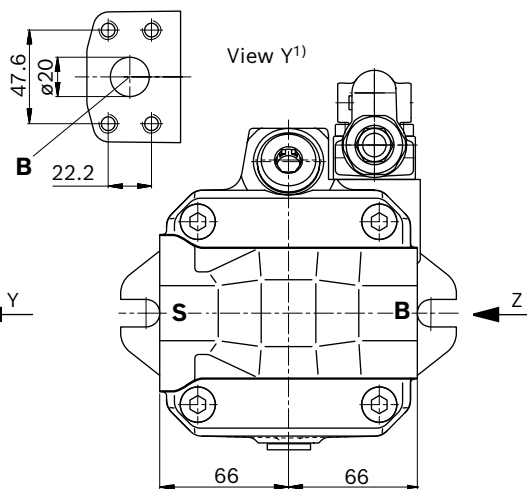
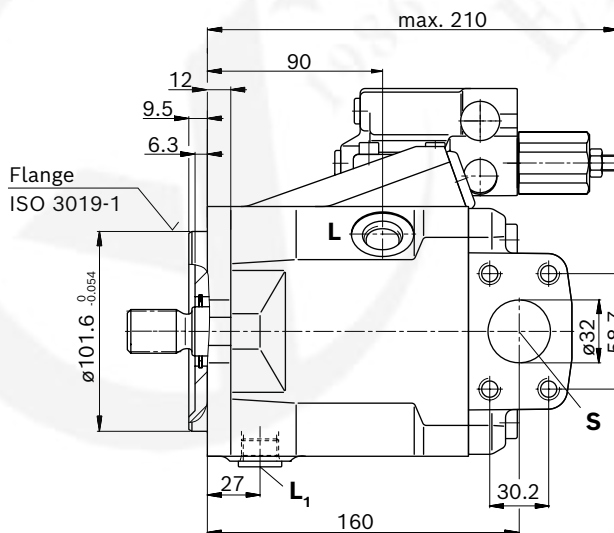


View X<sup>1)</sup>



Detail Z

▼ Port plate 12

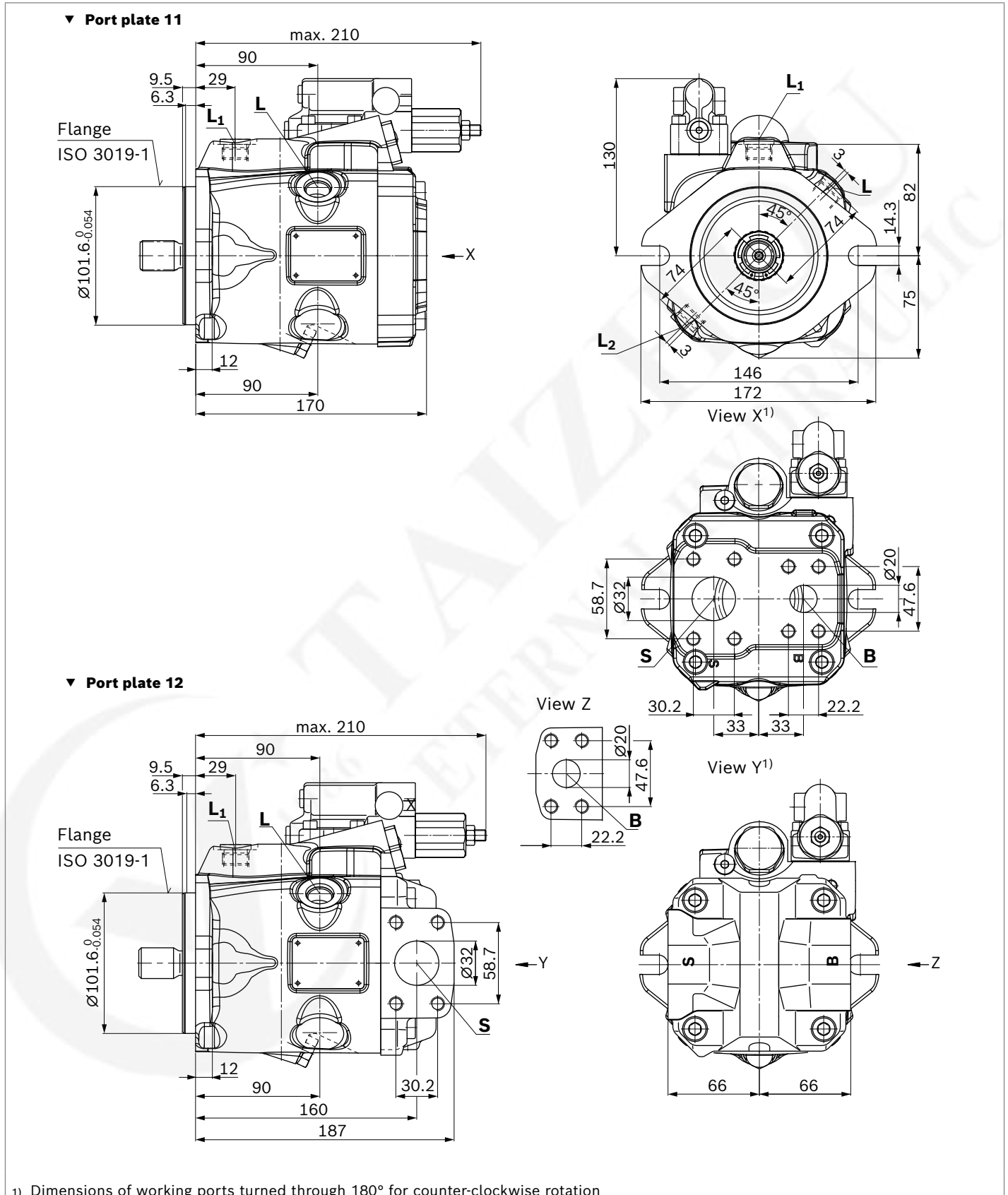


View Y<sup>1)</sup>

1) Dimensions of working ports turned through 180° for counter-clockwise rotation

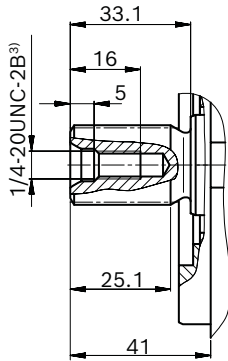
Dimensions, size 28

DR - Hydraulic pressure controller; Clockwise rotation, series 53



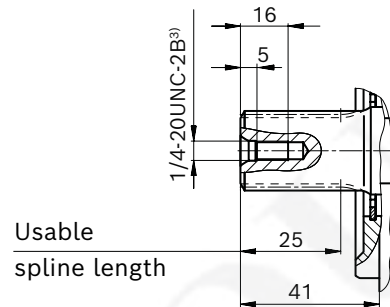
### ▼ Splined shaft 7/8 in (22-4, ISO 3019-1)

S – 13T 16/32DP<sup>1)</sup>



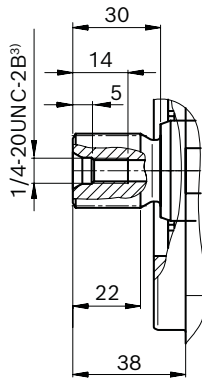
### ▼ Splined shaft 7/8 in (similar to ISO 3019-1)

R – 13T 16/32DP<sup>1)2)</sup>



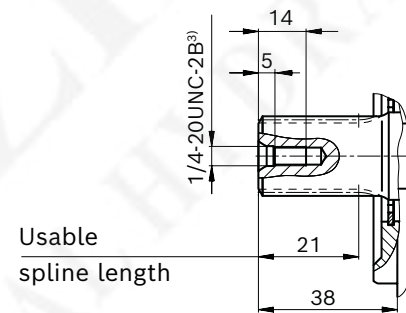
### ▼ Splined shaft 3/4 in (19-4, ISO 3019-1)

U – 11T 16/32DP<sup>1)</sup>



### ▼ Splined shaft 3/4 in (similar to ISO 3019-1)

W – 11T 16/32DP<sup>1)2)</sup>

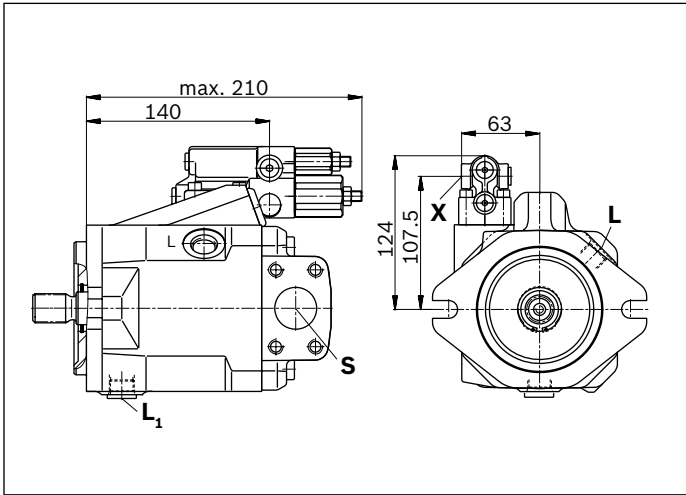


Ports	Standard	Size	$p_{max}$ [bar] <sup>4)</sup>	State <sup>8)</sup>
<b>B</b>	Working port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	3/4 in M10 × 1.5; 17 deep	315 O
<b>S</b>	Suction port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	1 1/4 in M10 × 1.5; 17 deep	5 O
<b>L</b>	Drain port	ISO 11926 <sup>5)</sup>	3/4-16UNF-2B; 12 deep	2 O <sup>6)</sup>
<b>L<sub>1</sub>, L<sub>2</sub><sup>7)</sup></b>	Drain port	ISO 11926 <sup>5)</sup>	3/4-16UNF-2B; 12 deep	2 X <sup>6)</sup>
<b>X</b>	Pilot pressure	ISO 11926	7/16-20UNF-2B; 11.5 deep	315 O

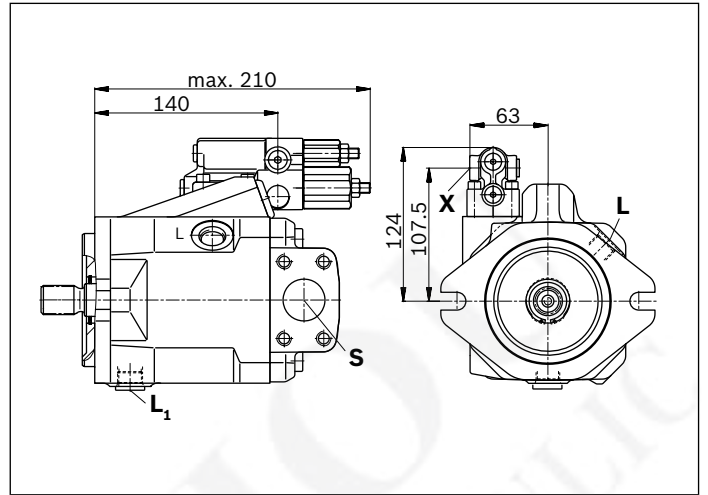
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.  
 3) Thread according to ASME B1.1  
 4) Depending on the application, momentary pressure peaks can occur.  
 Keep this in mind when selecting measuring devices and fittings.

5) The countersink may be deeper than specified in the standard.  
 6) Depending on the installation position, **L**, **L<sub>1</sub>** or **L<sub>2</sub>** must be connected (also see installation instructions starting on page 69).  
 7) Only for series 53  
 8) O = Must be connected (plugged on delivery)  
 X = Plugged (in normal operation)

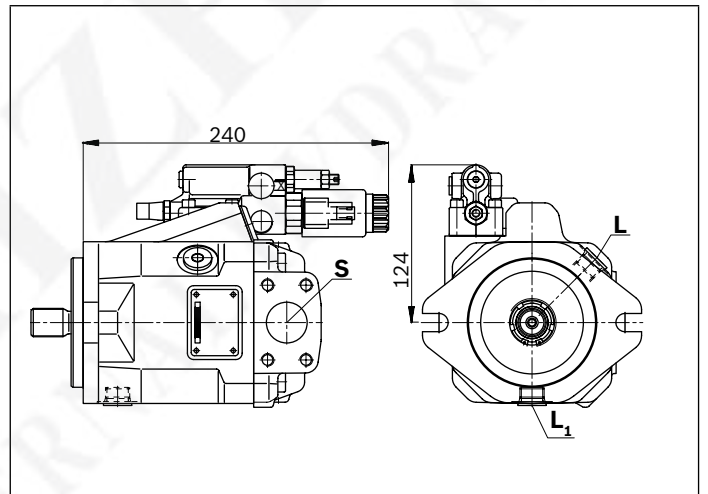
▼ DRG - Pressure controller, remotely controlled, series 52



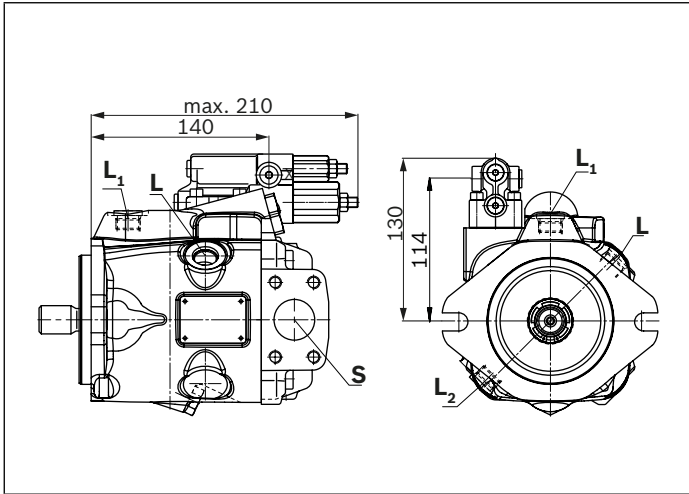
▼ DFR/DFR1 - Pressure and flow controller, series 52



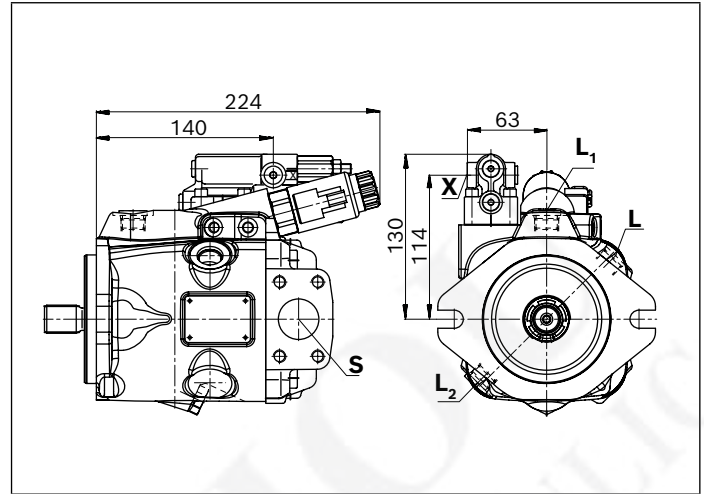
▼ ED7./ER7. - Electro-prop. Pressure control, series 52



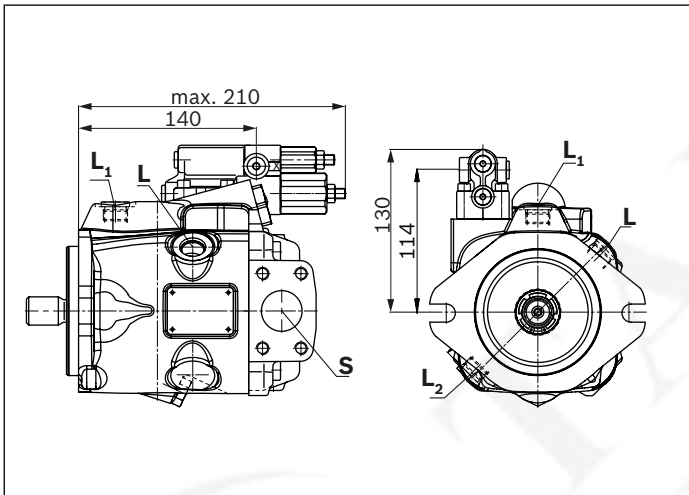
▼ DRG - Pressure controller, remotely controlled, series 53



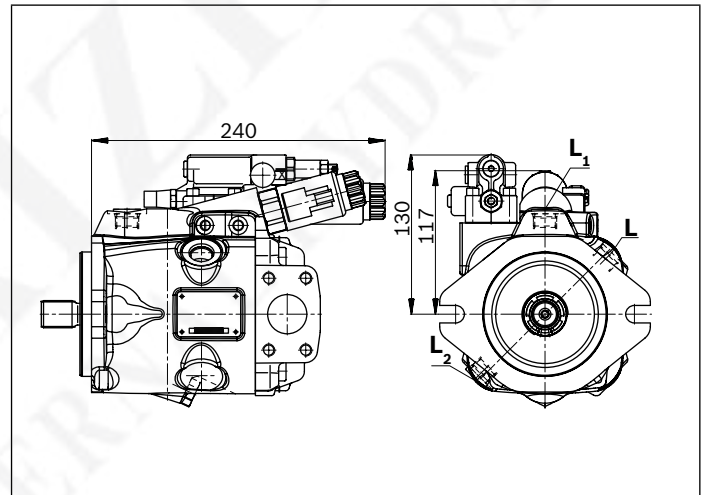
▼ EP.D. / EK.D. - Electro-proportional control, series 53



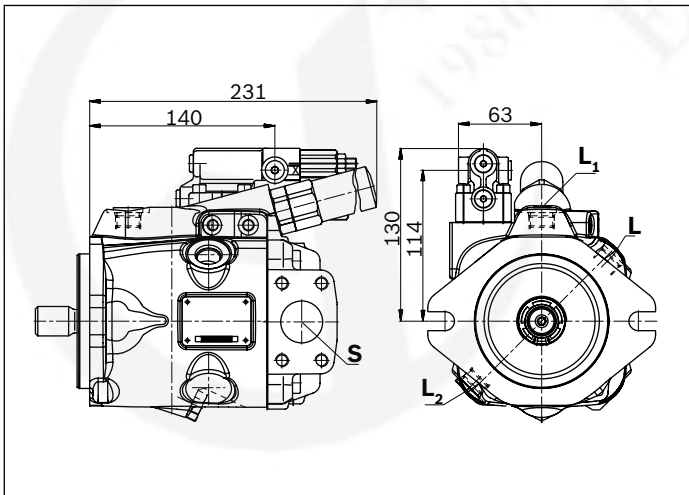
▼ DRF/DRS/DRSC - Pressure and flow controller, Series 53



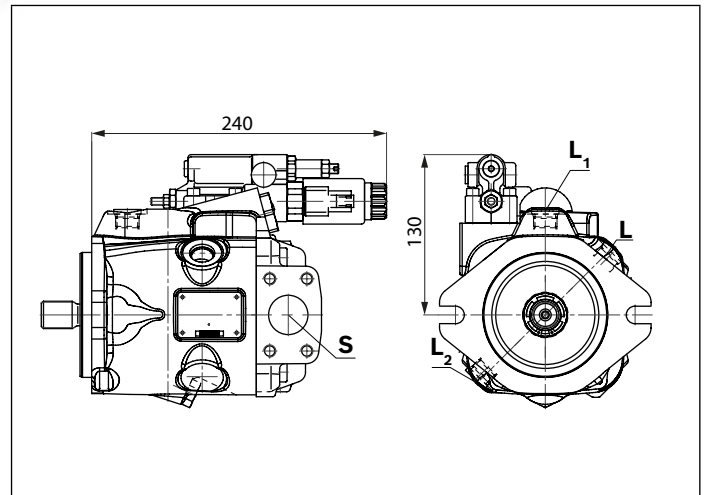
▼ EP.ED. / EK.ED. - Electro-proportional control, Series 53



▼ LA.D. - Pressure, flow and power controller, series 53

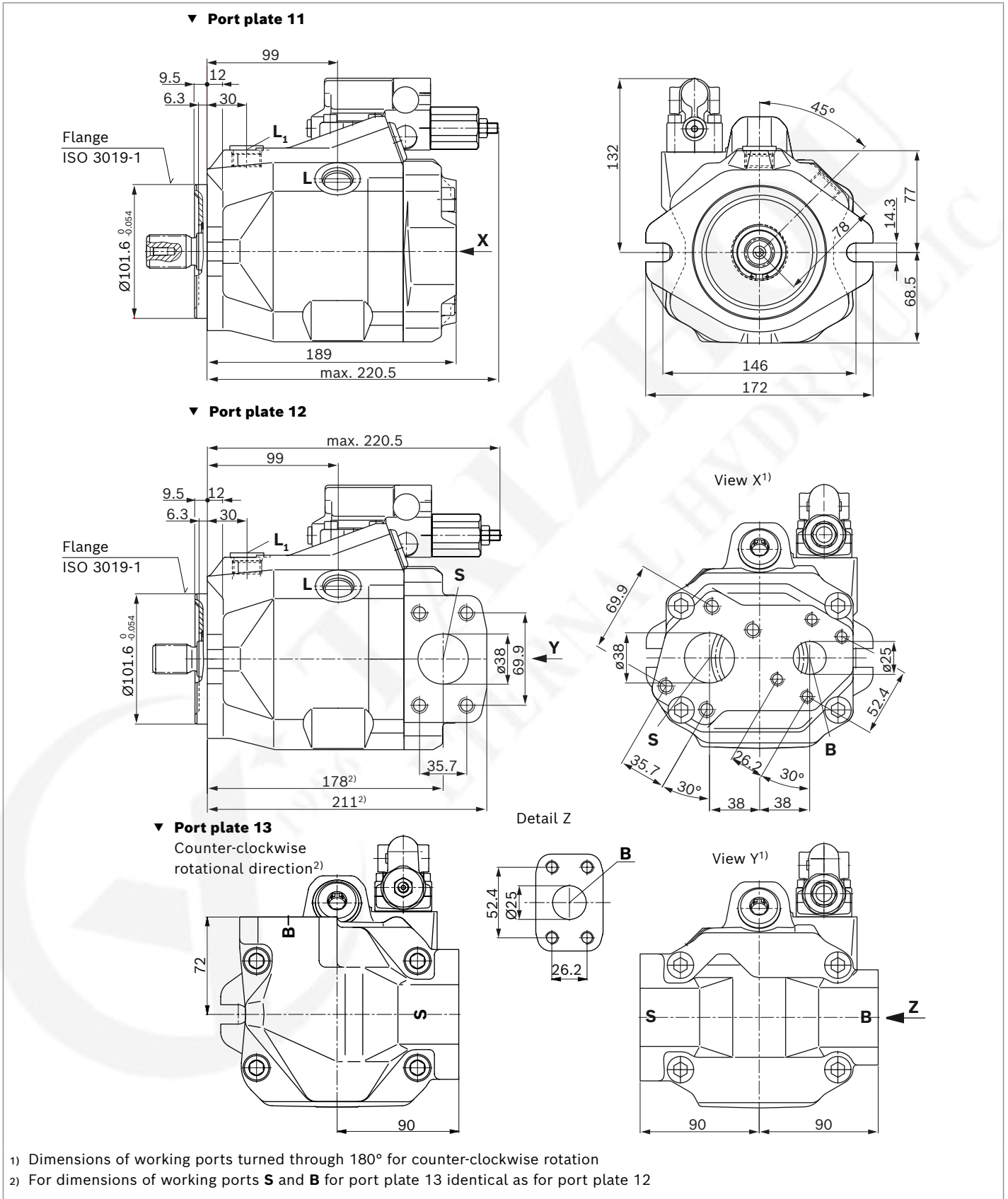


▼ ED7. / ER7. - Electro-prop. Pressure control, series 53



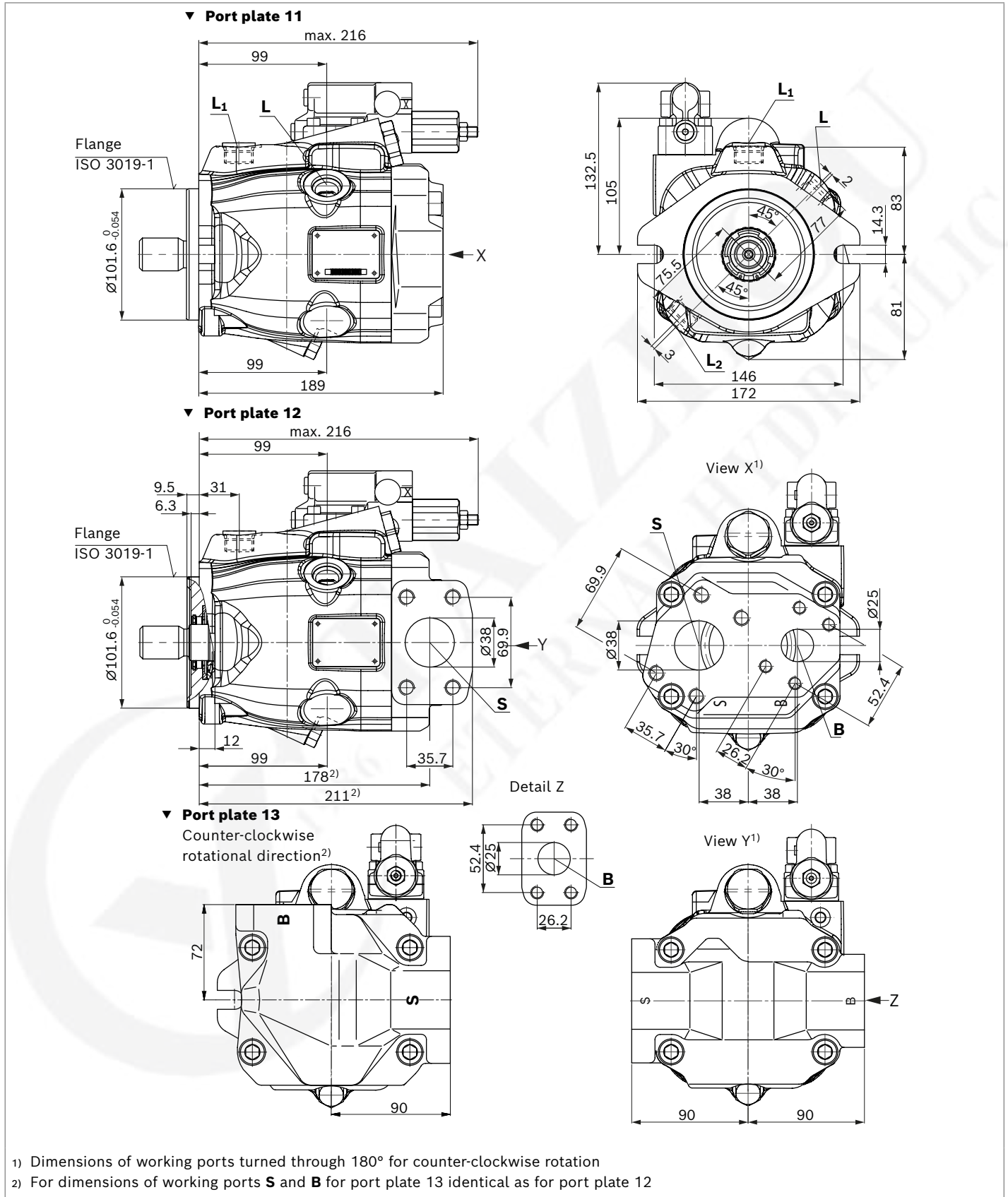
**Dimensions, size 45**

**DR - Hydraulic pressure controller; Clockwise rotation, series 52**



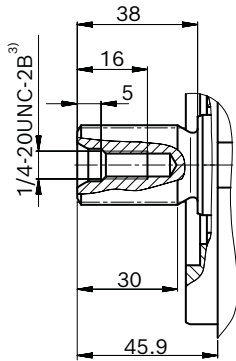
Dimensions, size 45

DR - Hydraulic pressure controller; Clockwise rotation, series 53



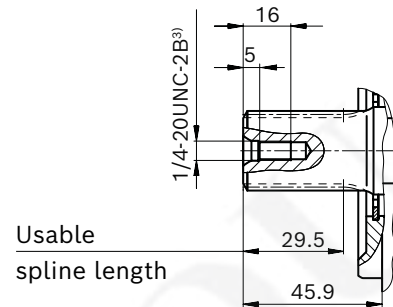
### ▼ Splined shaft 1 in (25-4, ISO 3019-1)

S – 15T 16/32DP<sup>1)</sup>



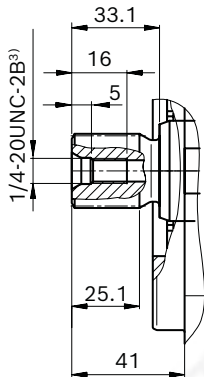
### ▼ Splined shaft 1 in (similar to ISO 3019-1)

R – 15T 16/32DP<sup>1)2)</sup>



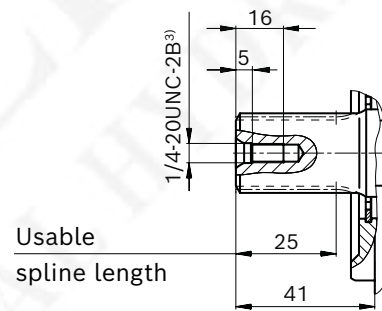
### ▼ Splined shaft 7/8 in (22-4, ISO 3019-1)

U – 13T 16/32DP<sup>1)</sup>



### ▼ Splined shaft 7/8 in (similar to ISO 3019-1)

W – 13T 16/32DP<sup>1)2)</sup>

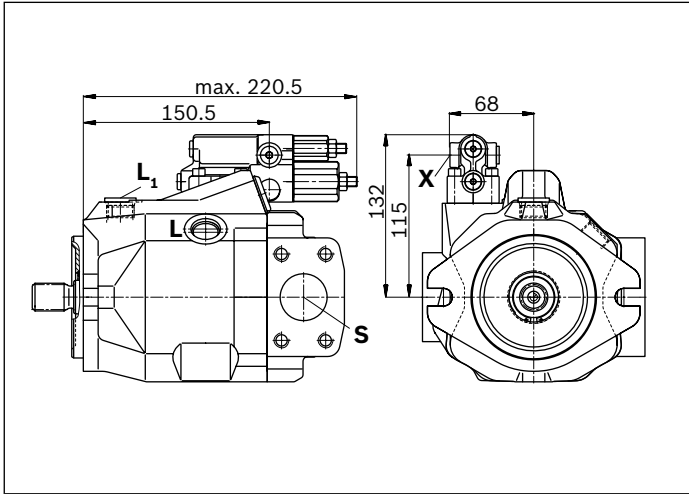


Ports	Standard	Size	$p_{max}$ [bar] <sup>4)</sup>	State <sup>8)</sup>	
<b>B</b>	Working port (standard pressure series)	ISO 6162-1	1 in	315	O
	Fastening thread	DIN 13	M10 × 1.5; 17 deep		
<b>S</b>	Suction port (standard pressure series)	ISO 6162-1	1 1/2 in	5	O
	Fastening thread	DIN 13	M12 × 1.75; 20 deep		
<b>L</b>	Drain port	ISO 11926 <sup>5)</sup>	7/8-14UNF-2B; 13 deep	2	O <sup>6)</sup>
<b>L<sub>1</sub>, L<sub>2</sub><sup>7)</sup></b>	Drain port	ISO 11926 <sup>5)</sup>	7/8-14UNF-2B; 13 deep	2	X <sup>6)</sup>
<b>X</b>	Pilot pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

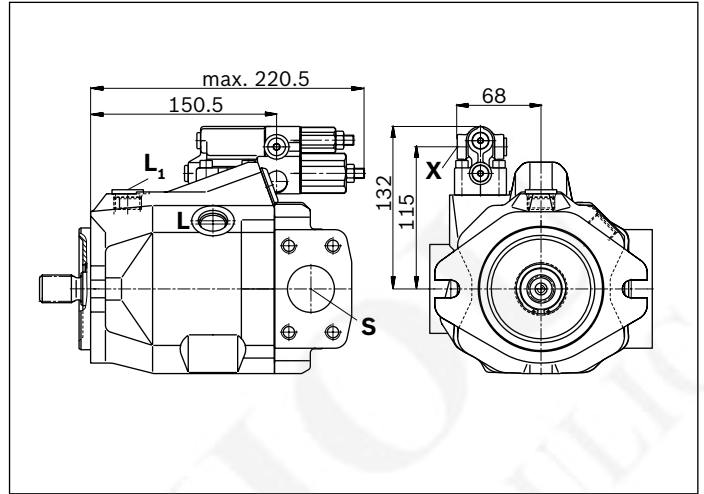
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.  
 3) Thread according to ASME B1.1  
 4) Depending on the application, momentary pressure peaks can occur.  
 Keep this in mind when selecting measuring devices and fittings.

5) The countersink may be deeper than specified in the standard.  
 6) Depending on the installation position, **L**, **L<sub>1</sub>** or **L<sub>2</sub>** must be connected (also see installation instructions starting on page 69).  
 7) Only series 53  
 8) O = Must be connected (plugged on delivery)  
 X = Plugged (in normal operation)

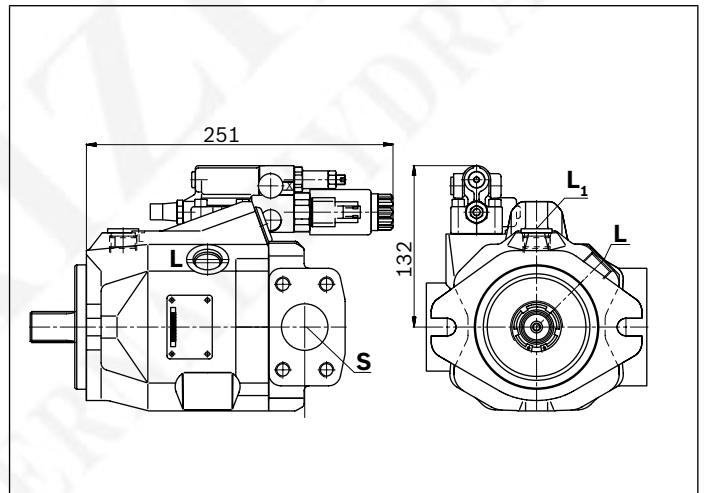
▼ DRG - Pressure controller, remotely controlled, series 52



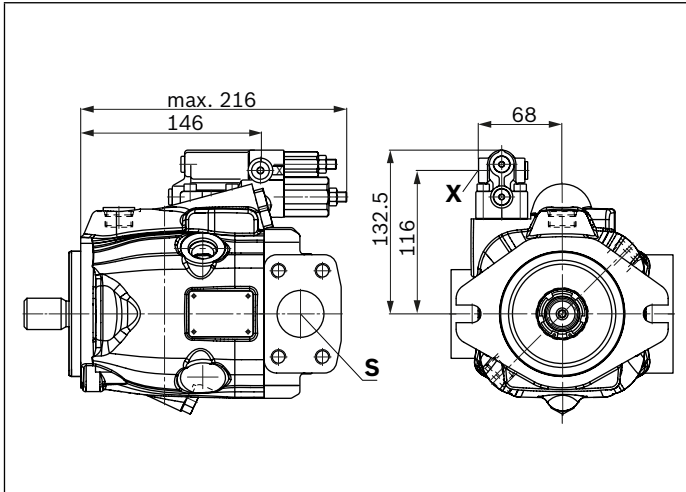
▼ DFR/DFR1/DRSC - Pressure and flow controller, series 52



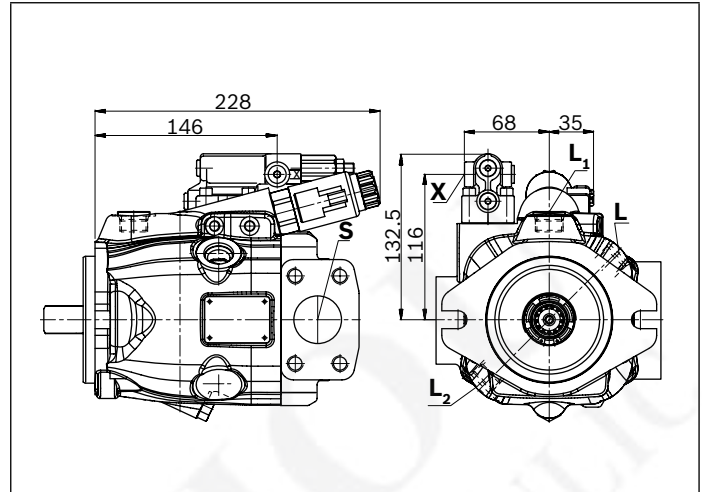
▼ ED7. / ER7. - Electro-prop. Pressure control, series 52



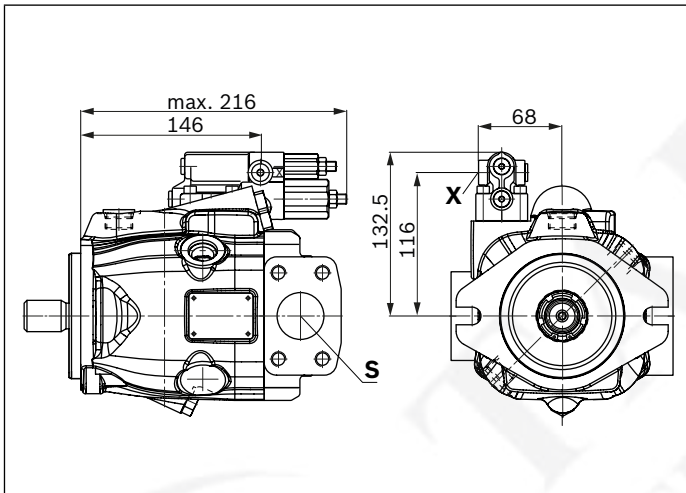
▼ DRG - Pressure controller, remotely controlled, series 53



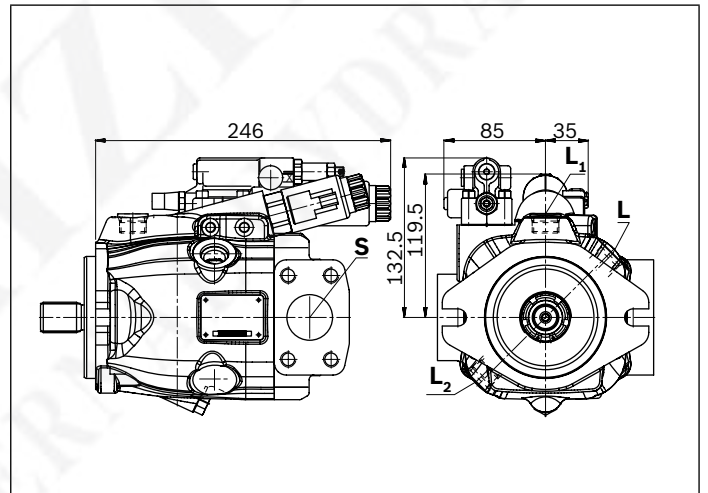
▼ EP.D. / EK.D. - Electro-proportional control, series 53



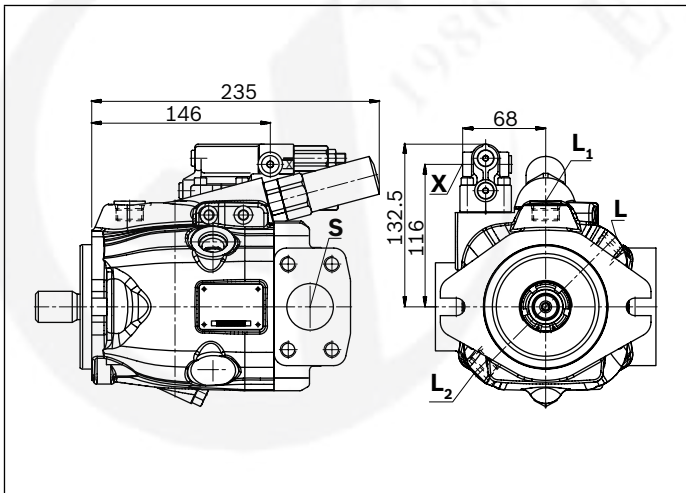
▼ DRF/DRS/DRSC - Pressure and flow controller, Series 53



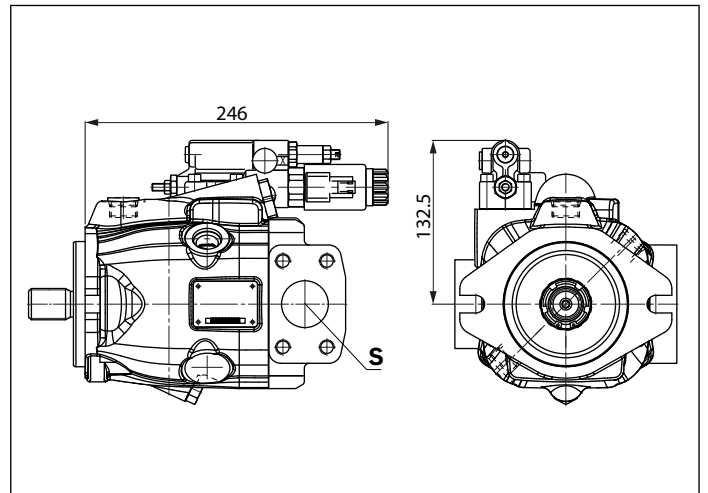
▼ EP.ED. / EK.ED. - Electro-prop. control, series 53



▼ LA.D. - Pressure, flow and power controller, series 53

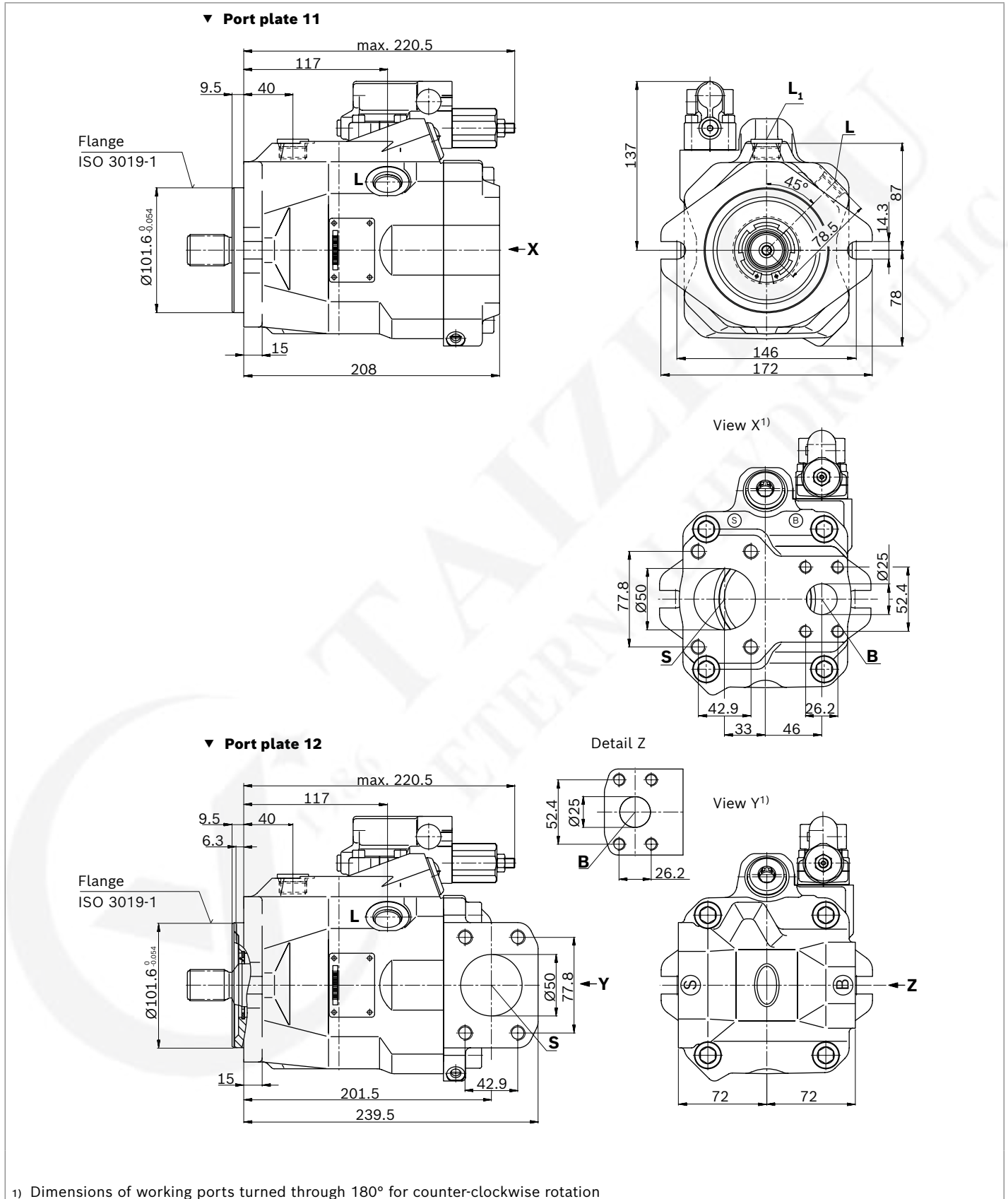


▼ ED7. / ER7. - Electro-prop. Pressure control, series 53



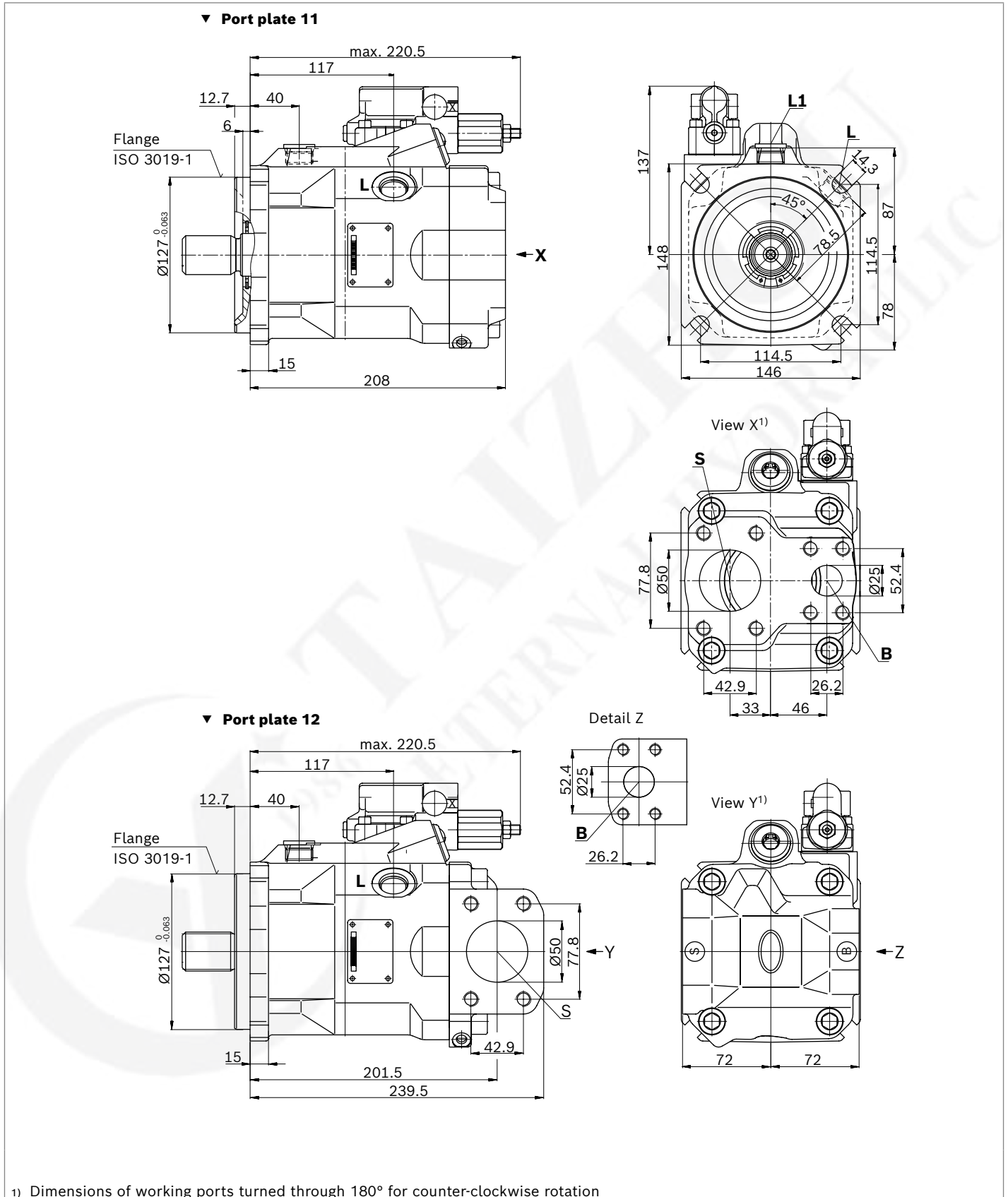
**Dimensions, size 60**

**DR - Hydraulic pressure controller; Clockwise rotation, mounting flange C series 52**



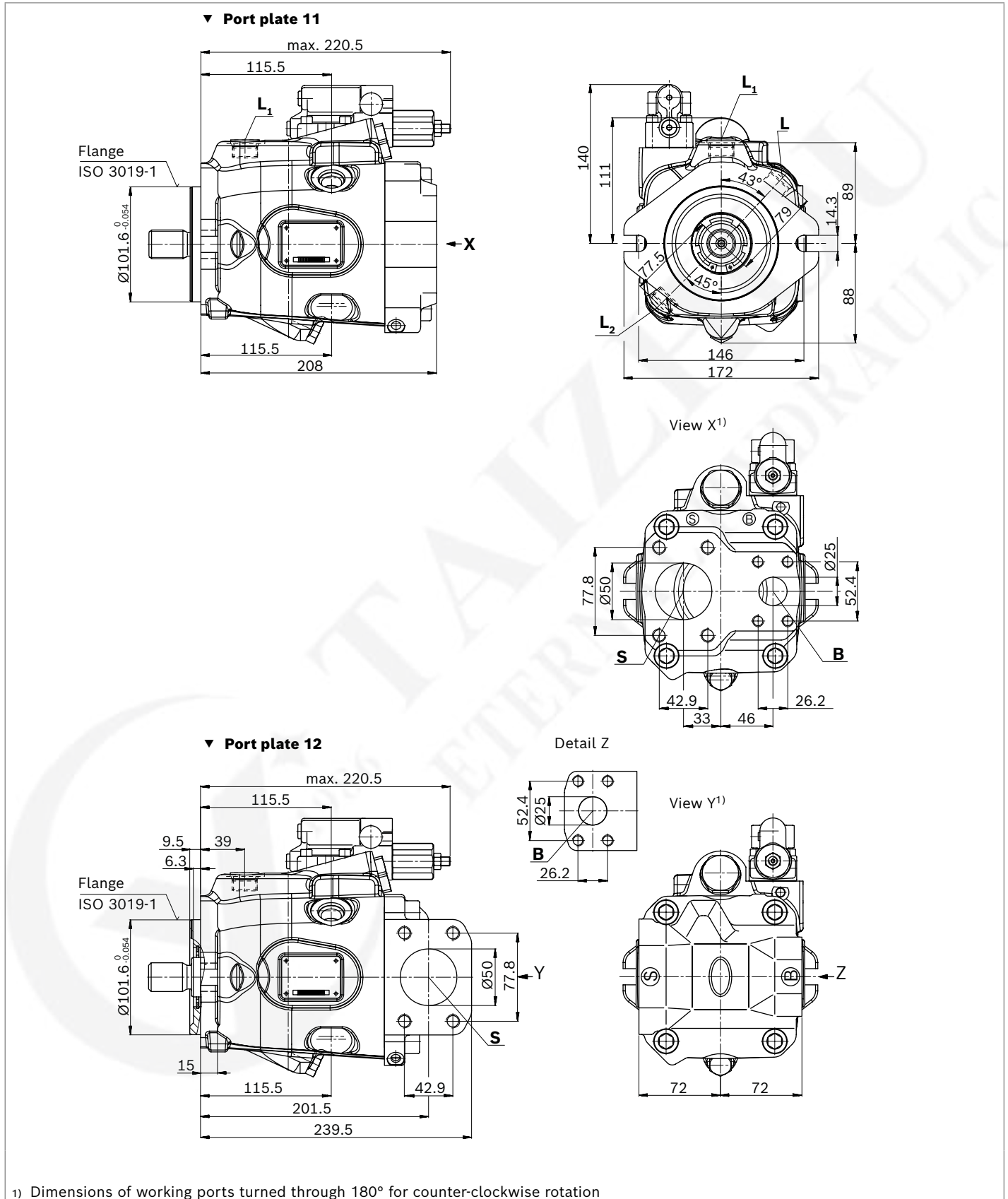
**Dimensions, size 60**

**DR – Hydraulic pressure controller; Clockwise rotation, mounting flange D series 52**



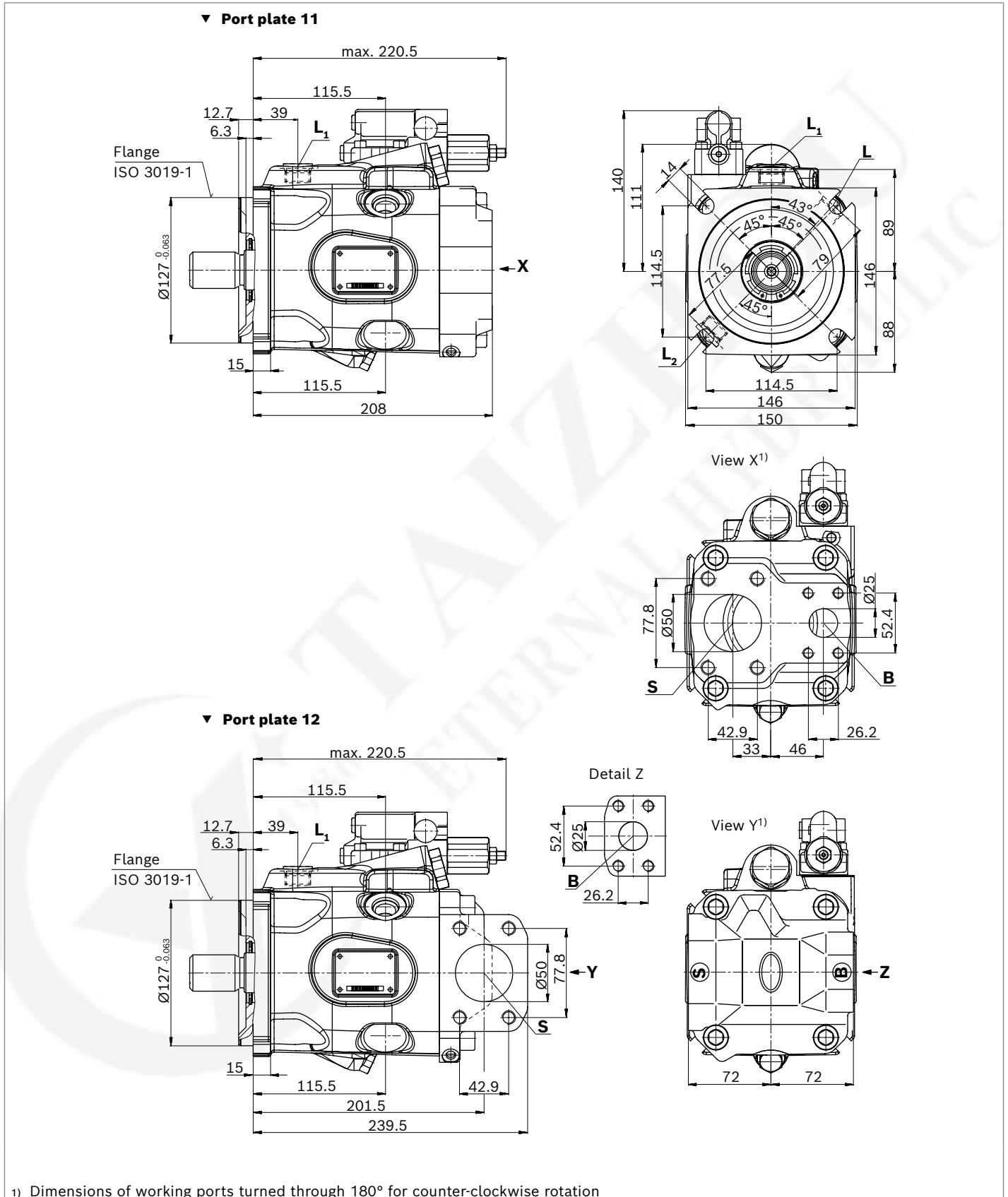
**Dimensions, size 63**

**DR - Hydraulic pressure controller; Clockwise rotation, mounting flange C series 53**



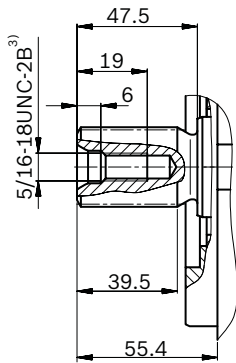
**Dimensions, size 63**

**DR - Hydraulic pressure controller; Clockwise rotation, mounting flange D series 53**



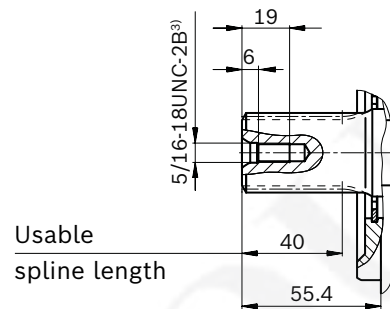
### ▼ Splined shaft 1 1/4 in (32-4, ISO 3019-1)

S – 14T 12/24DP<sup>1)</sup>



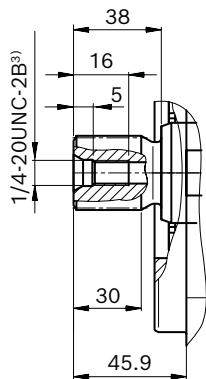
### ▼ Splined shaft 1 1/4 in (similar to ISO 3019-1)

R – 14T 12/24DP<sup>1)2)</sup>



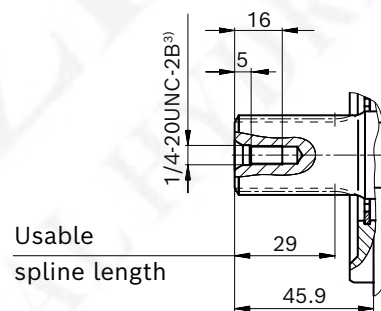
### ▼ Splined shaft 1 in (25-4, ISO 3019-1)

U – 15T 16/32DP<sup>1)</sup>



### ▼ Splined shaft 1 in (similar to ISO 3019-1)

W – 15T 16/32DP<sup>1)2)</sup>

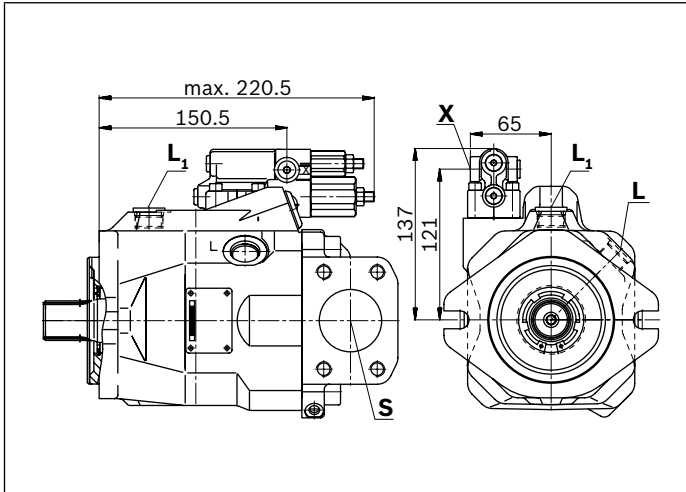


Ports		Standard	Size	$p_{max}$ [bar] <sup>4)</sup>	State <sup>8)</sup>
<b>B</b>	Working port (standard pressure series)	ISO 6162-1	1 in	315	O
	Fastening thread	DIN 13	M10 × 1.5; 17 deep		
<b>S</b>	Suction port (standard pressure series)	ISO 6162-1	2 in	5	O
	Fastening thread	DIN 13	M12 × 1.75; 20 deep		
<b>L</b>	Drain port	ISO 11926 <sup>5)</sup>	7/8-14UNF-2B; 13 deep	2	O <sup>6)</sup>
<b>L<sub>1</sub>, L<sub>2</sub></b> <sup>7)</sup>	Drain port	ISO 11926 <sup>5)</sup>	7/8-14UNF-2B; 13 deep	2	X <sup>6)</sup>
<b>X</b>	Pilot pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

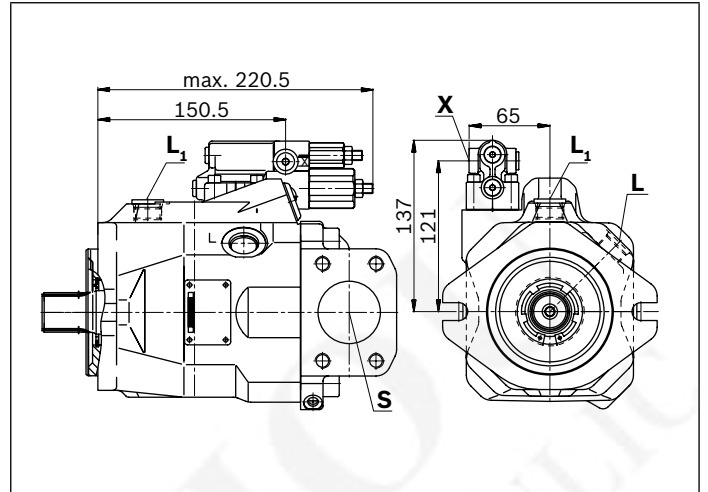
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.  
 3) Thread according to ASME B1.1  
 4) Depending on the application, momentary pressure peaks can occur.  
 Keep this in mind when selecting measuring devices and fittings.

5) The countersink may be deeper than specified in the standard.  
 6) Depending on the installation position, L, L<sub>1</sub> or L<sub>2</sub> must be connected (also see installation instructions starting on page 69).  
 7) Only series 53  
 8) O = Must be connected (plugged on delivery)  
 X = Plugged (in normal operation)

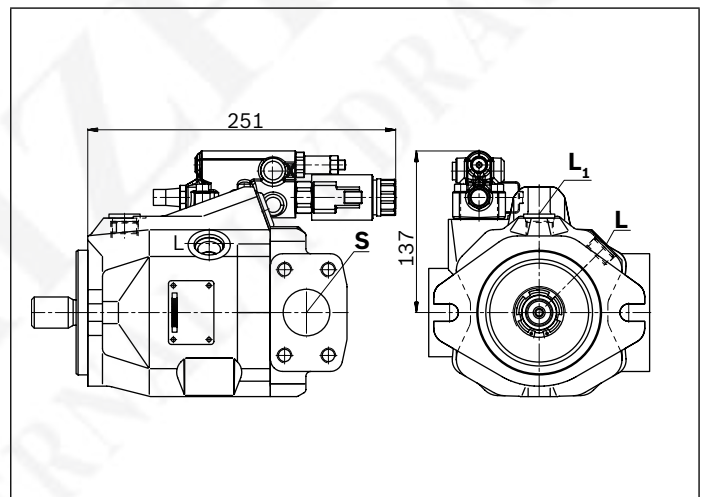
▼ DRG - Pressure controller, remotely controlled, series 52



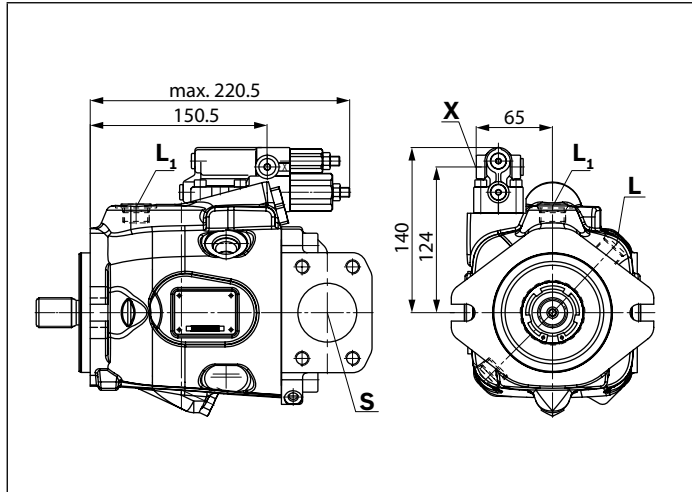
▼ DFR/DFR1/DRSC - Pressure and flow controller, series 52



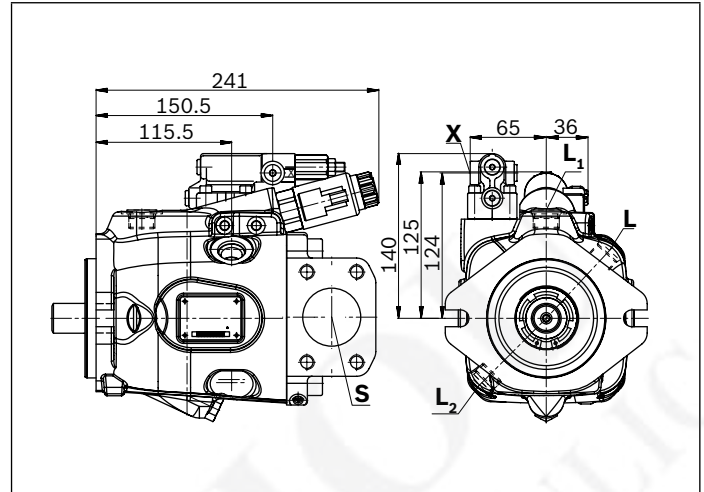
▼ ED7. / ER7. - Electro-prop. Pressure control, series 52



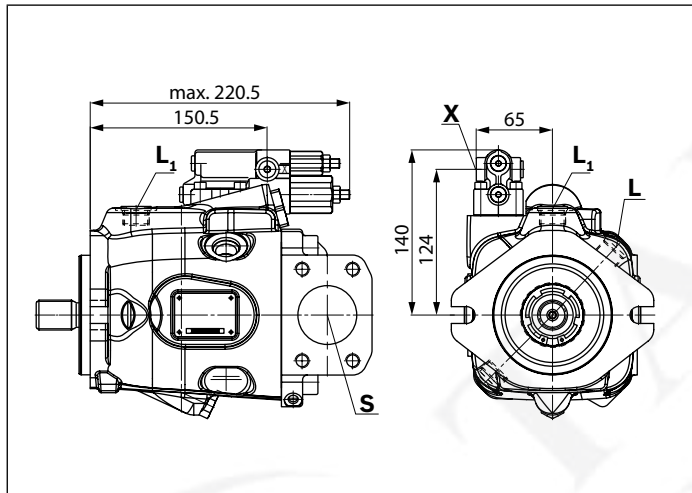
▼ DRG - Pressure controller, remotely controlled, series 53



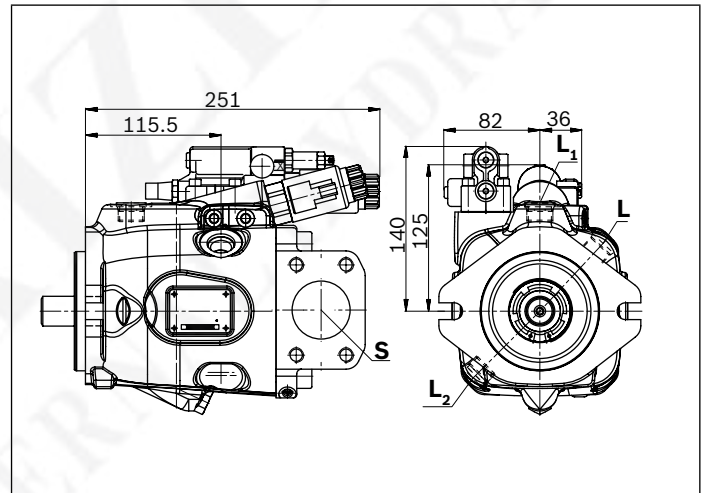
▼ EP.D. / EK.D. - Electro-proportional control, series 53



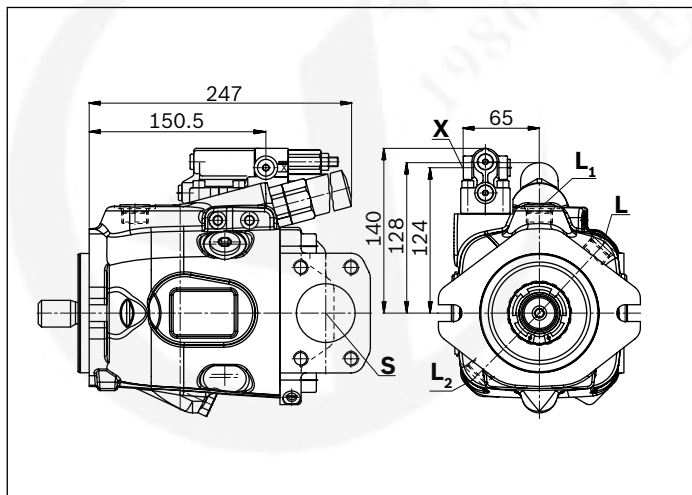
▼ DRF/DRS/DRSC - Pressure and flow controller, Series 53



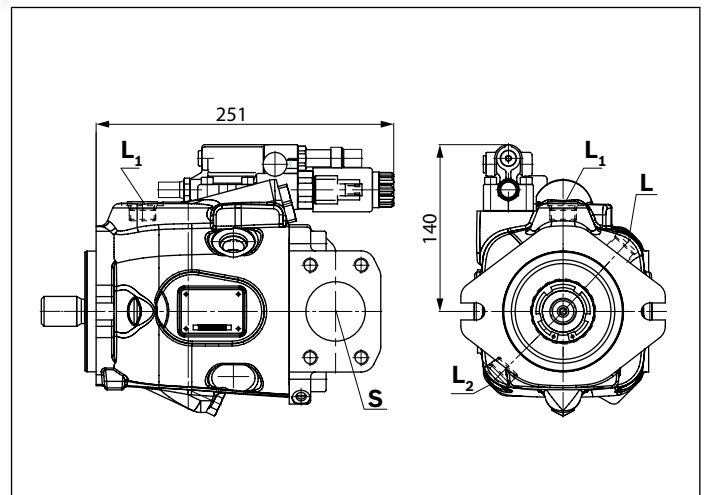
▼ EP.ED. / EK.ED. - Electro-prop. control, series 53



▼ LA.D. - Pressure, flow and power controller, series 53

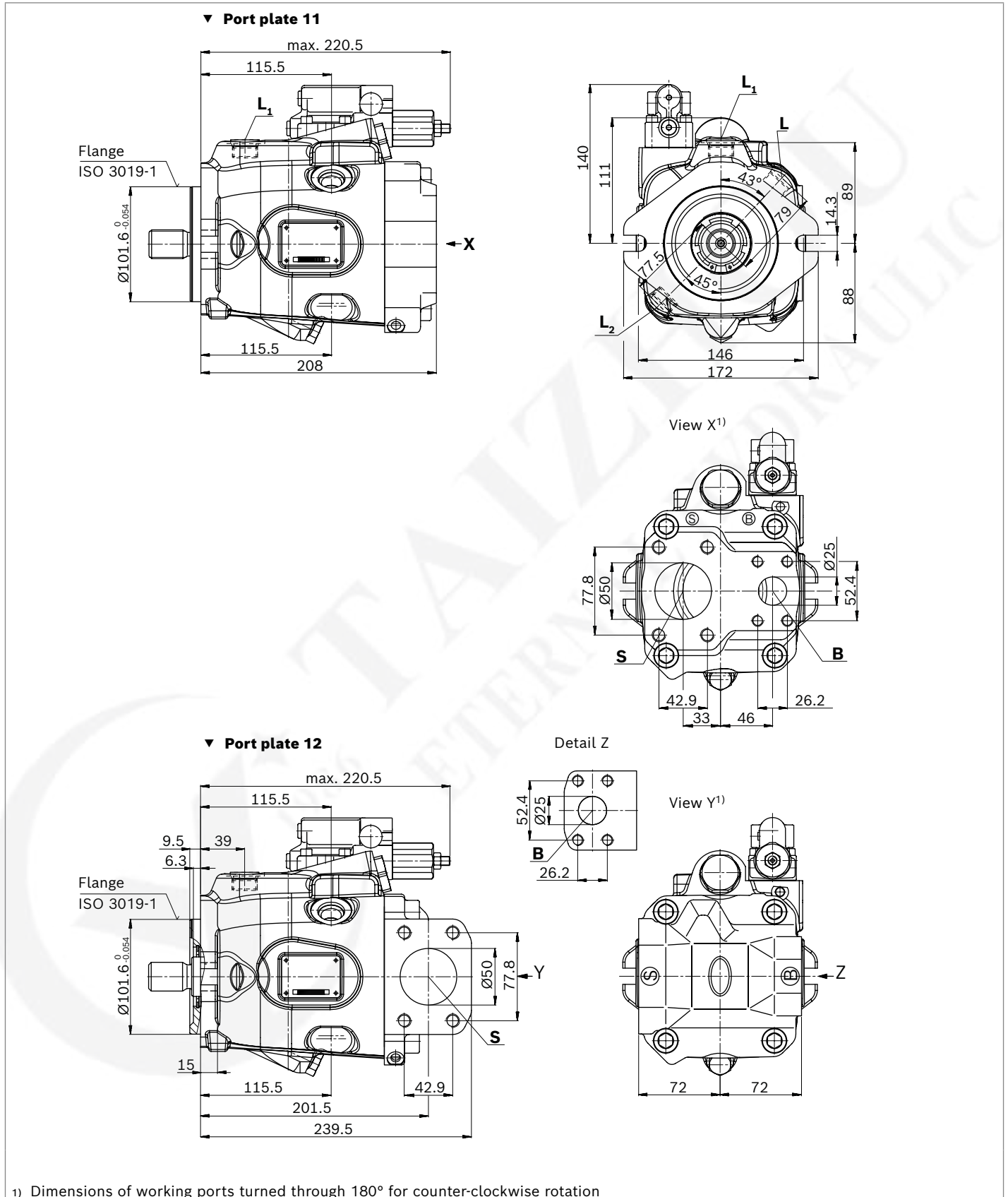


▼ ED7. / ER7. - Electro-prop. Pressure control, series 53



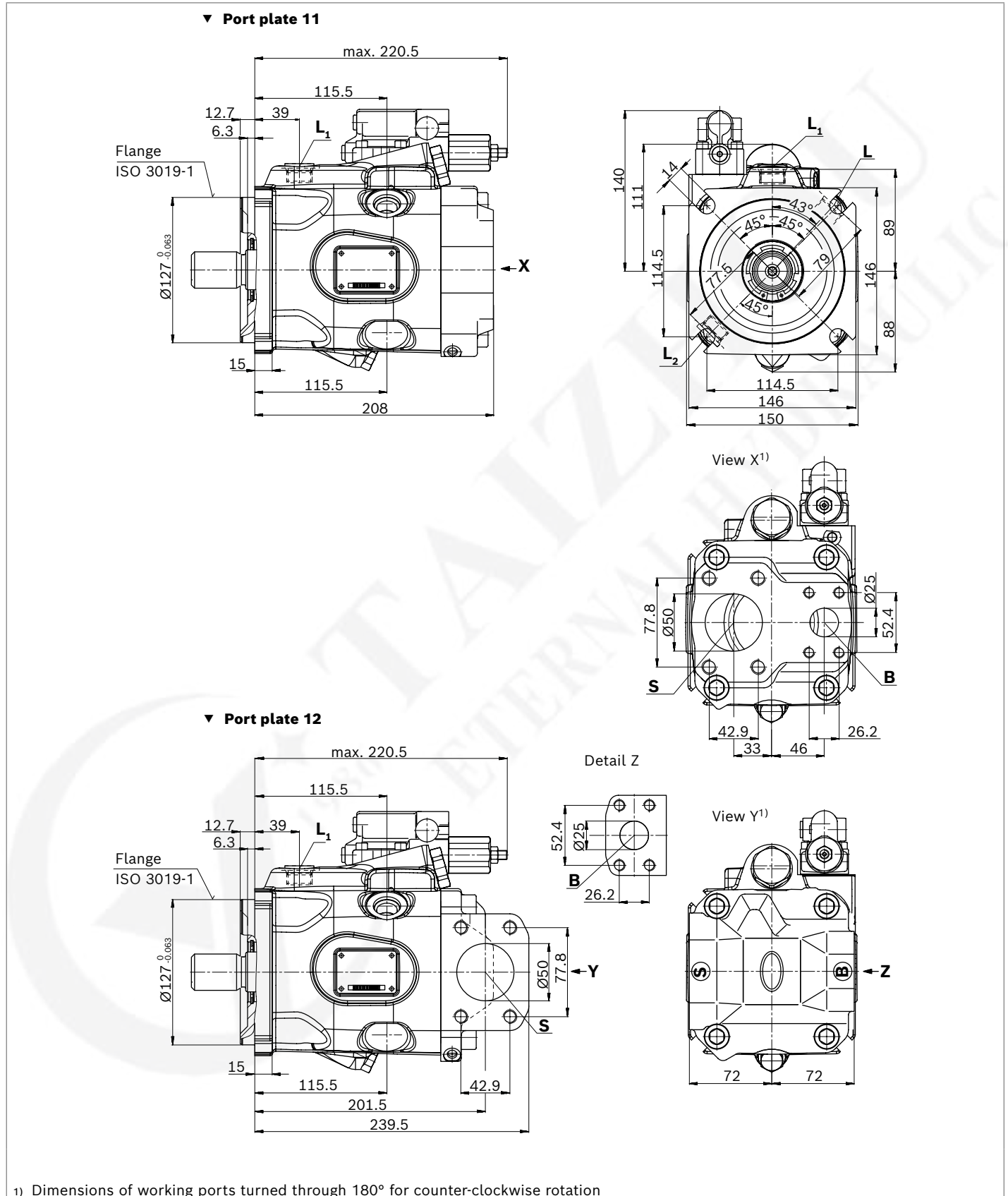
**Dimensions, size 72**

**DR – Hydraulic pressure controller; Clockwise rotation, mounting flange C series 53**



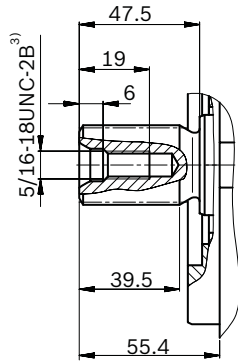
**Dimensions, size 72**

**DR - Hydraulic pressure controller; Clockwise rotation, mounting flange D series 53**



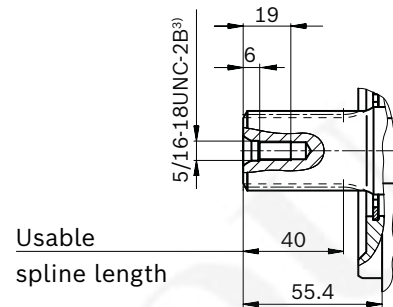
### ▼ Splined shaft 1 1/4 in (32-4, ISO 3019-1)

S – 14T 12/24DP<sup>1)</sup>



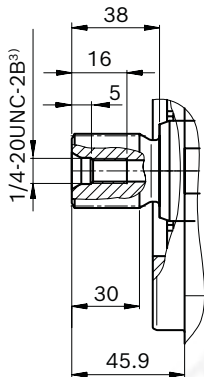
### ▼ Splined shaft 1 1/4 in (similar to ISO 3019-1)

R – 14T 12/24DP<sup>1)2)</sup>



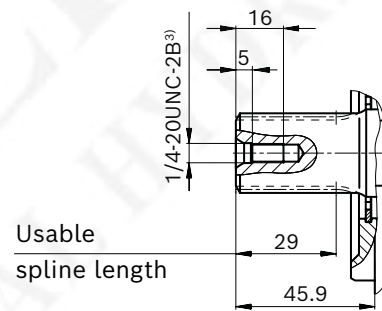
### ▼ Splined shaft 1 in (25-4, ISO 3019-1)

U – 15T 16/32DP<sup>1)</sup>



### ▼ Splined shaft 1 in (similar to ISO 3019-1)

W – 15T 16/32DP<sup>1)2)</sup>

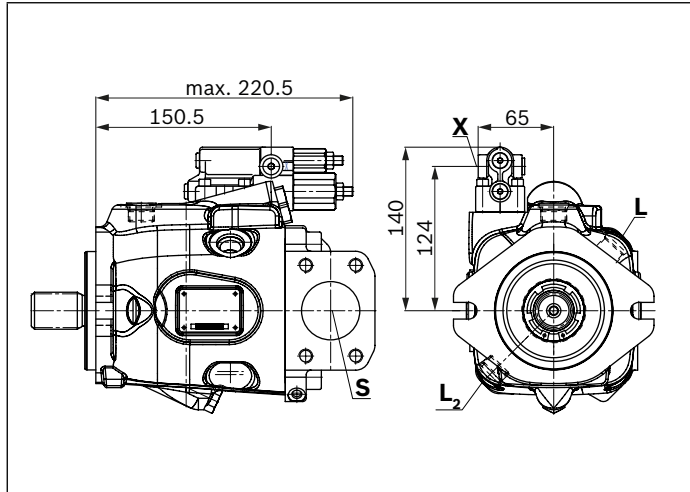


Ports		Standard	Size	$p_{max}$ [bar] <sup>4)</sup>	State <sup>8)</sup>
<b>B</b>	Working port (standard pressure series)	ISO 6162-1	1 in	315	O
	Fastening thread	DIN 13	M10 × 1.5; 17 deep		
<b>S</b>	Suction port (standard pressure series)	ISO 6162-1	2 in	5	O
	Fastening thread	DIN 13	M12 × 1.75; 20 deep		
<b>L</b>	Drain port	ISO 11926 <sup>5)</sup>	7/8-14UNF-2B; 13 deep	2	O <sup>6)</sup>
<b>L<sub>1</sub>, L<sub>2</sub><sup>7)</sup></b>	Drain port	ISO 11926 <sup>5)</sup>	7/8-14UNF-2B; 13 deep	2	X <sup>6)</sup>
<b>X</b>	Pilot pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

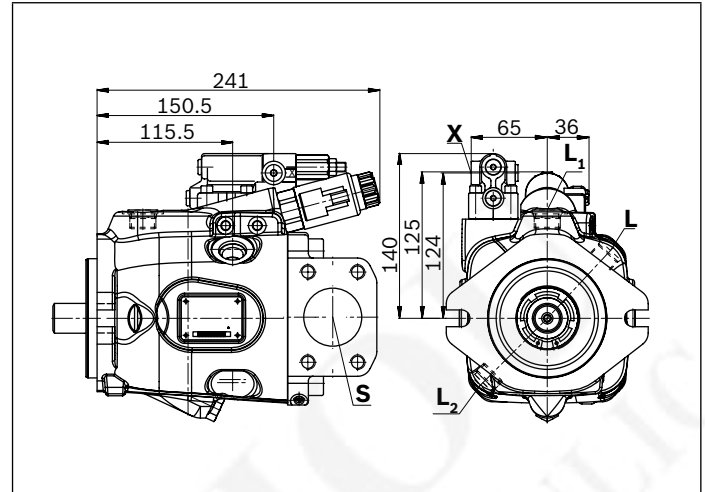
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.  
 3) Thread according to ASME B1.1  
 4) Depending on the application, momentary pressure peaks can occur.  
 Keep this in mind when selecting measuring devices and fittings.

5) The countersink may be deeper than specified in the standard.  
 6) Depending on the installation position, **L**, **L<sub>1</sub>** or **L<sub>2</sub>** must be connected (also see installation instructions starting on page 69).  
 7) Only series 53  
 8) O = Must be connected (plugged on delivery)  
 X = Plugged (in normal operation)

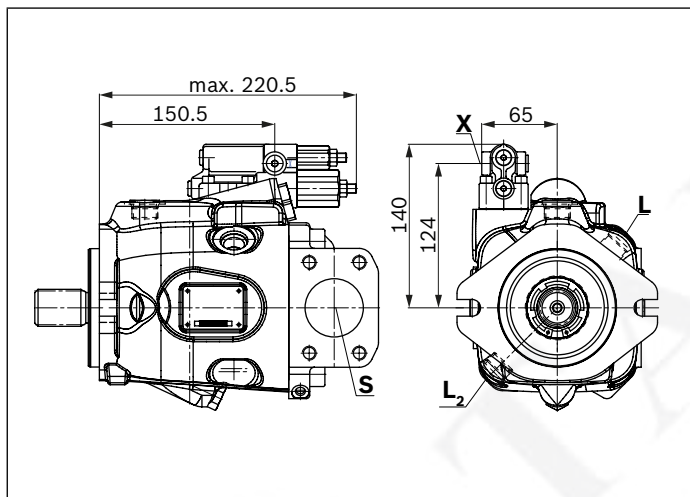
▼ DRG - Pressure controller, remotely controlled, series 53



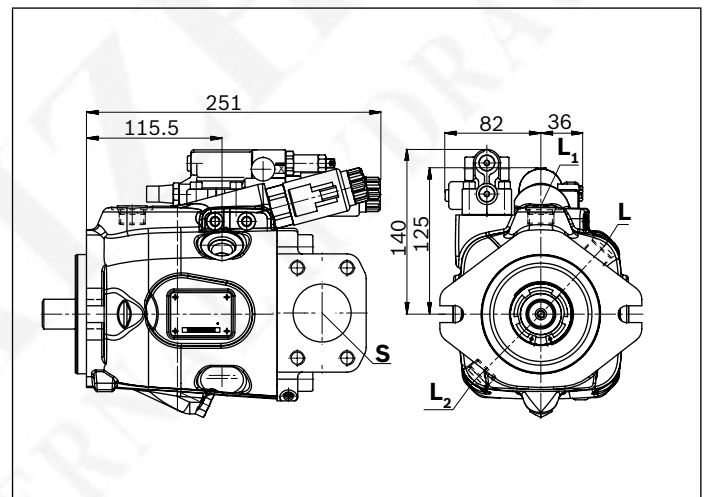
▼ EP.D. / EK.D. - Electro-proportional control, series 53



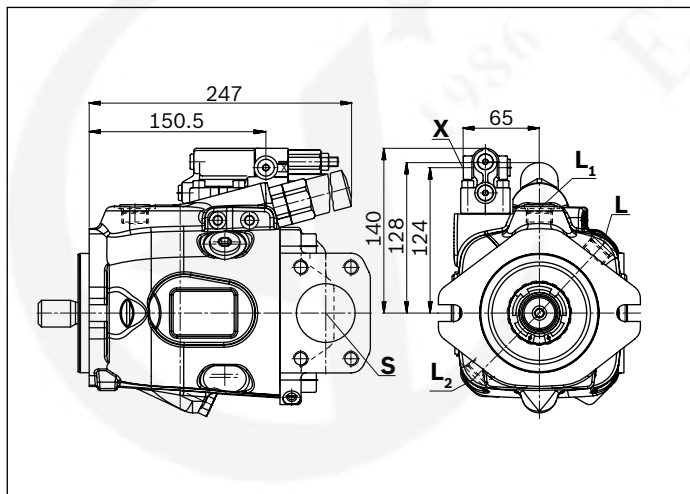
▼ DRF/DRS/DRSC - Pressure and flow controller, series 53



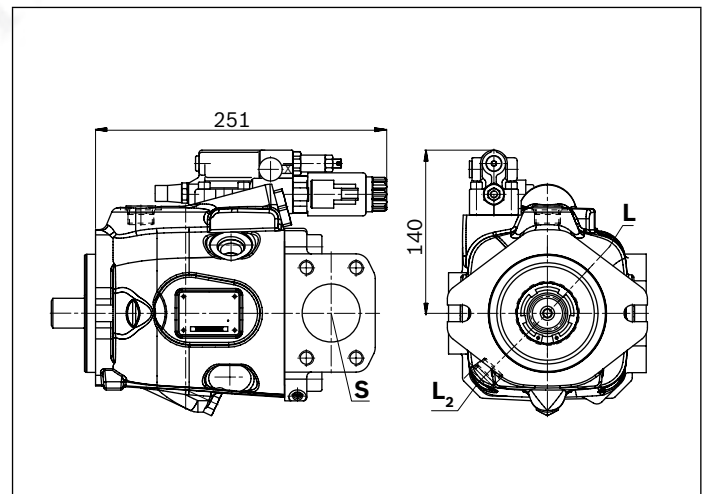
▼ EP.ED. / EK.ED. - Electro-prop. control, series 53



▼ LA.D. - Pressure, flow and power controller, series 53

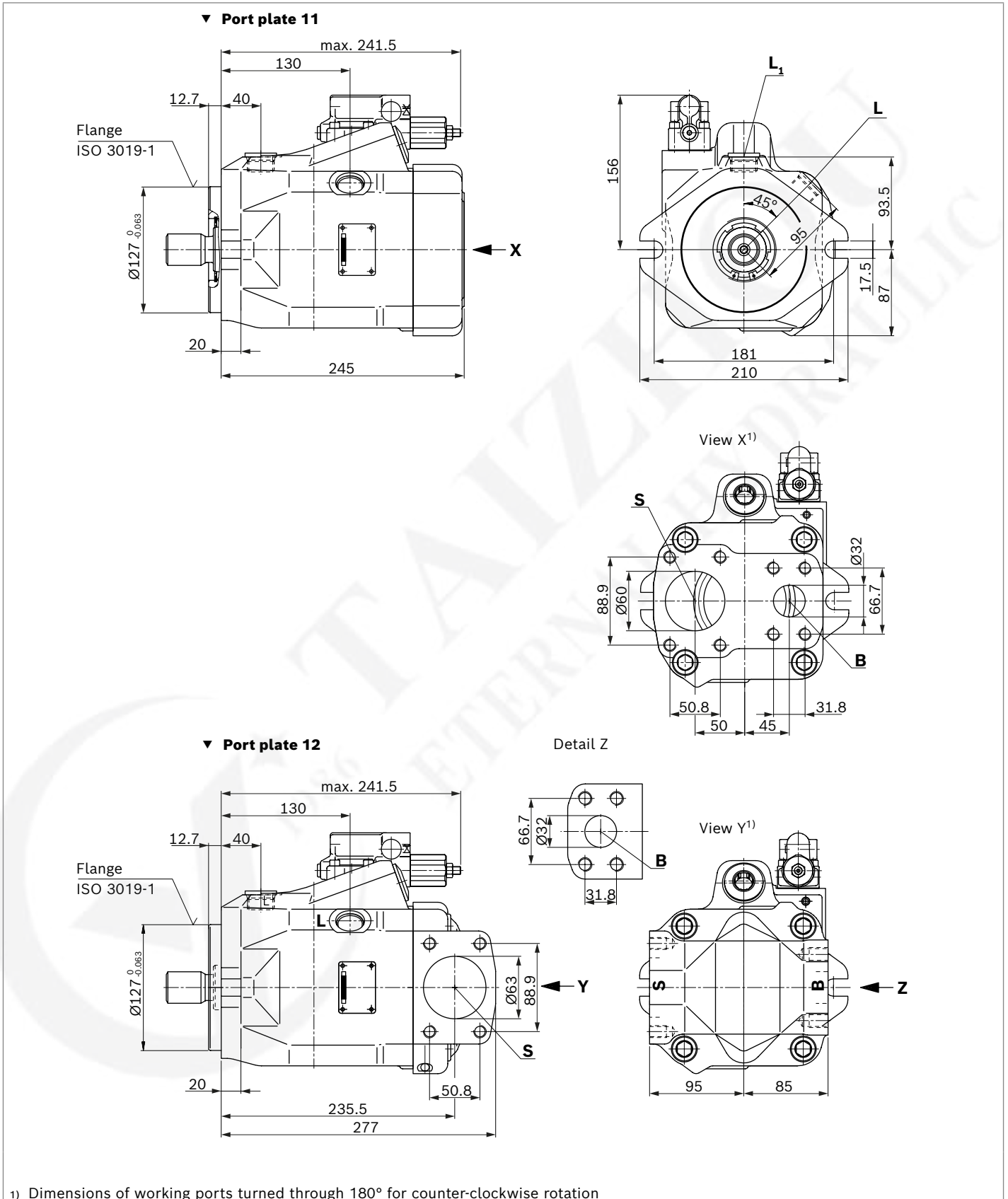


▼ ED7. / ER7. - Electro-prop. Pressure control, series 53



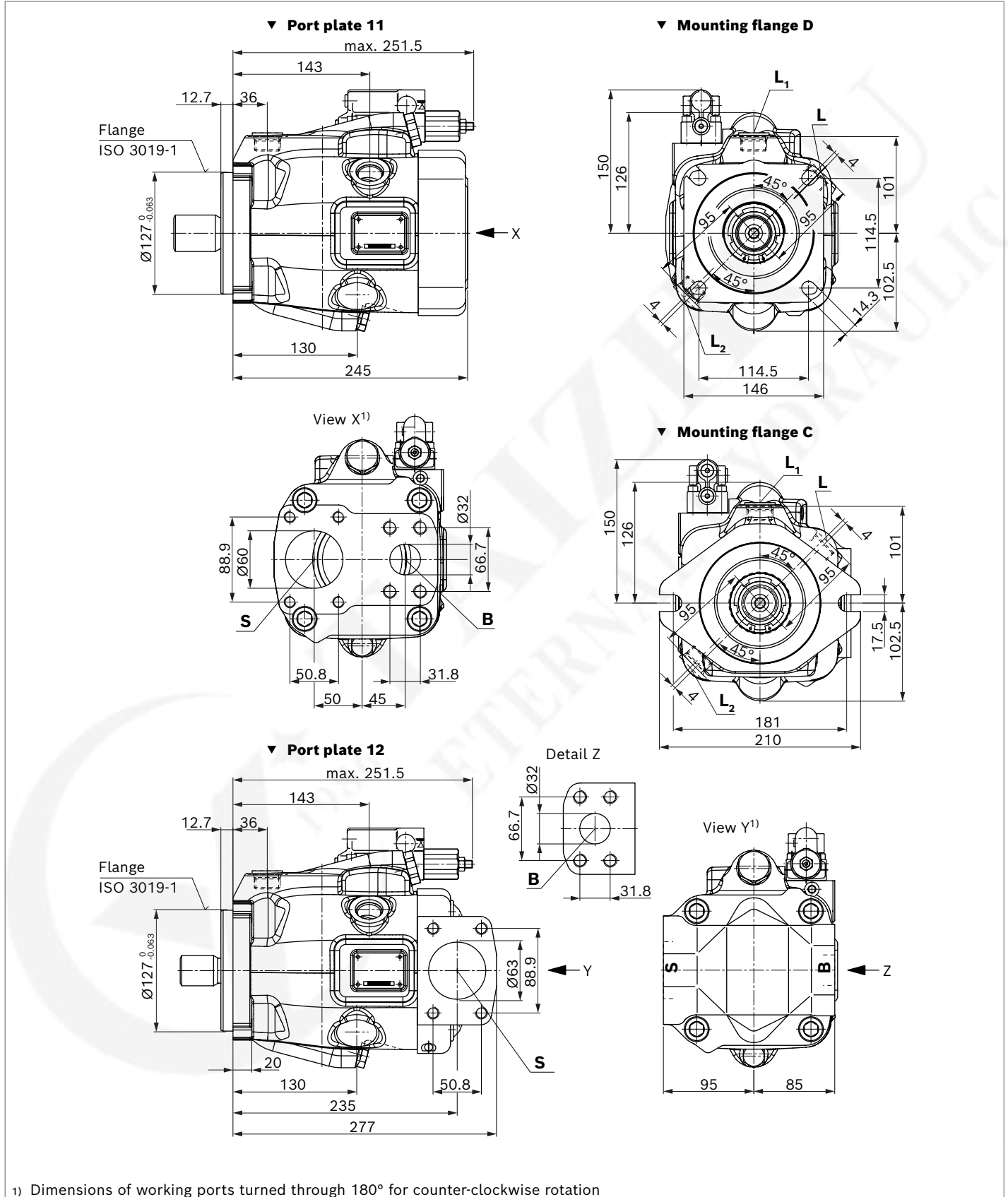
**Dimensions, size 85**

**DR - Hydraulic pressure controller; Clockwise rotation, mounting flange C series 52**



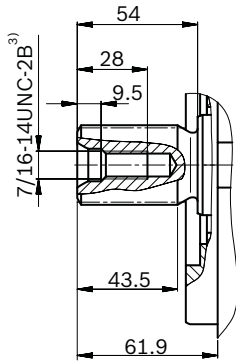
**Dimensions, size 85**

**DR - Hydraulic pressure controller; Clockwise rotation, mounting flange C and D series 53**



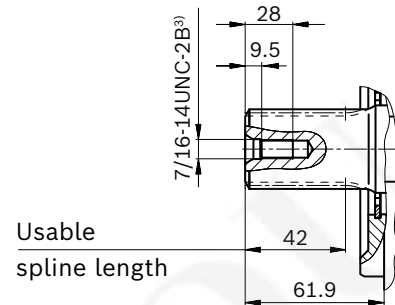
### ▼ Splined shaft 1 1/2 in (38-4, ISO 3019-1)

S – 17T 12/24DP<sup>1)</sup>



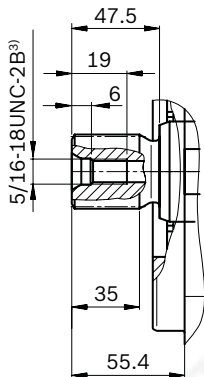
### ▼ Splined shaft 1 1/2 in (similar to ISO 3019-1)

R – 17T 12/24DP<sup>1)2)</sup>



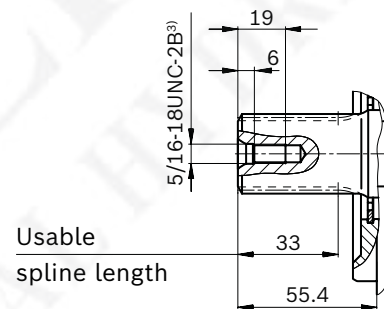
### ▼ Splined shaft 1 1/4 in (32-4, ISO 3019-1)

U – 14T 12/24DP<sup>1)</sup>



### ▼ Splined shaft 1 1/4 in (similar to ISO 3019-1)

W – 14T 12/24DP<sup>1)2)</sup>

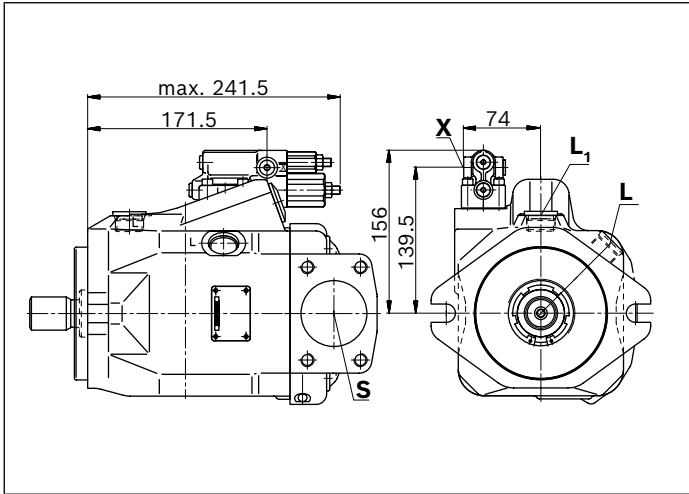


Ports		Standard	Size	$p_{max}$ [bar] <sup>4)</sup>	State <sup>8)</sup>
<b>B</b>	Working port (high-pressure series) Fastening thread	ISO 6162-2 DIN 13	1 1/4 in M14 × 2; 19 deep	315	O
<b>S</b>	Suction port (standard pressure series) Fastening thread	ISO 6162-1 DIN 13	2 1/2 in M12 × 1.75; 17 deep	5	O
<b>L</b>	Drain port	ISO 11926 <sup>5)</sup>	1 1/16-12UNF-2B; 15 deep	2	O <sup>6)</sup>
<b>L<sub>1</sub>, L<sub>2</sub><sup>7)</sup></b>	Drain port	ISO 11926 <sup>5)</sup>	1 1/16-12UNF-2B; 15 deep	2	X <sup>6)</sup>
<b>X</b>	Pilot pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

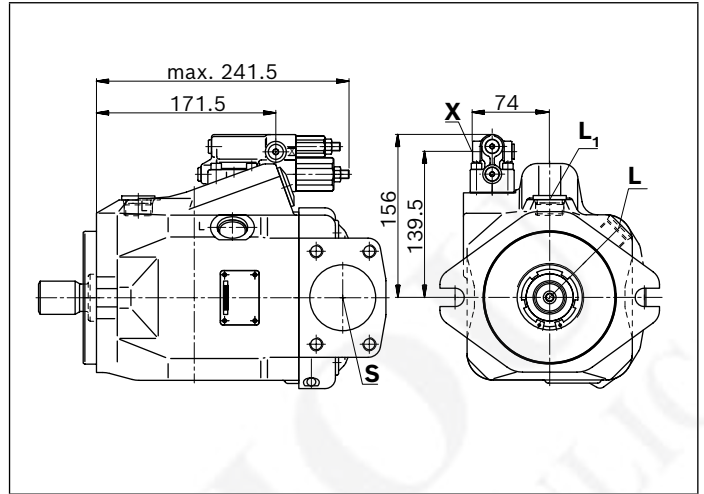
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.  
 3) Thread according to ASME B1.1  
 4) Depending on the application, momentary pressure peaks can occur.  
 Keep this in mind when selecting measuring devices and fittings.

5) The countersink may be deeper than specified in the standard.  
 6) Depending on the installation position, **L**, **L<sub>1</sub>** or **L<sub>2</sub>** must be connected (also see installation instructions starting on page 69).  
 7) Only series 53  
 8) O = Must be connected (plugged on delivery)  
 X = Plugged (in normal operation)

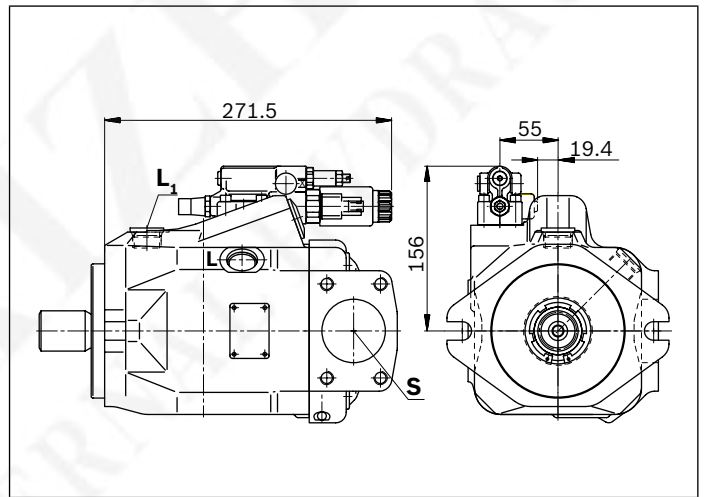
▼ DRG - Pressure controller, remotely controlled, series 52



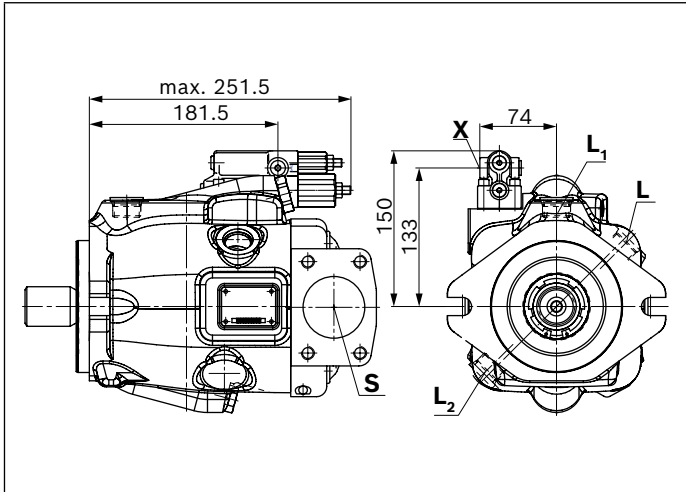
▼ DFR/DFR1/DRSC - Pressure and flow controller, series 52



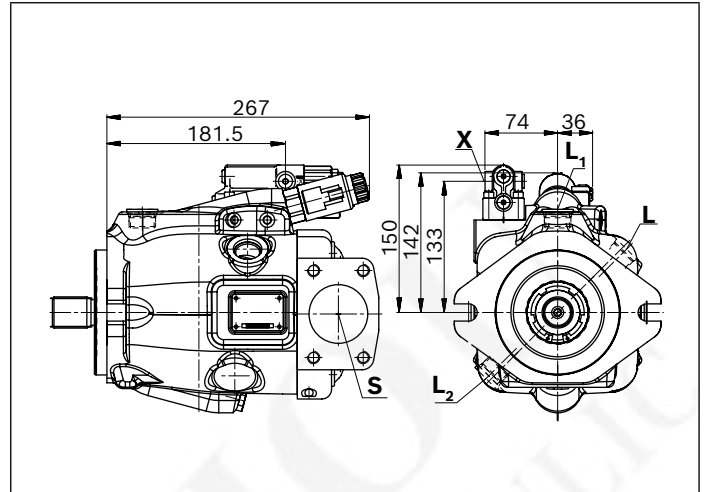
▼ ED7. / ER7. - Electro-prop. Pressure control, series 52



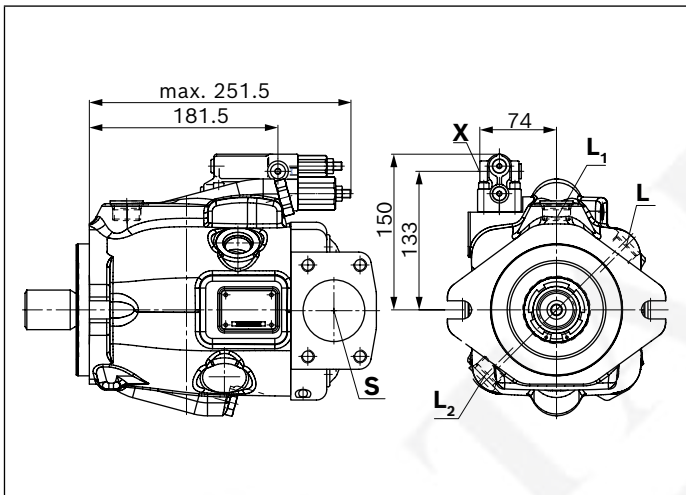
▼ DRG - Pressure controller, remotely controlled, series 53



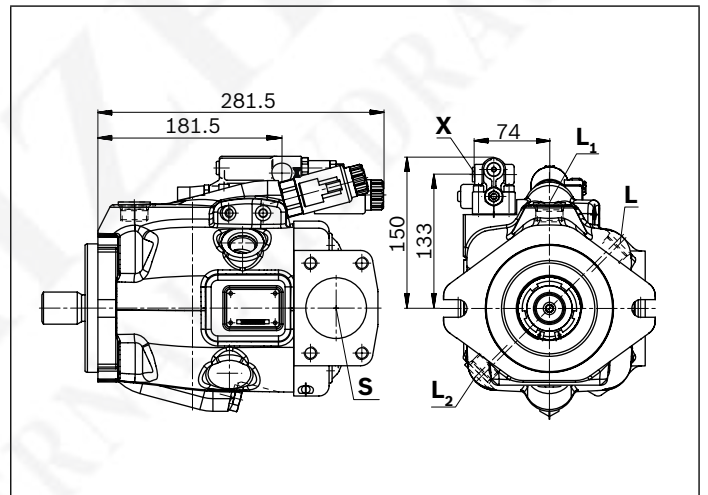
▼ EP.D. / EK.D. - Electro-proportional control, series 53



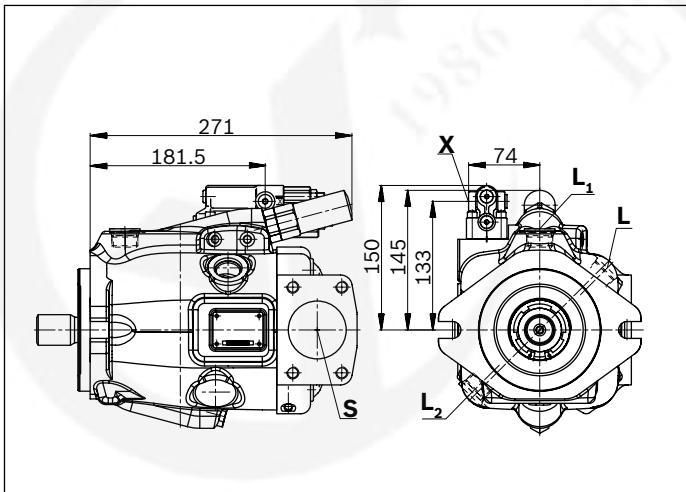
▼ DRF/DRS/DRSC - Pressure and flow controller, series 53



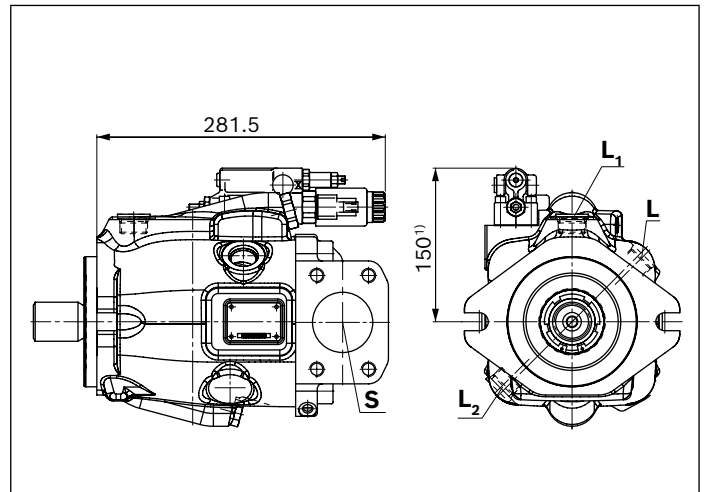
▼ EP.ED. / EK.ED. - Electro-prop. control, series 53



▼ LA.D. - Pressure, flow and power controller, series 53

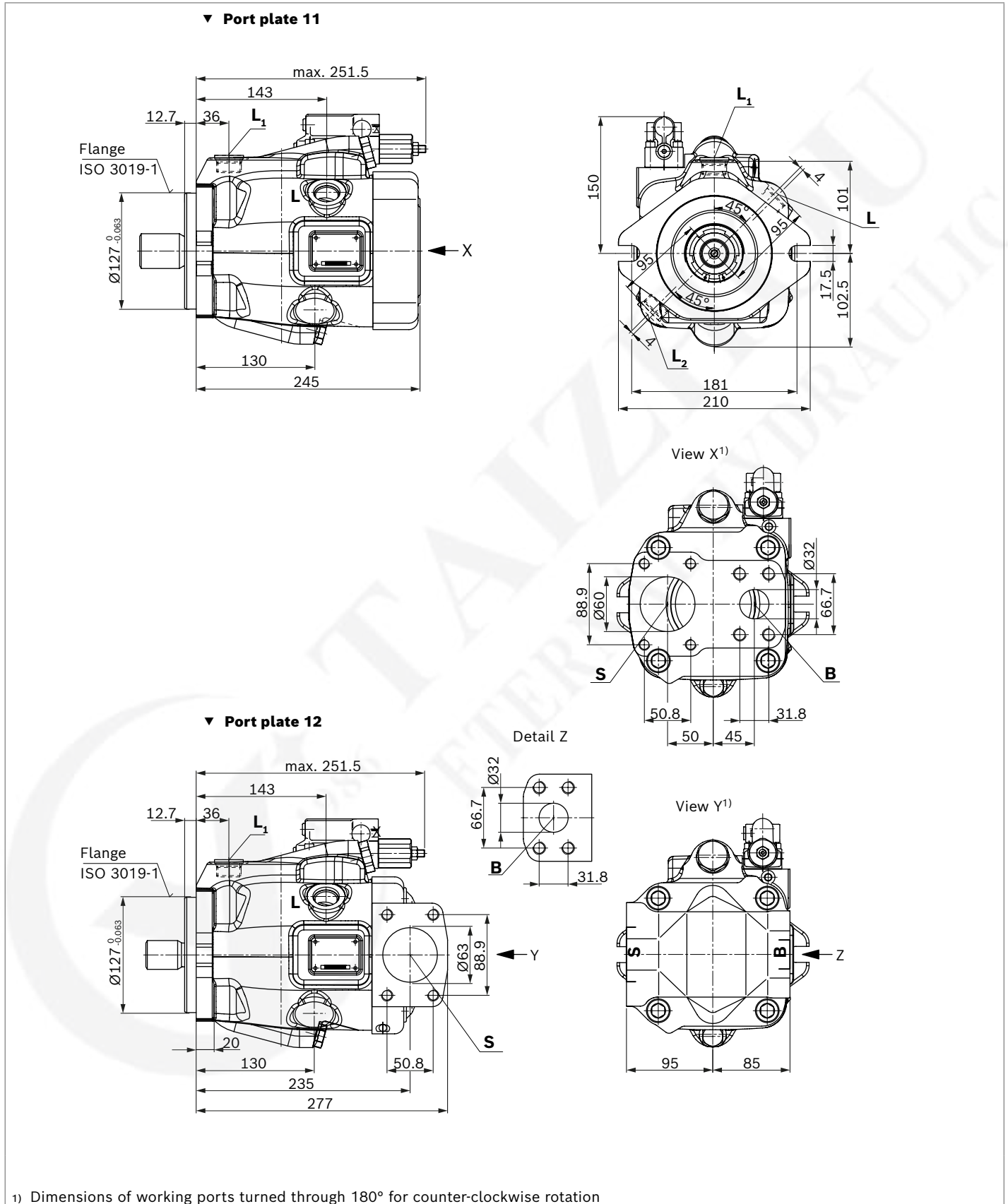


▼ ED7. / ER7. - Electro-prop. Pressure control, series 53



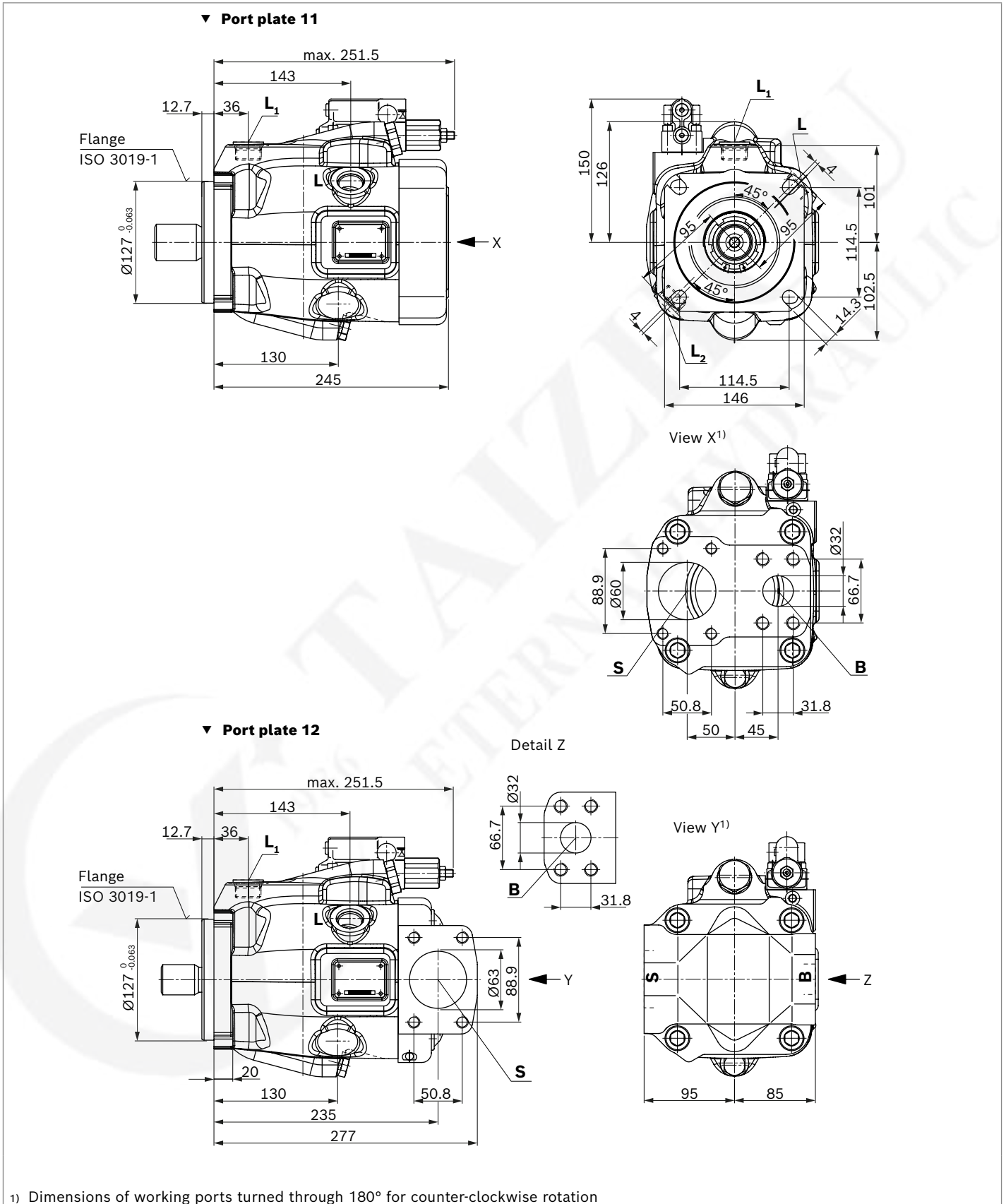
**Dimensions, size 100**

**DR - Hydraulic pressure controller; Clockwise rotation, mounting flange C series 53**

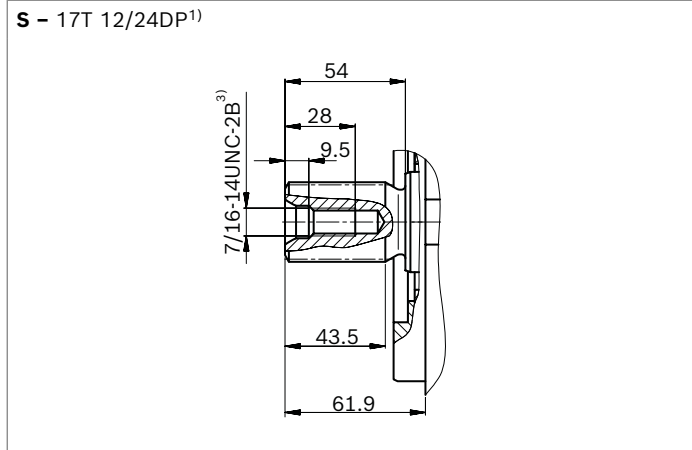


Dimensions, size 100

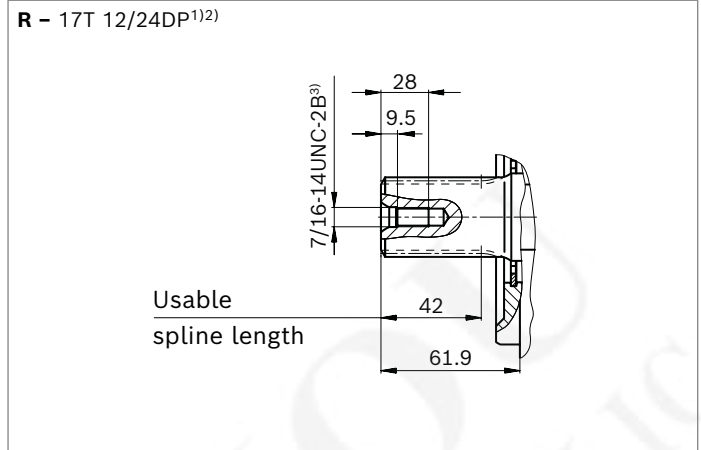
DR - Hydraulic pressure controller; Clockwise rotation, mounting flange D series 53



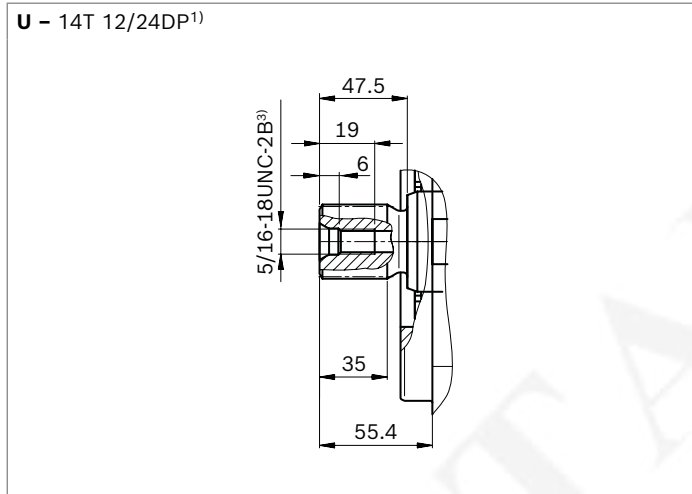
### ▼ Splined shaft 1 1/2 in (38-4, ISO 3019-1)



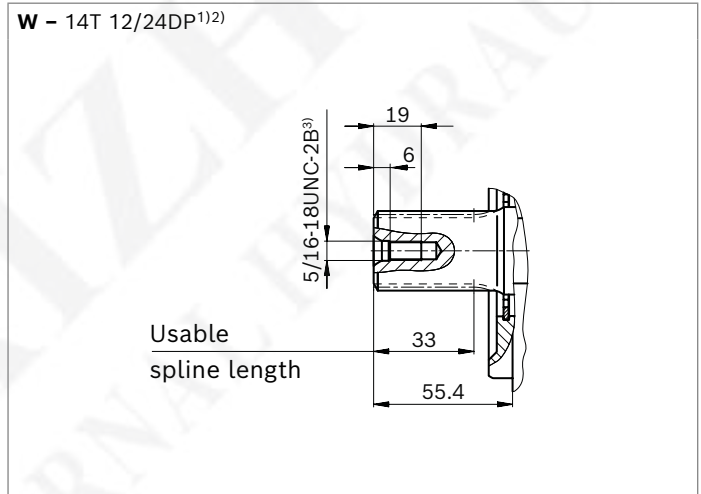
### ▼ Splined shaft 1 1/2 in (similar to ISO 3019-1)



### ▼ Splined shaft 1 1/4 in (32-4, ISO 3019-1)



### ▼ Splined shaft 1 1/4 in (similar to ISO 3019-1)

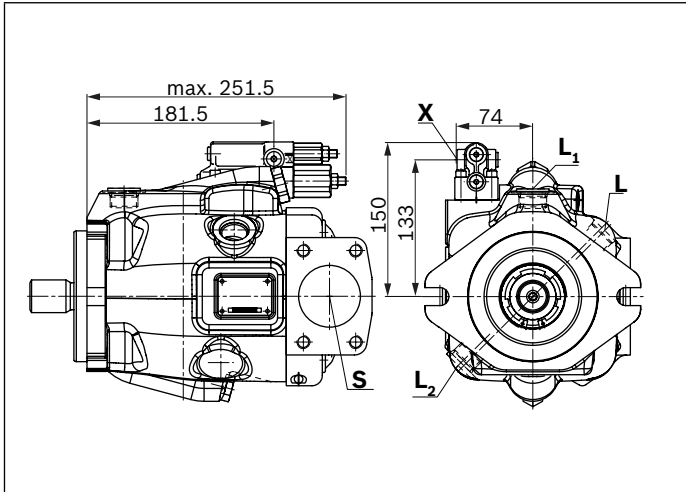


Ports		Standard	Size	$p_{max}$ [bar] <sup>4)</sup>	State <sup>8)</sup>
<b>B</b>	Working port (high-pressure series)	ISO 6162-2	1 1/4 in	315	O
	Fastening thread	DIN 13	M14 × 2; 19 deep		
<b>S</b>	Suction port (standard pressure series)	ISO 6162-1	2 1/2 in	5	O
	Fastening thread	DIN 13	M12 × 1.75; 17 deep		
<b>L</b>	Drain port	ISO 11926 <sup>5)</sup>	1 1/16-12UNF-2B; 15 deep	2	O <sup>6)</sup>
<b>L<sub>1</sub>, L<sub>2</sub></b> <sup>7)</sup>	Drain port	ISO 11926 <sup>5)</sup>	1 1/16-12UNF-2B; 15 deep	2	X <sup>6)</sup>
<b>X</b>	Pilot pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

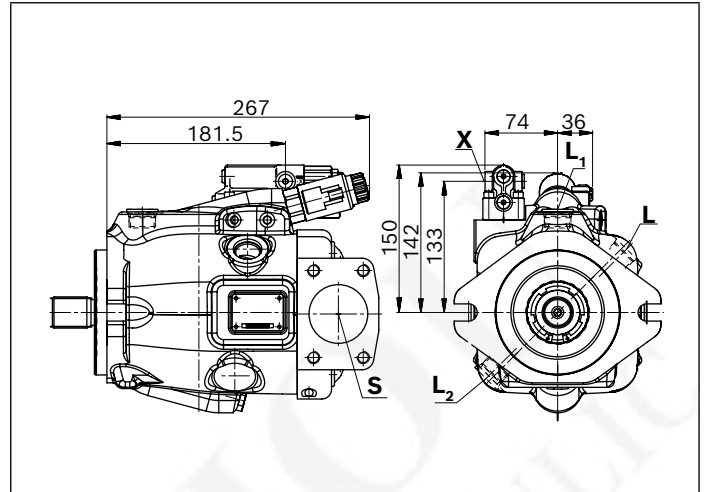
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard ISO 3019-1.  
 3) Thread according to ASME B1.1  
 4) Depending on the application, momentary pressure peaks can occur.  
 Keep this in mind when selecting measuring devices and fittings.

5) The countersink may be deeper than specified in the standard.  
 6) Depending on the installation position, **L**, **L<sub>1</sub>** or **L<sub>2</sub>** must be connected (also see installation instructions starting on page 69).  
 7) Only series 53  
 8) O = Must be connected (plugged on delivery)  
 X = Plugged (in normal operation)

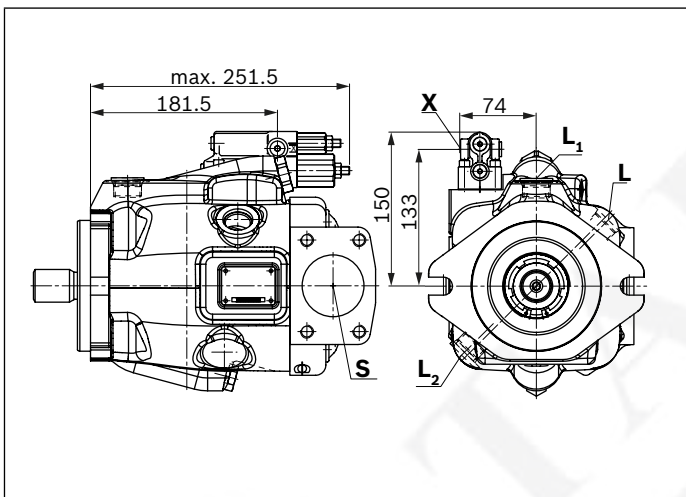
▼ DRG - Pressure controller, remotely controlled, series 53



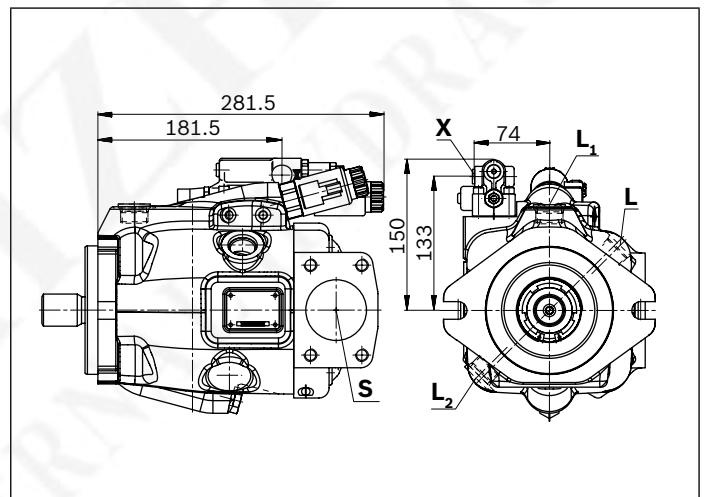
▼ EP.D. / EK.D. - Electro-proportional control, series 53



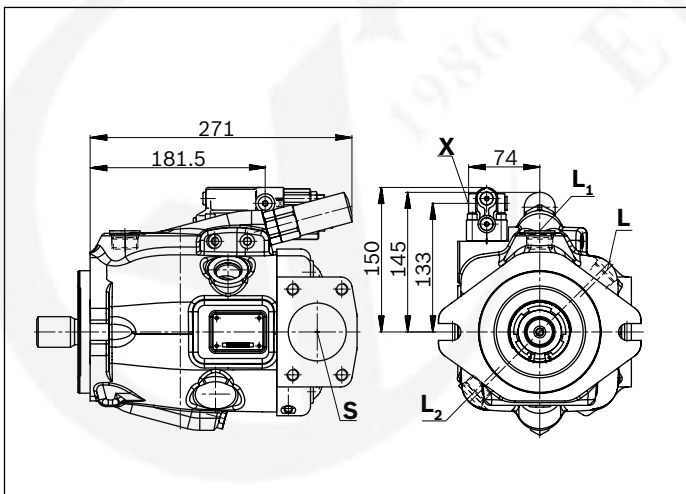
▼ DRF/DRS/DRSC - Pressure and flow controller, series 53



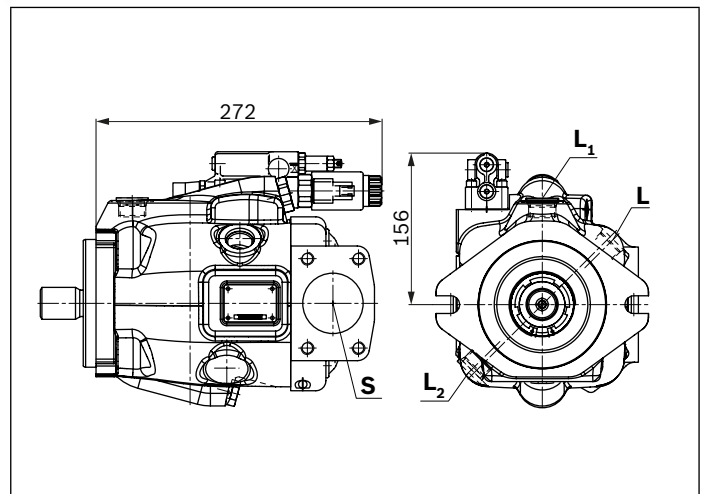
▼ EP.ED. / EK.ED. - Electro-prop. control, series 53



▼ LA.D. - Pressure, flow and power controller, series 53



▼ ED7. / ER7. - Electro-prop. Pressure control, series 53

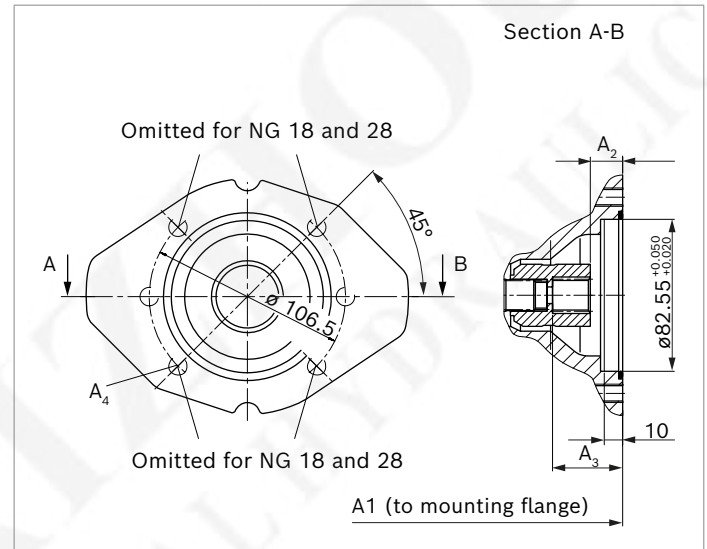
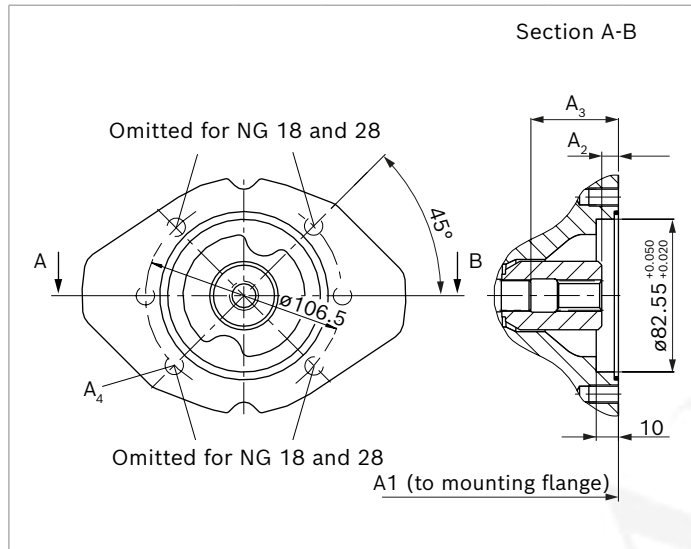


## Dimensions, through drive

Flange ISO 3019-1 (SAE)		Hub for splined shaft <sup>1)</sup>		Availability across sizes						Code	
Diameter	Mounting <sup>2)</sup>	Diameter		18	28	45	60/63	72	85		100
82-2 (A)	⌀, ∞	5/8 in	9T 16/32DP	●	●	●	●	●	●	●	K01
		3/4 in	11T 16/32DP	●	●	●	●	●	●	●	K52

● = Available    ○ = On request

### 82-2



K01 (SAE J744 16-4 (A))	NG	A1	A2 <sup>4)</sup>	A3 <sup>4)</sup>	A4 <sup>3)</sup>
	18	182	9.3	42.5	M10 × 1.5; 14.5 deep
	28	204	9.2	36.2	M10 × 1.5; 16 deep
	45	229	10	52.7	M10 × 1.5; 16 deep
	60/ 63	255	8.7	58.2	M10 × 1.5; 16 deep
	72	255	8.7	58.2	M10 × 1.5; 16 deep
	85	302	12.5	67.2	M10 × 1.5; 20 deep
	100	302	12.5	67.2	M10 × 1.5; 20 deep

K52 (SAE J744 19-4 (A-B))	NG	A1	A2 <sup>4)</sup>	A3 <sup>4)</sup>	A4 <sup>3)</sup>
	18	182	18.3	39.3	M10 × 1.5; 14.5 deep
	28	204	18.4	39.4	M10 × 1.5; 16 deep
	45	229	18.4	39.4	M10 × 1.5; 16 deep
	60/ 63	255	18.4	39.4	M10 × 1.5; 16 deep
	72	255	18.4	39.4	M10 × 1.5; 16 deep
	85	302	21.5	42.5	M10 × 1.5; 20 deep
	100	302	21.5	42.5	M10 × 1.5; 20 deep

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting holes pattern viewed on through drive with control at top

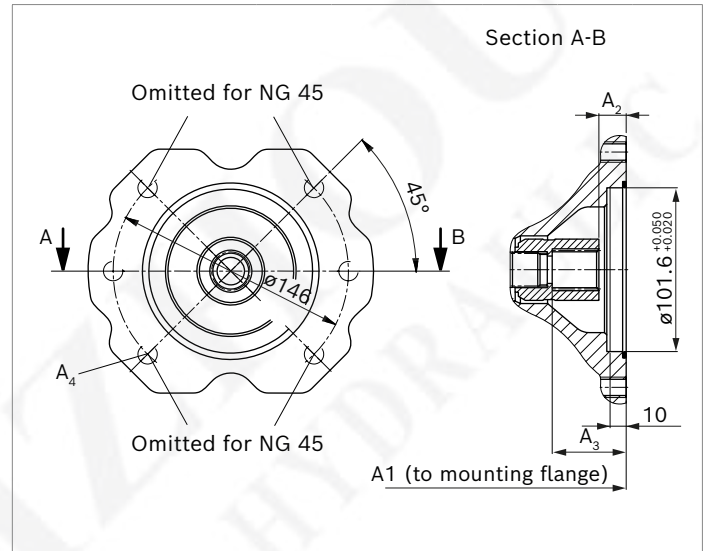
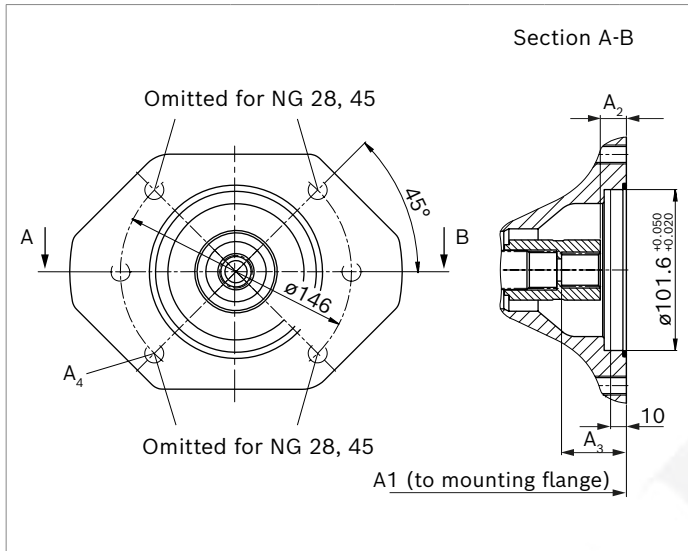
3) Thread according to DIN 13.

4) Minimum dimensions

Flange ISO 3019-1 (SAE)		Hub for splined shaft <sup>1)</sup>		Availability across sizes							Code
Diameter	Mounting <sup>2)</sup>	Diameter		18	28	45	60/63	72	85	100	
101-2 (B)	♂, ∞	7/8 in	13T 16/32DP	-	●	●	●	●	●	●	K68
		1 in	15T 16/32DP	-	-	●	●	●	●	●	K04

● = Available    ○ = On request

## 101-2



K68 (SAE J744 22-4 (B))	NG	A1	A2 <sup>4)</sup>	A3 <sup>4)</sup>	A4 <sup>3)</sup>
	28	204	17.4	42.4	M12 × 1.75; 18 deep
	45	229	17.4	42.4	M12 × 1.75; 18 deep
	60/ 63	255	17.4	42.4	M12 × 1.75; 18 deep
	72	255	17.4	42.4	M12 × 1.75; 18 deep
	85	302	20.5	45.5	M12 × 1.75; 20 deep
	100	302	20.5	45.5	M12 × 1.75; 20 deep

K04 (SAE J744 25-4 (B-B))	NG	A1	A2 <sup>4)</sup>	A3 <sup>4)</sup>	A4 <sup>3)</sup>
	45	229	17.9	47.4	M12 × 1.75; 18 deep
	60/ 63	255	17.9	47.4	M12 × 1.75; 18 deep
	72	255	17.9	47.4	M12 × 1.75; 18 deep
	85	302	20.7	50.2	M12 × 1.75; 20 deep
	100	302	20.7	50.2	M12 × 1.75; 20 deep

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting holes pattern viewed on through drive with control at top

3) Thread according to DIN 13.

4) Minimum dimensions

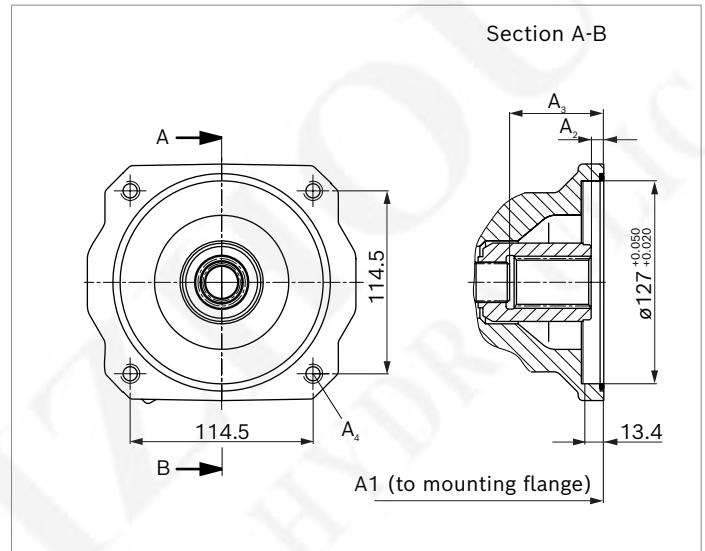
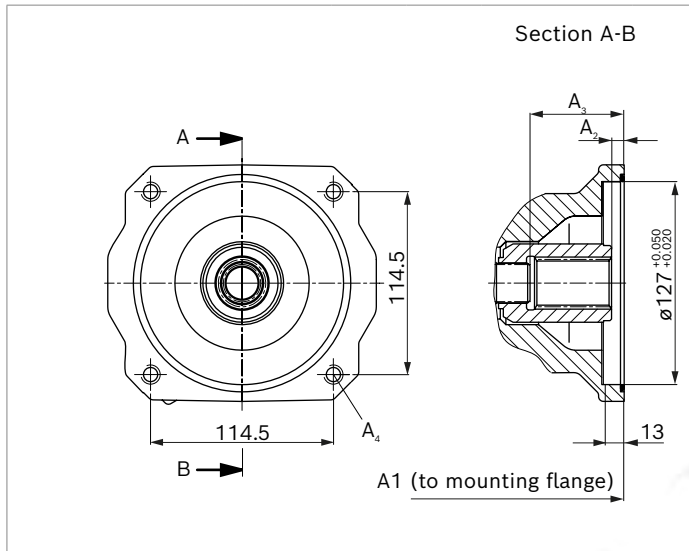
# A10VO 52&53系列柱塞泵 A10VO Series 52 and 53 Piston Pump



Flange ISO 3019-1 (SAE)		Hub for splined shaft <sup>1)</sup>		Availability across sizes						Code	
Diameter	Mounting <sup>2)</sup>	Diameter		18	28	45	60/63	72	85	100	
127-4 (C)		1 1/4 in	14T 12/24DP	-	-	-	●	●	●	●	K15
		1 1/2 in	17T 12/24DP	-	-	-	-	-	●	●	K16

● = Available    ○ = On request

## 127-4



K15 (SAE J744 32-4 (C))	NG	A1	A2 <sup>4)</sup>	A3 <sup>4)</sup>	A4 <sup>3)</sup>
60/ 63	255	17.9	55.9	M12 × 1.75; 16 deep	
72	255	17.9	55.9	M12 × 1.75; 16 deep	
85	301.5	22	60	M12 × 1.75; through	
100	301.5	22	60	M12 × 1.75; through	

K16 (SAE J744 32-4 (C))	NG	A1	A2 <sup>4)</sup>	A3 <sup>4)</sup>	A4 <sup>3)</sup>
85	301.5	12.8	67.2	M12 × 1.75; through	
100	301.5	12.8	67.2	M12 × 1.75; through	

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
2) Mounting holes pattern viewed on through drive with control at top

3) Thread according to DIN 13.  
4) Minimum dimensions

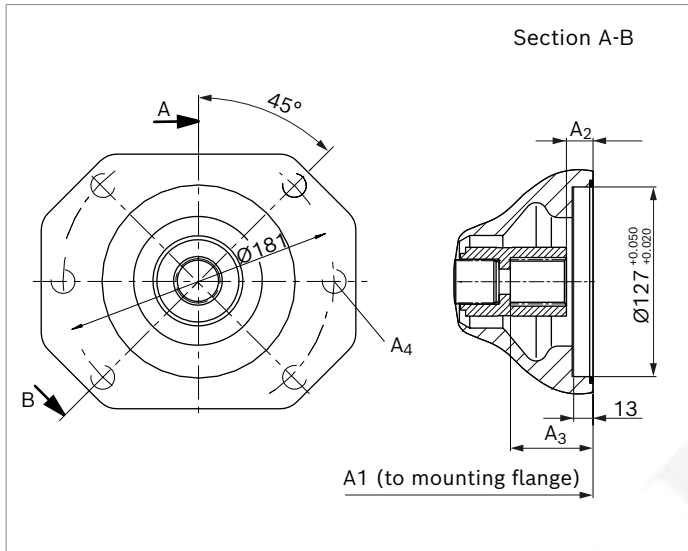
# A10VO 52&53系列柱塞泵 A10VO Series 52 and 53 Piston Pump



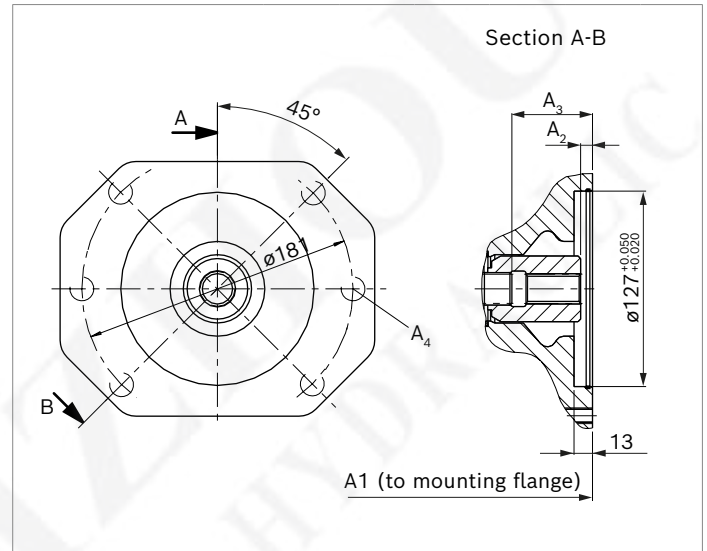
Flange ISO 3019-1 (SAE)		Hub for splined shaft <sup>1)</sup>		Availability across sizes							Code
Diameter	Mounting <sup>2)</sup>	Diameter		18	28	45	60/63	72	85	100	
127-2 (B)	♂, ∞	1 1/4 in	14T 12/24DP	-	-	-	-	-	●	●	K07
		1 1/2 in	17T 12/24DP	-	-	-	-	-	●	●	K24

● = Available    ○ = On request

## 127-2



K07 (SAE J744 32-4 (C))	NG	A1	A2 <sup>4)</sup>	A3 <sup>4)</sup>	A4 <sup>3)</sup>
	85	301.5	22	60	M16 × 2; 24 deep
	100	301.5	22	60	M16 × 2; 24 deep



K24 (SAE J744 38-4 (C-C))	NG	A1	A2 <sup>4)</sup>	A3 <sup>4)</sup>	A4 <sup>3)</sup>
	85	302	12.8	67.2	M16 × 2; 24 deep
	100	302	12.8	67.2	M16 × 2; 24 deep

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
2) Mounting holes pattern viewed on through drive with control at top

3) Thread according to DIN 13.  
4) Minimum dimensions

## Overview of mounting options

Through drive			Mounting options – 2nd pump			
Flange ISO 3019-1	Hub for splined shaft	Code	A10V(S)O/5x NG (shaft)	A10VO/31 NG (shaft)	A1VO/10 NG (shaft)	External gear pump
82-2 (A)	5/8 in	K01	10 (U), 18 (U)	18 (U)	18 (S2)	AZPF
	3/4 in	K52	10 (S), 18 (S, R)	18 (S, R)	18 (S3)	
101-2 (B)	7/8 in	K68	28 (S, R) 45 (U, W) <sup>1)</sup>	28 (S, R) 45 (U, W)	35 (S4)	AZPN/AZPG
	1 in	K04	45 (S, R) 60, 63 (U, W) <sup>2)</sup> 72 (U, W) <sup>2)</sup>	45 (S, R)	35 (S5)	
127-4 (C)	1 1/4 in	K15	60, 63 (S, R) 72 (S, R)	–	–	–
	1 1/2 in	K16	85 (S) 100 (S)	–	–	–
127-2 (C)	1 1/4 in	K07	85 (U) 100 (U)	71 (S, R)	–	PGH5
	1 1/2 in	K24	85 (S) 100 (S)	–	–	–

1) Not for NG28 with K68

2) Not for NG45 with K04

## Combination pumps A10VO + A10VO

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of pump 1 and 2 pumps must be linked by a "+".

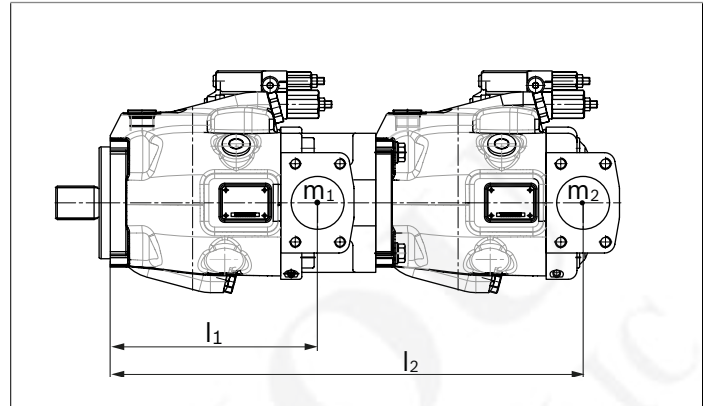
### Order example:

**A10VO85DRS/53R-VSC12K04+**

**A10VO45DRF/53R-VSC11N00**

A tandem pump, with two pumps of equal size, is permissible without additional supports, assuming that the dynamic mass acceleration does not exceed maximum 10 g (= 98.1 m/s<sup>2</sup>).

For combination pumps consisting of more than two pumps, a calculation of the mounting flange regarding the permissible mass torque is required (please contact us). Through drives are plugged with a **non-pressure-resistant** cover. This means the units must be sealed with a pressure-resistant cover before commissioning. Through drives can also be ordered with a pressure-resistant cover, please specify in plain text.



$m_1, m_2, m_3$	Weight of pump	[kg]
$l_1, l_2, l_3$	Distance from center of gravity	[mm]
$M_m = (m_1 \times l_1 + m_2 \times l_2 + m_3 \times l_3) \times$		$\frac{1}{102}$ [Nm]

### Notice

Through drives with installed hub are supplied with a spacer.

The spacer must be removed before the 2nd pump is installed and before commissioning. For further information, see instruction manual 92703-01-B

## Permissible moments of inertia

NG			10	18	28	45	60/63	72	85	100	
static	$M_m$	Nm	-	500	890	900	1370	1370	3080	3080	
			dynamic at 10 g (98.1 m/s <sup>2</sup> )	-	50	89	90	137	137	308	308
	Weight with through-drive plate	$m$	kg	-	13	18	24	28	28	45	45
	Weight without through-drive plate (e.g. 2nd pump)			8	11.5	15	18	22	22	36	36
	Distance, center of gravity <b>without</b> through drive	$l_1$	mm	-	78	85	96	105	105	122	122
	Distance, center of gravity <b>with</b> through drive	$l_1$	mm	-	87	99	115	127	127	150	150